Your Global Automation Partner

TURCK

# LTX
# Linear Position Sensors with Analog Output

Operating instructions

# Contents

# 1 About These Instructions

These operating instructions 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 will prevent the risk of personal injury or damage to property or the device. Retain these instructions for future use during the service life of the product. If the product is passed on, ensure that these instructions are handed over as well.

## 1.1 Target groups

These instructions are intended for qualified personnel and must be read carefully 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 an imminently hazardous, high-risk situation which, if not avoided, will result in death or serious injury.

**WARNING**
WARNING indicates a potentially hazardous, medium-risk situation which, if not avoided, could result in death or serious injury.

**CAUTION**
CAUTION indicates a situation that may result in property damage if not avoided.

**NOTE**
NOTE indicates tips, recommendations and important information. The notes will facilitate work, provide more information on specific actions and help prevent additional work due to incorrect processes.

➤ **CALL TO ACTION**
This symbol denotes action steps that the user must perform.

➥ **ACTION RESULT**
This symbol denotes the relevant results of actions and action sequences.

## 1.3 Other documents

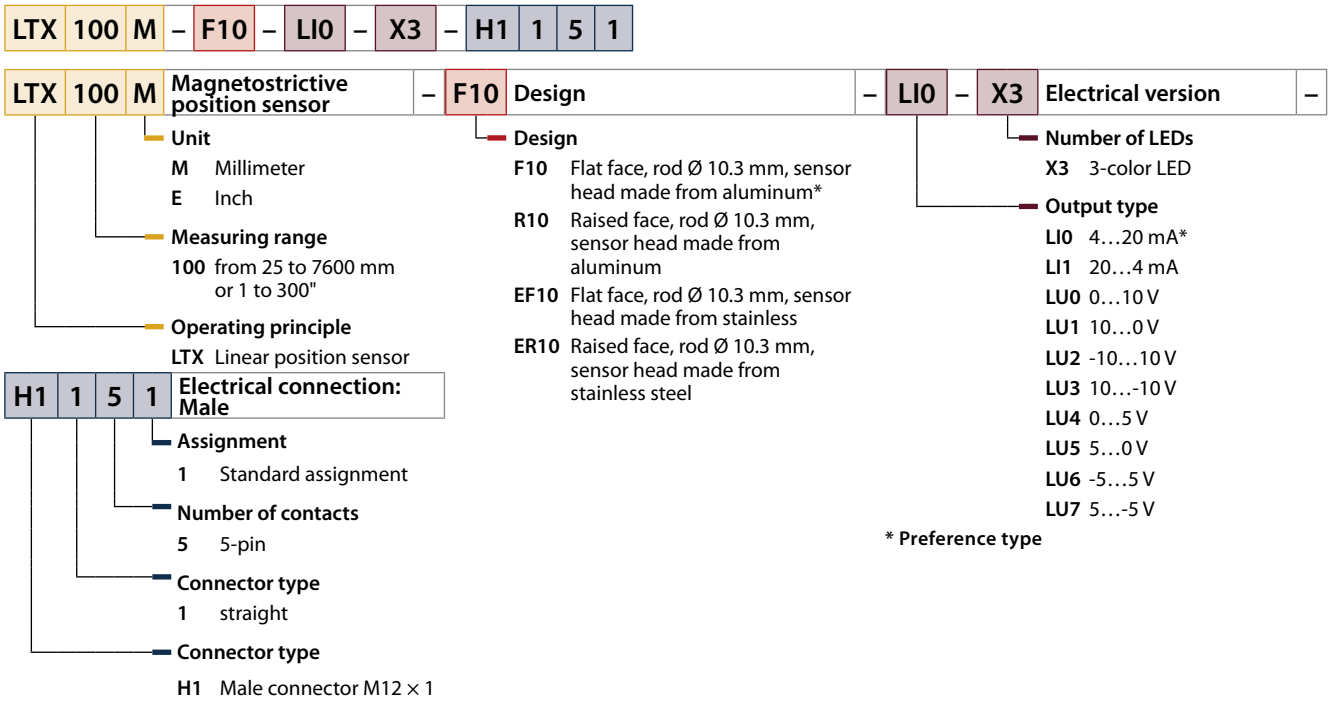
In addition to this document, the following material can be found on the Internet at www.turck.com:
- Data sheet
- EU declaration of conformity

## 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 any information is missing from the instructions, please send your suggestions to techdoc@turck.com.

# 2 Information About the Product

## 2.1 Product identification




**NOTE**

- Designs with manufacturer-compatible connectors as well as models with customer-specific blind zones are available on request.
- The preferred types are the LTX…M-F10-LI0-X3-H1151 devices.

## 2.2 Scope of delivery

The following are included in the scope of delivery:

- Linear position sensor (without positioning element)
- Quick Start Guide

## 2.3 Legal requirements

The device is subject to the following EU directives:

- 2014/30/EU (electromagnetic compatibility)

## 2.4 Manufacturer and service

Turck provides you with support and assistance for your projects — from the initial analysis to commissioning your application. The Turck product database contains software tools for programming, configuration and commissioning, as well as data sheets and CAD files in numerous export formats. You can access the product database at the following address:
**www.turck.de/products/**

Should you have any further questions, please contact the sales and service team in Germany on the following telephone numbers:
Sales: +49 208 4952-380
Technology: +49 208 4952-390

Outside Germany, please contact your Turck representative.

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Germany

# 3 For your Safety

The product is designed in accordance with the latest standards. However, residual risks still exist. Observe the following warnings and safety information to prevent personal injury or damage to property. Turck accepts no liability for damage caused by failure to observe these warning and safety instructions.

## 3.1 Intended use

The devices are intended solely for use in industrial areas.

The magnetostrictive linear position sensors are used for contactless and wear-free linear position detection. The devices are suitable for use in hydraulic cylinders. By adding float magnets (available as an option), the devices can also be used for level measurement. The measuring range is adjustable.

The devices must be used only 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 General safety information

- The devices are not safety components and must not be used for personal or property protection.
- The device must be mounted, installed, operated, parameterized and maintained only by trained and qualified personnel.
- The device complies exclusively with the EMC requirements for industrial applications and is not suitable for use in residential areas.

# 4 Product Description

The linear position sensors with an analog output are available with a current or voltage output. An M12 connector is available for the connection. All devices feature a rod design with IP68 protection. The devices operate without contact, which requires the use of a positioning element approved by Turck (see Accessories). The measuring range is adjustable.

The devices operate on an absolute basis; power outages do not necessitate renewed zero offset adjustment or recalibration. All position values are determined as absolute values; reference runs after a voltage drop are unnecessary.

## 4.1 Device overview

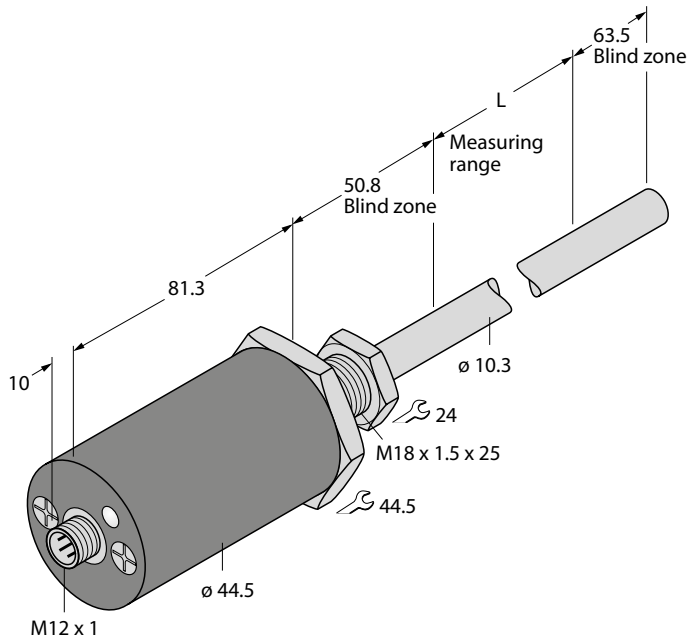



Fig. 1: Device dimensions of LTX…M… with standard blind zones (in mm)

### 4.1.1 Display elements

Each device has a 3-color LED for indicating the operating state and for diagnostics (see 8.1 LED display).

## 4.2 Properties and features

- Analog output
- Adjustable measuring range with adjustment protection
- Automatic signal control
- 7…30 VDC supply voltage
- Low power consumption
- High shock and vibration resistance
- Protection class IP68
- 16-bit resolution
- Status display via 3-color LED
- Sensor and pressure pipe can be replaced separately
- M12 connector

## 4.3 Operating principle

Turck LTX sensors utilize the magnetostrictive principle. A "waveguide" is located in the measuring probe of the linear position sensor. If a current signal generated at the waveguide encounters the externally applied magnetic field of the positioning element, mechanical feedback is produced in the waveguide. This feedback is evaluated in the sensor head and output as position information.

## 4.4 Functions and operating modes

The devices feature a current or voltage output. The device output provides a current or voltage signal proportional to the position of the positioning element (see output characteristics).

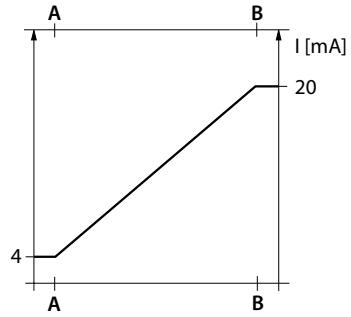



Fig. 2: Output characteristics – devices with 4…20 mA current output

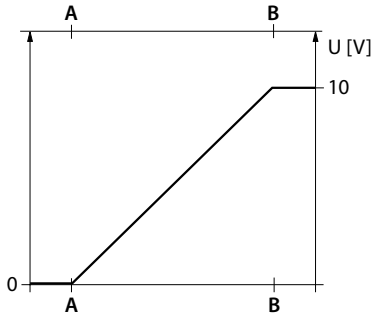



Fig. 3: Output characteristics – devices with 0…10 V voltage output

### 4.4.1 Automatic signal control

The device is automatically adjusted to the signal strength of the positioning element as soon as the sensor is supplied with power. The automatic signal control fully compensates for any tolerances.

### 4.4.2 Current output

LTX…LI… devices feature a current output, which outputs a current signal in line with the position of the positioning element (e.g. 4…20 mA, depending on design). The measuring range is adjustable.

### 4.4.3 Voltage output

LTX…LU… devices feature a voltage output, which outputs a voltage signal in line with the position of the positioning element (e.g. 0…10 V, depending on design). The measuring range is adjustable.

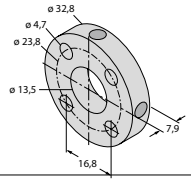
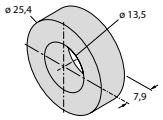
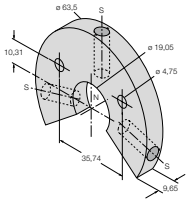
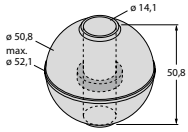
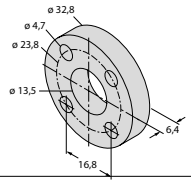
### 4.4.4 Preferred types LTX…M-F10-LI0-X3-H1151 – Measuring range

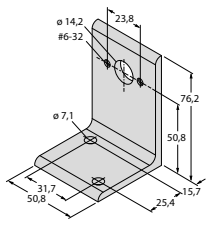
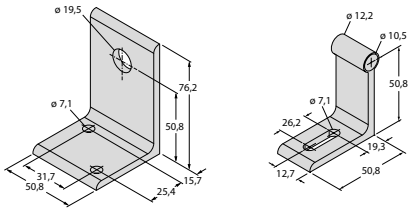
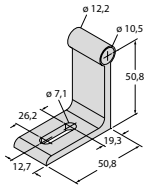
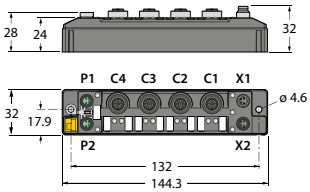
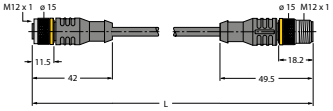
Preferred types LTX…M-F10-LI0-X3-H1151 are available with the following measuring lengths as standard:

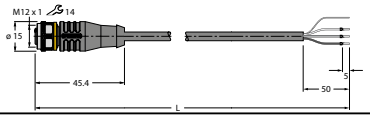
| Measuring range | configured |
|---|---|
| 100…500 mm | in 25 mm increments |
| 500…2000 mm | in 50 mm increments |
| 2000…7600 mm | in 500 mm increments |

## 4.5 Technical accessories

The following accessories are not supplied with the device:

| Dimension drawing | Type | Ident no. | Description |
|---|---|---|---|
| **Positioning element** | | | |
|  | STM-AL-R10 | 6900409 | Standard 4-hole positioning element, aluminum, suitable for mounting in hydraulic cylinders |
|  | CM-R10 | 6900416 | Standard positioning element, suitable for mounting in hydraulic cylinders |
|  | LSPM-AL-R10 | 6900414 | Ring-type positioning element with slot, aluminum, can be used for external mounting with mounting clamp RB-R10 |
|  | EF-R10 | 6900417 | Float-positioning element, stainless steel, specific weight 0.62 kg/m³, for external mounting for level monitoring |
| **Spacer** | | | |
|  | STS-R10 | 6900411 | Standard spacer produced from non-ferritic material for separating the positioning element from the ferritic base of the hydraulic piston rod, suitable for installation in hydraulic cylinders |

| Dimension drawing | Type | Ident no. | Description |
|---|---|---|---|
| **Accessories for external mounting** | | | |
|  | MMB-R10 | 6900004 | Mounting clamp for positioning element, for external mounting, with screws and standard STS-R10 spacer |
|  | MB-R10 | 6900419 | Mounting clamp for sensor head and rod, for external mounting, with screws |
|  | RB-R10 | 6900420 | Mounting clamp for rod, for external mounting, with screws |
| **Teach adapter** | | | |
| | RP-Q21 | 6900005 | Teach adapter to adjust the measuring range |
| **Fieldbus accessories** | | | |
|  | TBEN-S2-4AI | 6814025 | Compact multiprotocol I/O module for Ethernet (EtherNet/IP, Modbus TCP or PROFINET slave) with 4 analog inputs |
|  | RKC4T-2-RSC4.301T/TXL320 | 6630836 | 2 m adapter cable, 3-pin, PUR, for direct connection of the sensor to the block I/O module TBEN-S2-4AI, required module parameter setting: common ground (asymmetrical) |

| Dimension drawing | Type | Ident no. | Description |
|---|---|---|---|
| **Connection cable accessories** | | | |
|  | RKS4.5T-2/TXL | 6626373 | 2 m connection cable, M12 female connector, 5-pin, PUR, shielded |
|  | RKS4T-2/TXL | 6626293 | 2 m connection cable, M12 female connector, 3-pin, PUR, shielded |

In addition to the connection cables listed, Turck also offers additional versions for specific applications with suitable connections for the sensor. Further information can be found in the Connectivity section of the Turck product database at **https://pdb2.turck.de/en/DE/groups/**.

# 5 Mounting

The device can be mounted in a hydraulic cylinder or externally with a mounting bracket.

**CAUTION**
Incorrect mounting
**Risk of damage to the sensor**
- ➤ Secure the device in place using only the hexagon nut on the sensor head (max. tightening torque: 50 Nm).
- ➤ Do not fasten by turning the sensor head itself.
- ➤ Ensure that the positioning element is guided centrally over the pressure pipe along the entire measuring length (deviation < 0.5 mm).

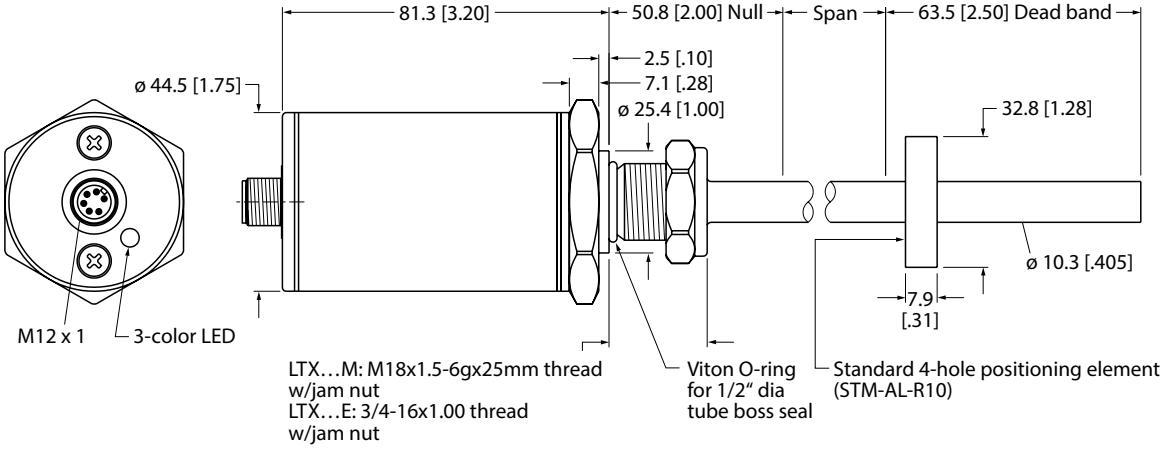



Fig. 4: Side view of LTX-R10 with dimensions in mm [in] (design with raised face)

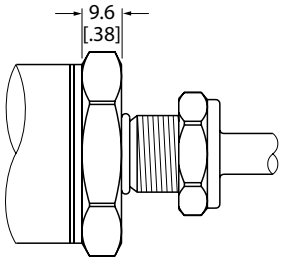



Fig. 5: Design with flat face (F10) – Housing nut with thread, dimensions in mm [in]

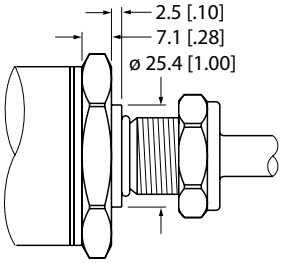



Fig. 6: Design with raised face (R10) – Housing nut with thread, dimensions in mm [in]

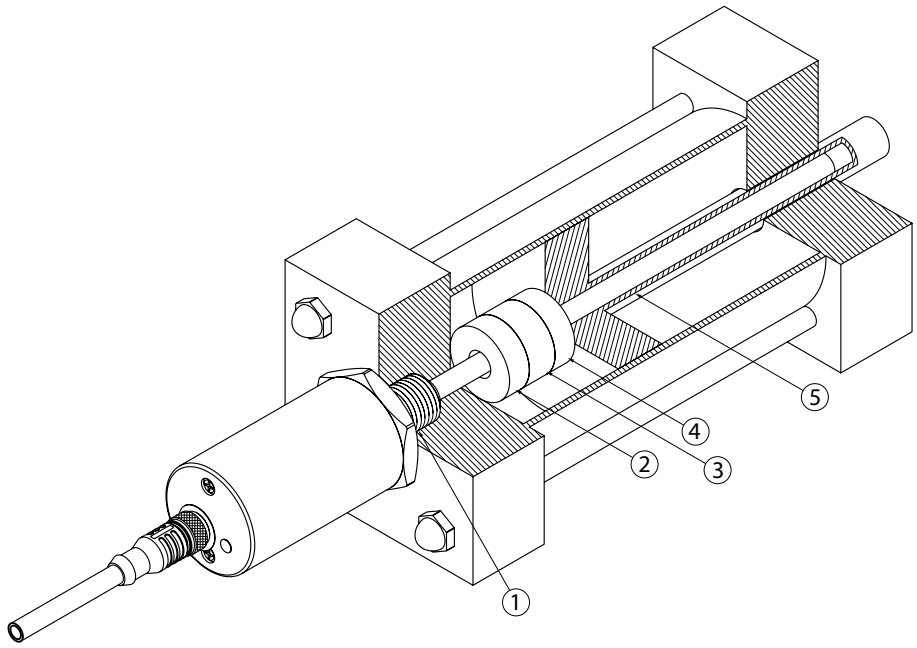
## 5.1 Mounting the device in a hydraulic cylinder

**CAUTION**
Incorrect mounting
**Risk of damage to the hydraulic cylinder**
➤ Observe the instructions from the cylinder manufacturer and the hydraulic cylinder specifications.

The devices can be mounted directly in a hydraulic cylinder. To do so, the cylinder piston rod must have a bore hole with a recommended diameter of 13.5 mm (depending on the cylinder design). To fasten the device, the end cap of the hydraulic cylinder must have an M18 × 1.5 threaded bore in accordance with ISO 6149-1.

### 5.1.1 Mounting the sensor

➤ Loosen and remove the hexagon nut on the sensor from the thread on the sensor head.
➤ Ensure that the pressure seal O-ring is located on the sensor head.
➤ Mount the non-ferrite spacer between the positioning element and base of the piston rod.
➤ Mount the positioning element. Observe a minimum distance of 51 mm between the positioning element and sensor head with the piston rod in the retracted position. If the minimum distance cannot be observed, sink the positioning element in the cylinder piston.
➤ Recommended for sensors with measuring probe lengths ≥ 1500 mm: use protecting ring, e.g. made of polymer (see Fig. 7, no. 2). The protecting ring prevents mechanical wear of positioning elements by the pressure pipe when the piston is fully extended.
➤ Fasten the positioning element and spacer with non-ferrite screws.
➤ Remove protective cap on the hydraulic cylinder (if present). The bore hole in the cylinder piston rod should have a minimum diameter of 13.5 mm.
➤ Insert the sensor pressure pipe into the cylinder piston.
➤ Screw the sensor into the M18 × 1.5 threaded bore of the hydraulic cylinder using the thread of the sensor head (max. tightening torque: 50 Nm).




| | |
|---|---|
| 1 | Viton O-ring |
| 2 | Protecting ring (optional) |
| 3 | 4-hole positioning element |
| 4 | Spacer for positioning element |
| 5 | 13.5 mm bore hole in the cylinder piston rod |

Fig. 7: Mounting the device in a hydraulic cylinder

## 5.2 Fastening the device externally with a mounting bracket

**CAUTION**
Magnetization of metal in close proximity with the measuring probe
**Inaccurate measurements**
➤ Mount the sensor measuring probe at least 7 mm away from ferromagnetic material.

**NOTE**
Non-ferrous materials, such as brass, copper, aluminum, demagnetized stainless steel or plastic do not impair the function of the sensor.

➤ Loosen the hexagon nut on the thread of the sensor head.
➤ Guide the mounting bracket over the pressure pipe up to the sensor head.
➤ If the mounting bracket has an M18 × 1.5 threaded hole, screw the sensor directly.
➤ Fasten the mounting bracket.
➤ Re-fasten the hexagon nut on the sensor head.

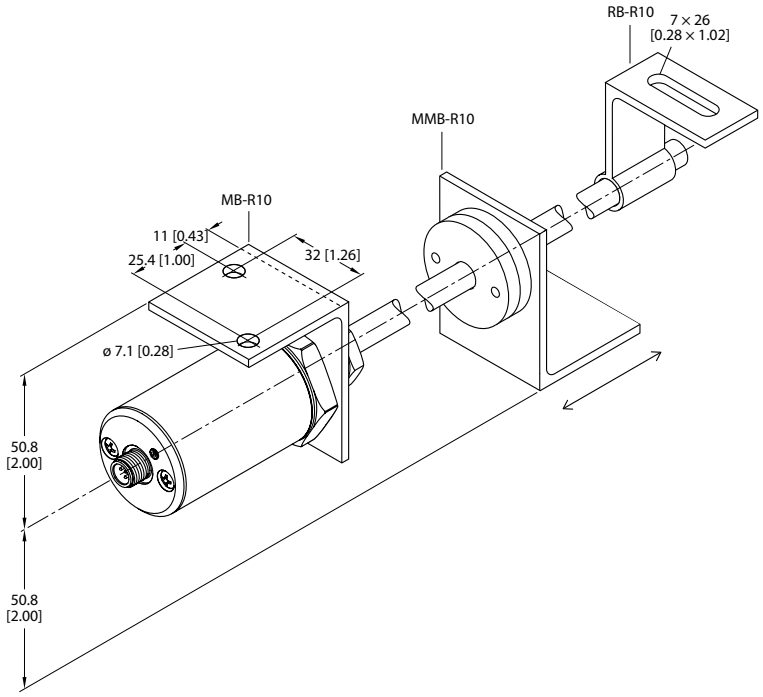



Fig. 8: Mounting the device with mounting brackets (dimensions in mm)

### 5.2.1 Fitting additional mounting elements (for external mounting)

On devices over 750 mm in length, additional mounting elements (RB-R10) increase protection against mechanical stresses such as impacts and vibrations. The mounting elements must be made from non-ferrite material.

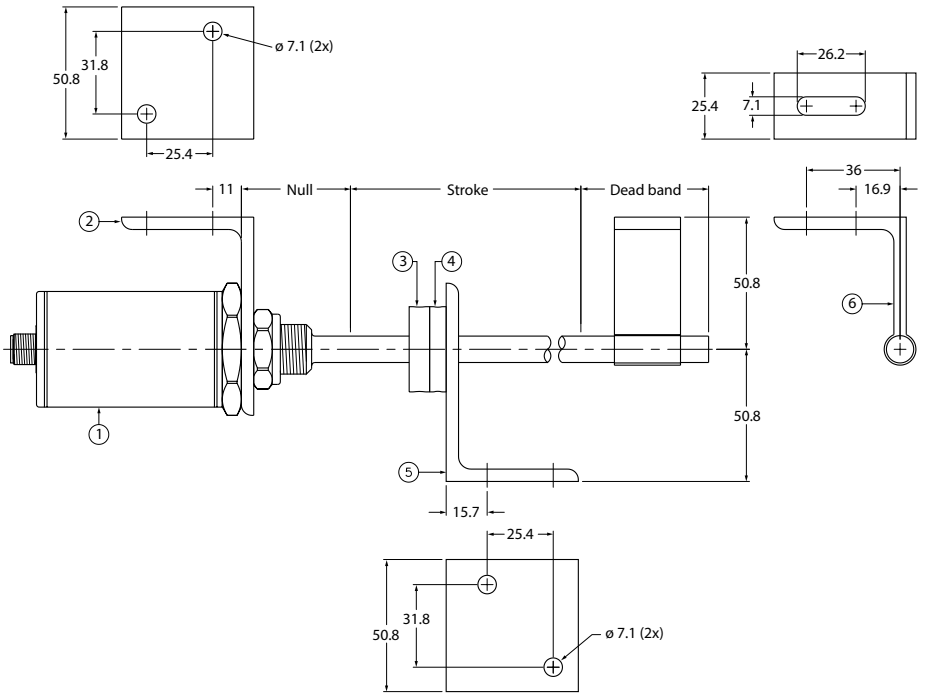
- ➤ When using additional mounting elements, use a positioning element with a slot.
- ➤ Fit mounting elements made from ferromagnetic (already magnetized) material at least 7 mm away from both the blind zone and the active measuring range of the sensor.
- ➤ Sensors with measuring probe lengths of 750…1800 mm: Fit additional mounting elements as per Fig. 9.
- ➤ Sensors with measuring probe lengths > 1800 mm: Fit mounting elements at distances of 1200 mm.

### 5.2.2 Mounting positioning elements (for external mounting)

- ➤ Maintain a distance of 7 mm between the positioning element and ferrite material. Use a spacer if necessary.
- ➤ Maintain a distance of 7 mm between the end of the measuring probe and ferrite material.

The positioning element must not touch the sensor along the entire measuring range.

- ➤ When using positioning elements with a slot: Observe ≤ 5 mm distance between the positioning element and measuring probe (nominal distance: 1.5 mm).
- ➤ Push the positioning element into the active measuring range of the sensor.
- ➤ Fasten the positioning element with non-ferrite screws.




| | |
|---|---|
| 1 | Sensor |
| 2 | Mounting element for sensor head |
| 3 | 4-hole positioning element (aluminum) |
| 4 | Spacer for positioning element |
| 5 | Mounting element for positioning element |
| 6 | Mounting element for measuring probe |

Fig. 9: Mounting the positioning element (dimensions in mm)

# 6 Connection

**CAUTION**
Couplings on the sensor cable
**Sensor fault**
➤ Do not route sensor cables close to high-voltage power supplies.

**NOTE**
➤ Keep the length of the connection cables as short as possible.
➤ Use shielded connection cables.
➤ Keep sensor cables away from the high-power AC cables and motor drive cables.
➤ Do not connect or disconnect the sensor when energized.

➤ Route high-voltage and low-voltage cables separately.
➤ Connect the female connector of the connection cable to the connector on the device.
➤ If the higher-level input is a differential (symmetrical) input, connect the sensor to the higher level as per Fig. 10.
➤ If the higher-level input is a common ground (asymmetrical) input, connect the sensor to the higher level as per Fig. 11.

**NOTE**
➤ Keep pin 2 potential-free during operation in order to prevent any accidental teach-in operations.

## 6.1 Wiring diagram

**NOTE**
The following figures detail the usual wire colors. In exceptional cases, this color assignment may differ.

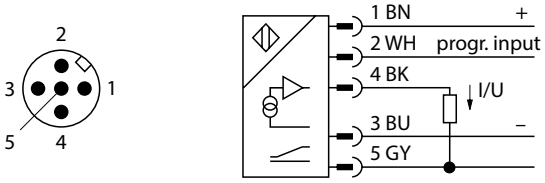
| Pin | Pin assignment | Wiring diagram |
|---|---|---|
| Pin 1 (BN) | $U_B$ |  |
| Pin 2 (WH) | Teach | |
| Pin 3 (BU) | GND | |
| Pin 4 (BK) | I/U | |
| Pin 5 (GY) | Position common | |



Fig. 10: Wiring diagram – higher-level input is differential (symmetrical)

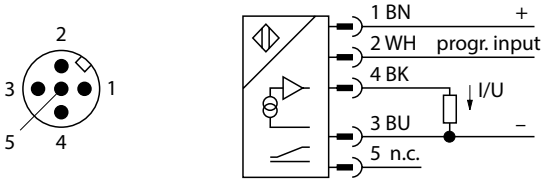
| Pin | Pin assignment | Wiring diagram |
|---|---|---|
| Pin 1 (BN) | $U_B$ |  |
| Pin 2 (WH) | Teach | |
| Pin 3 (BU) | GND | |
| Pin 4 (BK) | I/U | |
| Pin 5 (GY) | Position common | |



Fig. 11: Wiring diagram – higher-level input is common ground (asymmetrical)

# 7 Commissioning

Once the cables and the supply voltage are connected, the device automatically goes into operation. To ensure the correct calibration of the automatic signal control, the positioning element must be located in the active measuring range of the sensor when the supply voltage is connected.

# 8 Operation

## 8.1 LED display

| Color/status | Meaning |
|---|---|
| Off | No power supply present |
| Constant green light | Positioning element signal detected within taught range |
| Constant yellow light | Positioning element signal detected outside taught range |
| Constant red light | No positioning element signal detected |

Proceed as follows if no magnetic signal is detected (red LED lit):
➤ Place the positioning element in the active measuring range of the device.
➤ Reset the voltage.
➥ The device is automatically adjusted to the signal strength of the positioning element.

## 8.2 Diagnostics

The LTX with an analog output (4…20 mA) has a diagnostic feedback function. The 4…20 mA range makes it possible to locate the position of the positioning element in the set measuring range. If the positioning element is outside of the set measuring range, the analog output supplies the following values:
- 3.8 mA: Positioning element is located in the blind zone or no positioning element detected
- 3.9 mA or 20.1 mA: Positioning element is located outside of the set measuring range

# 9 Setting

The devices have an adjustable analog output. The measuring range can be set by manual bridging or with the RP-Q21 teach adapter. The zero point and end point of the measuring range can be set in succession or independently of one another.

## 9.1 Setting via manual bridging

➤ Supply the device with voltage.
➤ Place positioning element at the zero point of the measuring range.
➤ Bridge pin 2 and pin 3 for 4 s.
➤ Interrupt bridge between pin 2 and pin 3 for 1 s.
➥ Sensor starts teach mode.
➤ Bridge pin 2 and pin 3 within 5 s.
➥ Zero point of measuring range is stored.

➤ Place positioning element at end point of the measuring range.
➤ Bridge pin 2 and pin 3 for 4 s.
➤ Sensor starts teach mode.
➤ Interrupt bridge between pin 2 and pin 3 for 1 s.
➤ Bridge pin 1 and pin 2 within 5 s.
➥ End point of measuring range is stored.

## 9.2 Setting via teach adapter RP-Q21

➤ Connect the sensor to the teach adapter.
➤ Place positioning element at the zero point of the measuring range.
➤ Press the Zero button of the teach adapter for 4 s.
➤ Release the Zero button of the teach adapter for 1 s.
➥ Sensor starts teach mode.
➤ Press the Zero button of the teach adapter again within 5 s.
➥ Zero point of measuring range is stored.

➤ Place positioning element at end point of the measuring range.
➤ Press the Zero button of the teach adapter for 4 s.
➤ Release the Zero button of the teach adapter for 1 s.
➥ Sensor starts teach mode.
➤ Press the Span button of the teach adapter again within 5 s.
➥ End point of measuring range is stored.

# 10 Troubleshooting

If the device does not function as expected, check the LED feedback (see section "LED display"). Check whether there is any ambient interference. If there is no ambient interference, check the connections of the device for faults.

If no faults are identified, it indicates that the device is faulty. In this case, decommission the device and replace it with a new device of the same type.

## 10.1 Replacing the sensor head and measuring element

**WARNING**
Overpressure at the sensor head
**Risk of injury through uncontrolled ejection of sensor head**
➤ In pressurized systems, ensure that the pressure pipe is undamaged and pressure-proof.

**NOTE**
The system does not have to be depressurized for a fluid cylinder application.

The sensor head and measuring element can be replaced independently of the pressure pipe.
➤ Loosen the screws on the sensor head.
➤ Pull the sensor and measuring element out of the housing together as one piece. The end caps are not separately screwed to the sensor head.
➤ Insert a new sensor head and measuring element into the housing.
➤ Secure the screws, e.g. with Loctite 243.
➤ Fasten the screws on the sensor head (max. tightening torque < 1 Nm).

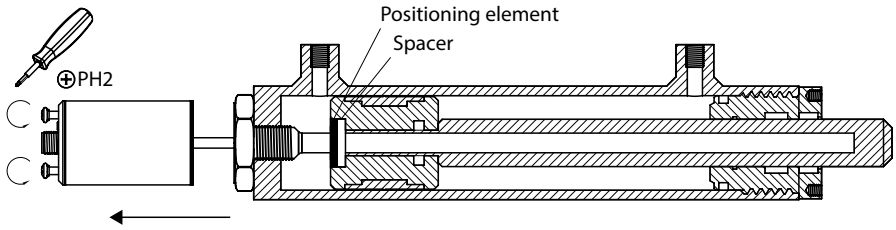



Fig. 12: Replacing the sensor head and measuring element

# 11 Maintenance

Ensure that the plug connections and connection cables are always in good condition. The devices are maintenance-free; clean using dry materials as required.

# 12 Repair

The device must not be repaired by the user. Take detective devices out of operation. Observe our return acceptance conditions when returning the device to Turck.

## 12.1 Returning devices

If a device has to be returned, please be aware that only devices with a decontamination declaration will be accepted. This is available for download at
http://www.turck.de/en/retoure-service-6079.php
and must be completed in full and affixed to the outside of the packaging such that it is secure and weather-proof.

# 13 Disposal


The devices must be disposed of correctly and must not be included in normal household garbage.

# 14 Technical Data

| Technical data | LTX-R10…/LTX-F10… | LTX-ER10…/LTX-EF10… |
|---|---|---|
| **Measuring range specifications** | | |
| Blind zone (connector end) | 50.8 mm | |
| Blind zone (end) | 63.5 mm | |
| Repeatability | ≤ 0.01% full scale | |
| Resolution | 16 bit | |
| Linearity | ≤ 0.01% full scale | |
| Operating temperature, rod | -40 °C … +105 °C | |
| Operating temperature, electronics | -40 °C … +85 °C | |
| Temperature drift | ≤ 10 ppm/°C | |
| **Electrical data** | | |
| Operating voltage | 7…30 VDC | |
| Current consumption | ≤ 100 mA/15 VDC | |
| Short-circuit protection | Yes/cyclic | |
| Output function | 5-wire, analog | |
| **Design** | | |
| Design | Cylindrical/smooth | |
| Housing material | Metal, aluminum, black | Metal, stainless steel, 304 |
| Material of active face | Metal, stainless steel, 316 | |
| Vibration resistance | 30 Hz (1 mm) | |
| Shock resistance | 100 g (11 ms) | |
| Pressure resistance (temporary) | 680 bar | |
| Pressure resistance (permanent) | 340 bar | |
| Protection class | IP68 | |

## 14.1 Update time

| Measuring length | Update time |
|---|---|
| 50 mm | 0.5 ms |
| 300 mm | 1 ms |
| 750 mm | 2 ms |
| 1250 mm | 3 ms |
| 2500 mm | 4 ms |
| 3800 mm | 5 ms |
| 4550 mm | 6 ms |
| 6350 mm | 7 ms |
| 7600 mm | 8 ms |

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