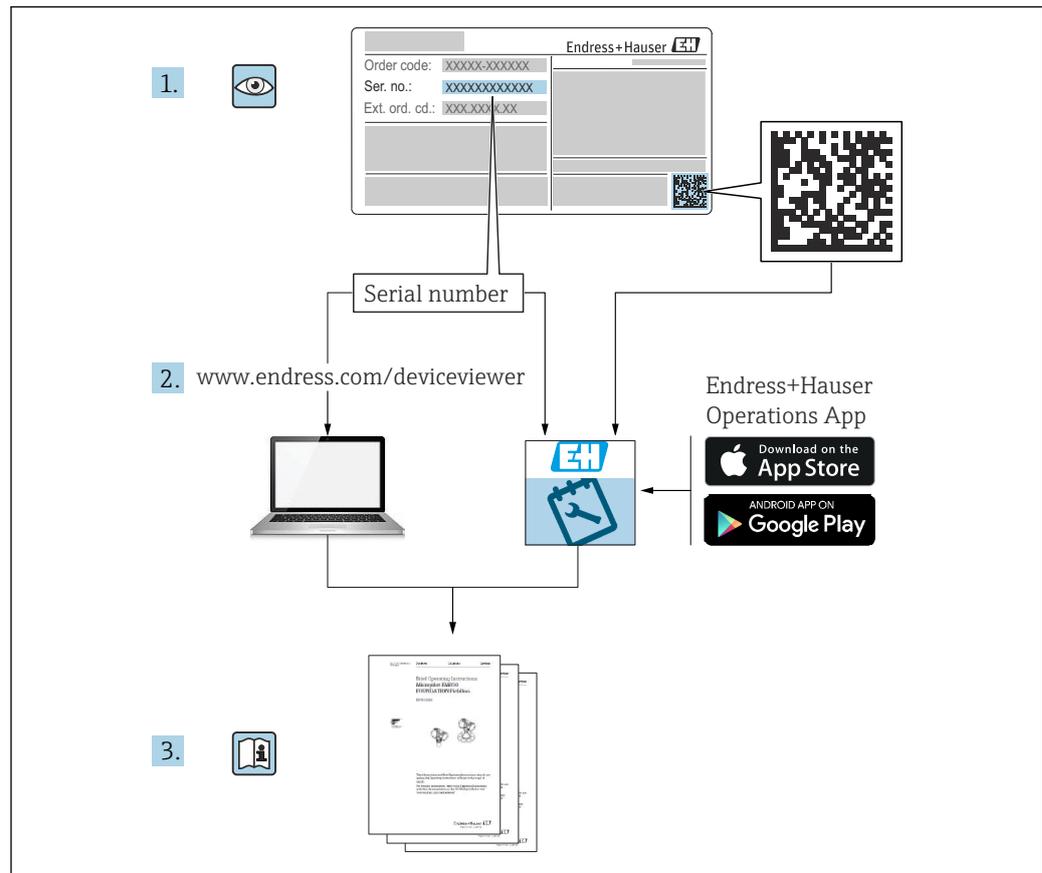


Operating Instructions

Waterpilot FMX21

Hydrostatic level measurement
4 to 20 mA analog





A0023555

- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid hazards for individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to this manual.

Table of contents

| | | | | | |
|----------|--|-----------|--------------------|---|-----------|
| 1 | About this document | 4 | 6.5 | Current consumption | 24 |
| 1.1 | Document function | 4 | 6.6 | Maximum load | 24 |
| 1.2 | Safety symbols | 4 | 6.7 | Connecting the measuring unit | 25 |
| 1.3 | Electrical symbols | 4 | 6.8 | Post-connection check | 26 |
| 1.4 | Tool symbols | 4 | 7 | Operation options | 27 |
| 1.5 | Symbols for certain types of Information | 5 | 7.1 | Overview of operation options | 27 |
| 1.6 | Symbols in graphics | 5 | 8 | Diagnostics and troubleshooting ... | 28 |
| 1.7 | Documentation | 5 | 8.1 | General troubleshooting | 28 |
| 1.8 | Registered trademarks | 6 | 8.2 | Troubleshooting specific to the device with optional Pt100 | 28 |
| 1.9 | Terms and abbreviations | 7 | 8.3 | Troubleshooting specific to TMT71 temperature head transmitter | 28 |
| 1.10 | Turn down calculation | 7 | 9 | Maintenance | 30 |
| 2 | Basic safety requirements | 9 | 9.1 | Exterior cleaning | 30 |
| 2.1 | Requirements for the personnel | 9 | 10 | Repair | 31 |
| 2.2 | Intended use | 9 | 10.1 | General information | 31 |
| 2.3 | Workplace safety | 9 | 10.2 | Spare parts | 31 |
| 2.4 | Operational safety | 9 | 10.3 | Return | 31 |
| 2.5 | Product safety | 10 | 10.4 | Disposal | 31 |
| 3 | Product description | 11 | 11 | Accessories | 32 |
| 3.1 | Mode of operation | 11 | 11.1 | Device-specific accessories | 32 |
| 4 | Incoming acceptance and product identification | 12 | 11.2 | Service-specific accessories | 34 |
| 4.1 | Incoming acceptance | 12 | 12 | Technical data | 36 |
| 4.2 | Product identification | 12 | 12.1 | Input | 36 |
| 4.3 | Manufacturer address | 12 | 12.2 | Output | 38 |
| 4.4 | Storage and transport | 13 | 12.3 | Performance characteristics | 39 |
| 5 | Installation | 14 | 12.4 | Environment | 41 |
| 5.1 | Installation requirements | 14 | 12.5 | Process | 43 |
| 5.2 | Additional mounting instructions | 15 | 12.6 | Additional technical data | 44 |
| 5.3 | Dimensions | 15 | Index | 45 | |
| 5.4 | Installation of the Waterpilot with a suspension clamp | 16 | | | |
| 5.5 | Mounting the device with a cable mounting screw | 17 | | | |
| 5.6 | Mounting the terminal box | 18 | | | |
| 5.7 | Mounting the TMT71 temperature head transmitter with terminal box | 18 | | | |
| 5.8 | Mounting the terminal strip for the Pt100 passive (without TMT71) | 19 | | | |
| 5.9 | Cable marking | 20 | | | |
| 5.10 | Cable shortening kit | 20 | | | |
| 5.11 | Post-mounting check | 21 | | | |
| 6 | Electrical connection | 22 | | | |
| 6.1 | Connecting the device | 22 | | | |
| 6.2 | Supply voltage | 23 | | | |
| 6.3 | Cable specifications | 24 | | | |
| 6.4 | Power consumption | 24 | | | |

1 About this document

1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

1.2 Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION

This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE

This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.3 Electrical symbols



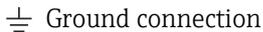
Direct current



Alternating current



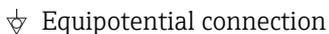
Direct current and alternating current



Grounded clamp, which is grounded via a grounding system.



Ground terminals, which must be grounded prior to establishing any other connections. The ground terminals are located on the inside and outside of the device.



A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

1.4 Tool symbols



Flat blade screwdriver



Phillips screwdriver



Allen key



Open-ended wrench

1.5 Symbols for certain types of Information

Permitted

Procedures, processes or actions that are permitted

Preferred

Procedures, processes or actions that are preferred

Forbidden

Procedures, processes or actions that are forbidden

Tip

Indicates additional information



Reference to documentation



Reference to page



Reference to graphic

1., 2., 3.

Series of steps



Result of a step



Help in the event of a problem



Visual inspection

1.6 Symbols in graphics

1, 2, 3, ...

Item numbers

1., 2., 3.

Series of steps

A, B, C, ...

Views

A-A, B-B, C-C etc.

Sections

1.7 Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads):



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

1.7.1 Technical Information (TI)

Planning aid

The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

1.7.2 Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value

The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

1.7.3 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

 The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.8 Registered trademarks

1.8.1 GORE-TEX®

Trademark of W.L. Gore & Associates, Inc., USA.

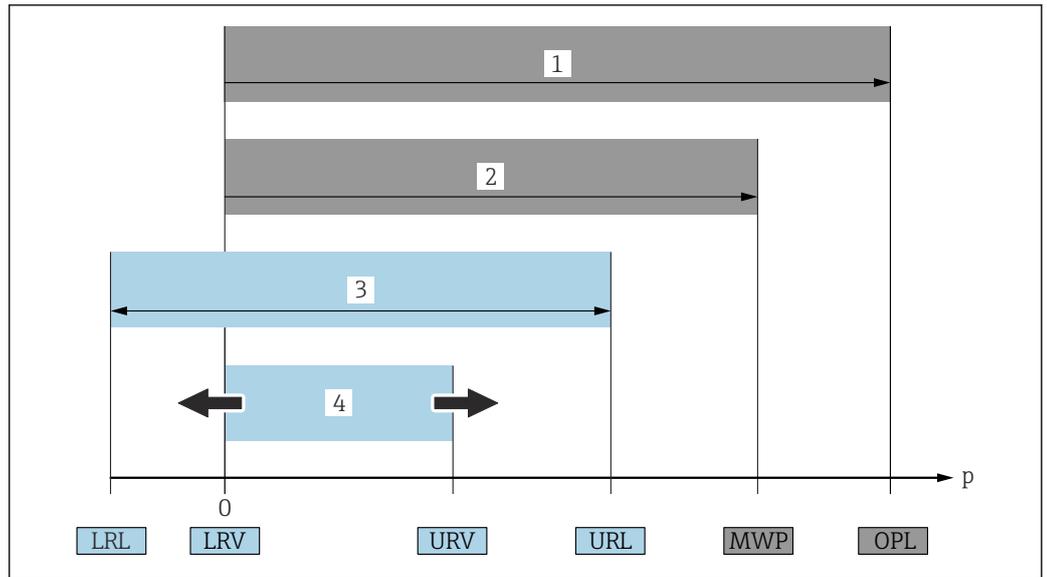
1.8.2 TEFLON®

Trademark of E.I. Du Pont de Nemours & Co., Wilmington, USA.

1.8.3 iTEMP®

Trademark of Endress+Hauser Wetzler GmbH + Co. KG, Nesselwang, D..

1.9 Terms and abbreviations



- 1 OPL: The OPL (over pressure limit = measuring cell overpressure limit) for the device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection must be taken into consideration in addition to the measuring cell. Observe pressure-temperature dependency. OPL (Over Pressure Limit) is a test pressure.
- 2 MWP: The MWP (maximum working pressure) for the measuring cells depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection also has to be taken into consideration besides the measuring cell. Observe pressure-temperature dependency. The maximum working pressure may be applied to the device for an unlimited period of time. The maximum working pressure can be found on the nameplate.
- 3 The maximum measuring range corresponds to the span between the lower range limit and upper range limit. This measuring range is equivalent to the maximum span that can be calibrated/adjusted.
- 4 The calibrated/adjusted measuring span corresponds to the span between the lower range limit and upper range limit. Factory setting: 0 to upper range limit. Other calibrated spans can be ordered as customized measuring spans.

p Pressure

LRL Lower range limit

URL Upper range limit

LRV Lower range value

URV Upper range value

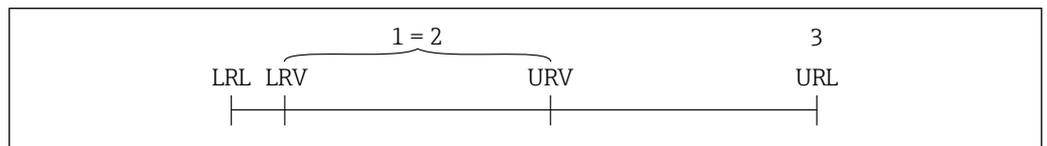
TD Turn down Example - see the following section.

PE Polyethylene

FEP Fluorinated ethylene propylene

PUR Polyurethane

1.10 Turn down calculation



1 Calibrated/adjusted measuring span

2 Zero point-based span (4 to 20 mA analog: customized span can only be set at the factory if ordered)

3 Upper range limit

Example:

- Measuring cell: 10 bar (150 psi)
- Upper range limit (URL) = 10 bar (150 psi)
- Calibrated/adjusted measuring span: 0 to 5 bar (0 to 75 psi)
- Lower range value (LRV) = 0 bar (0 psi)
- Upper range value (URV) = 5 bar (75 psi)

$$\text{TD} = \frac{\text{URL}}{|\text{URV} - \text{LRV}|}$$

In this example, the TD is 2:1. This span is based on the zero point.

2 Basic safety requirements

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Are authorized by the plant owner/operator.
- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Intended use

2.2.1 Application and media

Der Waterpilot FMX21 is a hydrostatic pressure sensor for measuring the level of fresh water, wastewater and salt water. The temperature is measured simultaneously in the case of sensor versions with a Pt100 resistance thermometer.

An optional temperature head transmitter converts the Pt100 signal into a 4 to 20 mA signal.

2.2.2 Incorrect use

The manufacturer is not liable for harm caused by improper or non-designated use.

Clarification for borderline cases:

- ▶ For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability.

2.3 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Damage to the device!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

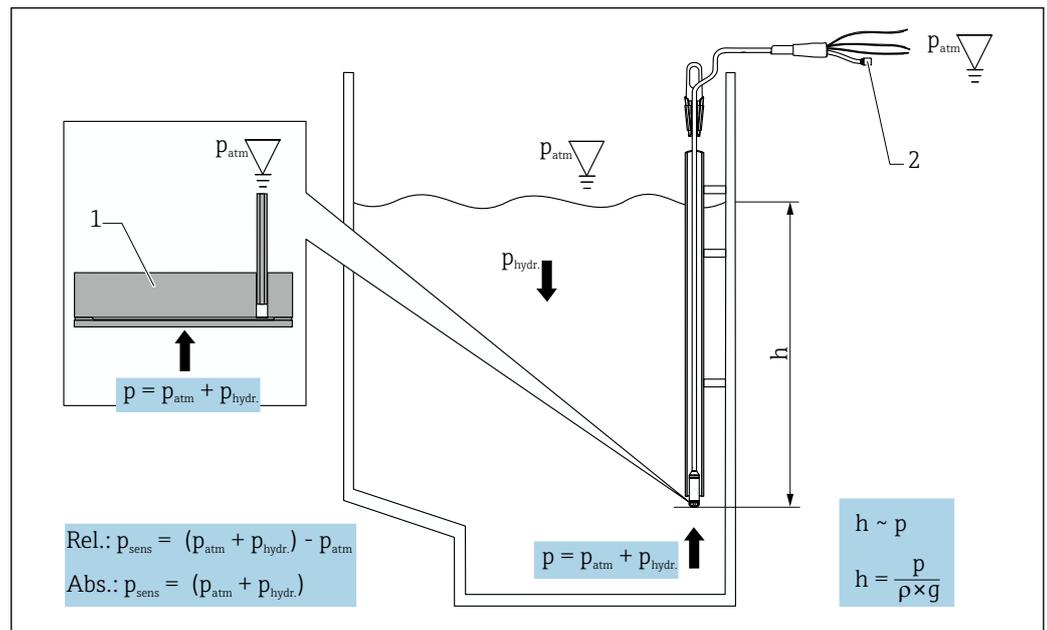
This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

3 Product description

3.1 Mode of operation

The ceramic measuring cell is a dry measuring cell, i.e. the pressure acts directly on the robust, ceramic process membrane of the Waterpilot FMX21. Changes in atmospheric pressure are guided via a pressure compensation tube through the supporting cable to the rear of the ceramic process membrane and are compensated for. A pressure-dependent change in capacitance, caused by the movement of the process membrane, is measured at the electrodes of the ceramic carrier. The electronics unit then converts this to a signal that is proportional to the pressure and linear to the level.



- 1 Ceramic measuring cell
- 2 Pressure compensation tube
- h Level height
- p Total pressure = atmospheric pressure + hydrostatic pressure
- ρ Density of the medium
- g Acceleration of free fall
- $p_{hydr.}$ Hydrostatic pressure
- p_{atm} Atmospheric pressure
- p_{sens} Pressure indicated by the sensor

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
 - ↳ Report all damage immediately to the manufacturer.
Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

 If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

The following options are available for identification of the device:

- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial numbers from the nameplates in *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.

4.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:

- Manufacturer identification, device designation
 - Order code
 - Extended order code
 - Serial number
 - Tag name (TAG) (optional)
 - Technical values such as supply voltage, current consumption, ambient temperature, communication-specific data (optional)
 - Degree of protection
 - Approvals with symbols
 - Reference to Safety Instructions (XA) (optional)
- ▶ Compare the information on the nameplate with the order.

4.3 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany
Place of manufacture: See nameplate.

4.4 Storage and transport

4.4.1 Storage conditions

Use original packaging.

Store the measuring device in clean and dry conditions and protect from damage caused by shocks (EN 837-2).

Storage temperature range

Device + Pt100 (optional)

-40 to +80 °C (-40 to +176 °F)

Cable

(when mounted in a fixed position)

- With PE: -30 to +70 °C (-22 to +158 °F)
- With FEP: -30 to +80 °C (-22 to +176 °F)
- With PUR: -40 to +80 °C (-40 to +176 °F)

Terminal box

-40 to +80 °C (-40 to +176 °F)

TMT71 temperature head transmitter (optional)

-40 to +100 °C (-40 to +212 °F)

4.4.2 Transporting the product to the measuring point

WARNING

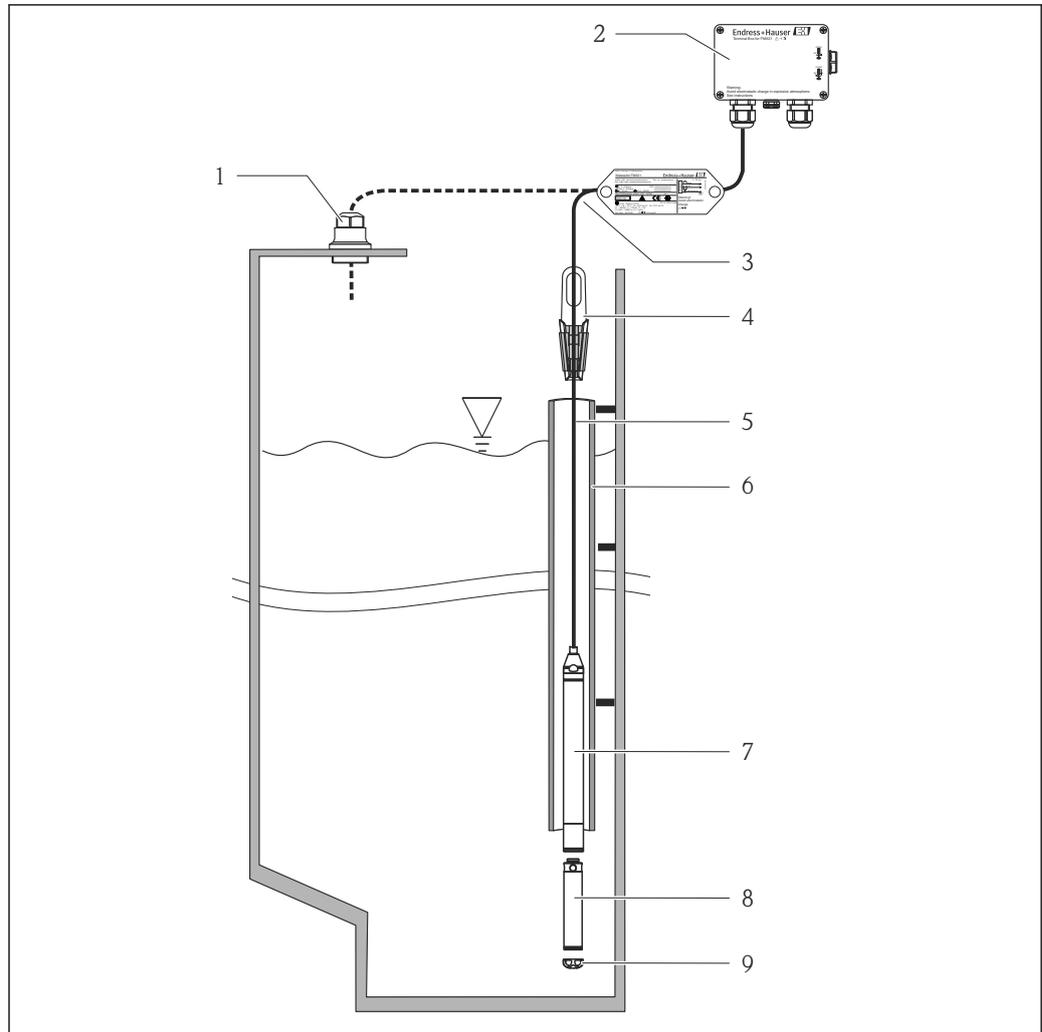
Incorrect transport!

Device or cable may become damaged, and there is a risk of injury!

- ▶ Transport measuring device in the original packaging.
- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.6 lbs).

5 Installation

5.1 Installation requirements

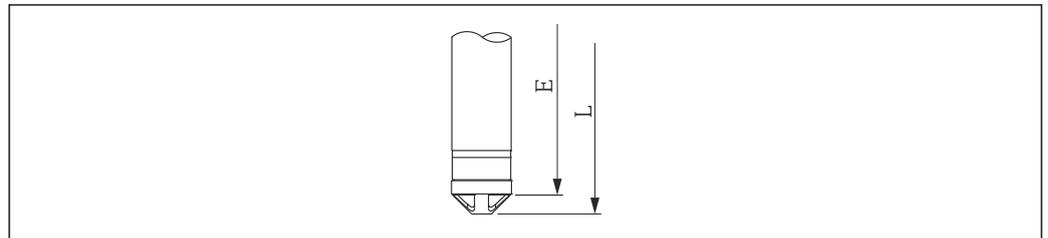


A0018770

- 1 Cable mounting screw (can be ordered as an accessory)
- 2 Terminal box (can be ordered as an accessory)
- 3 Bending radius of extension cable > 120 mm (4.72 in)
- 4 Suspension clamp (can be ordered as an accessory)
- 5 Extension cable
- 6 Guide tube
- 7 Device
- 8 Additional weight can be ordered as an accessory for the device with external diameter of 22 mm (0.87 in) and 29 mm (1.14 in)
- 9 Protective cap

5.2 Additional mounting instructions

- Cable length
 - Customer-specific in meters or feet.
 - Limited cable length when performing installation with freely suspended device with cable mounting screw or mounting clamp, as well as for FM/CSA approval: max. 300 m (984 ft).
- Sideways movement of the level probe can result in measuring errors. For this reason, install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least 1 mm (0.04 in) greater than the external diameter of the selected FMX21.
- To avoid mechanical damage to the measuring cell, the device is equipped with a protection cap.
- The cable must end in a dry room or a suitable terminal box. The terminal box from Endress+Hauser provides humidity and climatic protection and is suitable for installation outdoors →  32.
- Cable length tolerance: < 5 m (16 ft): ±17.5 mm (0.69 in); > 5 m (16 ft): ±0.2 %
- If the cable is shortened, the filter at the pressure compensation tube must be reattached. Endress+Hauser offers a cable shortening kit for this purpose →  32 (documentation SD00552P/00/A6).
- Endress+Hauser recommends using twisted, shielded cable.
- In shipbuilding applications, measures are required to restrict the spread of fire along cable looms.
- The length of the extension cable depends on the intended level zero point. The height of the protection cap must be taken into consideration when designing the layout of the measuring point. The level zero point (E) corresponds to the position of the process isolating diaphragm. Level zero point = E; tip of probe = L (see the following diagram).

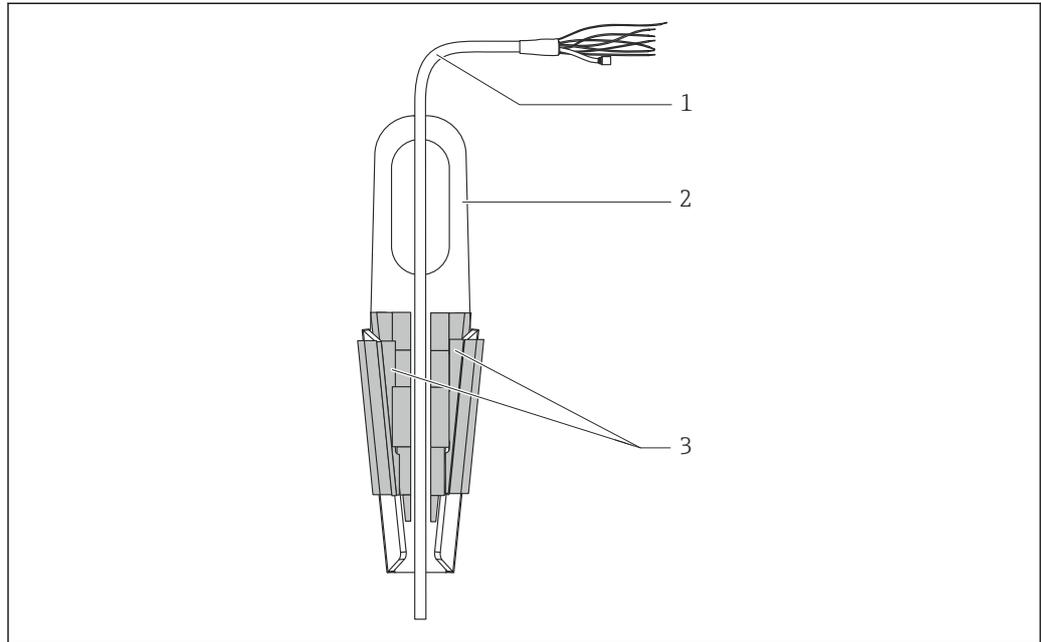


A0026013

5.3 Dimensions

For dimensions, see the Technical Information

5.4 Installation of the Waterpilot with a suspension clamp



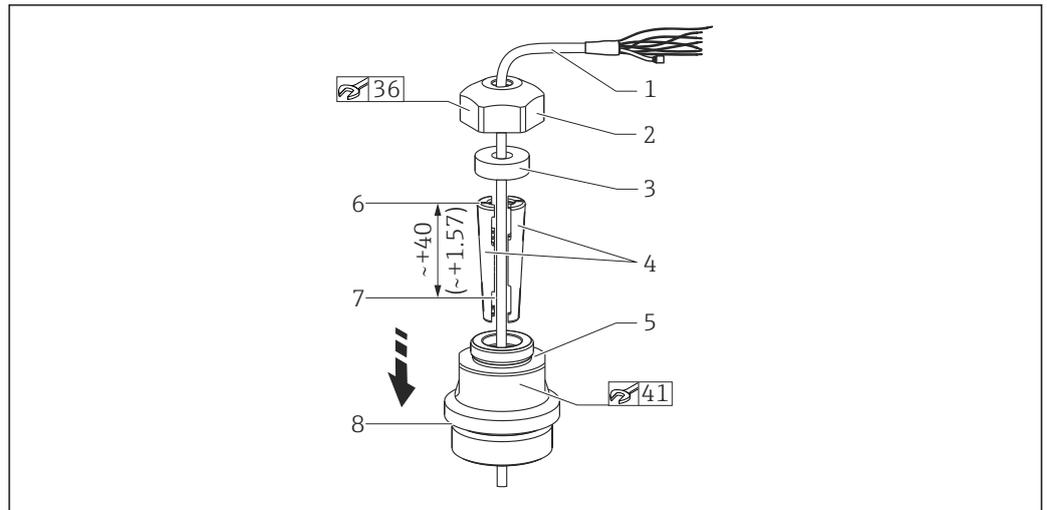
A0018793

- 1 Extension cable
- 2 Suspension clamp
- 3 Clamping jaw

5.4.1 Mounting the suspension clamp:

1. Mount the suspension clamp (item 2). Take the weight of the extension cable (item 1) and the device into account when selecting the fastening point.
2. Push up the clamping jaws (item 3). Place the extension cable (item 1) between the clamping jaws as shown in the graphic.
3. Hold the extension cable (item 1) in position and push the clamping jaws (item 3) back down. Tap the clamping jaws gently from above to fix them in place.

5.5 Mounting the device with a cable mounting screw



1 Illustrated with G 1½" thread. Unit of measurement mm (in)

- 1 Extension cable
- 2 Cover for cable mounting screw
- 3 Sealing ring
- 4 Clamping sleeves
- 5 Adapter for cable mounting screw
- 6 Top edge of clamping sleeve
- 7 Desired length of extension cable and Waterpilot probe prior to assembly
- 8 After assembly, item 7 is located next to the mounting screw with G 1½" thread: height of sealing surface of the adapter or NPT 1½" thread height of thread run-out of adapter

i If you want to lower the level probe to a certain depth, position the top edge of the clamping sleeve 40 mm (4.57 in) higher than the required depth. Then push the extension cable and the clamping sleeve into the adapter as described in Step 6 in the following section.

5.5.1 Mounting the cable mounting screw with a G 1½" or NPT 1½" thread:

1. Mark the desired length of extension cable on the extension cable.
2. Insert the probe through the measuring aperture and carefully lower on the extension cable. Fix the extension cable to prevent it from slipping.
3. Slide the adapter (item 5) over the extension cable and screw it tightly into the measuring aperture.
4. Slide the sealing ring (item 3) and cover (item 2) onto the cable from above. Press the sealing ring into the cover.
5. Place the clamping sleeves (item 4) around the extension cable (item 1) at the marked point as illustrated in the graphic.
6. Slide the extension cable with the clamping sleeves (item 4) into the adapter (item 5)
7. Fit the cover (item 2) with the sealing ring (item 3) onto the adapter (item 5) and securely screw together with the adapter.

i To remove the cable mounting screw, perform this sequence of steps in reverse.

CAUTION

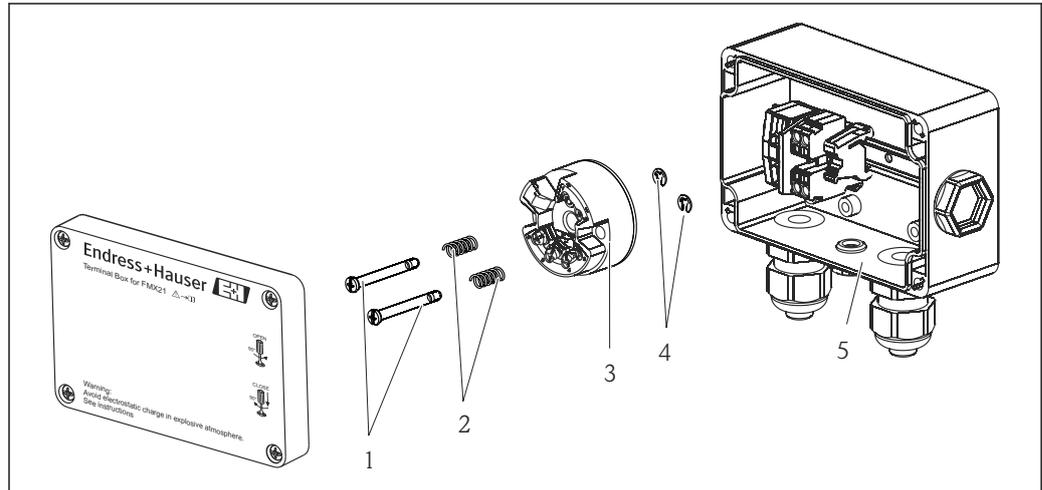
Risk of injury!

- Use only in unpressurized vessels.

5.6 Mounting the terminal box

The optional terminal box is mounted using four screws (M4). For the dimensions of the terminal box, see the Technical Information

5.7 Mounting the TMT71 temperature head transmitter with terminal box



- 1 Mounting screws
- 2 Mounting springs
- 3 TMT71 temperature head transmitter
- 4 Retaining rings
- 5 Terminal box

i Only open the terminal box with a screwdriver.

WARNING

Explosion hazard!

- ▶ The TMT71 is not designed for use in hazardous areas.

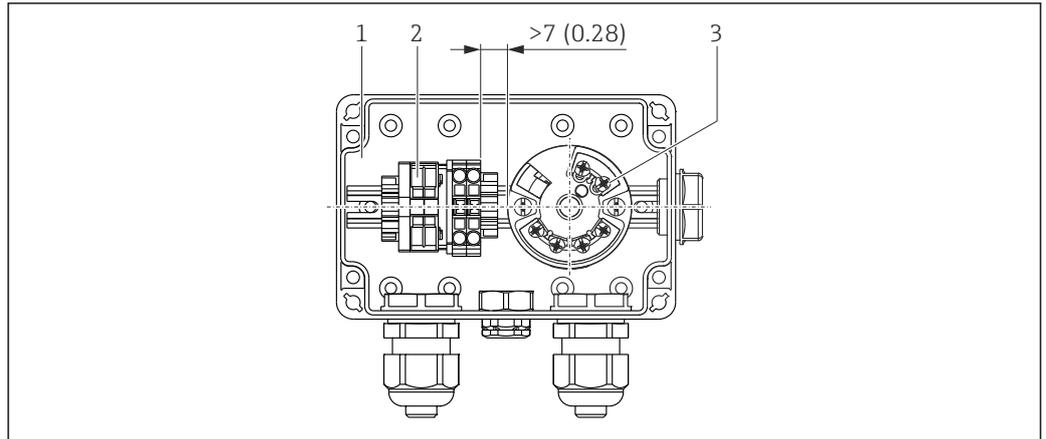
5.7.1 Mounting the temperature head transmitter:

1. Guide the mounting screws (item 1) with the mounting springs (item 2) through the bore of the temperature head transmitter (item 3)
2. Secure the mounting screws with the circlips (item 4). Circlips, mounting screws and springs are included in the scope of delivery for the temperature head transmitter.
3. Screw the temperature head transmitter into the field housing tightly. (Width of screwdriver blade max. 6 mm (0.24 in))

NOTICE

Avoid damage to the temperature head transmitter.

- ▶ Do not overtighten the mounting screw.



A0018696

Unit of measurement mm (in)

- 1 Terminal box
- 2 Terminal strip
- 3 TMT71 temperature head transmitter

NOTICE

Incorrect mounting!

- ▶ A distance of > 7 mm (28 in) must be maintained between the terminal strip and the TMT71 temperature head transmitter.

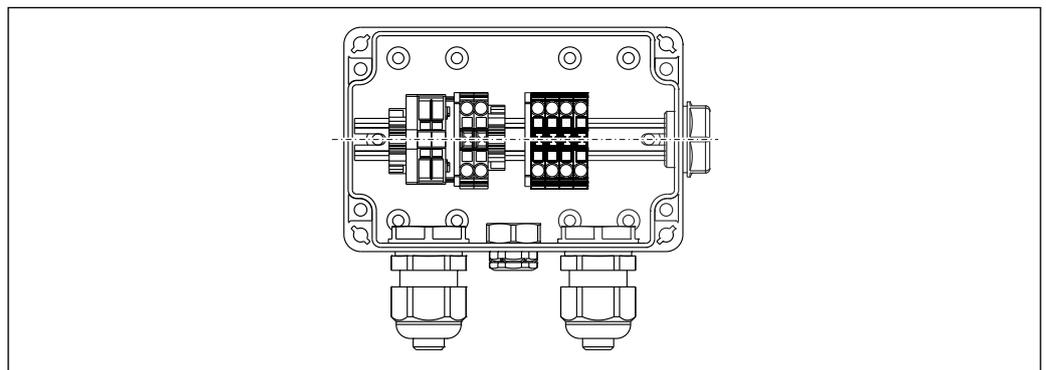
5.8 Mounting the terminal strip for the Pt100 passive (without TMT71)

If the FMX21 with optional Pt100 is supplied without the optional TMT71 temperature head transmitter, a terminal strip is provided with the terminal box for the purpose of wiring the Pt100.

⚠ WARNING

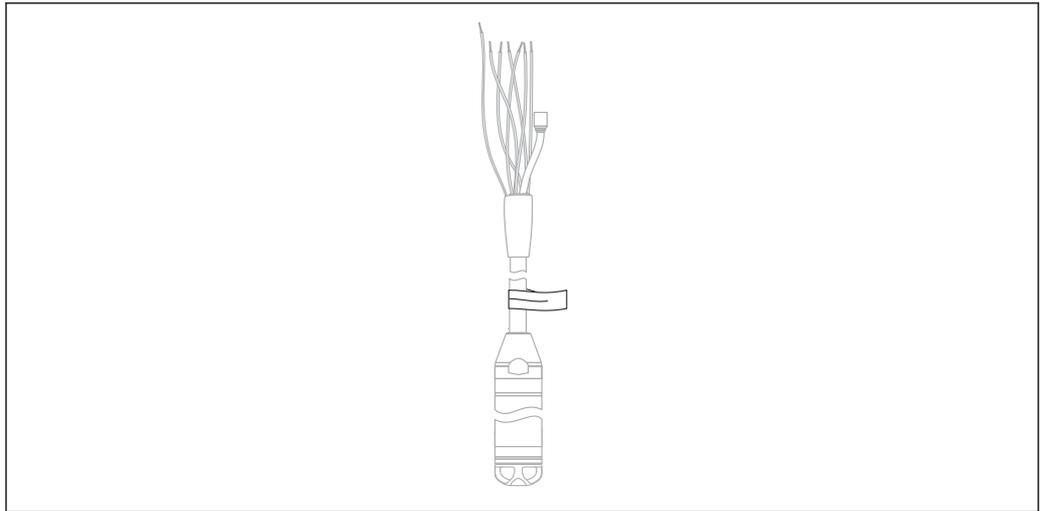
Explosion hazard!

- ▶ The Pt100, as well as the terminal strip, are not designed for use in hazardous areas.



A0018815

5.9 Cable marking



A0030955

- To make installation easier, Endress+Hauser marks the extension cable if a customer-specific length has been ordered.
- Cable marking tolerance (distance to lower end of level probe):
 - Cable length < 5 m (16 ft): ± 17.5 mm (0.69 in)
 - Cable length > 5 m (16 ft): ± 0.2 %
- Material: PET, stick-on label: acrylic
- Temperature resistance: -30 to $+100$ °C (-22 to $+212$ °F)

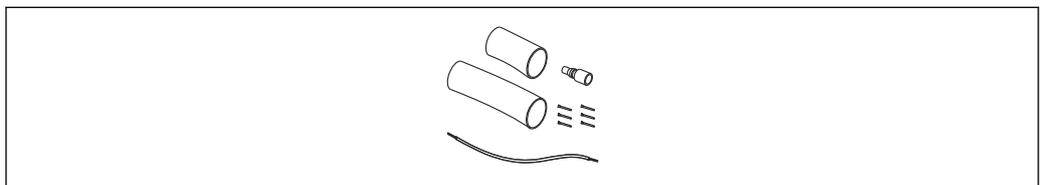
NOTICE

The marking is used exclusively for installation purposes.

- ▶ The mark must be thoroughly removed without trace in the case of devices with drinking water approval. The extension cable must not be damaged in the process.

 Not for the use of the device in hazardous areas.

5.10 Cable shortening kit



A0030948

The cable shortening kit is used to shorten a cable easily and professionally.

 The cable shortening kit is not designed for the device with FM/CSA approval.

- Ordering information: see Product Configurator
- Associated documentation SD00552P/00/A6.

5.11 Post-mounting check

- Is the device undamaged (visual inspection)?
- Does the device conform to the measuring point specifications?
 - Process temperature
 - Process pressure
 - Ambient temperature
 - Measuring range
- Are the measuring point identification and labeling correct (visual inspection)?
- Check that all screws are firmly seated

6 Electrical connection

⚠ WARNING

Reduced electrical safety due to incorrect connection!

- ▶ When using the measuring instrument in hazardous areas, the applicable national standards and regulations, as well as the safety instructions (XAs) and Installation or Control Drawings (ZDs) must also be observed. All data relating to explosion protection can be found in separate documentation which is available on request. This documentation is supplied with the devices as standard.

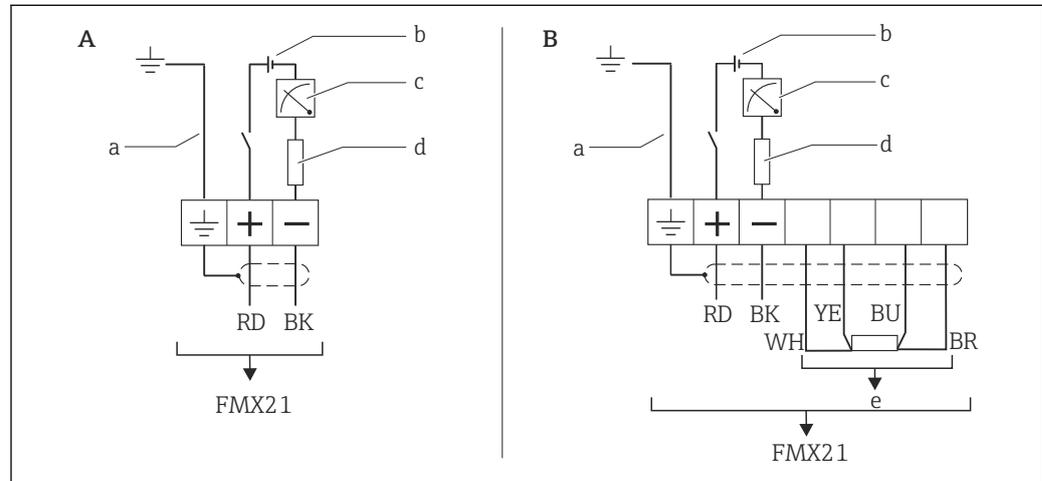
6.1 Connecting the device

⚠ WARNING

Reduced electrical safety due to incorrect connection!

- ▶ The supply voltage must match the supply voltage specified on the nameplate
- ▶ Switch off the supply voltage before connecting the device.
- ▶ The cable must end in a dry room or a suitable terminal box. The IP66/IP67 terminal box with GORE-TEX® filter from Endress+Hauser is suitable for outdoor installation. → 18
- ▶ Connect the device in accordance with the following diagrams. Reverse polarity protection is integrated in the device and the temperature head transmitter. Changing the polarities will not result in the destruction of the devices.
- ▶ A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010.

6.1.1 Device with Pt100



A0019441

- A Device
 B Device with Pt100 (not for use in hazardous areas)
 a Not for devices with external diameter of 29 mm (1.14 in)
 b 10.5 to 30 V_{DC} (hazardous area), 10.5 to 35 V_{DC}
 c 4 to 20 mA
 d Resistance (R_T)
 e Pt100

6.2.2 TMT71 temperature head transmitter (optional)

8 to 35 V_{DC}

6.3 Cable specifications

Endress+Hauser recommends using shielded, twisted-pair two-wire cables.

 The probe cables are shielded for device versions with outer diameters of 22 mm (0.87 in) and 42 mm (1.65 in).

6.3.1 Device + Pt100 (optional)

- Commercially available instrument cable
- Terminals, terminal box: 0.08 to 2.5 mm² (28 to 14 AWG)

6.3.2 TMT71 temperature head transmitter (optional)

- Commercially available instrument cable
- Terminals, terminal box: 0.08 to 2.5 mm² (28 to 14 AWG)
- Transmitter connection: max. 1.75 mm² (15 AWG)

6.4 Power consumption

6.4.1 Device + Pt100 (optional)

- ≤ 0.805 W at 35 V_{DC} (non-hazardous area)
- ≤ 0.690 W at 30 V_{DC} (hazardous area)

6.4.2 TMT71 temperature head transmitter (optional)

≤ 0.875 W at 35 V_{DC}

6.5 Current consumption

6.5.1 Device + Pt100 (optional)

Max. current consumption: ≤ 23 mA

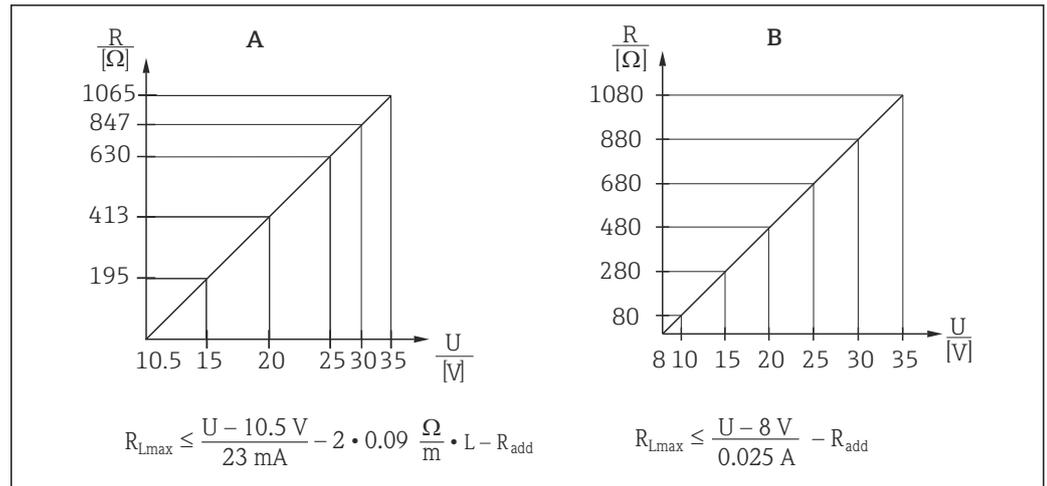
Min. current consumption: ≥ 3.6 mA

6.5.2 TMT71 temperature head transmitter (optional)

- Max. current consumption: ≤ 25 mA
- Min. current consumption: ≥ 3.5 mA

6.6 Maximum load

The maximum load resistance depends on the supply voltage (U) and must be determined individually for each current loop, see formula and diagrams for the device and temperature head transmitter. The total resistance resulting from the resistances of the connected devices, the connecting cable and, where applicable, the resistance of the extension cable may not exceed the load resistance value.



A0030561-EN

A Load diagram for device 4 to 20 mA analog for an approximate calculation of the load resistance. Additional resistances, such as the resistance of the extension cable, have to be subtracted from the value calculated as shown in the equation.

B Load diagram for TMT71 temperature head transmitter for estimating the load resistance. Additional resistances must be subtracted from the value calculated as shown in the equation

R_{Lmax} Max. load resistance [Ω]

R_{add} Additional resistances such as resistance of evaluating device and/or display unit, cable resistance [Ω]

U Supply voltage [V]

L Basic length of extension cable [m] (cable resistance per wire $\leq 0.09 \Omega/\text{m}$)

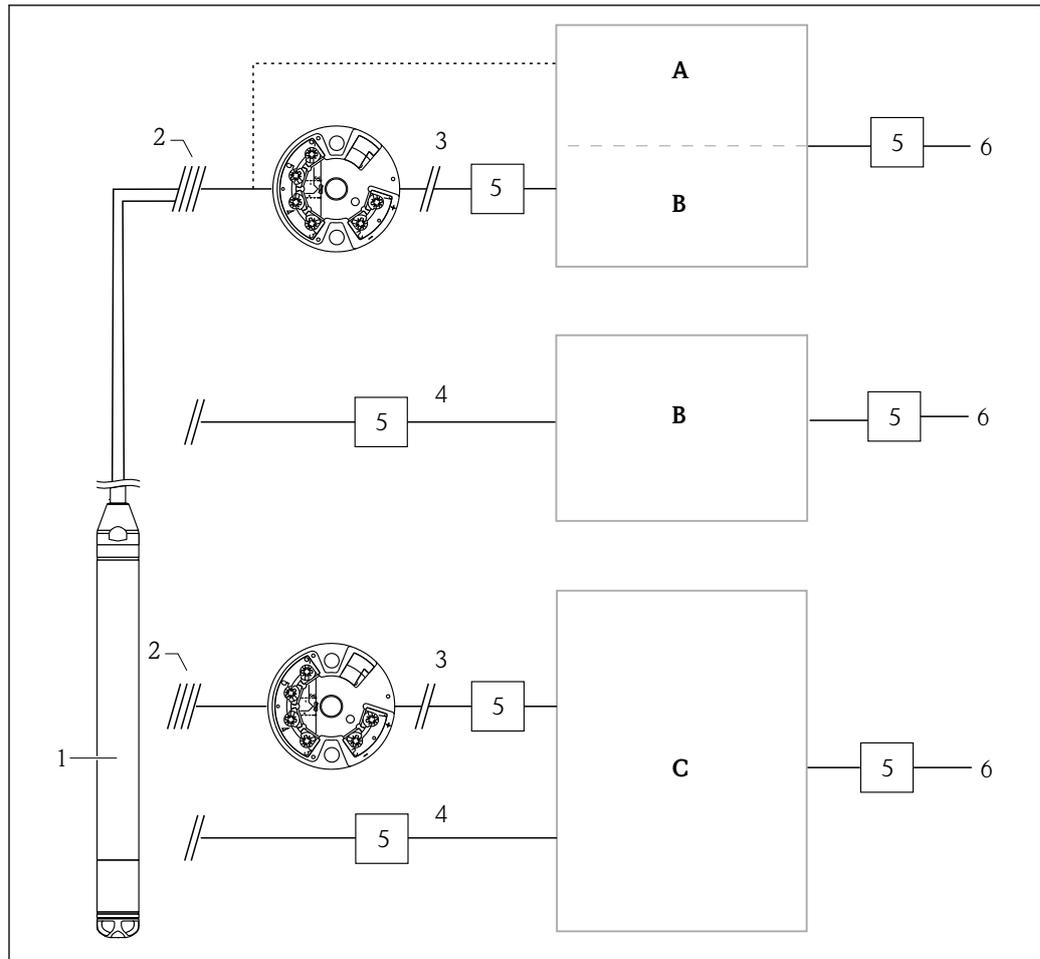


When using the measuring instrument in hazardous areas, the applicable national standards and regulations, as well as the safety instructions and Installation or Control Drawings (XA) must be observed.

6.7 Connecting the measuring unit

6.7.1 Overvoltage protection

To protect the Waterpilot and the TMT71 temperature head transmitter from large interference voltage peaks, Endress+Hauser recommends installing overvoltage protection upstream and downstream of the display and/or evaluation unit as shown in the graphic.



A0030206-EN

- A Power supply, display and evaluation unit with one input for Pt100
 B Power supply, display and evaluation unit with one input for 4 to 20 mA
 C Power supply, display and evaluation unit with two inputs for 4 to 20 mA
 1 Device
 2 Connection for integrated Pt100 in the FMX21
 3 4 to 20 mA (temperature)
 4 4 to 20 mA (level)
 5 Overvoltage protection, e.g. HAW from Endress+Hauser (not for use in hazardous areas.)
 6 Power supply

6.8 Post-connection check

- Are the device and cables free from damage (visual check)?
- Do the cables used comply with the requirements?
- Are the mounted cables strain-relieved?
- Are all cable glands installed, securely tightened and leak-tight?
- Does the supply voltage match the specifications on the nameplate?
- Is the terminal assignment correct?

7 Operation options

Endress+Hauser offers comprehensive measuring point solutions with display and/or evaluation units for the device and the TMT71 temperature head transmitter.

 Your Endress+Hauser service organization would be glad to be of service if you have any other questions. Contact addresses are available at: www.endress.com/worldwide

7.1 Overview of operation options

No display or other operation facility is required to operate the device.

8 Diagnostics and troubleshooting

8.1 General troubleshooting

Device is not responding

- Supply voltage does not match the voltage specified on the nameplate.
 - ↳ Apply correct voltage.
- Supply voltage has incorrect polarity.
 - ↳ Correct the polarity.
- Connecting cables are not making contact with the terminals.
 - ↳ Check the connection of the cables and correct if necessary.

Output current < 3.6 mA

Signal cable is not wired correctly.

Electronics unit is defective.

- ↳ Check wiring.

8.2 Troubleshooting specific to the device with optional Pt100

No measuring signal

- 4 to 20 mA cable not connected correctly
 - ↳ Connect device as per →  22
- No power supplied via the 4 to 20 mA cable
 - ↳ Check current loop
- Supply voltage too low (min. 10.5 V_{DC})
 - ↳ Check supply voltage
 - ↳ Overall resistance greater than max. load resistance
- Device is defective
 - ↳ Replace the device

Temperature measured value is inaccurate/incorrect (only for device with Pt100)

Pt100 connected in 2-wire circuit, cable resistance was not compensated for, cable not correct

- ↳ Compensate for the cable resistance
- ↳ Connect Pt100 as 3-wire or 4-wire circuit

8.3 Troubleshooting specific to TMT71 temperature head transmitter

No measuring signal

- 4 to 20 mA cable not connected correctly
 - ↳ Connect device as per →  22
- No power supplied via the 4 to 20 mA cable
 - ↳ Check current loop
- Supply voltage too low (min. 8 V_{DC})
 - ↳ Check supply voltage
 - ↳ Overall resistance greater than max. load resistance

Failure current ≤ 3.6 mA or ≥ 21 mA

- Pt100 not connected correctly
 - ↳ Connect device as per →  22
- 4 to 20 mA cable not connected correctly
 - ↳ Connect device as per →  22
- Pt100 resistance thermometer defective
 - ↳ Replace the device
- Temperature head transmitter defective
 - ↳ Replace the temperature head transmitter

Measured value is inaccurate/incorrect

Pt100 connected in 2-wire circuit, cable resistance was not compensated for

- ↳ Compensate for the cable resistance
- ↳ Connect Pt100 as 3-wire or 4-wire circuit

9 Maintenance

- Terminal box: Keep the GORE-TEX® filter free from contamination
- Device extension cable: Keep the Teflon filter in the pressure compensation tube free from contamination
- Check the process membrane for buildup at suitable intervals.

9.1 Exterior cleaning

Please note the following points when cleaning the device:

- The cleaning agents used should not corrode the surface and the seals.
- Mechanical damage to the process membrane, e.g. due to sharp objects, must be avoided.
- Only clean the terminal box with water or with a cloth dampened with very diluted ethanol.

10 Repair

10.1 General information

10.1.1 Repair concept

Repairs are not possible.

10.2 Spare parts

Product spare parts that are currently available can be found online at:
www.endress.com/onlinetools



Measuring instrument serial number:
Located on the device and spare part nameplate.

10.3 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: <https://www.endress.com>
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

10.4 Disposal



If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

11 Accessories

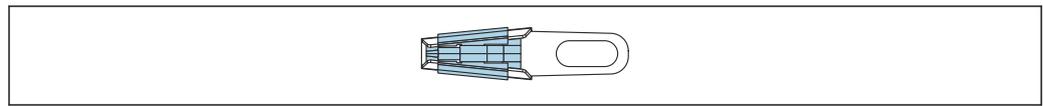
- i** ■ Observe the additional information in the individual sections!
- For additional information, see the sections "Mechanical construction" (in the Technical Information), "Environment", →  41, "Process" →  43 and "Mounting" →  14.

11.1 Device-specific accessories

Suspension clamp

For easy installation of the device, Endress+Hauser offers a suspension clamp.

- Product Configurator: the suspension clamp is optionally available
- Order number: 52006151

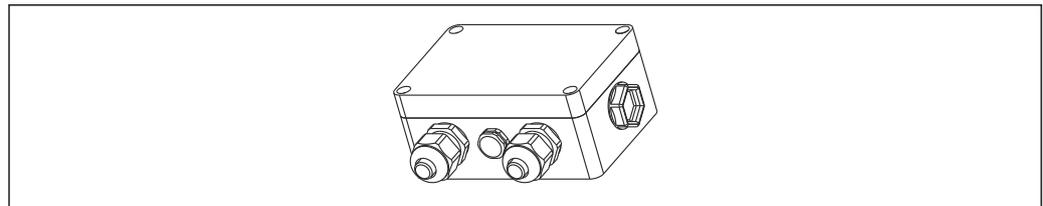


A0030950

Terminal box

Terminal box for terminal strip, temperature head transmitter and Pt100.

- Product Configurator: the terminal box is optionally available
- Order number: 52006152

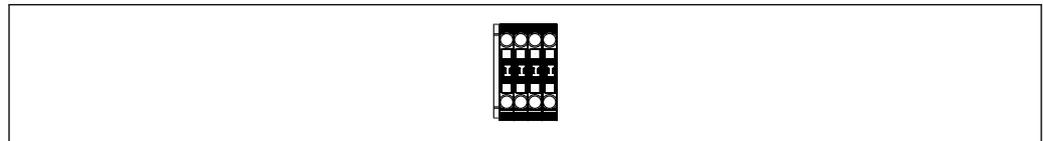


A0030967

4-terminal strip/terminals

4-terminal strip for wiring

Order number: 52008938

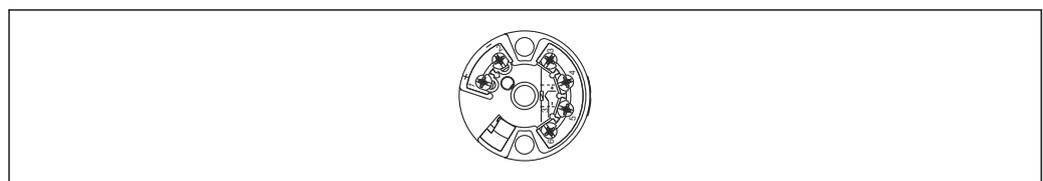


A0030951

Temperature head transmitter TMT71 for FMX21 4 to 20 mA analog

PC-programmable (PCP) temperature head transmitter for the conversion of various input signals.

- Product Configurator: the temperature head transmitter TMT71 is optionally available
→  32
- Order number: 71593573

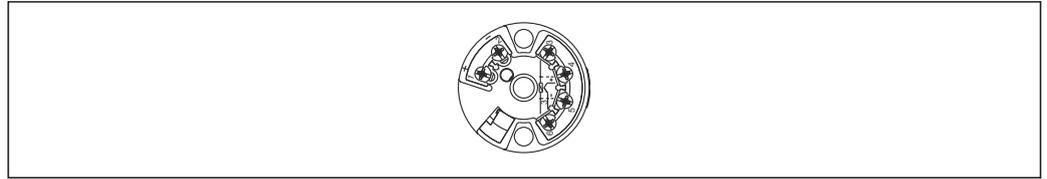


A0030952

Temperature head transmitter TMT72 for FMX21 4 to 20 mA HART

PC-programmable (PCP) temperature head transmitter for the conversion of various input signals.

- Product Configurator: the temperature head transmitter TMT72 is optionally available
- Order number: 71593576

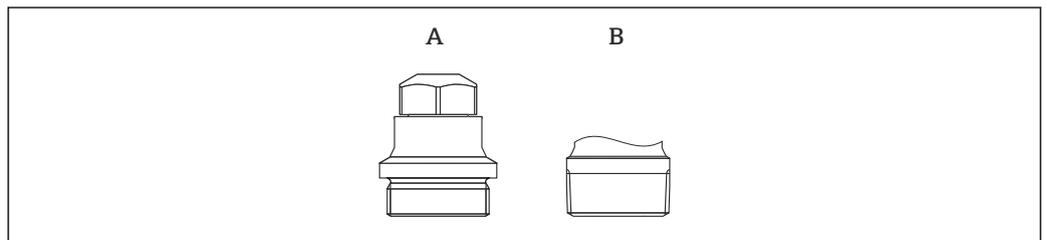


A0030952

Cable mounting screws

Endress+Hauser offers a cable mounting screw for easy device mounting and to seal the measuring aperture.

- G 1½" A
Order number: 52008264
- NPT 1½"
Order number: 52009311
- Product Configurator: the cable mounting screws are optionally available



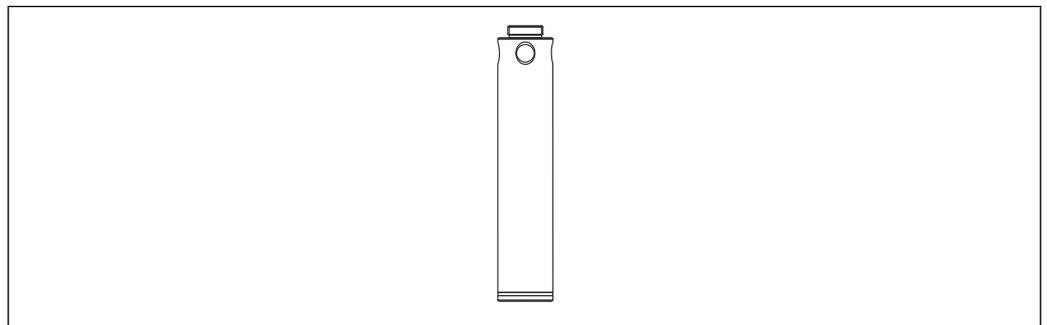
A0030953

- A G 1½" A
B NPT 1½"

Additional weight for device with an outer diameter of 22 mm (0.87 in) or 29 mm (1.14 in)

Endress+Hauser offers additional weights to prevent sideways movement that results in measurement errors, or to make it easier to lower the device in a guide tube.

- Product Configurator: the additional weight is optionally available
- Order number: 52006153

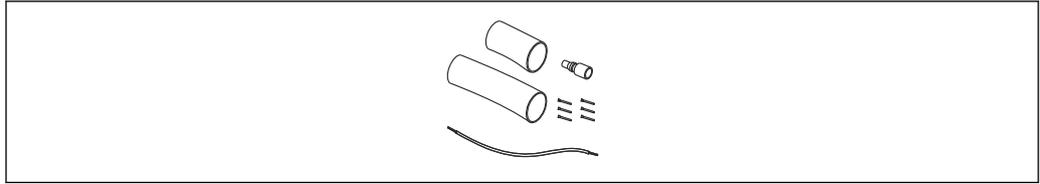


A0030954

Cable shortening kit

The cable shortening kit is used to shorten a cable easily and professionally.

- Product Configurator: the cable shortening kit is optionally available
- Order number: 71222671

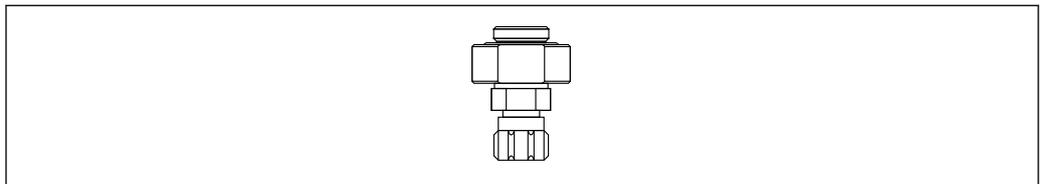


A0030948

Testing adapter for devices with an external diameter of 22 mm (0.87 in) or 29 mm (1.14 in)

Endress+Hauser offers a testing adapter to ease function-testing of the level probes.

- Product Configurator: the testing adapter is optionally available
- Order number: 52011868

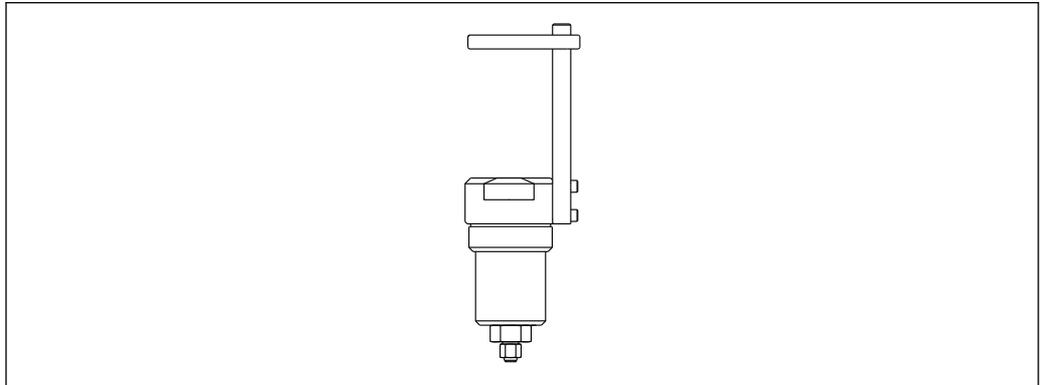


A0030956

Testing adapter for devices with an external diameter of 42 mm (1.65 in)

Endress+Hauser offers a testing adapter to ease function-testing of the level probes.

- Observe the maximum pressure for compressed air hose and maximum overload for level probe
- Maximum pressure for the quick coupling piece provided: 10 bar (145 psi)
- Order number: 71110310



A0030957

11.2 Service-specific accessories

DeviceCare SFE100

DeviceCare is an Endress+Hauser configuration tool for field devices using the following communication protocols: HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, IO/Link, Modbus, CDI and Endress+Hauser Common Data Interfaces.



Technical Information TI01134S

www.endress.com/sfe100

FieldCare SFE500

FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.

The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.



Technical Information TI00028S

www.endress.com/sfe500

Applicator

Software for selecting and sizing Endress+Hauser measuring devices:

- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:

<https://portal.endress.com/webapp/applicator>

12 Technical data

12.1 Input

12.1.1 Measured variable

FMX21 + Pt100 (optional)

- Hydrostatic pressure of a liquid
- Pt100: Temperature

TMT71 temperature head transmitter (optional)

Temperature

12.1.2 Measuring range

- Customer-specific measuring ranges or calibration that has been preset in the factory
- Temperature measurement of -10 to +70 °C (+14 to +158 °F) with Pt100 (optional)

Gauge pressure

| Sensor measuring range | Lowest calibratable span ¹⁾ | Vacuum resistance | Option ²⁾ |
|----------------------------------|--|--|----------------------|
| 0.1 bar (1.5 psi) | 0.01 bar (0.15 psi) | 0.3 bar _{abs} (4.5 psi _{abs}) | 1C |
| 0.2 bar (3.0 psi) | 0.02 bar (0.3 psi) | 0.3 bar _{abs} (4.5 psi _{abs}) | 1D |
| 0.4 bar (6.0 psi) | 0.04 bar (1.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1F |
| 0.6 bar (9.0 psi) | 0.06 bar (1.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1G |
| 1.0 bar (15.0 psi) | 0.1 bar (1.5 psi) | 0 bar _{abs} (0 psi _{abs}) | 1H |
| 2.0 bar (30.0 psi) | 0.2 bar (3.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1K |
| 4.0 bar (60.0 psi) | 0.4 bar (6.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1M |
| 10.0 bar (150 psi) ³⁾ | 1.0 bar (15.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1P |
| 20.0 bar (300 psi) ³⁾ | 2.0 bar (30.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 1Q |

1) Largest turn down that can be configured at the factory: 10:1, higher turn down can be configured on request or in the device (for FMX21 4 to 20 mA HART).

2) Product Configurator order code for "070"

3) These measuring ranges are not available for the probe version with plastic insulation, outer diameter of 29 mm (1.14 in).

Absolute pressure

| Sensor measuring range | Lowest calibratable span ¹⁾ | Vacuum resistance | Option ²⁾ |
|----------------------------------|--|--|----------------------|
| 2.0 bar (30.0 psi) | 0.2 bar (3.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 2K |
| 4.0 bar (60.0 psi) | 0.4 bar (6.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 2M |
| 10.0 bar (150 psi) ³⁾ | 1.0 bar (15.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 2P |
| 20.0 bar (300 psi) ³⁾ | 2.0 bar (30.0 psi) | 0 bar _{abs} (0 psi _{abs}) | 2Q |

1) Largest turn down that can be configured at the factory: 10:1, higher turn down can be configured on request or in the device (for FMX21 4 to 20 mA HART).

2) Product Configurator order code for "070"

3) These measuring ranges are not available for the probe version with plastic insulation, outer diameter of 29 mm (1.14 in).

12.1.3 Input signal

FMX21 + Pt100 (optional)

- Change in capacitance
- Pt100: Change in resistance

TMT71 temperature head transmitter (optional)

Pt100 resistance signal, 4 wire

12.2 Output

12.2.1 Output signal

Device + Pt100 (optional)

- 4 to 20 mA Analog, 2-wire for hydrostatic pressure measured value.
- Pt100: temperature-dependent resistance value

TMT71 temperature head transmitter (optional)

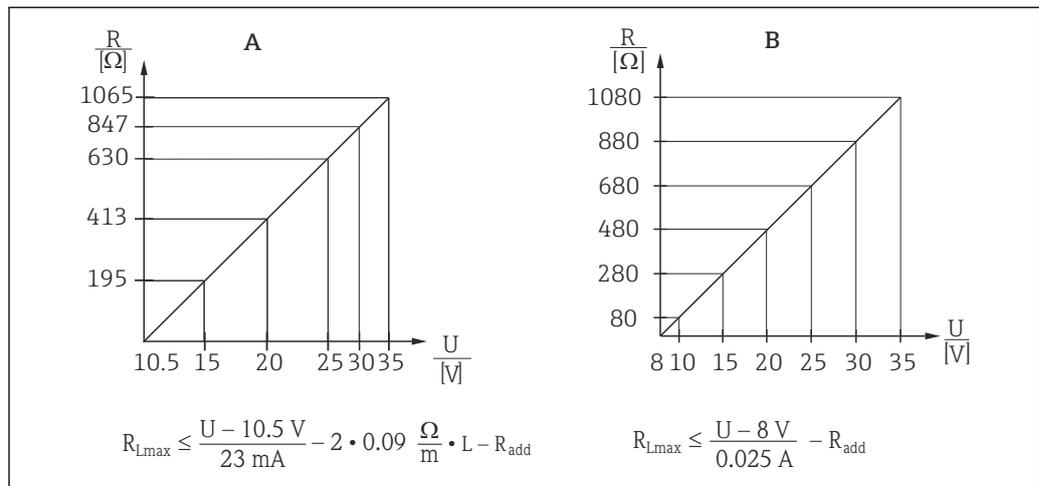
4 to 20 mA analog for temperature measured value, 2-wire

12.2.2 Signal range

3.8 to 20.5 mA

12.2.3 Maximum load

The maximum load resistance depends on the supply voltage (U) and must be determined individually for each current loop, see formula and diagrams for the device and temperature head transmitter. The total resistance resulting from the resistances of the connected devices, the connecting cable and, where applicable, the resistance of the extension cable may not exceed the load resistance value.



A0030561-EN

A Load diagram for device 4 to 20 mA analog for an approximate calculation of the load resistance. Additional resistances, such as the resistance of the extension cable, have to be subtracted from the value calculated as shown in the equation.

B Load diagram for TMT71 temperature head transmitter for estimating the load resistance. Additional resistances must be subtracted from the value calculated as shown in the equation

R_{Lmax} Max. load resistance [Ω]

R_{add} Additional resistances such as resistance of evaluating device and/or display unit, cable resistance [Ω]

U Supply voltage [V]

L Basic length of extension cable [m] (cable resistance per wire $\leq 0.09 \Omega/m$)

i When using the measuring instrument in hazardous areas, the applicable national standards and regulations, as well as the safety instructions and Installation or Control Drawings (XA) must be observed.

12.3 Performance characteristics

12.3.1 Reference operating conditions

Device + Pt100 (optional)

- As per IEC 60770
- Ambient temperature T_A = constant, in the range of: +21 to +33 °C (+70 to +91 °F)
- Humidity φ = constant, in the range of: 20 to 80 % rH
- Atmospheric pressure p_A = constant, in the range of:
860 to 1 060 mbar (12.47 to 15.37 psi)
- Position of the measuring cell constant, vertical in the range of $\pm 1^\circ$
- Input of LOW SENSOR TRIM and HIGH SENSOR TRIM for lower range value and upper range value (only for HART)
- Supply voltage constant: 21 to 27 V_{DC}
- Pt100: DIN EN 60770, $T_A = +25^\circ\text{C}$ (+77 °F)

TMT71 temperature head transmitter (optional)

Calibration temperature: +23 °C (+73 °F) ± 5 K

12.3.2 Reference accuracy

Device + Pt100 (optional)

The reference accuracy comprises the non-linearity after limit point configuration, hysteresis and non-reproducibility in accordance IEC 60770.

Standard version:

Setting ± 0.2 %

- to TD 5:1: < 0.2 % of set span
- from TD 5:1 to TD 20:1 $\pm(0.02 \times \text{TD} + 0.1)$

Platinum version:

- Setting ± 0.1 % (optional)
 - to TD 5:1: < 0.1 % of set span
 - from TD 5:1 to TD 20:1 $\pm(0.02 \times \text{TD})$
- Class B as per DIN EN 60751
Pt100: max. ± 1 K

TMT71 temperature head transmitter (optional)

- ± 0.2 K
- With Pt100: max. ± 0.9 K

12.3.3 Long-term stability

Device + Pt100 (optional)

- ≤ 0.1 % of URL/year
- ≤ 0.25 % of URL/5 years

TMT71 temperature head transmitter (optional)

≤ 0.1 K per year

12.3.4 Influence of medium temperature

- Thermal change in the zero output and the output span:
 - 0 to 30 °C (+32 to 86 °F): $< (0.15 + 0.15 \times \text{TD})\%$ of set span
 - 10 to +70 °C (+14 to 158 °F): $< (0.4 + 0.4 \times \text{TD})\%$ of set span
- Temperature coefficient (T_K) of the zero output and the output span
 - 10 to +70 °C (+14 to 158 °F): 0.1 % / 10 K of URL

12.3.5 Warm-up time

Device + Pt100 (optional)

- Device: < 6 s
- Pt100: 300 s

TMT71 temperature head transmitter (optional)

4 s

12.3.6 Response time

Device + Pt100 (optional)

- Device: 400 ms (T90 time), 500 ms (T99 time)
- Pt100: 160 s (T90 time), 300 s (T99 time)

12.4 Environment

12.4.1 Ambient temperature range

Device + Pt100 (optional)

- With external diameter of 22 mm (0.87 in) and 42 mm (1.65 in):
-10 to +70 °C (+14 to +158 °F) (= medium temperature)
- With external diameter of 29 mm (1.14 in):
0 to +50 °C (+32 to +122 °F) (= medium temperature)

Cables

(when mounted in a fixed position)

- With PE: -30 to +70 °C (-22 to +158 °F)
- With FEP: -40 to +70 °C (-40 to +158 °F)
- With PUR: -40 to +70 °C (-40 to +158 °F)

Terminal box

-40 to +80 °C (-40 to +176 °F)

TMT71 temperature head transmitter (optional)

-40 to +85 °C (-40 to +185 °F)

Temperature head transmitter 2-wire, configured for a measuring range of -20 to +80 °C (-4 to +176 °F). This configuration allows the temperature range of 100 K to be displayed with good resolution. Note that the Pt100 resistance thermometer is suitable for a temperature range of -10 to +70 °C (14 to +158 °F)

 The TMT71 temperature head transmitter is not designed for use in hazardous areas incl. CSA GP.

12.4.2 Storage temperature range

Device + Pt100 (optional)

-40 to +80 °C (-40 to +176 °F)

Cable

(when mounted in a fixed position)

- With PE: -30 to +70 °C (-22 to +158 °F)
- With FEP: -30 to +80 °C (-22 to +176 °F)
- With PUR: -40 to +80 °C (-40 to +176 °F)

Terminal box

-40 to +80 °C (-40 to +176 °F)

TMT71 temperature head transmitter (optional)

-40 to +100 °C (-40 to +212 °F)

12.4.3 Degree of protection

Device + Pt100 (optional)

IP68, permanently hermetically sealed at 20 bar (290 psi) (~200 m H₂O)

Terminal box (optional)

IP66, IP67

TMT71 temperature head transmitter (optional)

IP00, condensation permitted

When installed in the optional terminal boxes: IP66/IP67

12.4.4 Electromagnetic compatibility (EMC)**Device + Pt100 (optional)**

- EMC in accordance with all relevant requirements of EN 61326 series. For details, refer to the Declaration of Conformity.
- Maximum deviation: < 0.5 % of span.

TMT71 temperature head transmitter (optional)

Interference emission to EN 61326 Class B equipment, interference immunity to EN 61326 Appendix A (Industrial). For details, refer to the Declaration of Conformity.

12.5 Process

12.5.1 Medium temperature range

Device + Pt100 (optional)

- With external diameter of 22 mm (0.87 in) and 42 mm (1.65 in):
-10 to +70 °C (+14 to +158 °F)
- With external diameter of 29 mm (1.14 in):
0 to +50 °C (+32 to +122 °F)

TMT71 temperature head transmitter (optional)

-40 to +85 °C (-40 to +185 °F)

(= ambient temperature), install temperature head transmitter outside the medium.

Temperature head transmitter 2-wire, configured for a measuring range of -20 to +70 °C (-4 to +158 °F). This configuration offers a temperature range of 100 K which can be displayed with good resolution. Please note that the Pt100 resistance temperature detector is suitable for a temperature range of -10 to +70 °C (14 to +158 °F)

 The TMT71 temperature head transmitter is not designed for use in hazardous areas incl. CSA GP.

12.5.2 Medium temperature limit

Device + Pt100 (optional)

With external diameter of 22 mm (0.87 in) and 42 mm (1.65 in):
-20 to +70 °C (-4 to +158 °F)

 In hazardous areas incl. CSA GP, the medium temperature limit is -10 to +70 °C (+14 to +158 °F).

With external diameter of 29 mm (1.14 in): 0 to +50 °C (+32 to +122 °F)

 The FMX21 may be operated in this temperature range. The specification values, such as measurement accuracy, may be exceeded.

12.5.3 Process pressure range

Pressure specifications

 The maximum pressure for the device depends on the lowest-rated element with regard to pressure.

Components are: process connection, optional mounting parts, or accessories.

⚠ WARNING**Incorrect design or use of the device may cause injury due to bursting parts!**

- ▶ Only operate the device within the specified limits for the components!
- ▶ MWP (maximum working pressure): The maximum working pressure is specified on the nameplate. This value refers to a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited time. Note temperature dependence of MWP.
- ▶ The overpressure limit is the maximum pressure that a device may be subjected to during a test. The overpressure limit exceeds the maximum working pressure by a certain factor.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PT". The abbreviation "PT" corresponds to the OPL (Over Pressure Limit) of the device. OPL (Over Pressure Limit) is a test pressure.
- ▶ In the case of measuring cell range and process connection combinations where the overpressure limit (OPL) of the process connection is less than the nominal value of the measuring cell, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If the full measuring cell range is to be used, select a process connection with a higher OPL value.
- ▶ Avoid steam hammering! Steam hammering can cause zero point drift.
Recommendation: Residue (water droplets or condensation) may remain on the process membrane following CIP cleaning and can result in local steam hammering the next time steam cleaning takes place. Drying the process membrane (e.g. by blowing off excess moisture) has proven effective in avoiding steam hammering.

12.6 Additional technical data

See Technical Information TI00431P.

Index

A

Applications 9

C

CE mark 10

Cleaning 30

D

Declaration of Conformity 10

Disposal 31

E

Exterior cleaning 30

F

Fault identification 28

I

Intended use 9

M

Maintenance 30

Media 9

O

Operational safety 9

P

Product safety 10

R

Repair concept 31

Requirements for personnel 9

Return 31

S

Safety Instructions (XA) 6

Safety requirements

 Basic 9

Spare parts 31

 Nameplate 31

U

Use of measuring instruments

 Borderline cases 9

 Incorrect use 9

Use of the measuring instrument

 see Intended use

W

W@M Device Viewer 31

Workplace safety 9



71762964

www.addresses.endress.com
