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**TURCK**

LTX

# Linear Position Sensors with SSI Interface

Operating instructions



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# 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](http://www.turck.com):

- Data sheet
- EU declaration of conformity

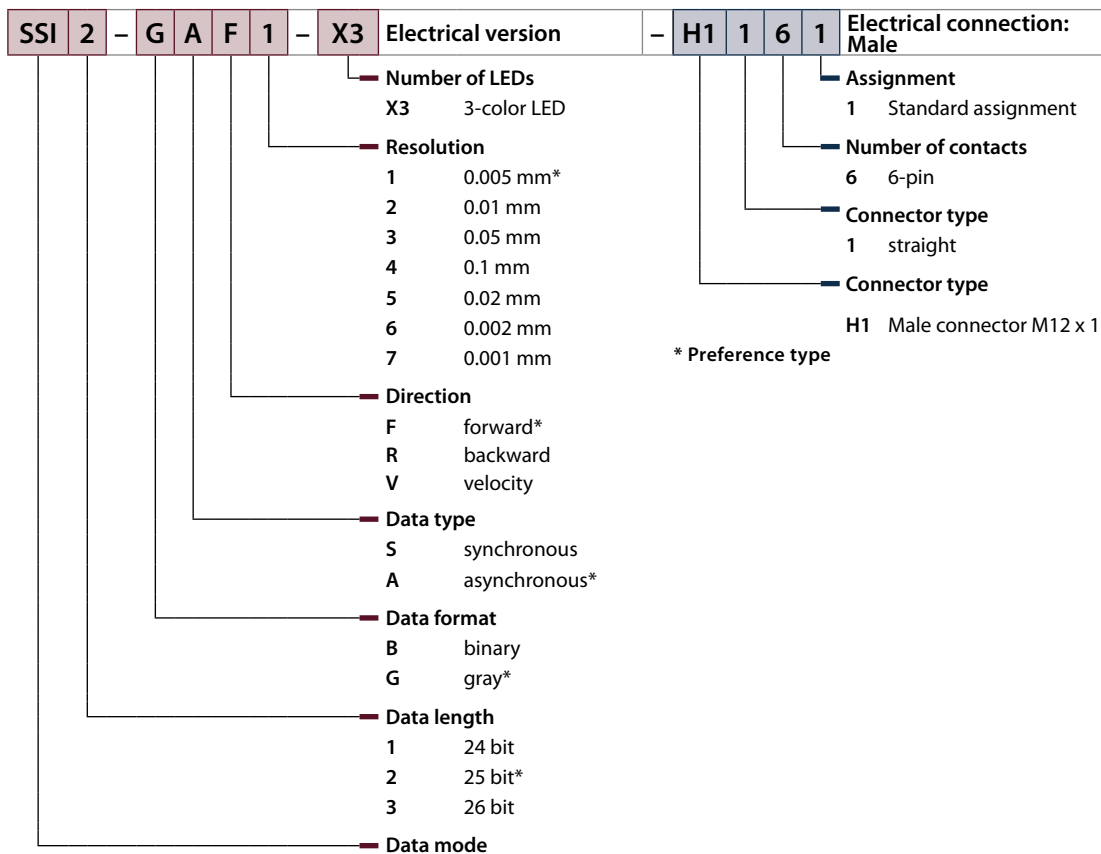
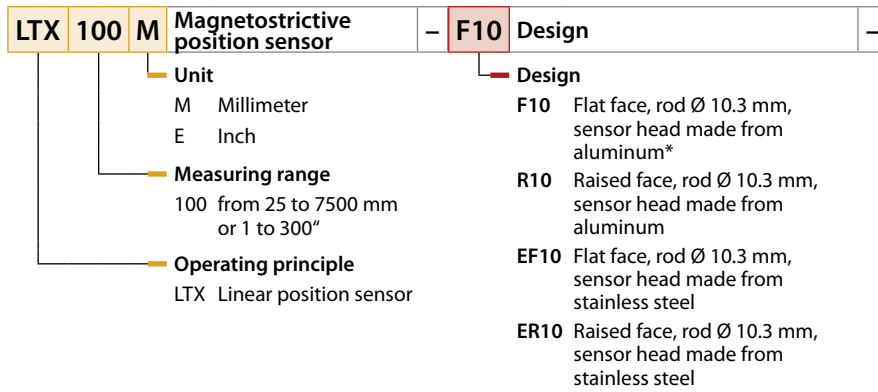
## 1.4 Feedback about these instructions

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](mailto:techdoc@turck.com).

## 2 Information About the Product

### 2.1 Product identification

**LTX 100 M - F10 - SSI 2 - G A F 1 - X3 - H1 1 6 1**



**NOTE**

- Designs with manufacturer-compatible connectors as well as models with customer-specific blind zones are available on request.
- LTX...M-F10-SSI2-GAF1-X3-H1161 devices are the preferred type.

## 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/](http://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.

Hans Turck GmbH & Co. KG  
Witzlebenstraße 7  
45472 Mülheim an der Ruhr  
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 SSI interface provide a serial synchronous interface output signal (SSI) proportional to the position of the positioning element. Different device variants enable the following measuring functions to be performed:

- Position measurement, forward measuring direction
- Position measurement, backward measuring direction
- Speed measurement

The devices can be connected using an M12 plug connector. 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 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

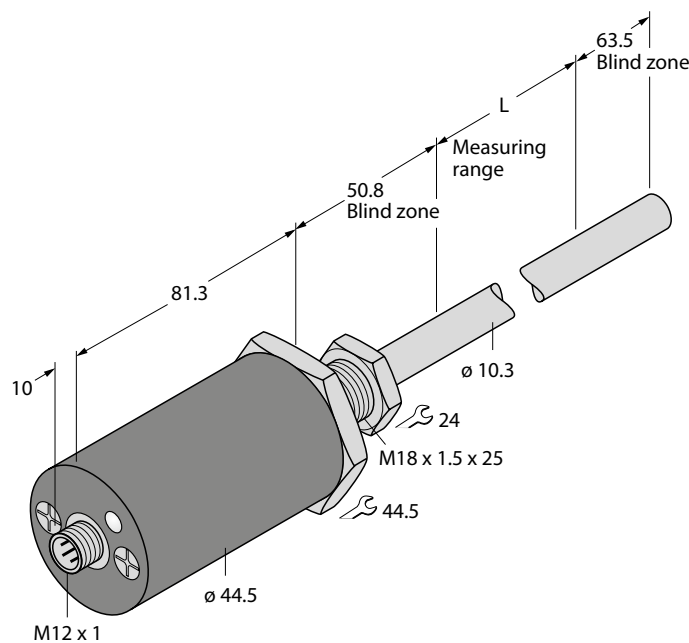


Fig. 1: Device dimensions of LTX...M... with standard blind zones (in mm)

#### 4.1.1 Display elements

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

## 4.2 Properties and features

- SSI output
- 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 have an SSI interface according to the RS422 standard. The process value is transferred via the interface either directly to the higher-level controller (with SSI card) or to a field-bus device.

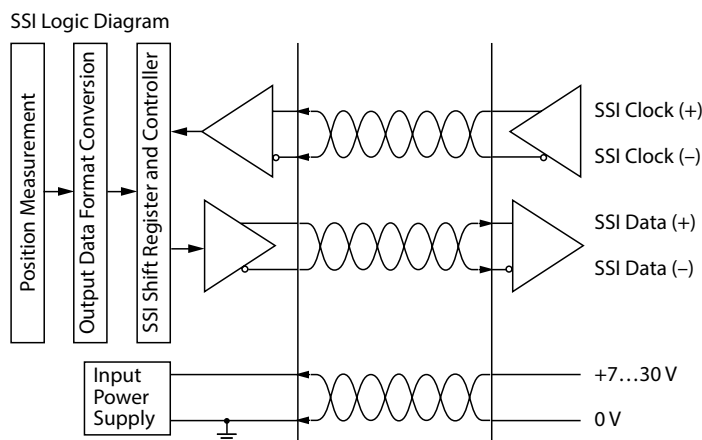


Fig. 2: Block diagram of the sensor control

The location of the positioning element on the sensor measuring probe is determined by means of a propagation time measurement and transmitted to the controller via the SSI interface. All position values are determined as absolute values; reference runs after a voltage drop are unnecessary.

New incoming position data is transferred via the data signal 605 ns after the rising edge of the clock signal. This time frame, including the elapsed time caused by the length of the cable, must be factored in when defining the transmission rates.

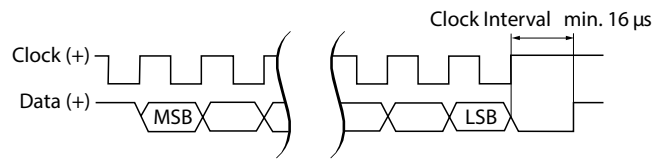


Fig. 3: SSI pulse diagram: Bitwise transmission from most significant bit (MSB) to least significant bit (LSB)

#### 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 Update mode

The devices can be operated in synchronous or asynchronous update mode. In asynchronous mode, up to 2000 measurements (depending on length, see also the "Update time" section) can be carried out per second to update the position values. In synchronous mode, the clock rate for the update depends on the controller (max. 2000 measurements per second, depending on length). If the controller queries the position data on the sensor faster than the data is provided by the sensor, the sensor automatically switches from synchronous to asynchronous mode and continues to provide the latest position information to the controller.



**NOTE**

Turck recommends operating the device in asynchronous update mode, if no highly dynamic control requirement is involved.

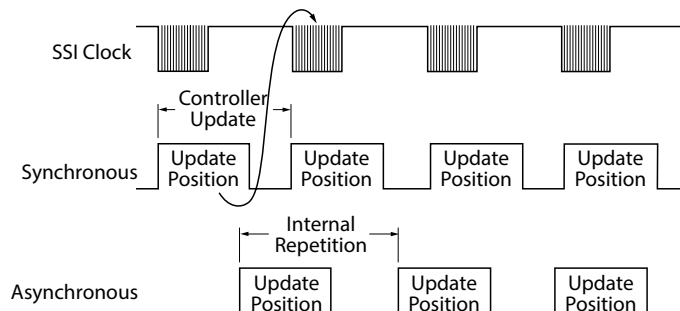


Fig. 4: Synchronous and asynchronous update mode

### Synchronous update mode

The clock pulse rate of the controller sets the frequency for reading the position data. The sensor transmits one position data bit to the controller with each pulse. The first clock edge of the controller signals the sensor to carry out a new position measurement. The updated position data is transferred in the next read cycle.



**NOTE**

In synchronous mode, the position data available to the controller is no more than one update cycle old.

### Asynchronous update mode

The sensor carries out position measurements according to a fixed internal request rate (sensor-internal measurement cycle) and provides the position information when requested by the controller.

#### 4.4.3 Measuring functions

Different device variants are available for performing different measuring functions:

| Device type      | Measuring function                     |   |
|------------------|--|---|
| LTX...SSI...F... | Position, forward measuring direction  | The position value is incremented during the movement along the measuring probe starting from the sensor head.                          |
| LTX...SSI...R... | Position, backward measuring direction | The position value is incremented during the movement in the direction of the sensor head starting from the end of the measuring probe. |
| LTX...SSI...V... | Speed measurement                      | The sensor provides speed information directly.   |

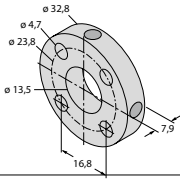
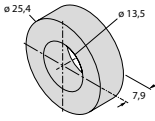
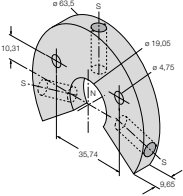
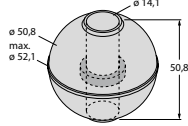
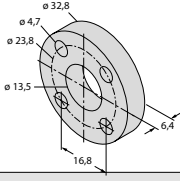
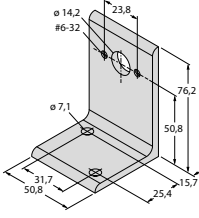
#### 4.4.4 Preferred type LTX...M-F10-SSI2-GAF1-X3-H1161 – Measuring range

Preferred types LTX...M-F10-SSI2-GAF1-X3-H1161 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   |
|---|-------------|-----------|---|
| <b>Positioning element</b><br> | 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/m <sup>3</sup> , for external mounting for level monitoring   |
| <b>Spacer</b>   |             |           |   |
|                              | 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 |
| <b>Accessories for external mounting</b>  |             |           |   |
|                              | MMB-R10     | 6900004   | Mounting clamp for positioning element, for external mounting, with screws and standard STS-R10 spacer  |

| Dimension drawing        | Type         | Ident no. | Description  |
|--------------------------|--------------|-----------|--|
|                          | 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                 |
| <b>Connection cables</b> |              |           |  |
|                          | RKC6T-2/S618 | U5311-51  | 2 m connection cable, M12 female connector, 6-pin, PVC, shielded           |
|                          | RKC6T-6/S618 | U99-11853 | 6 m connection cable, M12 female connector, 6-pin, PVC, shielded           |

## 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).

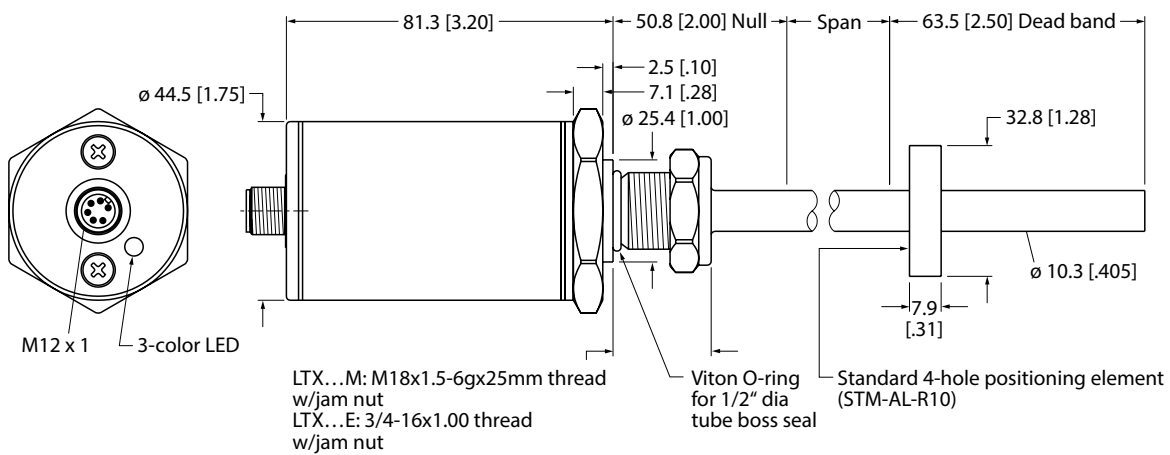


Fig. 5: Side view of LTX-R10 with dimensions in mm [in] (design with raised face)

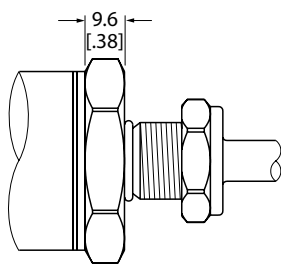


Fig. 6: Design with flat face (F10) – Housing nut with thread, dimensions in mm [in]

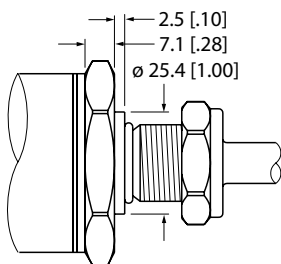


Fig. 7: Design with raised face (R10) – Housing nut with thread, dimensions in mm [in]

## 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  $\geq 1500$  mm: use protecting ring, e.g. made of polymer (see Fig. 8, 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).

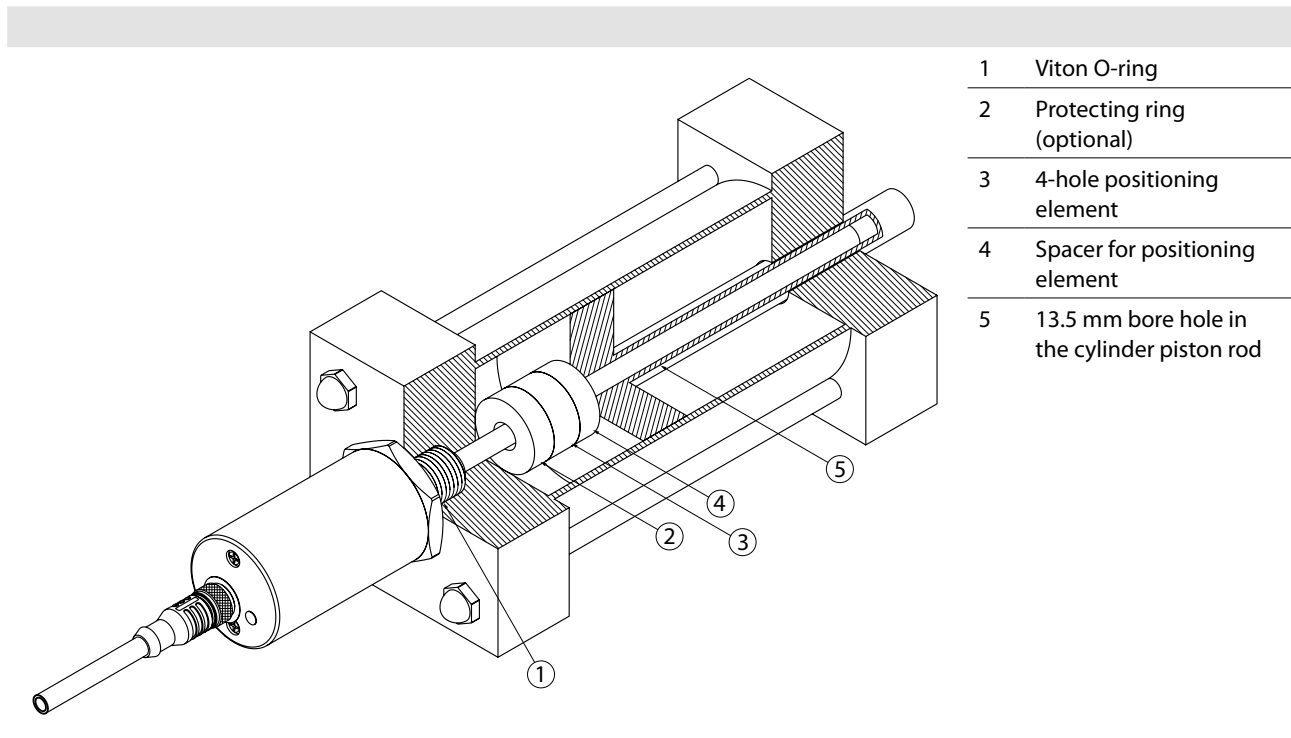


Fig. 8: Mounting the device in a hydraulic cylinder



## 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.

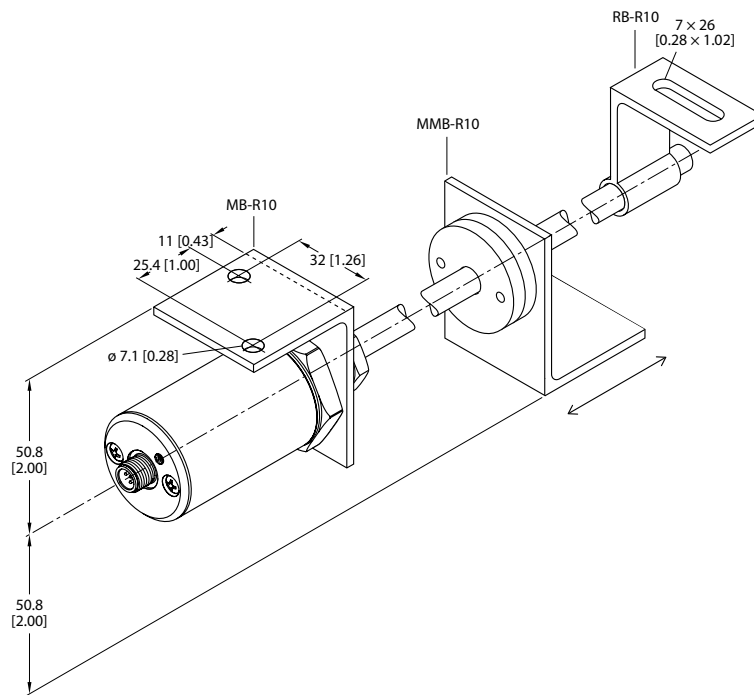


Fig. 9: Mounting the device with mounting brackets (dimensions in mm)

## 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 ring-type positioning element with slot as the positioning element.
- 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. 10.
- 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 ring-type positioning elements with slot: Observe  $\leq 5$  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.

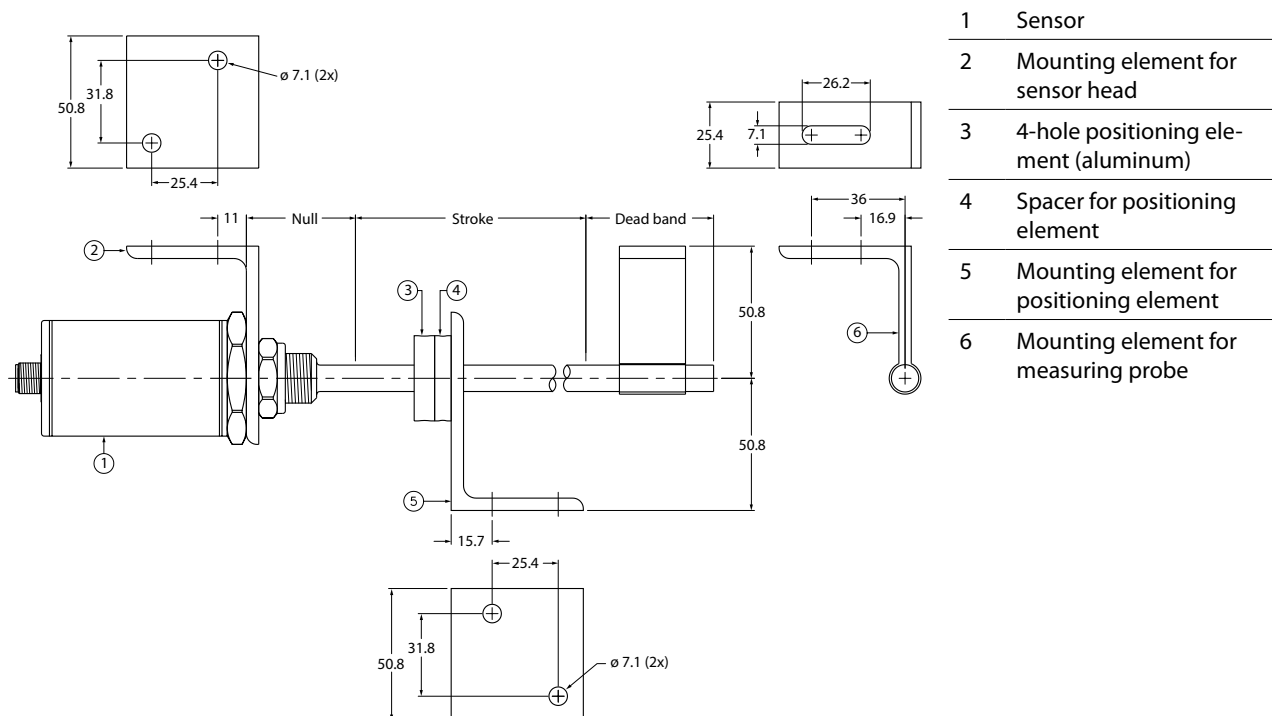


Fig. 10: Mounting the positioning element (dimensions in mm)

## 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.

The running lengths of the connection cables are limited and depend on the SSI clock frequencies. Different clock rates are recommended depending on the length of the connection cables. The clock rate and data frame lengths are set by the master.

| Cable length [m] | Baud rate |
|------------------|-----------|
| < 3              | 1 MBd     |
| < 50             | < 400 kBd |
| < 100            | < 300 kBd |
| < 200            | < 200 kBd |
| < 360            | < 100 kBd |

- Route high-voltage and low-voltage cables separately.
- Connect the female connector of the connection cable to the connector on the device.
- Connect the sensor to the higher level as per the pin assignment (Fig. 11).

### 6.1 Wiring diagram



**NOTE**

The following figure details the usual wire colors. In exceptional cases, this color assignment may differ.

| Pin   | Pin assignment   | Wiring diagram |
|-------|------------------|----------------|
| Pin 1 | U <sub>B</sub> + |                |
| Pin 2 | Data +           |                |
| Pin 3 | GND              |                |
| Pin 4 | Data -           |                |
| Pin 5 | Clock -          |                |
| Pin 6 | Clock +          |                |

Fig. 11: Wiring diagram

## 7 Commissioning



### NOTE

If the device is part of a closed system that has not yet been fully configured, the system may move in an uncontrolled manner the first time the supply voltage is connected.

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



### NOTE

The minimum SSI clock rate is 70 kHz.

### 8.1 LED display

| Color/status                                     | Meaning   |
|--|---|
| Off  | No power supply present   |
| Illuminated in green                             | Positioning element signal detected in taught range, SSI clock signal operational |
| Illuminated in yellow                            | No SSI clock signal detected  |
| Illuminated in red                               | No positioning element signal detected  |
| Red flashing/red-green flashing                  | Internal error  |
| Green with brief yellow flashing (1 s to 0.12 s) | Data not synchronous with controller (only in synchronous mode)                   |
| Yellow with brief red flashing (1 s to 0.12 s)   | SSI clock pulses do not match the SSI data length                                 |

If no positioning element is detected, the red LED lights up and the device transmits a position of zero.

Proceed as follows if no positioning element 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.

If, in synchronous mode, the data is not synchronized with the controller (LED green with brief yellow flashing, 1 s to 0.12 s), proceed as follows:

- Increase the update time via the module settings of the SSI master.

## 9 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.

### 9.1 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).

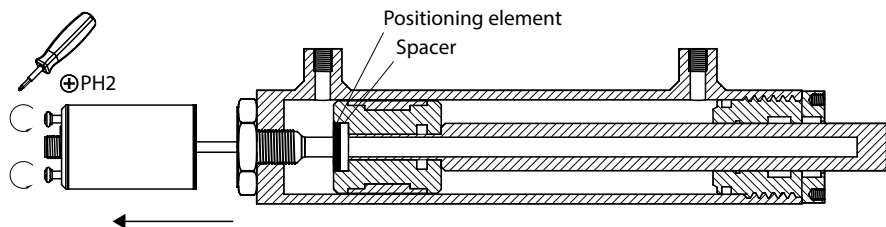


Fig. 12: Replacing the sensor head and measuring element

## 10 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.

## 11 Repair

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

### 11.1 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.

## 12 Disposal



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

## 13 Technical Data

| Technical data                        | LTX-R10.../LTX-F10...       | LTX-ER10.../LTX-EF10...     |
|---------------------------------------|-----------------------------|-----------------------------|
| <b>Measuring range specifications</b> |                             |                             |
| Blind zone (connector end)            | 50.8 mm                     |                             |
| Blind zone (end)                      | 63.5 mm                     |                             |
| Resolution                            | Selectable, see type code   |                             |
| Linearity                             | ≤ 0.01% full scale          |                             |
| Operating temperature, rod            | -40 °C ... +105 °C          |                             |
| Operating temperature, electronics    | -40 °C ... +85 °C           |                             |
| Temperature drift                     | ≤ 10 ppm/°C                 |                             |
| <b>Electrical data</b>                |                             |                             |
| Operating voltage                     | 7...30 VDC                  |                             |
| Current consumption                   | < 100 mA/15 VDC             |                             |
| Short-circuit protection              | Yes/cyclic                  |                             |
| Output function                       | 6-wire, SSI                 |                             |
| <b>Design</b>                         |                             |                             |
| 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                        |                             |

### 13.1 Update time

| Measuring length | Update time |
|------------------|-------------|
| 300 mm           | 500 μs      |
| 750 mm           | 850 μs      |
| 1000 mm          | 1 ms        |
| 2000 mm          | 2 ms        |
| 5000 mm          | 4 ms        |

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