Your Global Automation Partner

TURCK

RI...QR20...
Miniature Encoders

Instructions for Use

Contents

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:

- Data sheet

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

RI 360 P1 – QR20 – LU4 X2 – H1141

RI 360 P1 **Functional Principle** – QR20 **Design** – LU4 X2 **Electrical Version** –

Positioning Element
P1 P1-RI-QR20

Measuring Range
20 20°
40 40°
60 60°
90 90°
120 120°
240 240°
360 360°

Functional Principle
RI Rotary inductive

Design
QR20 Translucent housing, material Ultem

Number of LEDs
X2 Number of LEDs

Output Function
LU4 Voltage output 0.5…4.5 V
LI2 Current output, 4…20 mA

H1141 **Electrical Connection**

Electrical Connection

Blank	Cable, open end
0.15-DT04-3P	Deutsch DT connector, cable length 0.15 m
0.24-AMP01-3P	AMP connector, cable length 0.24 m
H1141	M12 × 1 connector, straight, 4-pin, standard assignment

NOTE
The RI20…, RI40…, RI90… variants with a current output are only available on request.
The devices with a current output are only available with Deutsch or AMP connectors on request.

2.2 Scope of delivery

The scope of delivery includes:

- Encoder – sensor
- Positioning element
- 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 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. [▷ 25].

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 miniature encoders of the RI…-QR20… series with an analog output are used for angle position measurement.

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 notes

- 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.
- If safe operation is no longer guaranteed: Take the device out of operation and ensure that it cannot be switched on again accidentally.

4 Product description

The inductive miniature encoders of the RI…-QR20 series are available with measuring ranges from 20° to 360°. The sensor and the positioning element of the encoders are fully encapsulated and designed as two independent and sealed units with protection to IP68/IP69K and contactless operation.

The QR20 rotary encoders are provided with an analog output (0.5…4.5 V or 4…20 mA). The range in which angle movements can be measured is factory set.

Devices with a fixed default setting are available for the following angle ranges:

- 20°
- 40°
- 60°
- 90°
- 120°
- 240°
- 360°

4.1 Device overview

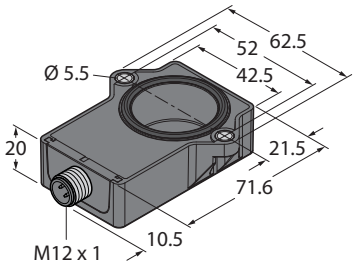


Fig. 1: QR20 miniature rotary encoder with M12 male connector

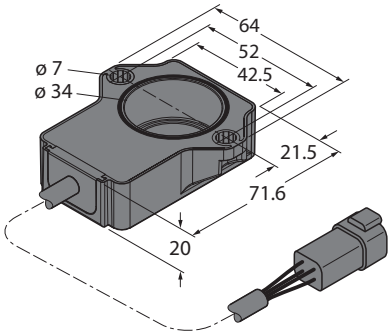


Fig. 2: QR20 miniature rotary encoder with Deutsch connector

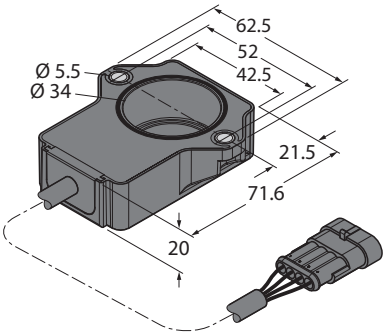


Fig. 3: QR20 miniature rotary encoder with AMP connector

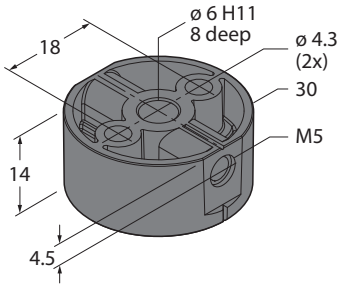


Fig. 4: P1-RI-QR20 positioning element

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

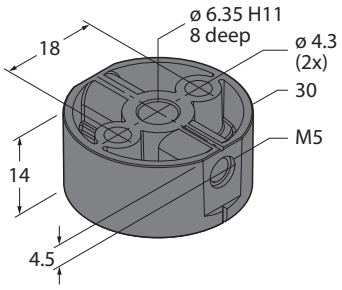


Fig. 5: P2-RI-QR20 positioning element

4.1.1 Indication elements

The devices are provided with two green LEDs for displaying operating voltage and device status.

4.2 Properties and features

- Rectangular, plastic
- Compact and robust housing
- Versatile mounting possibilities
- Measuring range indication via LED
- Immune to electromagnetic interference
- Degree of protection IP68/IP69K
- Protection from salt spray
- Resolution: 0.09°
- 3-wire
- Analog output 0.5…4.5 V or 4…20 mA

The RI…-LU4… miniature rotary encoders are also provided with the following features:

- For vehicle electrical systems,12 V and 24 V
- Increased noise immunity 100 V/m based on e1 type approval
- Protection from line-conducted interference in accordance with DIN ISO 7637-2 (SAE J 113-11)
- Extended temperature range

4.3 Operating principle

The QR20 miniature encoders have contactless operation based on the inductive resonant circuit measuring principle. Measurement is immune to magnetic fields as the positioning element is not based on a magnet but on an inductive coil system, through which the sensor and the positioning element (resonator) can form an oscillation circuit. Sensor and positioning element form an inductive measuring system. An induced voltage generates appropriate signals in the receiver coils of the sensor, depending on the location of the positioning element. The signals are evaluated in the internal 16-bit processor of the sensor and output as analog signals. The QR20 is an absolute encoder and outputs a unique analog value for every shaft position.

4.4 Functions and operating modes

The devices are provided with an analog output (current or voltage). The device output supplies an analog signal corresponding to the location of the positioning element.

4.4.1 Current output

The RI…-QR20…-LI… devices are provided with a current output that supplies a current signal in the range of 4…20 mA, which corresponds to the location of the positioning element. If the positioning element is not detected, for example due to damage to the shaft, the output signal increases to a fault signal of 22 mA. The following figures show the current signal of the devices in relation to the particular angle ranges:

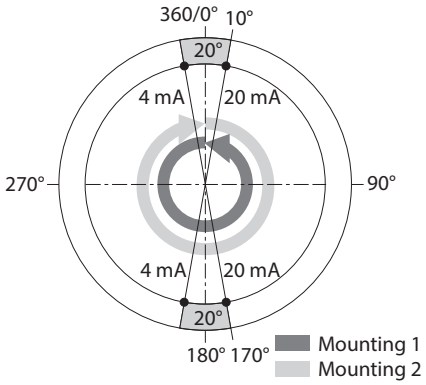


Fig. 6: RI20…

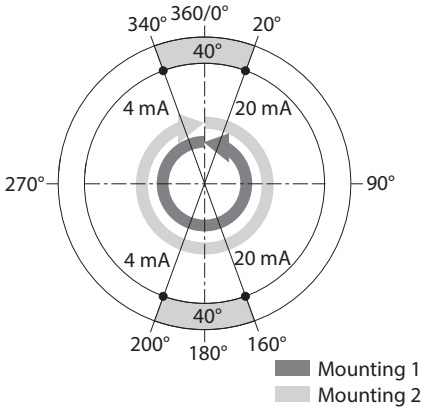


Fig. 7: RI40…

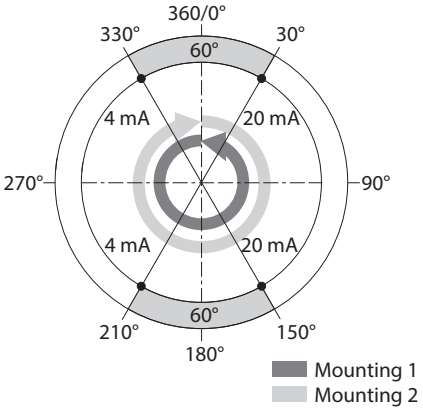


Fig. 8: RI60…

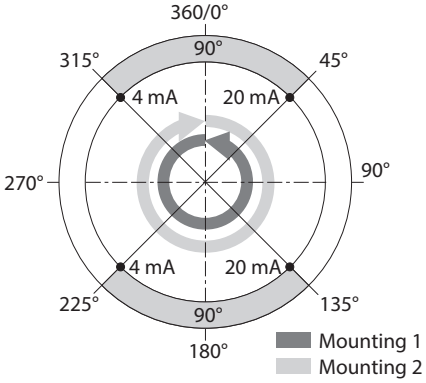


Fig. 9: RI90…

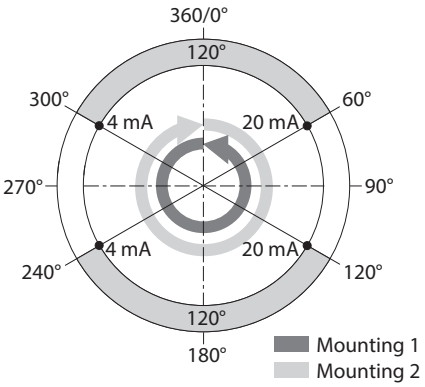


Fig. 10: RI120…

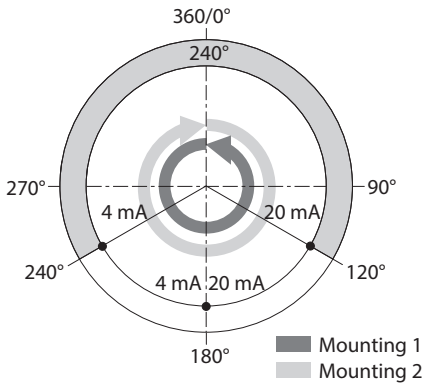


Fig. 11: RI240…

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

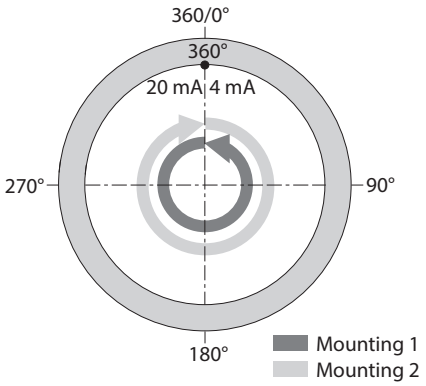


Fig. 12: RI360…

4.4.2 Voltage output

The RI…-QR20…-LU… devices are provided with a voltage output that outputs a voltage signal in the range from 0.5…4.5 V, which corresponds to the location of the positioning element. If the positioning element is not detected, for example due to damage to the shaft, the output signal increases to a fault level of 5 V. The following figures show the voltage signal of the devices in relation to the particular angle ranges:

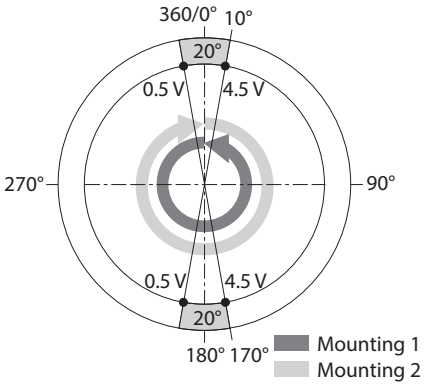


Fig. 13: RI20…

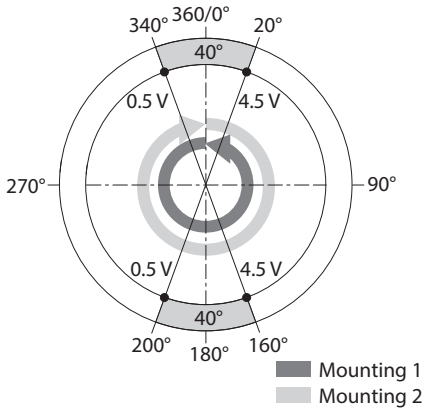


Fig. 14: RI40…

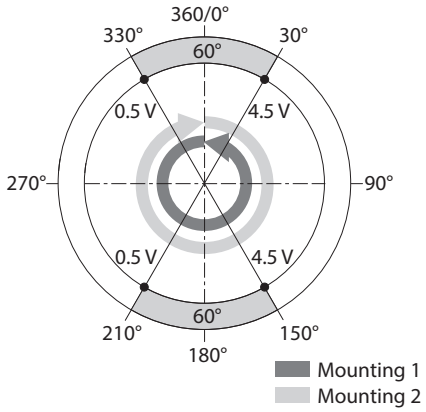


Fig. 15: RI60…

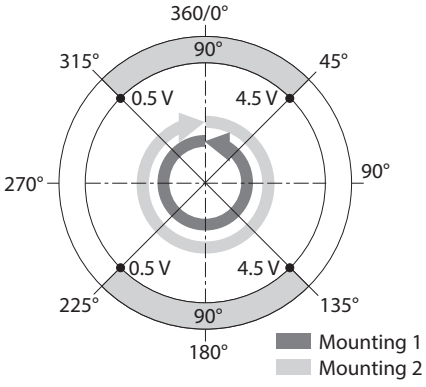


Fig. 16: RI90…

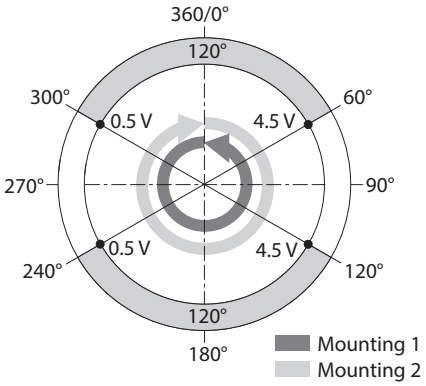


Fig. 17: RI120…

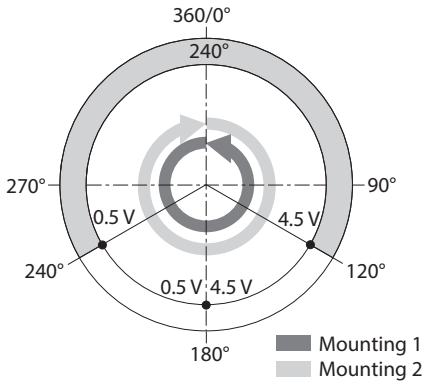


Fig. 18: RI240…

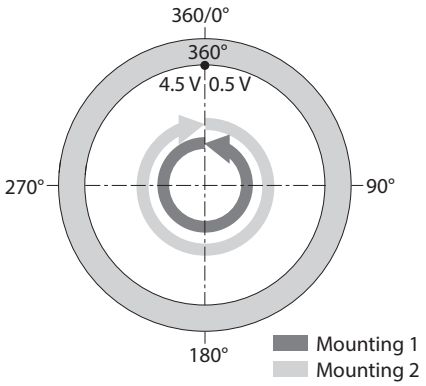
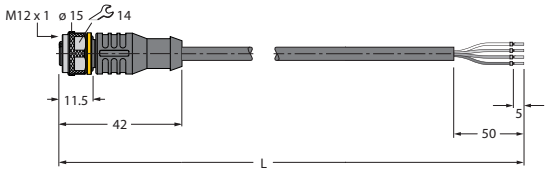
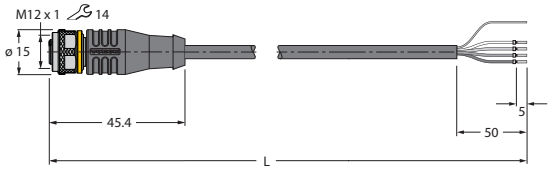
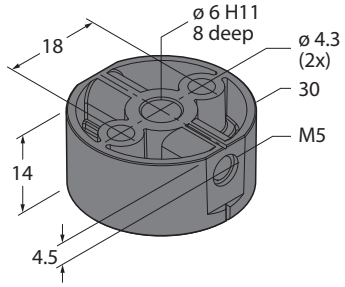
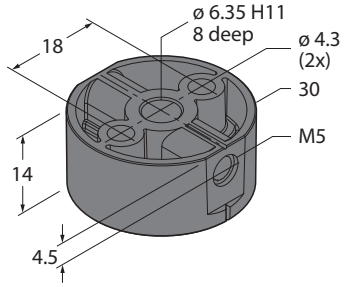


Fig. 19: RI360…

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

4.5 Technical accessories

Dimension drawing	Type	ID	Description
	RKC4.4T-2/ TEL	6625013	Connection cable, M12 female connector, straight, 4-pin, cable length: 2 m, jacket material: PVC, black; cULus approval; other cable lengths and types available, see www.turck.com
	RKS4.4T-2/ TEL	6626321	Connection cable, M12 female connector, straight, 4-pin, shield connected to coupling nut/ screw, cable length: 2 m, jacket material: PVC, black; cULus approval; other cable lengths and types available, see www.turck.com
	P1-RI-QR20	1593041	Positioning element for RI-QR20 encoder, for Ø 6 mm shafts
	P2-RI-QR20	1593042	Positioning element for RI-QR20 encoder, for Ø 6.35 mm shafts

5 Installing

There are two mounting options for the rotary encoder:

- Mount the positioning element in the housing so that it is fully surrounded by the housing (mounting option 1).
- Mount the positioning element above the sensor housing (mounting option 2).

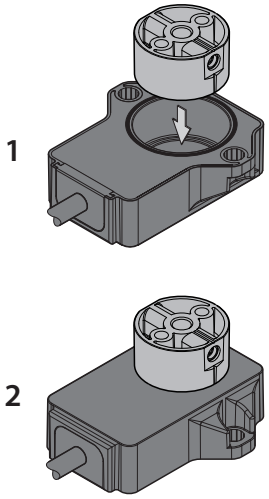


Fig. 20: Mounting options

5.1 Mounting the positioning element in the housing (mounting option 1)

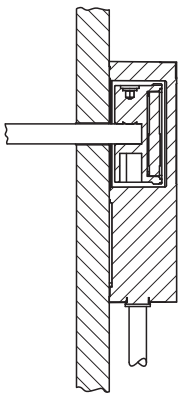


Fig. 21: Mounting the positioning element in the housing

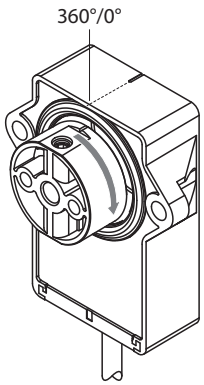


Fig. 22: Aligning the positioning element

- ▶ Push the positioning element onto the shaft.
- ▶ Fasten the positioning element on the shaft.
- ▶ Place the encoder sensor with the front facing the shaft over the positioning element and align to the required position of the zero point. The positioning element has the correct clearance if the opening of the sensor is flush with the shaft.
- ▶ Fasten the encoder with two screws in order to produce a closed and protected unit.

5.2 Mounting the positioning element above the sensor housing (mounting option 2)

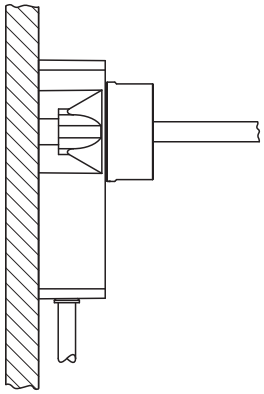


Fig. 23: Mounting the positioning element above the sensor housing

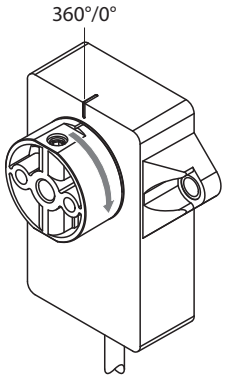


Fig. 24: Aligning the positioning element

- Fasten the encoder sensor with two screws in the surrounding area and with the rear facing the shaft.
- Push the positioning element onto the shaft and align to the required position of the zero point.
- Fasten the positioning element on the shaft.

6 Connection

The miniature encoder is provided with an analog output and is available in the following connection variants:

- M12 connector
- Cable outlet
- Cable with 3-pin AMP connector (only RI…LU4…)
- Cable with 3-pin Deutsch connector (only RI…LU4…)

NOTICE
Wrong coupling
Damage to the connector possible
▶ Ensure correct connection.

NOTE
Turck recommends the use of shielded connection cables.

▶ Ensure that the entire plant is in a de-energized state during the electrical installation.
▶ Connect the female connector of the connection cable to the male connector of the device.

6.1 Wiring diagrams — devices with a current output

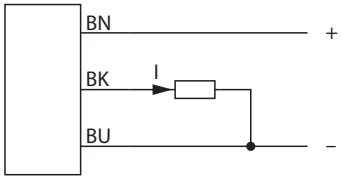


Fig. 25: Cable connection — wiring diagram

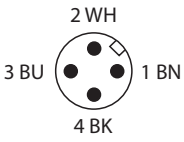


Fig. 26: M12 connector — pin layout

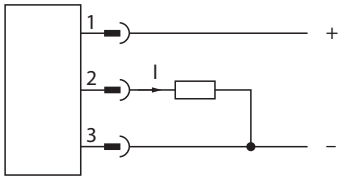


Fig. 27: M12 connector — wiring diagram

6.2 Wiring diagrams — devices with a voltage output

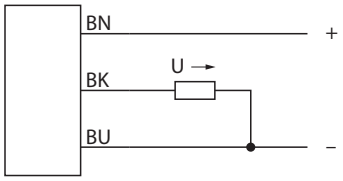


Fig. 28: Cable connection — wiring diagram

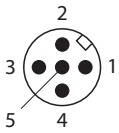


Fig. 29: M12 connector — pin layout

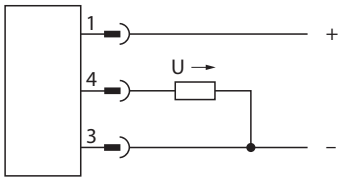


Fig. 30: M12 plug connector — wiring diagram

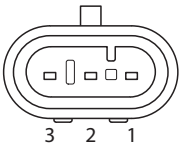


Fig. 31: AMP connector — pin layout

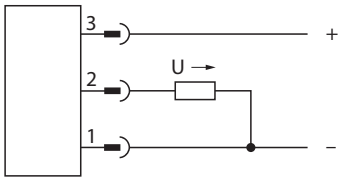


Fig. 32: AMP connector — wiring diagram

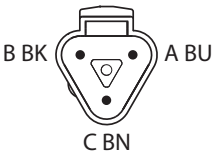


Fig. 33: Deutsch connector — pin layout

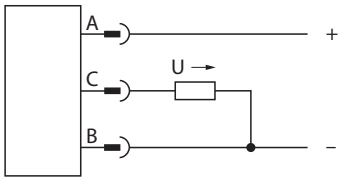


Fig. 34: Deutsch connector — wiring diagram

7 Commissioning

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

8 Operation

8.1 LED indications

LED indication	Meaning
Green	Sensor power supply correct.
Green flashing	Positioning element is within the measuring range with reduced signal quality (e.g. gap too large).
Off	Positioning element is not within the measuring range or no power supply available.

9 Troubleshooting

The strength of the resonance coupling is indicated by an LED. Any faults are indicated via the LEDs.

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.

10 Maintenance

Ensure that the plug connections and cables are always in good condition.

The devices are maintenance-free, clean dry if required.

11 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.

11.1 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.

12 Decommissioning

- Disconnect the connection cable from the power supply and/or processing units.
- Disconnect the connection cable from the device.
- Undo the connections of the device or if necessary the mounting aid for the mounting area.
- If present: undo the connection between the device and the mounting aid.

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 — RI…-QR20-LU…

Technical data	
Measuring principle	Inductive
Starting torque, shaft load (radial/axial)	Not applicable with contactless measuring principle
Resolution	0.09°
Measuring range	0…360°
Nominal distance	1 mm
Repetition accuracy	≤ 0.025 % of full scale
Linearity tolerance	≤ 0.9 % of full scale
Temperature drift	≤ ± 0.01 %/K
Ambient temperature	-40…+85 °C
Storage temperature	-40…+125 °C
Temperature changes (EN 60068-4-2)	-40…+85 °C, 20 cycles
Operating voltage	8…30 VDC
Ripple	≤ 10 % U_{ss}
Insulation test voltage	≤ 0.5 kV
Short-circuit protection	Yes
Wire breakage / reverse polarity protection	No/yes (voltage supply)
Output type	Absolute singleturn
Output function	3-wire, analog output
Voltage output	0.5…4.5 V
Diagnostics	Positioning element not detected: Output signal 5 V
Load resistance voltage output	≥ 4.7 kΩ
Sampling rate	800Hz
Load dump protection (DIN ISO 7637-2)	Severity degree IV/Level 4
Current consumption	< 100 mA
Design	
Dimensions	71.6 × 62.5 × 20 mm
Flange type	Flange without mounting bracket
Shaft type	Blind hole shaft
Shaft diameter D	6 mm 6.35 mm
Housing material	Plastic, Ultem
Electrical connection	RI…-QR20-LU4X2: cable RI…-QR20-LU4X2-H1141: connector, M12, 4-pin RI…-QR20…-DT04-3P: cable with male connector, Deutsch DT04-3P RI…-QR20…-AMP01-3P: cable with male connector, AMP Superseal
Cable quality	Ø 5.2 mm, Lif32Y32Y, TPE
Cable cross section	3 × 0.5 mm^2

Technical data	
Vibration resistance	55 Hz (1 mm)
Vibration resistance (EN 60068-2-6)	20 g, 10…3000 Hz, 50 cycles, 3 axes
Shock resistance (EN 60068-2-27)	100 g, 11 ms ½ sine; each 3 ×, 3 axes
Continuous shock resistance (EN 60068-2-29)	40 g, 6 ms ½ Sinus, 4000 × each, 3 axes
Salt mist test (EN 60068-2-52)	Degree of severity 5 (4 test cycles)
Type of protection	IP68/IP69K
MTTF	423 years to SN 29500 (Ed. 99) 40 °C
LED indications	
Measuring range indication	Multifunction LED green, green flashing

14.2 Technical data — RI…-QR20-LI…

Technical data	
Measuring principle	Inductive
Starting torque, shaft load (radial/axial)	Not applicable with contactless measuring principle
Resolution	0.09°
Measuring range	0…360°
Nominal distance	1 mm
Repetition accuracy	≤ 0.025 % of full scale
Linearity tolerance	≤ 0.9 % of full scale
Temperature drift	≤ ± 0.02 %/K
Ambient temperature	-25…+70 °C
Operating voltage	15…30 VDC
Ripple	≤ 10 % U_{ss}
Insulation test voltage	≤ 0.5 kV
Short-circuit protection	Yes
Wire breakage / reverse polarity protection	yes/completely
Output type	Absolute singleturn
Output function	3-wire, analog output
Voltage output	4…20 mA
Diagnostics	Positioning element not detected: Output signal 22 mA, (typ.)
Load resistance voltage output	≤ 0.4 kΩ
Sampling rate	500 Hz
Current consumption	<100 mA
Design	
Dimensions	71.6 × 62.5 × 20 mm
Flange type	Flange without mounting bracket
Shaft type	Blind hole shaft
Shaft diameter D	6 mm 6.35 mm
Housing material	Plastic, Ultem
Electrical connection	RI…-QR20-LI2X2: cable RI…-QR20-LI2X2-H1141: connector, M12, 4-pin
Cable quality	Ø 5.2 mm, Lif32Y32Y, TPE
Cable cross section	3 × 0.5 mm^2
Vibration resistance	55 Hz (1 mm)
Vibration resistance (EN 60068-2-6)	20 g, 10…3000 Hz, 50 cycles, 3 axes
Shock resistance (EN 60068-2-27)	100 g, 11 ms ½ sine; each 3 ×, 3 axes
Continuous shock resistance (EN 60068-2-29)	40 g, 6 ms ½ Sinus, 4000 × each, 3 axes
Type of protection	IP68/IP69K
MTTF	348 years to SN 29500 (Ed. 99) 40 °C
LED indications	
Measuring range indication	Multifunction LED green, green flashing

15 Turck subsidiaries — contact information

Germany	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr **www.turck.de**
Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria **www.turck.com.au**
Belgium	TURCK MULTIPROX 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**
China	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin **www.turck.com.cn**
France	TURCK BANNER S.A.S. 11 rue de Courtalin Bat C, Magny Le Hongre, F-77703 MARNE LA VALLEE Cedex 4 **www.turckbanner.fr**
Great Britain	TURCK BANNER LIMITED Blenheim House, Hurricane Way, GB-SS11 8YT Wickford, Essex **www.turckbanner.co.uk**
India	TURCK India Automation Pvt. Ltd. 401-403 Aurum Avenue, Survey. No 109 /4, Near Cummins Complex, Baner-Balewadi Link Rd., 411045 Pune - Maharashtra **www.turck.co.in**
Italy	TURCK BANNER S.R.L. Via San Domenico 5, IT-20008 Bareggio (MI) **www.turckbanner.it**
Japan	TURCK Japan Corporation Syuuhou Bldg. 6F, 2-13-12, Kanda-Sudacho, Chiyoda-ku, 101-0041 Tokyo **www.turck.jp**
Canada	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 **www.turck.ca**
Korea	Turck Korea Co, Ltd. B-509 Gwangmyeong Technopark, 60 Haan-ro, Gwangmyeong-si, 14322 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**
Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Wien **www.turck.at**
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**
Russian Federation	TURCK RUS OOO 2-nd Pryadilnaya Street, 1, 105037 Moscow **www.turck.ru**
Sweden	Turck Sweden Office 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**
Czech Republic	TURCK s.r.o. Na Brne 2065, CZ-500 06 Hradec Králové **www.turck.cz**
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**
Hungary	TURCK Hungary kft. Árpád fejedelem útja 26-28., Óbuda Gate, 2. em., H-1023 Budapest **www.turck.hu**
USA	Turck Inc. 3000 Campus Drive, USA-MN 55441 Minneapolis **www.turck.us**

TURCK

Over 30 subsidiaries and over
60 representations worldwide!

100001183 | 2022/03

www.turck.com