TI00431P/00/EN/19.26-00
71762965
2026-03-09

Technical Information
Waterpilot FMX21

Hydrostatic level measurement

Compact transmitter for level measurement

Field of application

The Waterpilot FMX21 is a pressure sensor for hydrostatic level measurement.

Endress+Hauser offers three different versions of the device:
- FMX21 with a stainless steel housing, outer diameter 22 mm (0.87 in):
  This version is excellently suited to drinking water applications and for use in bore holes and wells with small diameters
- FMX21 with a stainless steel housing, outer diameter 42 mm (1.65 in):
  Heavy-duty version and easy to clean thanks to flush membrane, ideally suited to wastewater and wastewater treatment plants
- FMX21 with plastic insulation, outer diameter 29 mm (1.14 in):
  Robust version for use in salt water and very well suited to applications on ships (e.g. ballast water tanks)

Your benefits

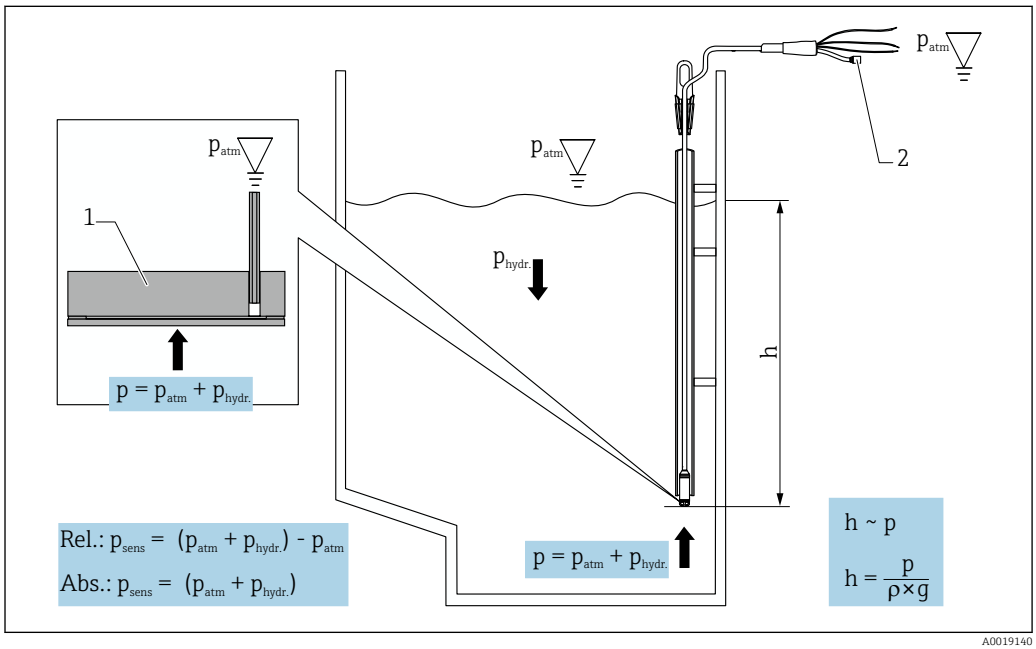
- High resistance to overload
- High-precision, robust ceramic measuring cell with long-term stability
- Climate proofed sensor thanks to completely potted electronics and 2-filter pressure compensation system
- Simultaneous measurement of level and temperature with optionally integrated Pt100 temperature sensor
- Accuracy
  - Standard reference accuracy ±0.2 %
  - PLATINUM version ±0.1 %
- Automatic density compensation to increase accuracy
- Usage in drinking water: KTW, NSF, ACS
- Approvals: ATEX, FM, CSA
- Marine approvals: GL, ABS, BV, DNV
- Extensive range of accessories provides complete measuring point solutions

Endress+Hauser
People for Process Automation

Function and system design

Measuring principle

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*

Temperature measurement

With optional Pt100 resistance thermometer [1)]

For simultaneous measurement of level and temperature, Endress+Hauser offers the device with an optional 4-wire Pt100 resistance thermometer → 🖹 51. The Pt100 is categorized as Accuracy Class B as per DIN EN 60751.

With optional Pt100 and TMT71 temperature head transmitter

To convert the temperature signal to an analog, scalable 4 to 20 mA output signal, Endress+Hauser also offers the TMT71 temperature head transmitter.

Ordering information: → 🖹 49; "Accessories" → 🖹 51. Technical Information TI01393T.

With optional Pt100 and TMT72 temperature head transmitter [1)]

Endress+Hauser also offers the TMT72 temperature head transmitter with HART protocol for converting the temperature signal to an analog, scalable 4 to 20 mA output signal superimposed with HART 6.0. See also: "Density compensation with Pt100 temperature sensor" → 🖹 11

1) Not for use in hazardous areas.

Input

Measured variable

FMX21 + Pt100 (optional)

- Hydrostatic pressure of a liquid
- Pt100: Temperature

TMT71 temperature head transmitter (optional)

Temperature

TMT72 temperature head transmitter (optional)

Temperature

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).

Output

Output signal

Device + Pt100 (optional)

- 4 to 20 mA Analog, 2-wire for hydrostatic pressure measured value.
- 4 to 20 mA HART with superimposed digital communication protocol HART 6.0, 2-wire for hydrostatic pressure measured value.
  Options:
  - Max. alarm (factory setting 22 mA): can be set from 21 to 23 mA
  - Hold measured value: last measured value is held
  - Min. alarm: 3.6 mA
- Pt100: temperature-dependent resistance value

TMT71 temperature head transmitter (optional)

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

TMT72 temperature head transmitter (optional)

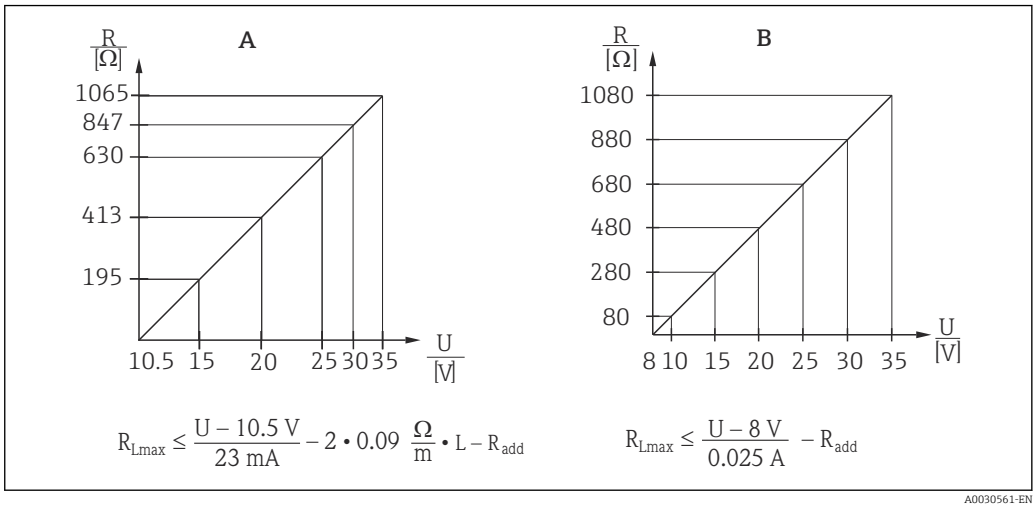
4 to 20 mA HART with superimposed digital communication protocol HART 5.0 for temperature measured value, 2-wire

Signal range

3.8 to 20.5 mA

Maximum load 4 to 20 mA analog

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.



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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 ≤0.09 Ω/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.

Maximum load 4 to 20 mA HART

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

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 .

Supply voltage

Device + Pt100 (optional)

- 10.5 to 35 V (non-hazardous area)
- 10.5 to 30 V (hazardous area)

TMT71 temperature head transmitter (optional)

8 to 35 V_{DC}

TMT72 temperature head transmitter (optional)

11.5 to 35 V_{DC}

Power consumption

Device + Pt100 (optional)

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

TMT71 temperature head transmitter (optional)

≤ 0.875 W at 35 V_{DC}

TMT72 temperature head transmitter (optional)

≤ 0.805 W at 35 V_{DC}

Current consumption

Device + Pt100 (optional)

Max. current consumption: ≤ 23 mA
Min. current consumption: ≥ 3.6 mA

TMT71 temperature head transmitter (optional)

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

TMT72 temperature head transmitter (optional)

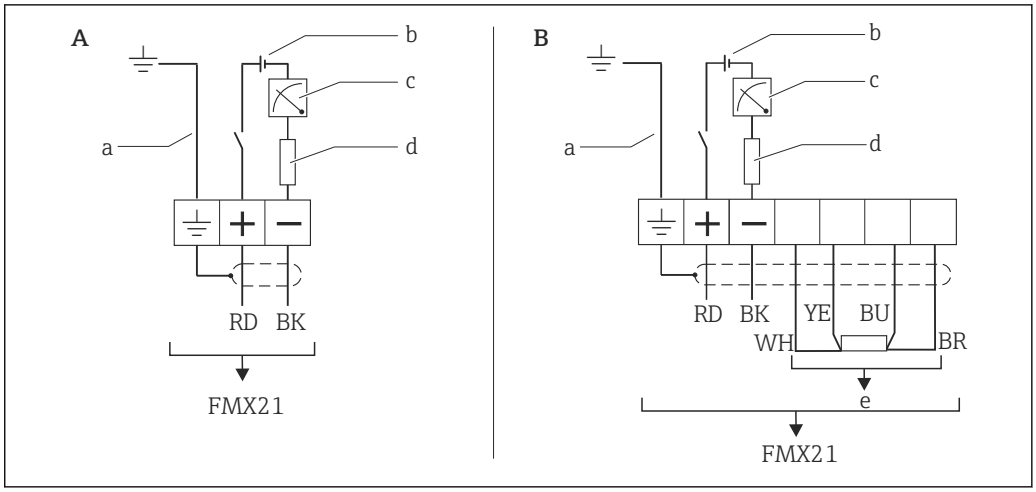
- Max. current consumption: ≤ 23 mA
- Min. current consumption: ≥ 3.5 mA

Electrical connection

- Reverse polarity protection is integrated in the device and the temperature head transmitter. Changing the polarities will not result in damage to the devices.
- The cable must end in a dry room or a suitable terminal box. The terminal box (IP66, IP67) with GORE-TEX® filter from Endress+Hauser is suitable for outdoor installation. The terminal box can be ordered as an accessory via the device order code.

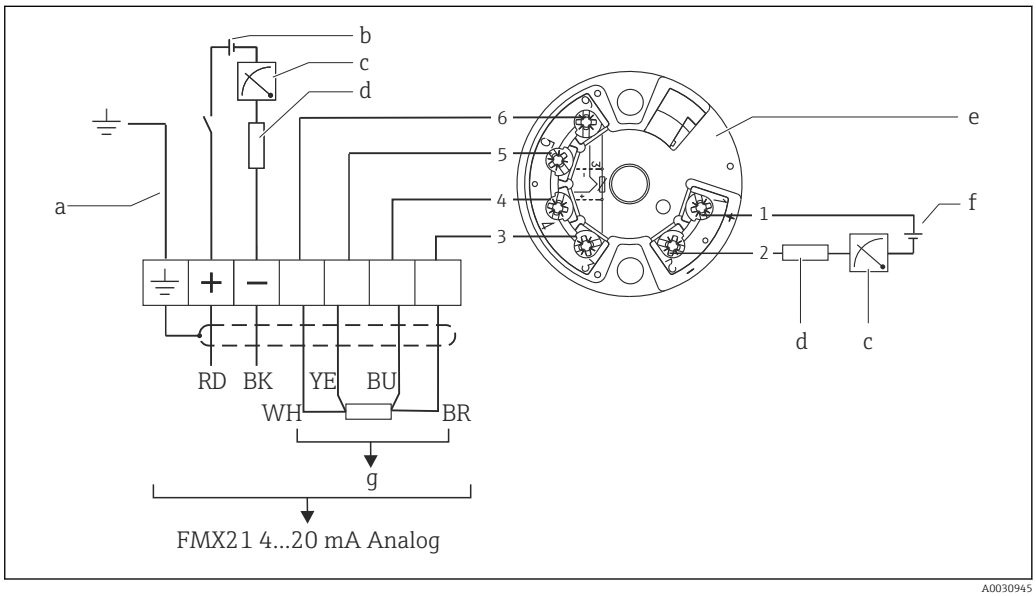
The electrical connection is established with the corresponding wires of the probe cable and with the optional use of the terminal box → 🖹 36 and a power supply (e.g. RN221N active barrier → 🖹 9).

Device with Pt100



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_L)
e Pt100

Device with Pt100 and TMT71 temperature head transmitter



a Not for devices with external diameter of 29 mm (1.14 in)
b 10.5 to 35 V_{DC}
c 4 to 20 mA
d Resistance (R_L)
e TMT71 temperature head transmitter (4 to 20 mA) (not for use in hazardous areas)
f 8 to 35 V_{DC}
g Pt100
1...6 Pin assignment

Performance characteristics

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 1060 mbar (12.47 to 15.37 psi)
- Position of the measuring cell constant, vertical in the range of ±1 °
- 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}
- Load: 250 Ω
- Pt100: DIN EN 60770, T_A = +25 °C (+77 °F)

TMT71 temperature head transmitter (optional)

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

TMT72 temperature head transmitter (optional)

Calibration temperature: +25 °C (+77 °F) ±5 K

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 ±(0.02 x 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 ±(0.02 x 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

TMT72 temperature head transmitter (optional)

- ±0.2 K
- With Pt100: max. ±0.9 K

Resolution

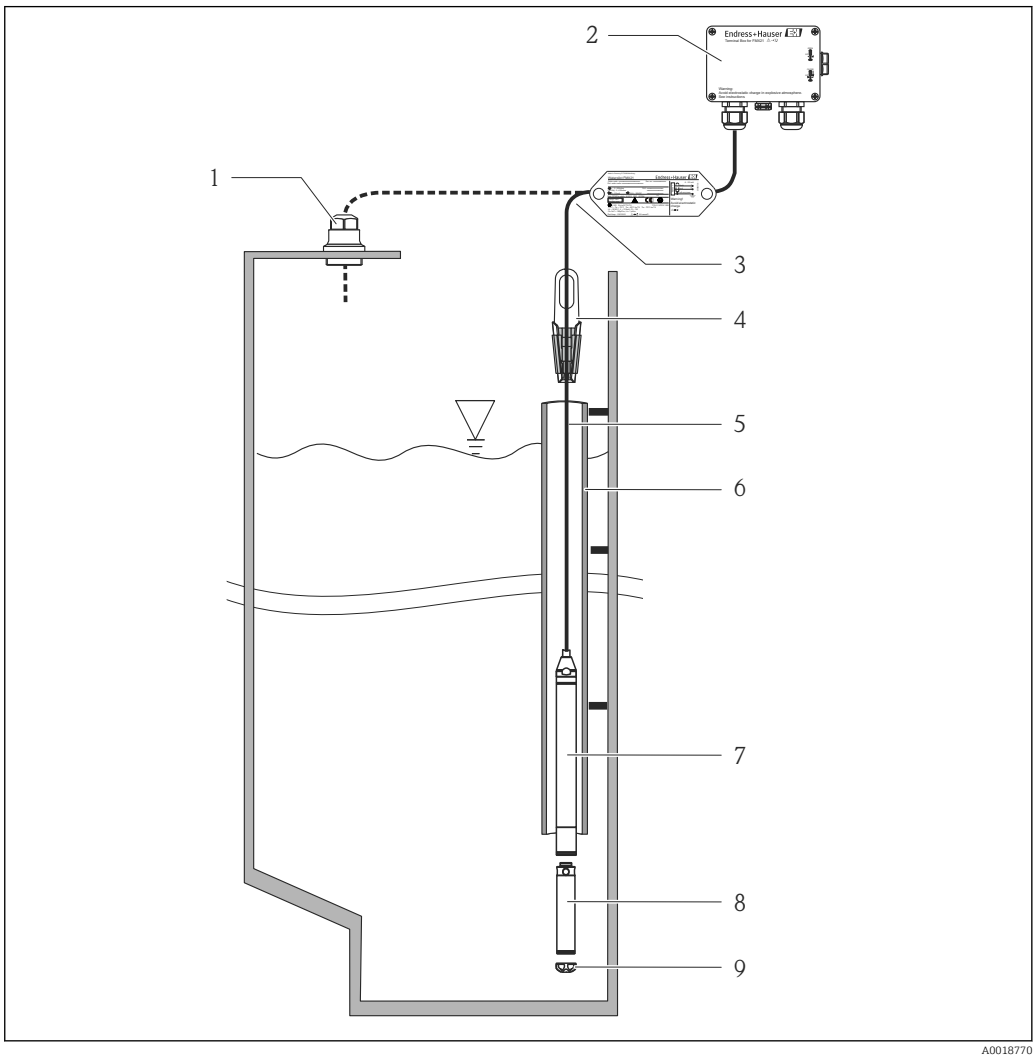
Current output: 1 µA

Reading cycle

HART commands: on average 2 to 3 per second

Installation

Installation instructions



1 *Cable mounting screw can be ordered via the order code or as an accessory → 51*
2 *Terminal box can be ordered via the order code or as an accessory → 51*
3 *Bending radius of extension cable > 120 mm (4.72 in)*
4 *Suspension clamp can be ordered via the order code or as an accessory → 51*
5 *Extension cable, cable length → 28*
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)→ 51*
9 *Protective cap*

Additional installation instructions

- 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 → 51.
- 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 → 51 (documentation SD00552P/00/A6).

Environment

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.

TMT72 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 TMT72 temperature head transmitter is not designed for use in hazardous areas incl. CSA GP.

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)

TMT72 temperature head transmitter (optional)

−40 to +100 °C (−40 to +212 °F)

Degree of protection

Device + Pt100 (optional)

IP68, permanently hermetically sealed at 20 bar (290 psi) (~200 m H_2O)

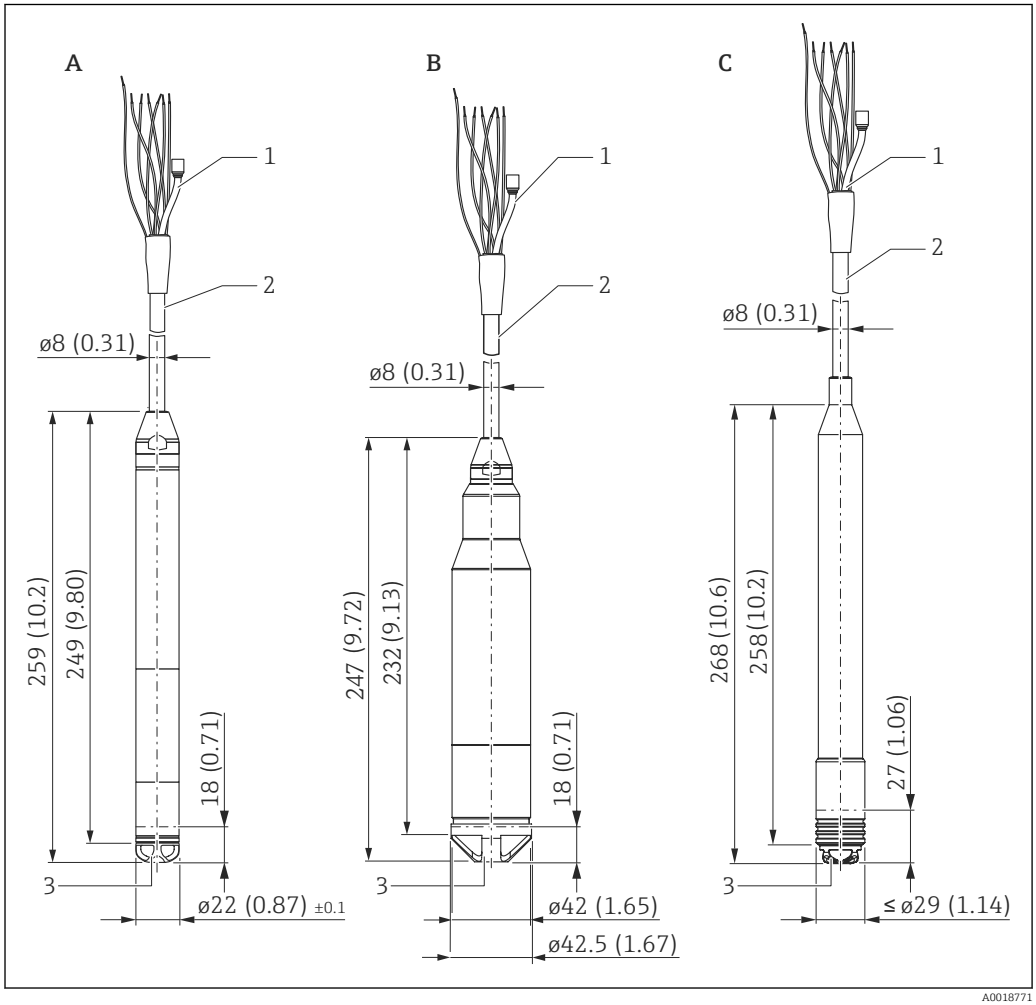
Mechanical construction

The following dimensions are rounded values. As a result, there may be deviations from the specifications in the Product Configurator at www.endress.com.

To view CAD data:

1. Enter www.endress.com in your web browser
2. Search for the device
3. Select the **Configuration** button
4. Configure the device
5. Select the **CAD drawings** button

Dimensions of the level probe



Unit of measurement mm (in)

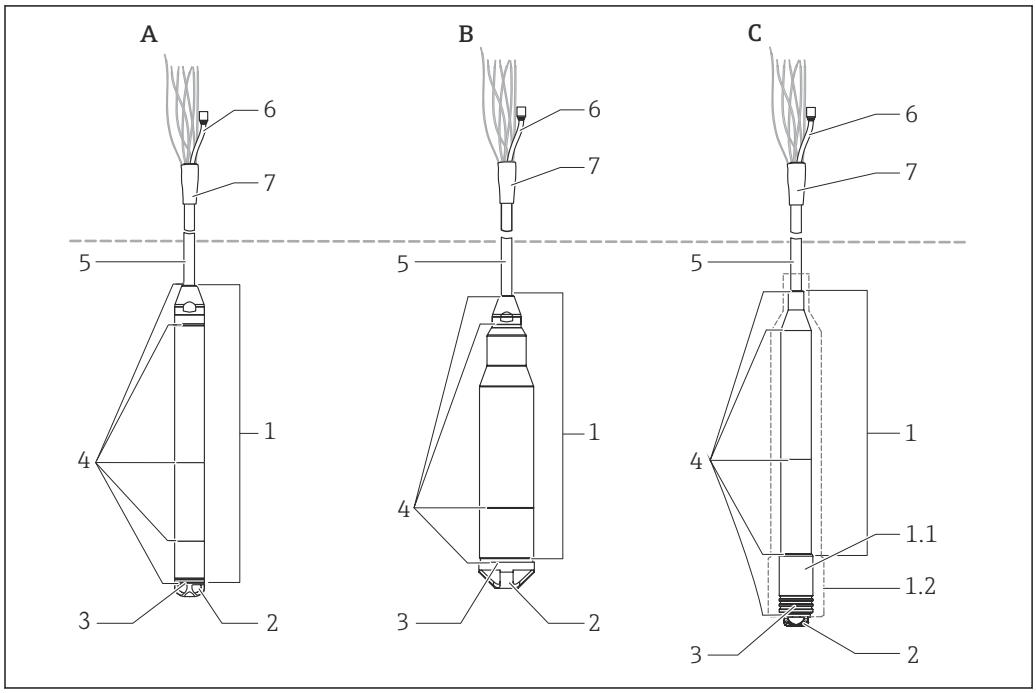
A Probe tube; 316L, outer diameter 22 mm (0.87 in)
B Probe tube; 316L, outer diameter 42 mm, flush mount
C Probe tube; PPS/polyolefin>316L, outer diameter 29 mm, saltwater applications
1 Pressure compensation tube
2 Extension cable (length, see → 28
3 Protective cap

3. Insert the HART communication resistor in the slot in the housing.

Weight

- Level probe, external diameter of 22 mm (0.87 in):
  344 g (12.133 oz)
- Level probe, external diameter of 42 mm (1.65 in):
  1376 g (48.532 oz)
- Level probe, external diameter of 29 mm (1.14 in):
  394 g (13.896 oz)
- Extension cable:
  - PE: 52 g/m (0.035 lbs/1 ft)
  - PUR: 60 g/m (0.040 lbs/1 ft)
  - FEP: 108 g/m (0.072 lbs/1 ft)
- Suspension clamp:
  170 g (5.996 oz)
- Cable mounting screw G 1½" A:
  770 g (27.158 oz)
- Cable mounting screw NPT 1½":
  724 g (25.535 oz)
- Terminal box:
  235 g (8.288 oz)
- TMT71 temperature head transmitter:
  40 g (1.411 oz)
- TMT72 temperature head transmitter:
  40 g (1.411 oz)
- Additional weight:
  300 g (10.581 oz)
- Testing adapter:
  39 g (1.376 oz)

Materials



Materials in contact with process

1 level probe
316L (1.4404/1.4435) [2)]
- **A:** External diameter 22 mm (0.87 in)
- **B:** External diameter 42 mm (1.65 in)
- **C:** External diameter max. 29 mm (1.14 in)

1.1 Sensor sleeve
PPS (Polyphenylene sulfide)

1.2 Heat shrink tube
Polyolefin and hot melt adhesive

The heat-shrink tube around the level probe acts as insulation. It prevents electrical contact between the level probe and the tank. Electrochemical corrosion is thus avoided.

2 Protective cap
- For A and C: with external diameter 22 mm (0.87 in) and 29 mm (1.14 in) (order number: 52008999):
  POM
- For B: device with external diameter 42 mm (1.65 in) (order number: 917755-0000):
  PFA

3 Process ceramic
Al_2O_3 (Aluminum oxide ceramic)

4 Seal
- EPDM
- FKM

5 Seal
Extension cable insulation, choose from:
- PE-LD (Low-density polyethylene)
- FEP (Fluorinated ethylene propylene)
- PUR (Polyurethane)

Materials not in contact with process

6 Pressure compensation tube
PA

2) Material 316L (1.4404/1.4435) not in contact with the process in the case of level probe C

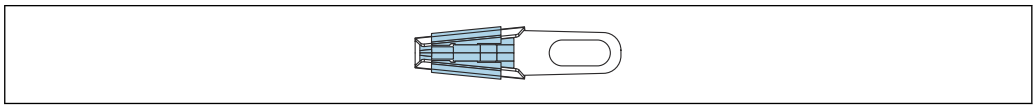
Accessories

- Observe the additional information in the individual sections!
- For additional information, see the sections "Mechanical construction" → 34, "Environment", → 30, "Process" → 32 and "Mounting" → 27.

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



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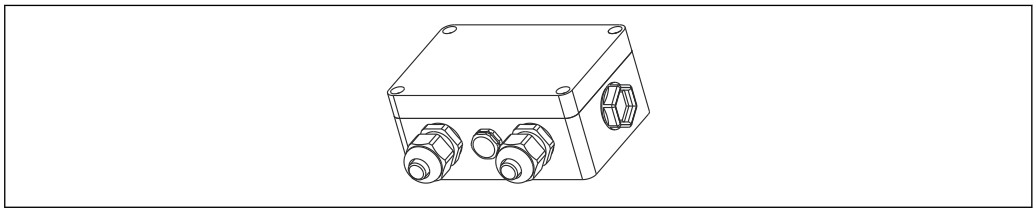
Terminal box

Terminal box for terminal strip, temperature head transmitter and Pt100.
- Product Configurator: the terminal box is optionally available
- Order number: 52006152



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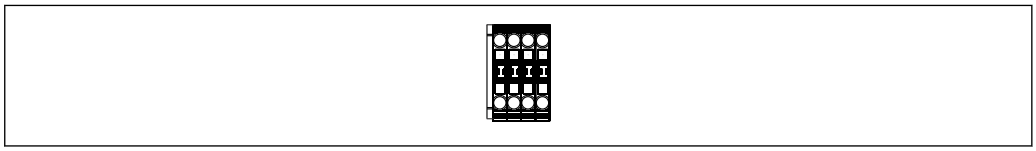
4-terminal strip/terminals

4-terminal strip for wiring
Order number: 52008938



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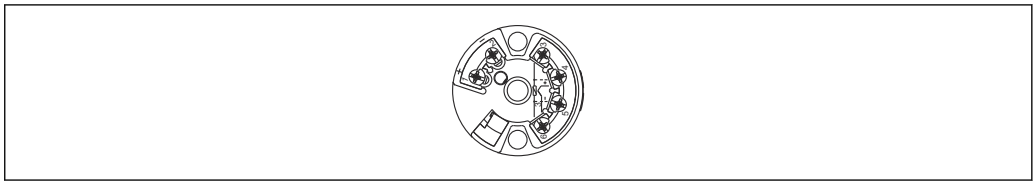
Temperature head transmitter TMT71 for FMX21 4 to 20 mA analog

PC-programmable (PCP) temperature head transmitter for the conversion of various input signals.
- Product Configurator: the temperature head transmitter TMT71 is optionally available → 51
- Order number: 71593573



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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