TURCK

Your Global Automation Partner

RI360P1-DSU35TC-ELI-EXI Inductive Angle Sensor with Analog Output

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 personnel with knowledge of explosion protection (e.g. EN 60079-14 etc.) 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
- Declarations of conformity (current version)
- Quick Start Guide
- Approvals

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 angle sensors:

- RI360P1-DSU35TC-ELI-EXI

2.2 Scope of delivery

The delivery consists of the following:

- Sensor
- Positioning element P1-RI-DSU35
- Countersunk screw M6 × 25
- 2 cylinder screws M5 × 12
- 2 lock washers A5
- 2 cable glands (blue)
- Dummy plug

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 [▷ 22].

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 inductive angle sensors RI…DSU35… record angles in the range of 0…360° without making contact. The devices with analog output have a teach button in the terminal chamber and are suitable for operation in Zone 1 and Zone 21.

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 notes

- 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.

3.4 Notes on Ex protection

- When using the device in Ex areas, the user must have knowledge of explosion protection (IEC/EN 60079-14 etc.).
- Observe national and international regulations for explosion protection.
- Only use the device within the permissible operating and ambient conditions (see certification data and Ex approval specifications).
- Never connect equipment to intrinsically safe circuits if this equipment was previously used once in non-intrinsically safe circuits.

3.4.1 Requirements for Ex approvals

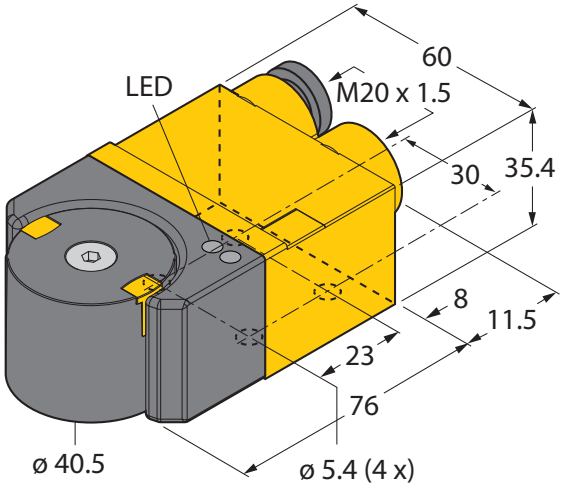
- Avoid static charging if the device will be used in the following areas: Group IIC or Group IIA or IIB, where the Ga protection level is required.
- Do not use the device in areas with a Ga protection level if the ambient temperature exceeds 80 °C.

4 Product description

The inductive angle sensors of the RI360…DSU35TC… product series measure angular movements up to 360°. The sensor and the positioning element are fully potted and designed as two independent and fully sealed units with protection to IP68 and IP69K, which work together without contact. Due to their functional principle, the sensors are immune to electromagnetic interference. The positioning elements with the optionally available adapter sleeves can be mounted on ferritic and non-ferritic shafts with a diameter of up to 30 mm. Mounting kits are available for mounting on larger rotary actuators.

The devices feature an analog output with a teach-in function. Teaching-in is carried out via a switch in the terminal chamber. An output signal between 4 and 20 mA is output via the angular position of the positioning element.

4.1 Device overview



4.1.1 Indication elements

The devices have a green operating voltage LED and a yellow status LED.

4.1.2 Operating elements

Start and end points for analog signals can be set via the teach button installed in the terminal chamber and the effective direction of the encoder can be changed.

4.2 Properties and characteristics

- Rectangular, housing DSU35
- Plastic, PP-GF30
- Detection of angular positions from 0 to 360°
- Measuring range can be adjusted via teach button in the terminal chamber
- Analog output, 4…20 mA
- Immune to electromagnetic interference
- 14…30 VDC

4.3 Functional principle

The angle sensors work contact-free on the basis of the inductive resonator measuring principle. This measuring principle allows for a design with a fully potted sensor housing without seals that is separate from the positioning element. Magnetic fields disturb the measuring process very little because the positioning element is not based on a magnet but on an inductive coil system where the sensor and positioning element (resonator) form an oscillating circuit.

The device provides an output signal that corresponds to the angle of the positioning element.

4.4 Functions and operating modes

Output function

The device has an adjustable current output that outputs a current signal in the range of 4…20 mA in the same way as 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 22 mA.

NOTE
During the teaching-in process, the loop current is 22 mA.

- 4…20 mA

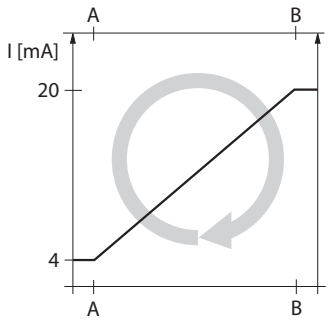


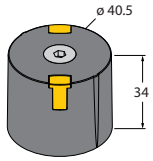
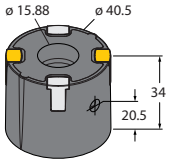
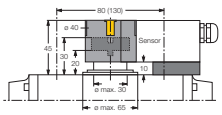
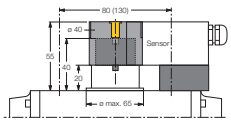
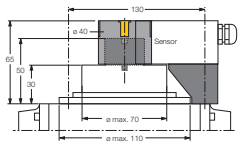
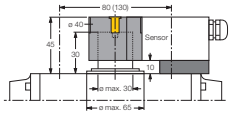
Fig. 1: Output signal curve at factory setting — CW rotation direction

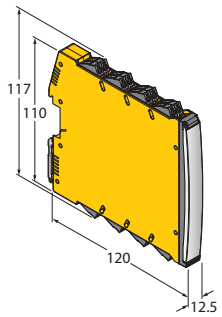
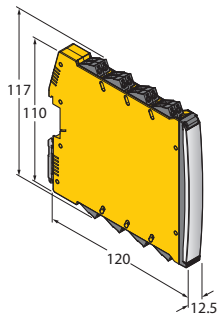
Setting options via teach button

The following settings can be made using the teach button in the terminal chamber:

- Desired measuring range with start and end values
- Effective direction of the encoder
- Reset to factory settings

4.5 Technical accessories

Dimension drawing	Type	ID	Description
	P1-RI-DSU35	6901086	Positioning element for inductive angle sensors DSU35 for rotary actuators; mounting on connection shaft with countersunk screw M6 × 25
	P4-RI-DSU35	100002204	Positioning element for inductive angle sensors DSU35 for rotary actuators; mounting on connection shaft (shaft extension) 5/8 with set screw
	BTS-DSU35-Z01	6900229	Mounting kit for dual sensors for larger rotary actuators; Ø spacer plate and snap ring: max. 65 mm; hole pattern on flange: 30 × 80 mm (30 × 130 mm); connection shaft (shaft extension) height: 20 mm/Ø max. 30 mm
	BTS-DSU35-Z02	6900230	Mounting kit for dual sensors for larger rotary actuators; Ø spacer plate and snap ring: max. 65 mm; hole pattern on flange: 30 × 80 mm (30 × 130 mm); connection shaft (shaft extension) height: 20 mm/Ø max. 45 mm
	BTS-DSU35-Z03	6900231	Mounting kit for dual sensors for larger rotary actuators; Ø spacer plate and snap ring: max. 110 mm; hole pattern on flange: 30 × 130 mm; connection shaft (shaft extension) height: 30 mm/Ø max. 70 mm
	BTS-DSU35-Z07	6900403	Mounting kit for dual sensors for larger rotary actuators; Ø spacer plate and snap ring: max. 110 mm; hole pattern on flange: 30 × 130 mm; connection shaft (shaft extension) height: 50 mm/Ø max. 75 mm

Dimension drawing	Type	ID	Description
	IMX12-AI01-1I-1IU-H0/24VDC	7580313	Isolating transducer; 1-channel; power supply of passive 2-wire isolating transducers with HART communication, connection of active 2-wire transmitters, SIL2 acc. to IEC61508; Ex-proof version; selectable with either current source/sink or voltage output; removable screw terminals; 24 VDC power supply
	IMX12-AI01-2I-2IU-H0/24VDC	7580305	Isolating transducer; 2-channel; power supply of passive 2-wire isolating transducers with HART communication as well as connection of active 2-wire transmitters, SIL2 acc. to IEC61508; Ex-proof version; selectable with either current source/sink or voltage output; removable screw terminals; 24 VDC power supply

5 Installing

The device can be mounted without mounting accessories on rotating shafts made from ferrous material with diameters of up to 14 mm or on non-ferrous shafts. For ferrous shafts with larger diameters, mounting kit BTS-DSU35-Z02 is required:

NOTICE
Insufficient clearance from metal surrounding the positioning element
Loss of function due to weakening of the oscillating circuit!

- ▶ Ensure sufficient clearance between the surrounding area and positioning element.
- ▶ Carry out a function test prior to commissioning.

- Avoid static charges on plastic devices and cables.
- Do not mount the device in a dust flow and avoid build-up of dust deposits.
- Protect devices and cables against mechanical damage.
- To avoid contamination, remove the housing covers and plug only shortly before mounting.

5.1 Mounting the sensor on ferrous shafts (Ø ≤ 14 mm) or non-ferrous shafts

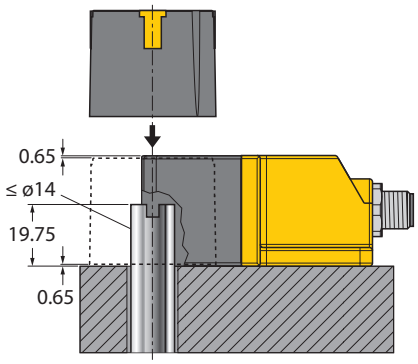


Fig. 2: Mounting the sensor — shaft diameter of up to 14 mm

The positioning element must be centered within the sensor's detection range. The following prerequisites must be fulfilled for this purpose:

- The shaft protrudes 19.75 mm from the mounting surface.
- The shaft features a groove as anti-rotation protection for the positioning element.

- ▶ Screw the sensor on to the mounting surface.
- ▶ Fit the positioning element on the shaft.
- ▶ Align the positioning element in the center of the sensor's detection range. The ideal distance to the upper and lower sensor edge is 0.65 mm.
- ▶ Attach the positioning element. The nominal distance between the sensor and positioning element is 1 mm.

5.2 Mounting the sensor on ferrous shafts (Ø > 14 mm)

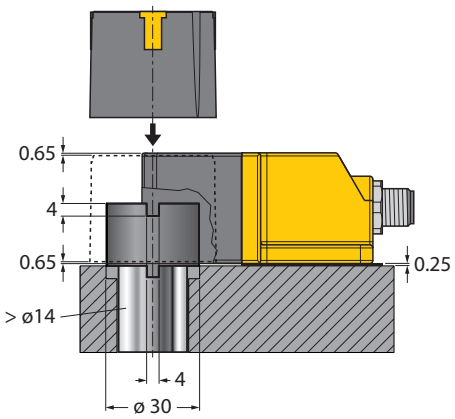


Fig. 3: Mounting the sensor — shaft diameter greater than 14 mm

Mounting kit BTS-DSU35-Z02 allows the device to be mounted on rotating shafts made from ferrous material with a diameter greater than 14 mm.

The positioning element must be centered within the sensor's detection range. The following prerequisites must be fulfilled for this purpose:

- The shaft is flush with the mounting surface.
- The shaft features a groove as anti-rotation protection for the positioning element.

▶ Insert a spacer plate (0.25 mm) between the sensor and the mounting surface.
▶ Screw the sensor on to the spacer plate.
▶ Fit mounting kit BTS-DSU35-Z02 on the shaft.
▶ Fit the positioning element on mounting kit BTS-DSU35-Z02.
▶ Align the positioning element in the center of the sensor's detection range. The ideal distance to the upper and lower sensor edge is 0.65 mm.
▶ Attach the positioning element. The nominal distance between the sensor and positioning element is 1 mm.

6 Connection

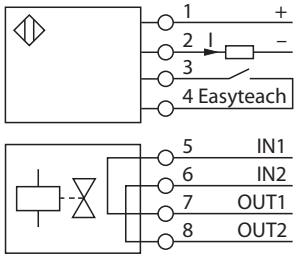


Fig. 4: Wiring diagram

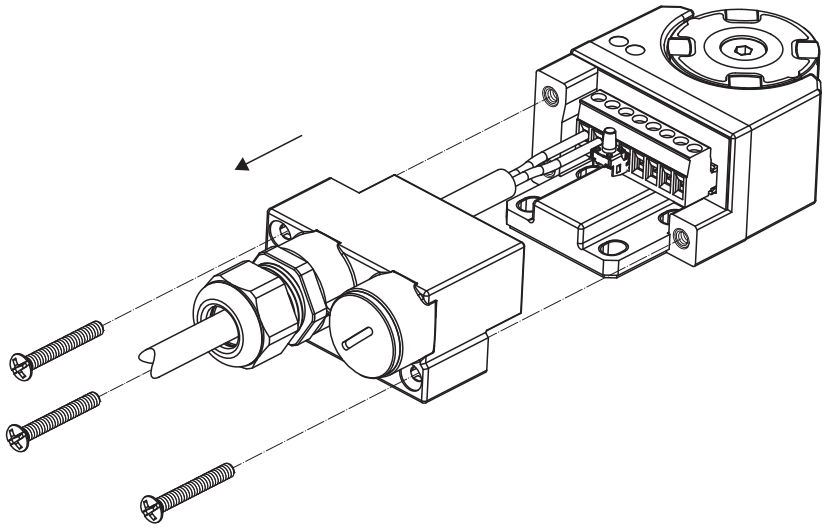


Fig. 5: Removing the housing part

- Open the terminal chamber via the external cable glands and remove the housing part.
- Insert stranded wires with a stripped length of 6 mm and suitable wire end sleeves into the terminal chamber.
- Connect the connection cable to the connector strip according to the wiring diagram.
- Close the housing and secure the screws.
- Connect the open end of the connection cable to the power source and/or evaluation devices in accordance with the wiring diagram.

7 Commissioning

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

8 Operation

8.1 LEDs

LED	Color/state	Meaning
Operating voltage	Green	The sensor is supplied properly and the positioning element is located in the detection zone.
Status	Yellow	The positioning element is in the measuring range with limited signal quality (e.g. distance too great).
	Yellow flashing	The positioning element is not within the detection range.

9 Setting

The following parameters can be set via teaching-in:

Parameter	Description
Start point	The start of the analog measuring range is defined according to the effective direction.
End point	The end of the analog measuring range is defined according to the effective direction.
Effective direction	The effective direction of the encoder is set clockwise (CW) or counterclockwise (CCW).
Factory setting	Resets the sensor to factory settings.

9.1 Setting via the Easy-Teach function

Teaching-in is carried out via the teach button in the terminal chamber. To actuate the teach button, the housing must be removed.

During normal operation, the operating voltage LED lights up green. After successful teaching-in, the operating voltage LED flashes green briefly.

Dismantling the housing

- Loosen the screws on the housing.
- Remove the housing part above the terminal chamber.

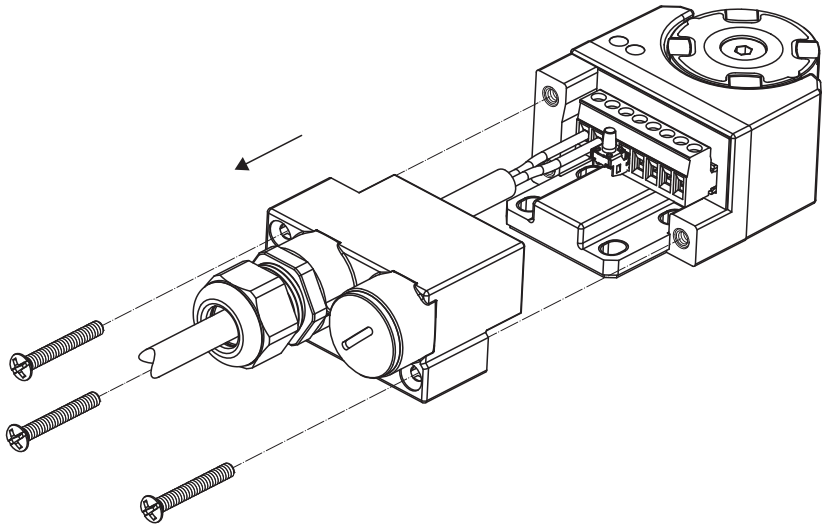


Fig. 6: Removing the housing part

Setting options for the Easy-Teach function

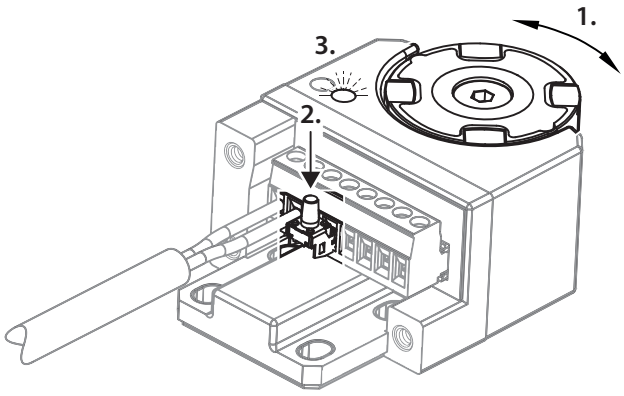


Fig. 7: Carrying out the teaching-in procedure

Setting the start point of the analog signal

- ▶ Turn the positioning element to the desired start point (1).
- ▶ Press the teach button for 3 s (2).
- ⇨ The status LED flashes 1 × yellow (3).

Setting the end point of the analog signal

To set the end point of the analog signal, a start point must be set.

- ▶ Turn the positioning element to the desired end point (1).
- ▶ Press the teach button for 5 s (2).
- ⇨ The status LED flashes 2 × yellow (3).

Set the encoder's effective direction clockwise (CW) or counterclockwise (CCW)

- ▶ Hold down the teach button for 8 s (2).
- ⇨ The status LED flashes 3 × yellow (3).

Resetting the encoder to factory settings

- ▶ Hold down the teach button for 12 s (2).
- ⇨ The status LED flashes 4 × yellow (3).
- ⇨ The set start and end points are reset to factory settings and the effective direction is reset to CW.

10 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.

11 Maintenance

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

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

12 Repair

The device must not be repaired by the user. Take defective devices out of operation and return them to Turck for an error analysis. 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

Technical data	
Measuring principle	Inductive
Measuring range (A…B)	0…360°
Nominal distance	1 mm
Repetition accuracy	≤ 0.025 % of full scale
Linearity deviation	≤ 0.6 % of full scale
Temperature drift	≤ ± 0.02 %/K
Ambient temperature	-25…+70 °C
Output type	Absolute single-turn
Electrical data	
Operating voltage	14…30 VDC
Ripple	≤ 10 % Uss
Insulation test voltage	≤ 0.5 kV
Short-circuit protection	Yes
Wire break/reverse polarity protection	Yes/complete
Output function	Two-wire, analog output
Current output	4…20 mA
Diagnostics	Positioning element not within detection range: Output signal 22 mA
Load resistance, current output	≤ [(UB -14 V)/20 mA] kΩ
Sampling rate	500 Hz
Valve control	Exi (max. 30 V)
Internal capacitance (C_i)/ inductance (L_i)	0 nF/0 µH
Mechanical data	
Design	Dual sensor for rotary actuators, DSU35
Dimensions	76 × 60 × 35.4 mm
Flange type	Flange without fixing element
Housing material	Plastic, PP-GF30
Housing material of positioning element	Plastic, PA66 + PA6I/6T-GF40
Electrical connection	Terminal chamber
Ambient conditions	
Ambient temperature	Max. ambient temperature, see appendix
Vibration resistance	55 Hz (1 mm)
Shock resistance	30 g (11 ms)
Degree of protection	IP68, IP69K
MTTF	138 years acc. to SN 29500 (Ed. 99) 40 °C
Included in delivery	Positioning element P1-Ri-DSU35, countersunk screw M6 × 25, 2x cylinder screws M5 × 12, 2x lock washers A5, 2x cable glands (blue), 1x dummy plug

15 Appendix

15.1 Approvals and markings

Approvals	
KEMA 03 ATEX1122 X CE 0102	Ex II 1 G Ex ia IIB/IIC T4…T6 Ga Ex II 2 G Ex ia IIC T4…T6 Gb Ex II 2 D Ex ia IIIC T85 °C…T115 °C Db
IECEx DEK 14.0065X	Ex ia IIB/IIC T4…T6 Ga Ex ia IIC T4…T6 Gb Ex ia IIIC T85 °C…T115 °C Db

Maximum ambient temperature

Max. ambient temperature	Temperature class	Max. surface temperature	P_i
+79 °C	T4	T106 °C	1000 mW
+73 °C	T5	T100 °C	1000 mW
+66 °C	T6	T85 °C	600 mW
+62 °C	T6	T85 °C	800 mW
+58 °C	T6	T85 °C	1000 mW

16 Turck branches — contact data

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
Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Vienna www.turck.at
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
Canada	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 www.turck.ca
China	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin www.turck.com.cn
Czech Republic	TURCK s.r.o. Na Brne 2065, CZ-500 06 Hradec Králové www.turck.cz
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
Hungary	TURCK Hungary kft. Árpád fejedelem útja 26-28., Óbuda Gate, 2. em., H-1023 Budapest www.turck.hu
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 ISM Akihabara 1F, 1-24-2, Taito, Taito-ku, 110-0016 Tokyo www.turck.jp

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
United Kingdom	TURCK BANNER LIMITED Blenheim House, Hurricane Way, GB-SS11 8YT Wickford, Essex www.turckbanner.co.uk
USA	Turck Inc. 3000 Campus Drive, USA-MN 55441 Minneapolis www.turck.us

TURCK

Your Global Automation Partner

Over 30 subsidiaries and
60 representations worldwide!

100046871 | 2024/11

www.turck.com