TURCK

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

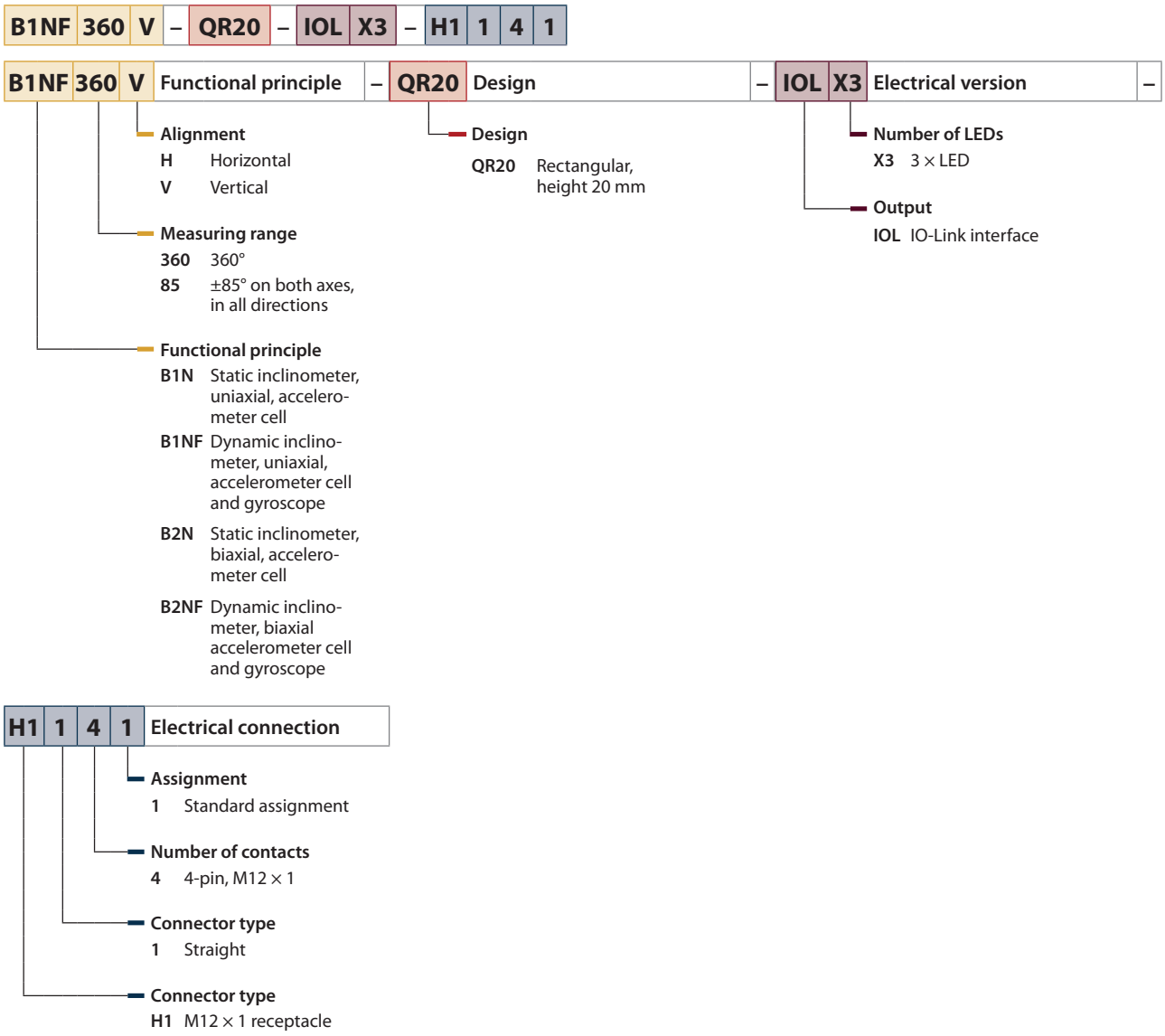
1.4 Feedback about these instructions

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 scope of delivery includes:

- Inclinometer
- Quick Start Guide

2.3 TURCK service

TURCK supports you in your projects — from the initial analysis right through to the commissioning of your application. At www.turck.com, you will find 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 [▸ 21].

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 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 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 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 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

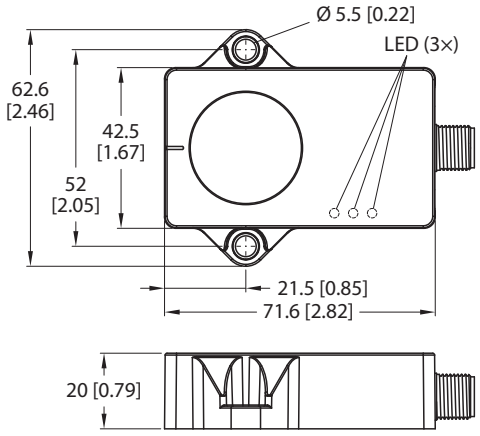


Fig. 1: Dimensions

4.1.1 Indication elements

The B1N… devices have one green and one yellow LED. The green LED indicates the operating voltage and the device status. The yellow LED is lit when the spirit level function is active.

The B2N… devices have one 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°. 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.

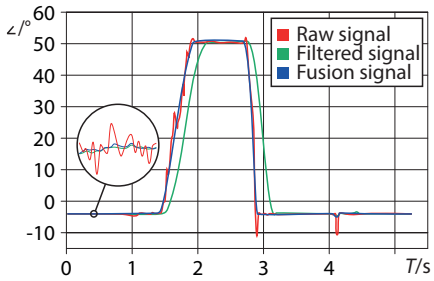


Fig. 2: Fusion algorithm — minimizing interfering acceleration

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

In order to operate in IO-Link mode, the device must be connected to an IO-Link master. When the port is configured in IO-Link mode, bidirectional IO-Link communication takes place between the IO-Link master and the device. To make this possible, the device is integrated via an IO-Link master at the control level. First the communication parameters are exchanged, and then the cyclic data exchange of process data (objects) starts.

4.4.2 Measurement axes

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

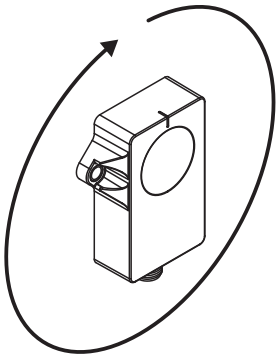


Fig. 3: One measurement axis

The 2-axis inclinometers cover the angle range of ±85° on two axes in all directions. This results in an unmeasurable angle of 10° per 180°.

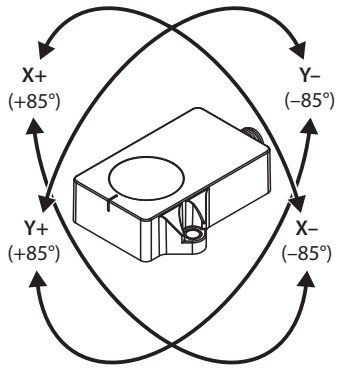
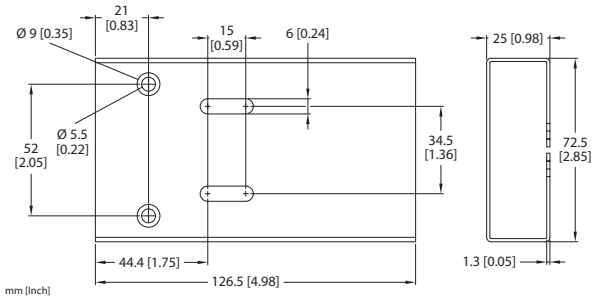
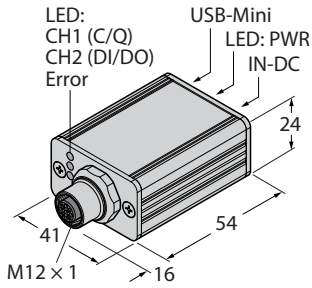
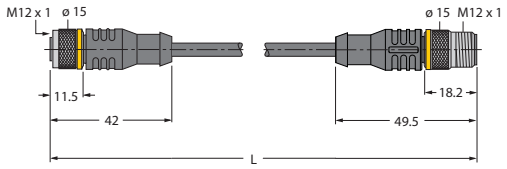
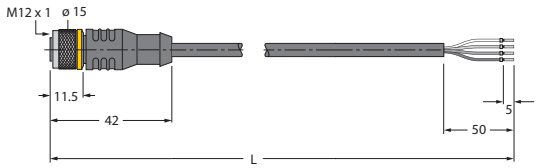


Fig. 4: Two measurement axes

4.4.3 Temperature measurement

The inclinometers can output the temperature as acyclic data. The measurement range is -40…+85 °C with a resolution of 1 °C. The measurement has an accuracy of ±3 °C.

4.5 Technical accessories

Dimension drawing	Type	ID	Description
	GUARD-QR20	100027185	Protective housing for QR20 inclinometers for protecting against mechanical impact; material: Stainless steel
	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 www.turck.com
	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 www.turck.com

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.

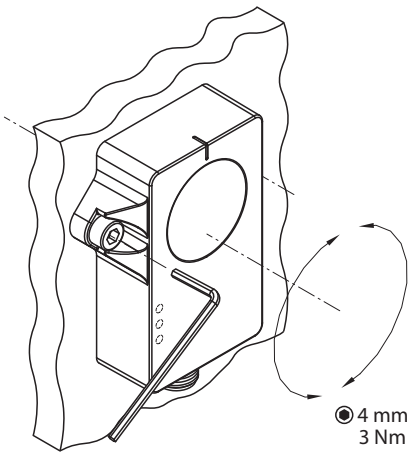


Fig. 5: B1N…V… — vertical installation

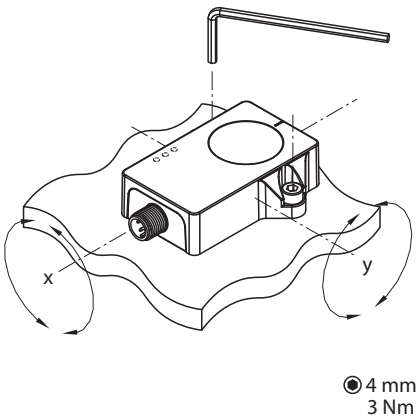


Fig. 6: B2N…H… — horizontal installation

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

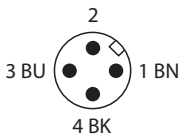


Fig. 7: Pin assignment

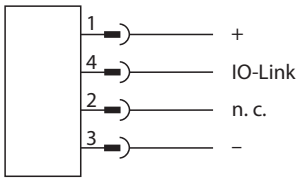


Fig. 8: Wiring diagram

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 ±0.5° 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 (± 0.5°)
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-specific parameters. Communication is not interrupted and the sensor is switched to a predefined state. Identification parameters are not affected by this command.
Restore factory settings	The function restores the device to the factory setting. The device is restarted after the restoration. 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 functionality 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 can be so that the process values increase to indicate a counterclockwise direction.
Set center point	The function enables the current inclination to be defined as the new measuring range center point. The teach function is triggered at bit 0 for the X axis and bit 1 for the Y axis. On one-axis devices, the teach function is triggered via bit 2. On two-axis devices, the taught measuring range center point must not deviate from the physical zero point by more than 30°. The accuracy at the edges of the measuring edge decreases depending on the size of the zero point offset.
Configuring process data	The process data is structured in accordance with the IO-Link Smart Sensor Profile. On one-axis sensors the angle value is transferred twice; in one of these cases, the value is inverted. 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: **Signed:** 16-bit angle information is output for each measurement axis. In **Signed** 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. **Unsigned:** 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.

Parameter	Meaning
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 via the TURCK Automation Suite (TAS)

The devices can be configured via a PC with TAS. The IODD can be read in via TAS such that all parameters of the IODD can be accessed.

An IO-Link master with integrated USB interface (ID 6825482) and an adapter cable (ID 6625005) are required to access the sensor parameters.

9.3 Setting via FDT/IODD

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.

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.

If the device does not work as expected, proceed as follows:

- Exclude environmental disturbances.
- Check the connections of the device for errors.
- Check device for parameterization errors.

If the malfunction persists, the device is faulty. 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-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°	
Operating voltage	18…30 VDC	
Ripple	≤ 10 % U_{ss}	
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	
Design	Rectangular, QR20	
Dimensions	71.4 × 62.5 × 20 mm	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 × 1	
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
Type of protection	IP68/IP69K	
Altitude	Max. 5000 m	
MTTF	548 years in accordance with SN 29500 (Ed. 99) 40 °C	
Operating voltage indication	1 × LED, green	
Measuring range indication	2 × LED, yellow	

The specifications for repeatability and linearity deviation apply to the inclination angles per axis at an ambient temperature of 20 °C. The accuracy depends on the movement characteristics in the application.

14.2 Technical data B2N…-QR20-IOLX3-H1141

Type	B2N85H-QR20-IOLX3-H1141	B2NF85H-QR20-IOLX3-H1141
ID	100025086	100020901
Measuring range	±85°	
Number of measuring axes	2	
Repetition accuracy	≤ 0.2°	≤ 0.1°
Linearity deviation	< ±0.2 %	< ±0.15 %
Temperature drift	0.02°/K	
Resolution	0.01°	
Operating voltage	18…30 VDC	
Ripple	≤ 10 % U_{ss}	
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	
Design	Rectangular, QR20	
Dimensions	71.4 × 62.5 × 20 mm	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 × 1	
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
Type of protection	IP68/IP69K	
Altitude	Max. 5000 m	
MTTF	548 years in accordance with SN 29500 (Ed. 99) 40 °C	
Operating voltage indication	1 × LED, green	
Measuring range indication	2 × LED, yellow	

The specifications for repeatability and linearity deviation apply to the inclination angles per axis at an ambient temperature of 20 °C. The accuracy depends on the movement characteristics in the application.

15 TURCK branches — contact data

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Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Vienna www.turck.at
Belgium	Turck Multiprox N. V. Lion d'Orweg 12, B-9300 Aalst www.multiprox.be
Brazil	Turck do Brasil Automação Ltda. Rua Anjo Custódio Nr. 42, Jardim Anália Franco, CEP 03358-040 São Paulo www.turck.com.br
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Korea	Turck Korea Co, Ltd. A605, 43, Iljik-ro, Gwangmyeong-si 14353 Gyeonggi-do www.turck.kr
Malaysia	Turck Banner Malaysia Sdn Bhd Unit A-23A-08, Tower A, Pinnacle Petaling Jaya, Jalan Utara C, 46200 Petaling Jaya Selangor www.turckbanner.my
Mexico	Turck Comercial, S. de RL de CV Blvd. Campestre No. 100, Parque Industrial SERVER, C.P. 25350 Arteaga, Coahuila www.turck.com.mx
Netherlands	Turck B. V. Ruiterlaan 7, NL-8019 BN Zwolle www.turck.nl
Poland	TURCK sp.z.o.o. Wroclawska 115, PL-45-836 Opole www.turck.pl
Romania	Turck Automation Romania SRL Str. Siriului nr. 6-8, Sector 1, RO-014354 Bucuresti www.turck.ro
Sweden	Turck AB Fabriksstråket 9, 433 76 Jonsered www.turck.se
Singapore	TURCK BANNER Singapore Pte. Ltd. 25 International Business Park, #04-75/77 (West Wing) German Centre, 609916 Singapore www.turckbanner.sg
South Africa	Turck Banner (Pty) Ltd Boeing Road East, Bedfordview, ZA-2007 Johannesburg www.turckbanner.co.za
Turkey	Turck Otomasyon Ticaret Limited Sirketi Inönü mah. Kayisdagi c., Yesil Konak Evleri No: 178, A Blok D:4, 34755 Kadiköy/ Istanbul www.turck.com.tr
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