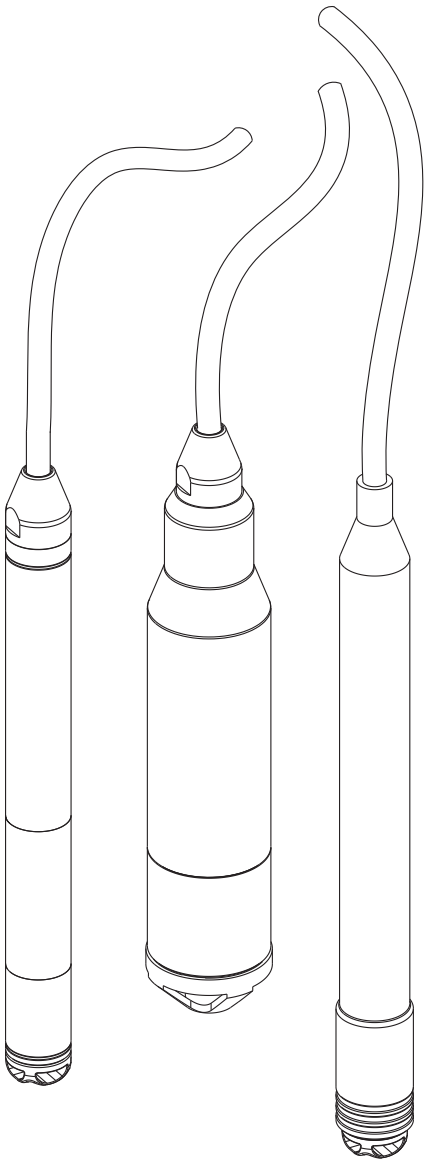
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Valid from software version:
01.00.zz

Operating Instructions
Waterpilot FMX21
Hydrostatic level measurement

HART COMMUNICATION PROTOCOL



Endress+Hauser
People for Process Automation

Table of contents

1 About this document 3

1.1 Symbols 3
1.2 Registered trademarks 4

2 Basic safety instructions 5

2.1 Designated use 5
2.2 Installation, commissioning and operation 5
2.3 Operational safety and process safety 5

3 Incoming acceptance and product identification 6

3.1 Incoming acceptance 6
3.2 Product identification 6
3.3 Transport and storage 8
3.4 Scope of delivery 8
3.5 CE mark, Declaration of Conformity 8

4 Mounting 9

4.1 Mounting requierements 9
4.2 Mounting the Waterpilot with a mounting clamp 10
4.3 Mounting with an extension cable mounting screw 11
4.4 Mounting the terminal box 12
4.5 Mounting the TMT182 temperature head transmitter 12
4.6 Mounting the terminal strip for the Pt100 passive (without TMT182) 13
4.7 Post-mounting check 13

5 Electrical connection. 14

5.1 Connecting the device 14
5.2 Connecting the measuring unit 18
5.3 Post-connection check 22

6 Operability 22

6.1 Overview of operation options 22

7 Commissioning 24

7.1 Function check 24
7.2 Commissioning with FieldCare 24
7.3 Pressure measurement 27
7.4 Level measurement 29
7.5 Linearization 44

8 Troubleshooting 48

8.1 Messages 48
8.2 Malfunctions of Waterpilot FMX21 with optional Pt100 50
8.3 Malfunctions of TMT182 temperature head transmitter 51
8.4 Firmware history 51

9 Maintenance 51

9.1 Exterior cleaning 51

10 Repair 52

10.1 Spare parts 52
10.2 Return 52
10.3 Disposal 52

11 Accessories 52

11.1 Mounting clamp 52
11.2 Terminal box 52
11.3 Additional weight for Waterpilot with outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in) 53
11.4 TMT182 temperature head transmitter (4 to 20 mA HART) 53
11.5 Extension cable mounting screw 53
11.6 Terminals 54
11.7 Cable marking 54
11.8 Cable shortening kit 54
11.9 Testing adapter for FMX21 with outer diameter of 22 mm (0.87 in) and outer diameter of 29 mm (1.14 in) 55

12 Technical data. 55

13 Appendix 56

13.1 Overview of the operating menu 56
13.2 Description of parameters 64

Index. 81

1 About this document

1.1 Symbols

1.1.1 Safety symbols

Symbol	Meaning
 A0011189-DE	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in seriousor fatal injury.
 A0011190-DE	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in seriousor fatal injury.
 A0011191-DE	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minoror medium injury.
 A0011192-DE	NOTICE! This symbol contains information on procedures and other facts which do not result in personalinjury.

1.1.2 Electrical symbols

Symbol	Meaning
A0018335	Direct current A terminal to which DC voltage is applied or through which direct current flows.
A0018336	Alternating currrent A terminal to which alternating voltage is applied or through which alternating current flows.
 A0018337	Direct current and alternating current ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
 A0018338	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system..
 A0018339	Protective ground connection A terminal which must be connected to ground prior to establishing any other connections.
 A0011201	Equipotential connection 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 praxis.

1.1.3 Symbols for certain types of information

Symbol	Meaning
 A0011193	Tip Indicates additional information.
 A0015484	Reference to page Refers to the corresponding page number.

1.1.4 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
A, B, C, D, ...	Views
 A0011187	Hazardous area Indicates a hazardous area.
 A0011188	Safe area (non-hazardous area) Indicates a non-hazardous location.

1.1.5 Symbols at the device

Symbol	Meaning
	Connecting cable immunity to temperature change Indicates that the connecting cables must be able to withstand temperatures of at least 85 °C (185 °F).

1.2 Registered trademarks

GORE-TEX®
Trademark of W.L. Gore & Associates, Inc., USA.

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

HART®
Trademark of the HART Communication Foundation, Austin, USA.

FieldCare®
Trademark of Endress+Hauser Process Solutions AG.

iTEMP®
Trademark of Endress+Hauser Wetzer GmbH + Co. KG, Nesselwang, D.

2 Basic safety instructions

2.1 Designated use

The 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 to a 4 to 20 mA signal with superimposed digital communication protocol HART 6.0.

The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated.

2.2 Installation, commissioning and operation

The Waterpilot FMX21 and the (optional) TMT182 temperature head transmitter are designed to meet state-of-the-art safety requirements and comply with applicable regulations and EC Directives. If used incorrectly or for applications for which they are not intended, the devices can be a source of application-related danger, e.g. product overflow due to incorrect installation or configuration. For this reason, installation, connection to the electricity supply, commissioning, operation and maintenance of the measuring system must only be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist staff must have read and understood these Operating Instructions and must follow the instructions they contain. Modifications and repairs to the devices are permissible only if they are expressly allowed in the Operating Instructions. Pay particular attention to the data and information on the nameplate.

2.3 Operational safety and process safety

Alternative monitoring measures have to be taken while configuring, testing or servicing the device to ensure the operational and process safety.

2.3.1 Hazardous area (optional)

Devices for use in hazardous areas bear an additional marking on the nameplate (→ 6). If using the measuring system in hazardous areas, the appropriate national standards and regulations must be observed. The device is accompanied by separate Ex documentation, which is an integral part of this documentation. The installation regulations, connection values and safety instructions listed in this document must be observed. The documentation number of the related Safety Instructions (XA) is also indicated on the nameplate.

- Ensure that all personnel are suitably qualified.
- Measuring point requirements with regard to measurement and safety must be observed.
- Please refer to the "Ordering information" section of Technical Information TI00431P/00/EN for versions for approvals in the order code.

3 Incoming acceptance and product identification

3.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

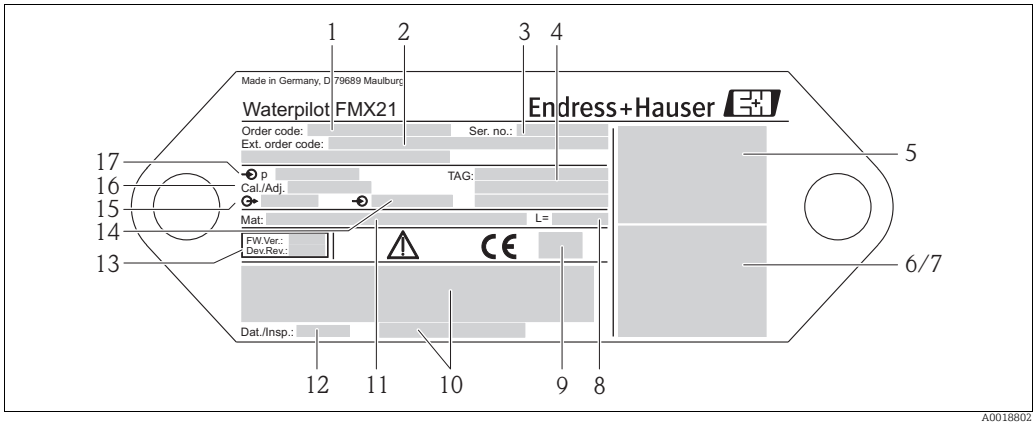
3.2 Product identification

The following options are available for identification of the measuring device:

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

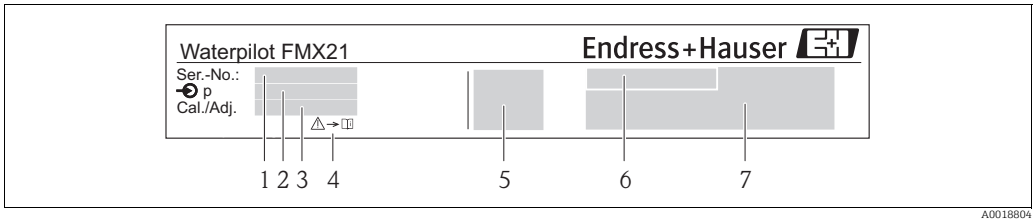
3.2.1 Identifying the measuring device via the nameplate

The nameplate is secured to the extension cable of the FMX21 (→ 9).



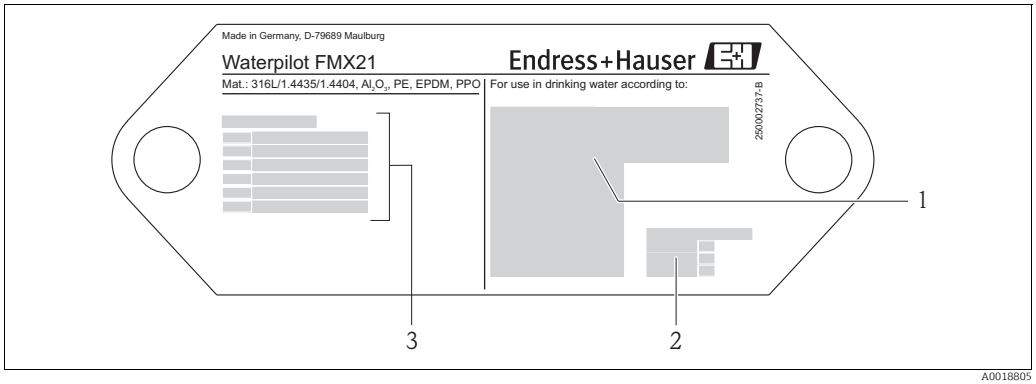
1 *Order code (reduced for re-orders)*
See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 *Extended order code (complete)*
3 *Serial number (for identification)*
4 *TAG (tag name)*
5 *FMX21 connection diagram*
6 *Pt100 connection diagram (optional)*
7 *Warning (hazardous area), (optional)*
8 *Length of the extension cable*
9 *Approval symbol, e.g. CSA, FM, ATEX (optional)*
10 *Text for approval (optional)*
11 *Wetted materials*
12 *Test date (optional)*
13 *Software version/Device Revision*
14 *Supply voltage*
15 *Output signal*
16 *Nominal measuring range*
17 *Set measuring range*

In addition, the FMX21 with an outer diameter of 22 mm (0.87 in) and 42 mm (1.65 in) also bears the following information:



1 *Serial number*
2 *Nominal measuring range*
3 *Set measuring range*
4 *CE mark or approval symbol*
5 *Certificate number (optional)*
6 *Text for approval (optional)*
7 *Reference to documentation (→ 5)*

Nameplate for additional approvals



1 *Approval symbol (drinking water approval)*
2 *Reference to appropriate documentation*
3 *Approval number (marine approval)*

3.2.2 Identifying the measuring device via the order code

Specific device features make up the order code. You can assign these features in the "Ordering information" section of Technical Information TI00431P/00/EN.

3.2.3 Identifying the sensor type

In the case of relative pressure or gauge pressure sensors, the "Pos. zero adjust" parameter appears in the operating menu. In the case of absolute pressure sensors, the "Position offset" parameter appears in the operating menu.

3.3 Transport and storage

3.3.1 Transport

NOTICE

Devices or cable may be damaged

- ▶ Comply with the safety instructions, transport conditions for devices over 18 kg (39.6lbs) (DIN EN 61010-1).
- ▶ Transport the measuring device to the measuring point in its original packaging.

3.3.2 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:
- FMX21: −40 to +80 °C (−40 to +176 °F)
- TMT182: −40 to +100 °C (−40 to +212 °F)
- Terminal box: −40 to +80 °C (−40 to +176 °F)

3.4 Scope of delivery

The scope of delivery comprises:
- Waterpilot FMX21, optionally with integrated Pt100 resistance thermometer
- Optional accessories (→ 52)

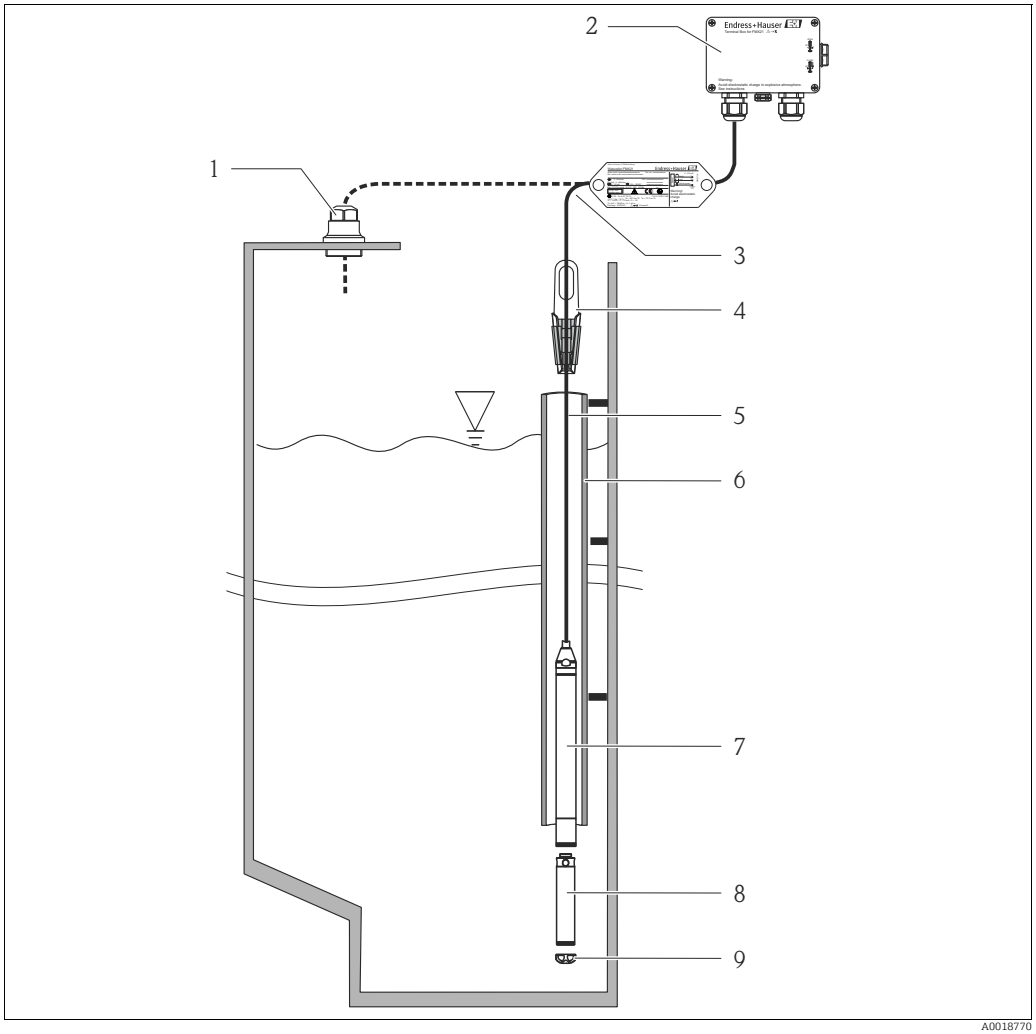
Documentation supplied:
- Operating Instructions BA00380P/00/EN (this document)
- Final inspection report
- Drinking water approval (optional): SD00289P, SD00319P, SD00320P
- Devices suitable for use in hazardous areas: Additional documentation such as Safety Instructions (XA, ZD)

3.5 CE mark, Declaration of Conformity

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations as listed in the EC Declaration of Conformity and thus comply with the legal requirements of the EC Directives. Endress+Hauser confirms the conformity of the device by affixing to it the CE mark.

4 Mounting

4.1 Mounting requierements



Installation examples, here illustrated with FMX21 with an outer diameter of 22 mm (0.87 in), Accessories → 52

1 *Extension cable mounting screw (can be ordered as an accessory)*
2 *Terminal box (can be ordered as an accessory)*
3 *Extension cable bending radius > 120 mm (4.72 in)*
4 *Mounting clamp (can be ordered as an accessory)*
5 *Extension cable*
6 *Guide pipe*
7 *Waterpilot FMX21*
8 *Additional weight can be ordered as an accessory for FMX21 with an outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)*
9 *Protection cap*

4.1.1 Additional mounting instruction

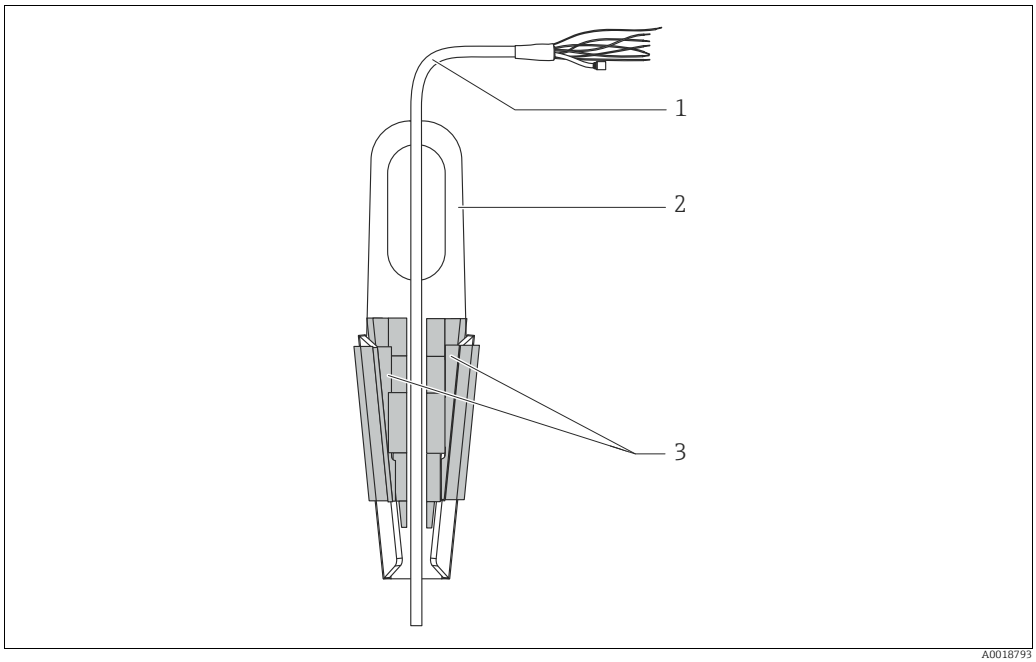
- Cable length
  - Customer-specific length in meters or feet.
  - Limited cable length when performing installation with freely suspended device with extension cable mounting screw or mounting clamp, as well as for FM/CSA approval: max. 300 m (984 ft).
- Sideways movement of the level probe can result 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) bigger than the outer diameter of the selected FMX21.

- The device is provided with a protection cap to prevent mechanical damage to the measuring cell.
- The cable must end in a dry room or a suitable terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.
- If the cable is shortened, the filter at the pressure compensation tube has to be reattached (→ 54 "Cable shortening kit").
- Endress+Hauser recommends using twisted, shielded cables.

4.1.2 Dimensions

For dimensions, please refer to Technical Information TI00431P/00/EN, "Mechanical construction" section (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

4.2 Mounting the Waterpilot with a mounting clamp

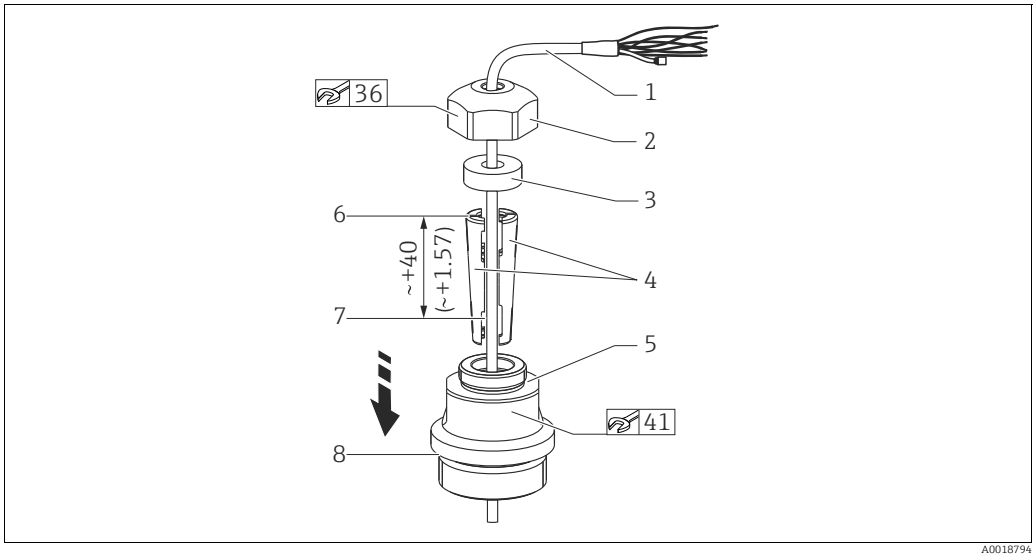


1 Extension cable
2 Mounting clamp
3 Clamping jaws

4.2.1 Mounting the mounting clamp:

1. Mount the mounting clamp (item 2). When selecting the place to fix the unit, take the weight of the extension cable (item 1) and the device into account.
2. Raise the clamping jaws (item 3). Position the extension cable (item 1) between the clamping jaws as illustrated in the graphic.
3. Hold the extension cable in position (item 1) and push the clamping jaws (item 3) back down. Tap the clamping jaws gently from above to fix in place.

4.3 Mounting with an extension cable mounting screw



A0018794

Illustrated with thread G 1½". Dimensions in mm (in)

1 *Extension cable*
2 *Cover mounting screw*
3 *Sealing ring*
4 *Clamping sleeves*
5 *Mounting screw adapter*
6 *Top edge of clamping sleeve*
7 *Required length of extension cable and Waterpilot probe before 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*

If you want to lower the level probe to a certain depth, place the top edge of the clamping sleeve 40 mm (1.57 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.

4.3.1 Mounting extension cable mounting screw with G 1½" or NPT 1½" thread:

1. Mark the desired length of the extension cable on the extension cable, see additional information on this page.
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. Push the adapter (item 5) over the extension cable and screw it tightly into the measuring aperture.
4. Push 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 sleeve (item 4) around the extension cable (item 1) at the mark (item 1) in accordance with step 1.
6. Push the extension cable with the clamping sleeve (item 4) into the adapter (item 5).
7. Push the cover (item 2) and sealing ring (item 3) onto the adapter (item 5) and screw tightly to the adapter.

Reverse the sequence of steps to remove the extension cable mounting screw.

⚠ CAUTION

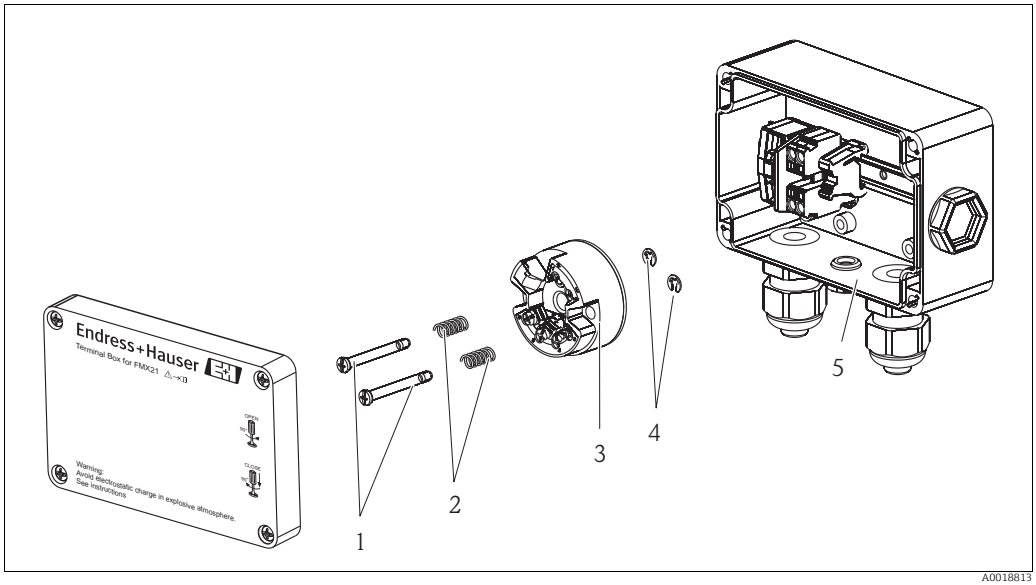
Risk of injury

▶ Application in unpressurized containers only.

4.4 Mounting the terminal box

The optional terminal box is mounted with four screws (M4). For the dimensions of the terminal box, please refer to Technical Information TI00431P/00/EN, "Mechanical construction" section (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

4.5 Mounting the TMT182 temperature head transmitter



Temperature head transmitter with terminal box

1 *Mounting screws*
2 *Mounting springs*
3 *TMT182 temperature head transmitter*
4 *Circlips*
5 *Terminal box*

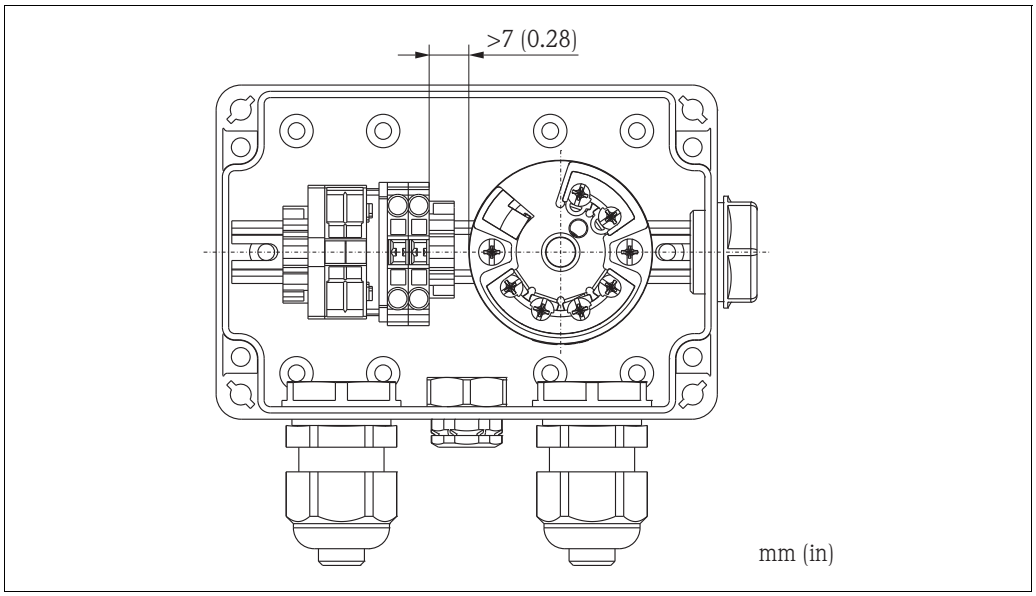
Only open the terminal box with a screwdriver.

⚠ WARNING
Explosion hazard!
▶ The TMT182 is not designed for use in hazardous areas.

4.5.1 Mounting the temperature head transmitter:

1. Guide the mounting screws (item 1) with the mounting springs (item 2) through the guide holes of the temperature head transmitter (item 3).
2. Fix 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. (Max. width of screwdriver blade 6 mm (0.24 in))

NOTICE
Prevent damage to the temperature head transmitter.
▶ Do not tighten the mounting screw too tightly.



A0018696

NOTICE

A minimum distance of > 7 mm (> 0.28 in) must be maintained between the terminal strip and the TMT182 temperature head transmitter.

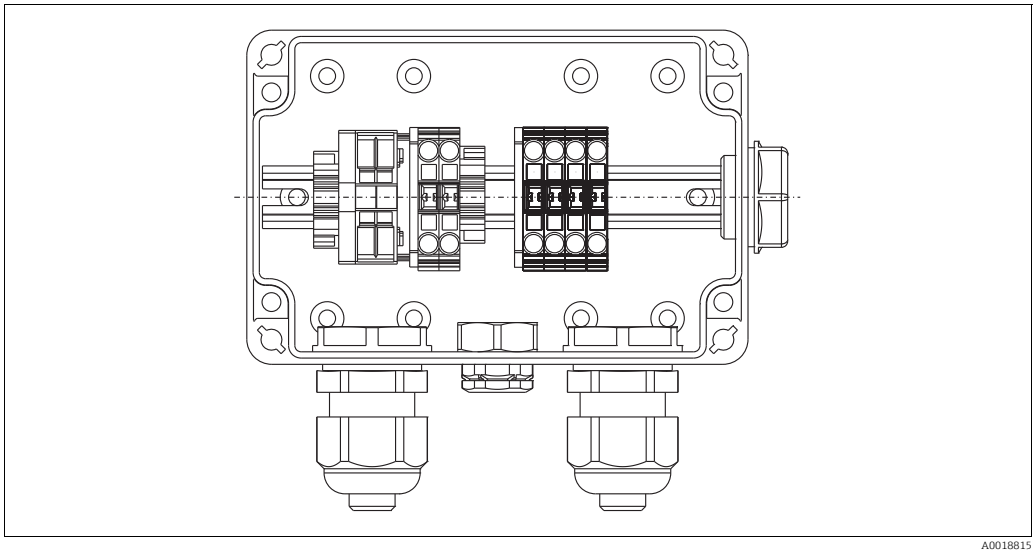
4.6 Mounting the terminal strip for the Pt100 passive (without TMT182)

If the FMX21 with optional Pt100 is supplied without the optional TMT182 temperature head transmitter, the terminal box is accompanied by a terminal strip for wiring the Pt100.

⚠ WARNING

Explosion hazard!

▶ The Pt100 and the terminal strip are not designed for use in hazardous areas.



A0018815

4.7 Post-mounting check

Check that all screws are firmly seated.

5 Electrical connection

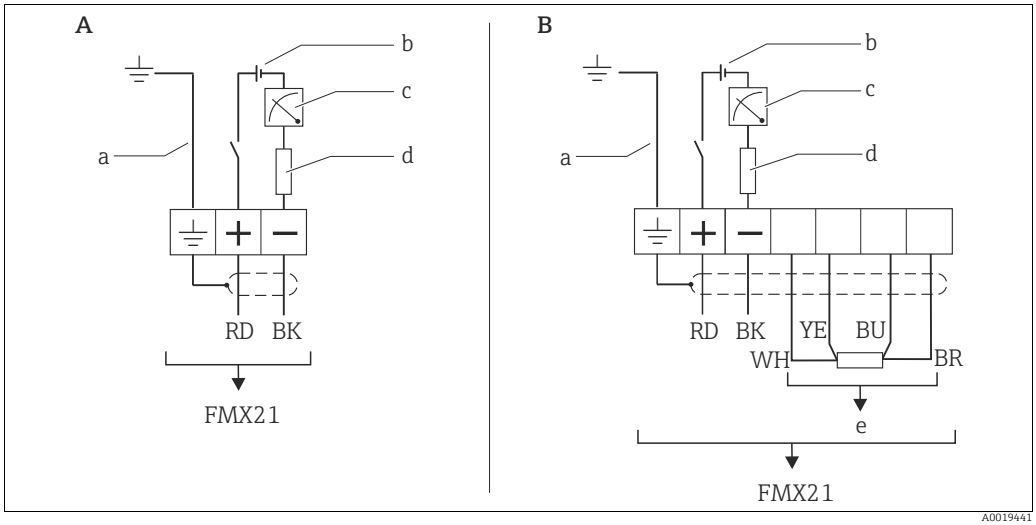
5.1 Connecting the device

⚠ WARNING

Explosion hazard!

- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

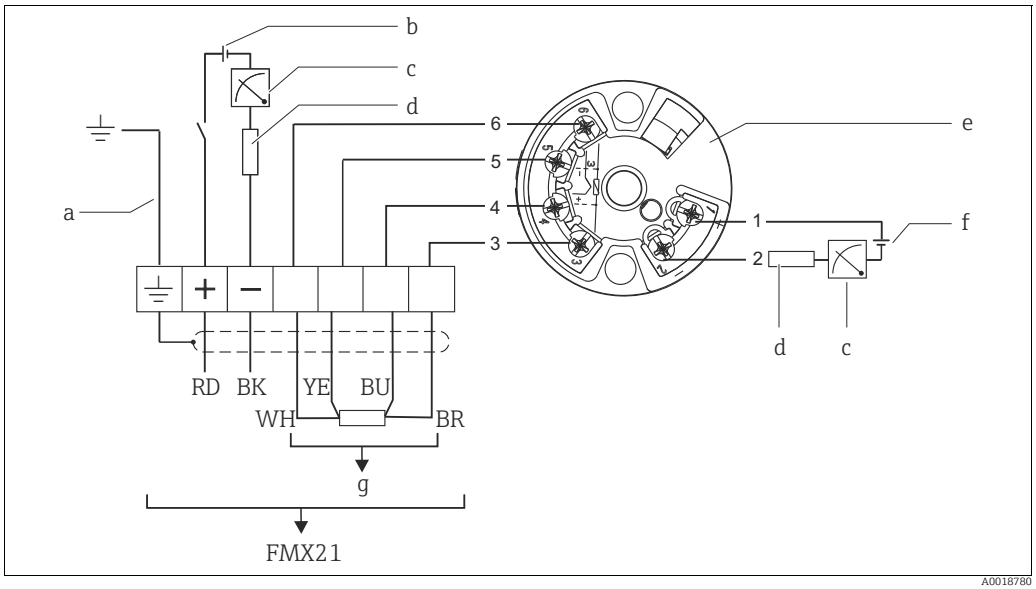
- The supply voltage must match the supply voltage on the nameplate (→ 6).
- Switch off the supply voltage before connecting the device.
- The cable must end in a dry room or a suitable terminal box. The IP66/IP67 terminal box with a GORE-TEX® from Endress+Hauser is suitable for outdoor installation (→ 12).
- Connect the device in accordance with the following diagrams. Reverse polarity protection is integrated in the Waterpilot FMX21 and the TMT182 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.



A Waterpilot FMX21
B Waterpilot FMX21 with Pt100 [1], version "NB" for feature 610 "Accessories" in the order code

a Not for FMX21 with an outer diameter of 29 mm (1.14 in)
b 10.5 to 30 V DC (Ex), 10.5 to 35 V DC
c 4 to 20 mA
d Resistance (R_L)
e Pt100

[1] Not for use in hazardous areas.



Waterpilot FMX21 with Pt100 and TMT182 temperature head transmitter [1], versions "NB" und "PT", feature 610 and 620 in the order code (see also → Technical Information TI00431P/00/EN, "Ordering information" section)

a Not for FMX21 with an outer diameter of 29 mm (1.14 in)
b 10.5 to 35 V DC
c 4 to 20 mA
d Resistance (R_L)
e TMT182 temperature head transmitter (4 to 20 mA HART)
f 11.5 to 35 V DC
g Pt100

[1] Not for use in hazardous areas.

Wire colors
RD = red, BK = black, WH = white, YE = yellow, BU = blue, BR = brown

5.1.1 Connection data

Connection classification as per IEC 61010-1:

- Overvoltage category 1
- Pollution degree 1

Connection data in the hazardous area

4 to 20 mA	**Ex ia IIC T4 to T6**
Ui	30 V DC
Ii	133 mA
Pi	1.0 W
Ci	10.3 nF (sensor); 180 pF/m (cable)
Li	0 µH (sensor); 1 µH/m (cable)
Ta	−10 °C (+14 °F) ≤ Ta ≤ +70 °C (+158 °F) for T4 −10 °C (+14 °F) ≤ Ta ≤ +40 °C (+104 °F) for T6

5.1.2 Supply voltage

Version	FMX21	FMX21 + Pt100	TMT182 temperature head transmitter
Version for the non-hazardous area	10.5 to 35 V DC	10.5 to 35 V DC	11.5 to 35 V DC
Version for the hazardous area	10.5 to 30 V DC	–	–

When the device is used in hazardous areas, the supply voltage is restricted as above in accordance with the requirements of the certificate in question.

5.1.3 Cable specification

- FMX21 with optional Pt100
  - Commercially available, shielded instrument cable
  - Terminals, terminal box: 0.08 to 2.5 mm^2 (28 to 14 AWG)
- TMT182 temperature head transmitter (optional)
  - Commercially available instrument cable
  - Terminals, terminal box: 0.08 to 2.5 mm^2 (28 to 14 AWG)
  - Transmitter terminals: max. 1.75 mm^2 (16 AWG)

The extension cables are shielded for versions with outer diameters of 22 mm (0.87 in) or 42 mm (1.65 in).

In the following cases, Endress+Hauser recommends the use of a shielded cable as the cable extension:
- For large distances between the end of the extension cable and the display and/or evaluation unit.
- For large distances between the end of the extension cable and the temperature head transmitter.
- When directly connecting the Pt100 signal to a display and/or evaluation unit.

5.1.4 Power consumption, current consumption

	FMX21	FMX21 + Pt100	TMT182 temperature head transmitter
Power consumption	≤ 0.805 W at 35 V DC (non-hazardous area) ≤ 0.690 W at 30 V DC (hazardous area)	≤ 0.805 W at 35 V DC	≤ 0.805 W at 35 V DC
Current consumption	Max. ≤ 23 mA Min. ≥ 3.6 mA	Max. ≤ 23 mA Min. ≥ 3.6 mA Pt100: ≤ 0.6 mA	Max. ≤ 23 mA Min. ≥ 3.5 mA

5.1.5 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 FMX21 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.

FMX21

$$R_{Lmax} \leq \frac{U - 10.5\ V}{23\ mA} - 2 \cdot 0.09\ \frac{\Omega}{m} \cdot L - R_{add}$$

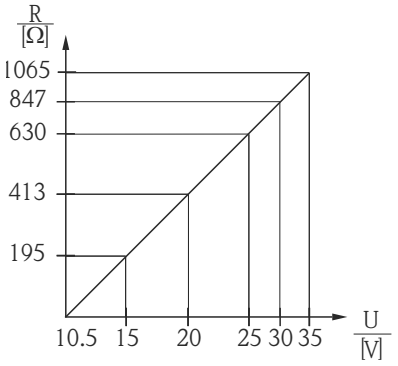
A0018753-EN

Temperature head transmitter

$$R_{Lmax} \leq \frac{U - 11.5\ V}{0.023\ A} - R_{add}$$

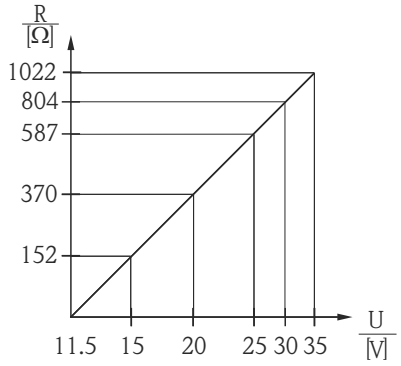
A0018754-EN

R_{Lmax} = *Max. load resistance [Ω]*
R_{add} = *Additional resistances such as resistance of evaluation unit and/or display unit, cable resistance [Ω]*
U = *Supply voltage [V]*
L = *Simple length of extension cable [m] (cable resistance per wire ≤ 0.09 Ω/m)*



A0018765

FMX21 load chart for estimating 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.



A0018766

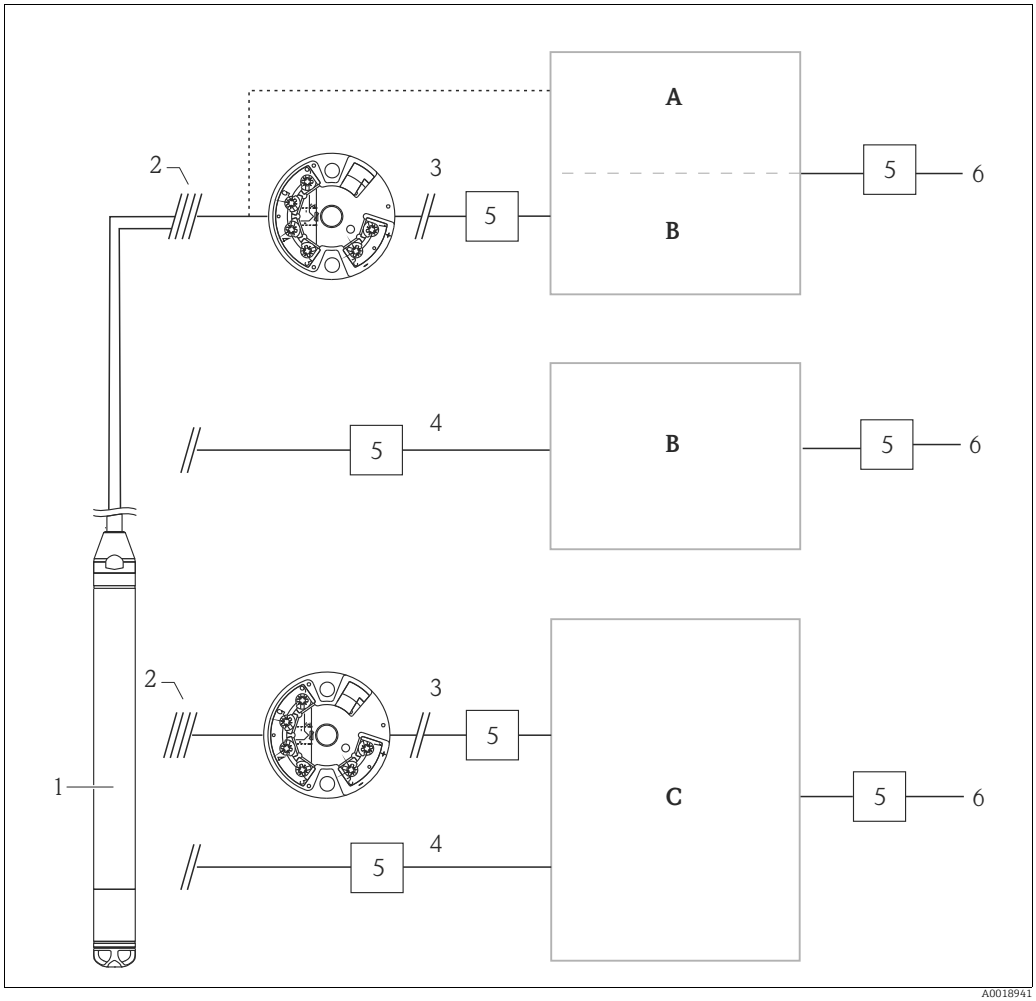
Temperature head transmitter load chart for estimating the load resistance. Additional resistances have to be subtracted from the value calculated as shown in the equation.

When operating using a HART handheld terminal or a PC with an operating program, a minimum communication resistance of 250 Ω has to be taken into account.

5.2 Connecting the measuring unit

5.2.1 Overvoltage protection

To protect the Waterpilot and the TMT182 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.



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 Waterpilot FMX21 HART
2 Connection for integrated Pt100 temperature sensor in the FMX21 HART
3 4 to 20 mA HART(Temperature)
4 4 to 20 mA HART(Level)
5 Overvoltage protection (OP), e.g. HAW from Endress+Hauser (not for use in hazardous areas)
6 Power supply

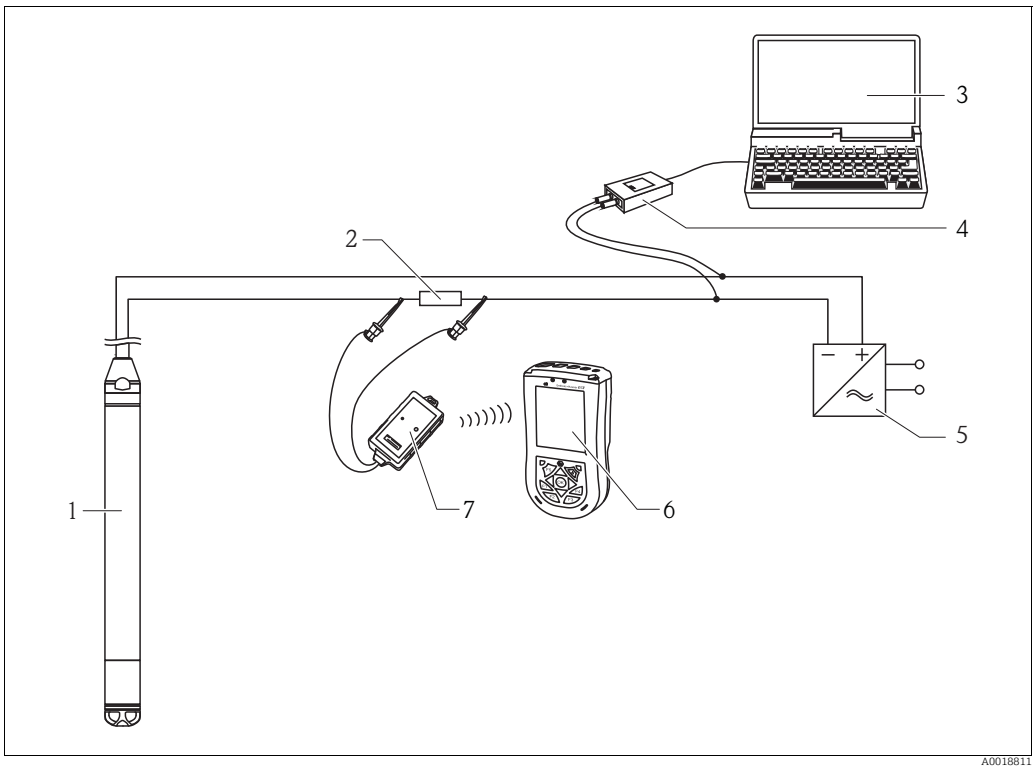
Further information on the TMT182 temperature head transmitter for HART applications from Endress+Hauser can be found in "Technical Information" TI00078R/09/EN.

5.2.2 Connecting Commubox FXA195

The Commubox FXA195 connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using Endress+Hauser's FieldCare operating program. Power is supplied to the Commubox through the USB port. The Commubox is also suitable for connection to intrinsically safe circuits. → See Technical Information TI00404F/00/EN for further information.

5.2.3 Connecting Field Xpert SFX

Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA). For details, see Operating Instructions BA00060S/04/EN.



1 Waterpilot FMX21
2 Necessary communication resistor ≥250 Ω
3 Computer with operating tool (e.g. FieldCare)
4 Commubox FXA195 (USB)
5 Transmitter power supply unit, e.g. RN221N (with communication resistor)
6 Field Xpert SFX
7 VIATOR Bluetooth-Modem with cable connection

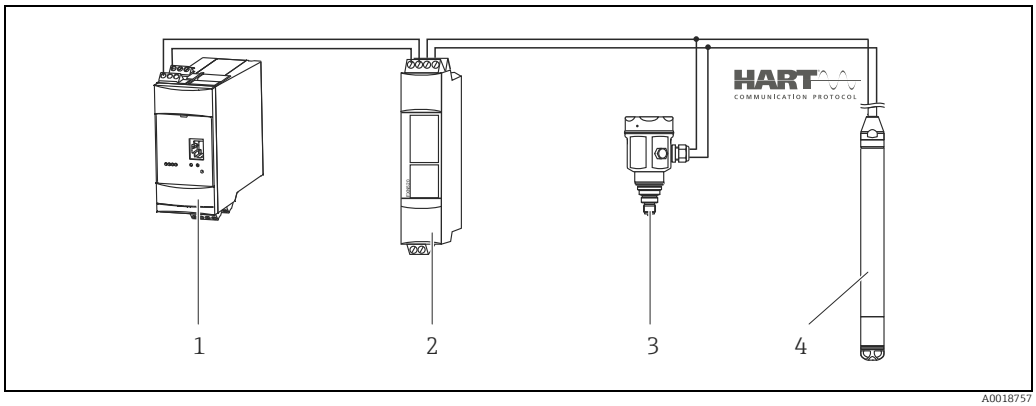
Only use certified operating devices in hazardous area!

⚠ WARNING

Explosion hazard!

- Do not change the battery of the handheld terminal in the hazardous area.
- When using the measuring device in hazardous areas, installation must comply with the applicable national standards and regulations and the Safety Instructions (XAs) or the Installation or Control Drawings (ZDs).

5.2.4 Connecting for air pressure compensation with external measured value



1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 Cerabar
4 Waterpilot FMX21

It is advisable to use an absolute pressure probe for applications in which condensation can occur. In the case of level measurement with an absolute pressure probe, the measured value is affected by fluctuations in the ambient air pressure. To correct the resulting measured error, you can connect an external absolute pressure sensor (e.g. Cerabar) to the HART signal cable, switch the waterpilot to the burst mode and the Cerabar to operate in mode "Electr. Delta P".

By switching on the application "Electr. Delta P", the external absolute pressure sensor calculates the difference between the two pressure signals and can thus determine the level precisely.
Only one level measured value can be corrected in this way (→ 39).

If using intrinsically safe devices, strict compliance with the rules for interconnecting intrinsically safe circuits as stipulated in IEC60079-14 (proof of intrinsic safety) is mandatory.

5.2.5 Connecting external temperature sensor/temperature head transmitter for density compensation

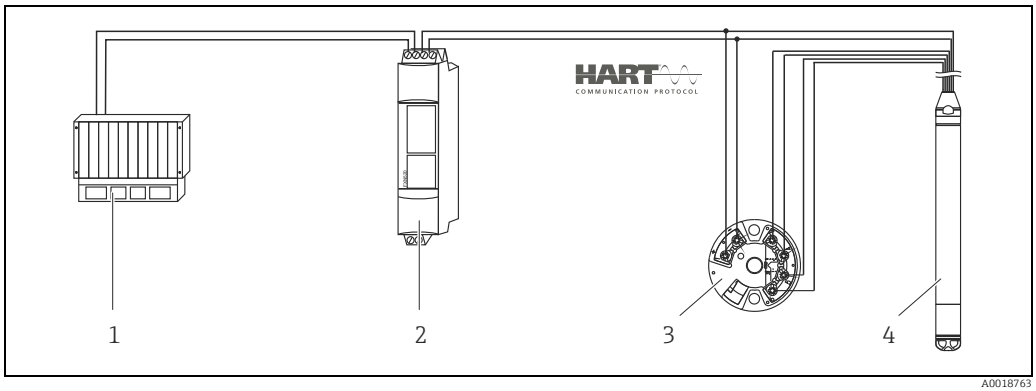
The Waterpilot FMX21 can correct measured errors that result from fluctuations in the density of the water caused by temperature. Users can choose from the following options:

Use the internally measured sensor temperature of the FMX21

The internally measured sensor temperature is calculated in the Waterpilot FMX21 for density compensation. The level signal is thus corrected according to the density characteristic line of the water (→ 41).

Use the optional internal Pt100 temperature sensor for density compensation in a suitable HART master (e.g. PLC)

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor.
Endress+Hauser additionally offers the TMT182 temperature head transmitter to convert the Pt100 signal to a 4 to 20 mA HART signal.
The temperature and pressure signal is transmitted to the HART master (e.g. PLC) where a corrected level value can be generated using a stored linearization table or the density function (of a chosen medium) → 42.



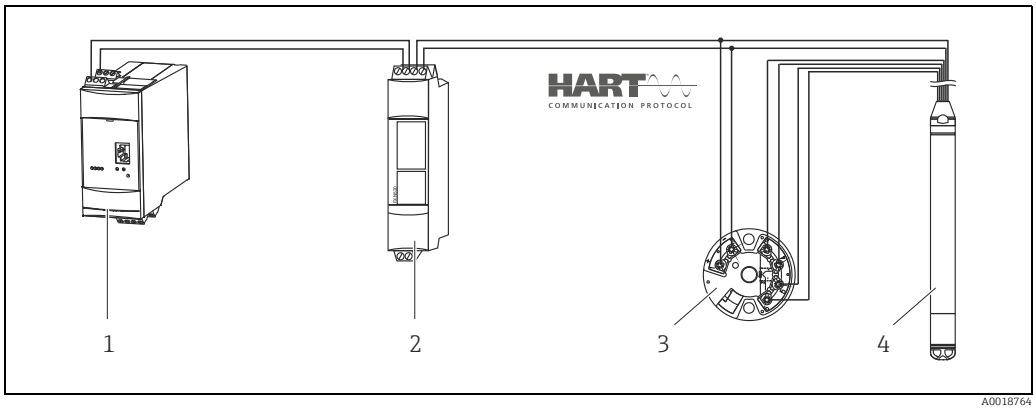
A0018763

1 HART-Master, e.g. PLC (programmable logic controller)
2 Multidrop-Connector FXN520
3 TMT182 temperature head transmitter
4 Waterpilot FMX21

Use an external temperature signal which is transmitted to the FMX21 via HART burst mode

The Waterpilot FMX21 is available with an optional Pt100 temperature sensor. In this case, the signal of the Pt100 is analyzed using a HART-compliant (at least HART 5.0) temperature transmitter that supports burst mode. The temperature signal can thus be transmitted to the FMX21. The FMX21 uses this signal for the density correction of the level signal (→ 43).

The TMT182 temperature head transmitter is not suitable for this configuration.



A0018764

1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 TMT182 temperature head transmitter (burst mode)
4 Waterpilot FMX21

Without additional compensation due to the anomaly of water, errors of up to 4 % may occur at a temperature of +70 °C (+158 °F), for example. With density compensation, this error can be decreased to 0.5 % in the entire temperature range from 0 to +70 °C (+32 to +158 °F).

For further information on the devices, please refer to the appropriate Technical Information:
- TI00078R: Temperaturkopftransmitter TMT182 (4...20 mA HART)
- TI00369F: Fieldgate FXA520
- TI00400F: Multidrop-Connector FXN520

5.3 Post-connection check

The following checks must be performed after completing electrical connection of the device:
- Does the supply voltage match the specifications on the nameplate?
- Is the device connected as per Section 5.1 "Switching on the device"?
- Are all screws firmly tightened?
- Optional terminal box: are the cable glands leaktight?

6 Operability

Endress+Hauser offers comprehensive measuring point solutions with display and/or evaluation units for the Waterpilot FMX21 and TMT182 temperature head transmitter.

Please contact your Endress+Hauser sales representative, if you have any other questions. Contact addresses can be found on the Internet: www.endress.com/worldwide.

6.1 Overview of operation options

6.1.1 Operation via FieldCare

The FieldCare operating program is an Endress+Hauser plant asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices fromother manufacturers that support the FDT standard. Hardware and software requirements can be found on the Internet: www..endress.com → Search: FieldCare → FieldCare → Technical data

FieldCare supports the following functions:
- Configuration of transmitters in online and offline mode
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port of a computer
- HART via Fieldgate FXA520

- Further information on FieldCare and software download can be found on the Internet (→ see: www.endress.com → Select Country → Download → Text Search: FieldCare).
- Connecting Commubox FXA195 (→ 19)
- As not all internal device dependencies can be mapped in offline operation, the consistency of the parameters must be checked before the parameters are transmitted to the device.

6.1.2 Operation via Field Xpert SFX

Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA). For details, see Operating Instructions BA00060S/04/EN.

6.1.3 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access. The "Operator code" parameter is used to lock the device.

Parameter name	Description
Operator code Entry Menu path: Setup → Extended Setup → User code	Use this function to enter a code to lock or unlock operation. User input: ▪ To lock: Enter a number ≠ the release code (value range: 1 to 65535). ▪ To unlock: Enter the release code. The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code will be visible and unlocked by entering the number "5864". Factory setting: 0

The release code is defined in the "Code definition" parameter.

Parameter name	Description
Code definition Entry Menu path: Setup → Extended Setup → Code definition	Use this function to enter a release code with which the device can be unlocked. User input: ▪ A number between 0 and 9999 Factory setting: 0

6.1.4 Resetting to factory settings (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings (→ 64, "System"). Enter the code by means of the "Enter reset code" parameter (menu path: Expert → System → Management → Enter reset code). There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation has to be unlocked to be able to perform a reset (→ 23, "Locking/unlocking operation").

Any customer-specific configurations carried out by the factory are not affected by a reset (customer-specific configuration remains). If you want to change the customer-specific settings configured at the factory, please contact Endress+Hauser Service. Since there is no specific service level, order code and serial number can be changed without a specific release code.

Reset code	Description and effect
62	PowerUp reset (warm start) ▶ The device is restarted. Data are read back anew from the EEPROM (processor is initialized again). ▶ Any simulation which may be running is ended.
333	User reset ▶ The device is restarted. ▶ Any simulation which may be running is ended. ▶ This code resets all the parameters apart from: – Device tag – Linearization table – Operating hours – Event logbook – Current trim

Reset code	Description and effect
7864	Total reset ▶ The device is restarted. ▶ Any simulation which may be running is ended. ▶ This code resets all the parameters apart from: – Operating hours – Event logbook

After a "Total reset" in FieldCare you have to press the "refresh" button in order to ensure that the measuring units are also reset.

7 Commissioning

7.1 Function check

Before commissioning your measuring point, ensure that the post-installation and post-connection check have been performed.

- For the "Post-installation" checklist (→ 13)
- For the "Post-connection" checklist (→ 22)

7.2 Commissioning with FieldCare

If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession:

1. "S140 Working range P" or "F140 Working range P" [1)]
2. "S841 Sensor range" or "F841 Sensor range" [1)]
3. "S971 Sensor range" [1)]

[1)] Depending on the setting in the "Alarm behavior"

The following languages are available for FieldCare:
- German
- English
- French
- Italian
- Spanish
- Japanese
- Chinese simplified

The device is configured for the Pressure measuring mode as standard. The measuring range and the unit in which the measured value is transmitted correspond to the data on the nameplate.

7.2.1 Basic settings

- Start FieldCare and establish the connection to the Waterpilot FMX21.
- Select the measuring mode and press "Enter" to confirm:

Parameter name	Description
Measuring mode Selection	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. If the measuring mode is changed, no conversion takes place. The device has to be recalibrated or as per if the measuring mode is changed. Options: ▪ Pressure ▪ Level Factory setting: Pressure

- Select the pressure unit and press "Enter" to confirm:

Parameter name	Description
Press. eng. unit Selection	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. Options: ▪ mbar, bar ▪ mmH2O, mH2O, inH2O ▪ ftH2O ▪ Pa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ kgf/cm^2 Factory setting: mbar or bar depending on the sensor nominal measuring range, or as per order specifications

7.2.2 Position adjustment

Due to orientation of the device, there may be a zero point shift in the pressure measured value. You can correct this shift with the following parameters:

Parameter name	Description
Position adjustment (relative pressure sensor) Entry	Position adjustment – the pressure difference between the set point and the measured pressure must not be known. Example: – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. Factory setting: Abort
Position offset (absolute pressure sensor) Entry	Position adjustment – the pressure difference between zero (set point) and the measured pressure must be known. Example: – Measured value = 982.2 mbar (15 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Position offset" parameter. This means that you assign the value 980.0 to the pressure present. – Measured value (after pos. zero adjust) = 980.0 mbar (15 psi) – The current value is also corrected. Factory setting: 0.0

7.2.3 Configuring the damping

Parameter name	Description
Damping value Entry	The damping affects the speed at which the measured value reacts to changes in pressure. Low damping: reacts quickly, measured value might fluctuate. High damping: reacts slowly, measured value is stable. Factory setting: 2.0 as per order specifications

7.3 Pressure measurement

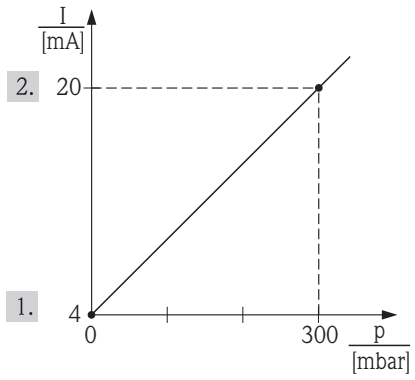
7.3.1 Calibration with reference pressure (wet calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
The pressure values 0 mbar and 300 mbar (4.5 psi) can be specified. The device is already mounted, for example.

For a description of the parameters mentioned → 64 "Description of parameters".

	Description
1	Perform position adjustment → 26.
2	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	The pressure for the lower-range value (4 mA value) is present at the device, here 0 mbar for example.
	Select the "Get LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the lower current value (4 mA).
5	The pressure for the upper-range value (20 mA value) is present at the device, here 300 mbar (4.5 psi) for example.
	Select the "Get URV" parameter. Menu path: Setup → Extended setup → Current output → Get URV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the upper current value (20 mA).
6	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).



Calibration with reference pressure

1 See Table, Step 4.
2 See Table, Step 5.

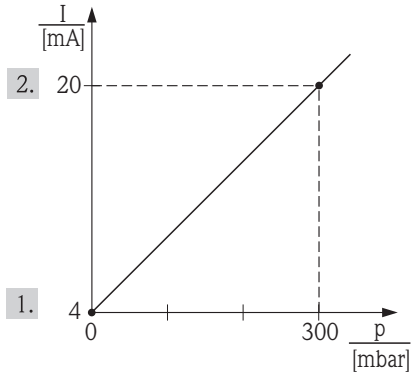
7.3.2 Calibration without reference pressure (dry calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
This is a theoretical calibration, i.e. the pressure values for the lower and upper range are known.

Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. the measured value is not zero in a pressureless condition. For information on how to perform position adjustment → 26.

	Description
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "Set LRV" parameter. Menu path: Setup → Set LRV
	Enter the value for the "Set LRV" parameter (here 0 mbar) and confirm. This pressure value is assigned to the lower current value (4 mA).
4	Select the "Set URV" parameter. Menu path: Setup → Set URV
	Enter the value for the "Set URV" parameter (here 300 mbar (4.5 psi)) and confirm. This pressure value is assigned to the upper current value (20 mA).
5	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).



Calibration without reference pressure

1 See Table, Step 3.
2 See Table, Step 4.

7.4 Level measurement

7.4.1 Information on level measurement

You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.

- The limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together.

7.4.2 Overview of level measurement

Measuring task	Level selection	Measured variable options	Description	Measured value display
Calibration takes place by entering two pressure/level value pairs.	"In pressure"	Via the "Output unit" parameter: %, level, volume or mass units.	– Calibration with reference pressure (wet calibration), see → 32, "Section 7.4.4" – Calibration without reference pressure (dry calibration), → 30, Section 7.4.3"	The measured value display and the "Level before lin" parameter display the measured value.
Calibration takes place by entering the density and two height/level value pairs.	"In height"		– Calibration with reference pressure (wet calibration), → 36, "Section 7.4.6" – Calibration without reference pressure (dry calibration), → 34, Section 7.4.5"	

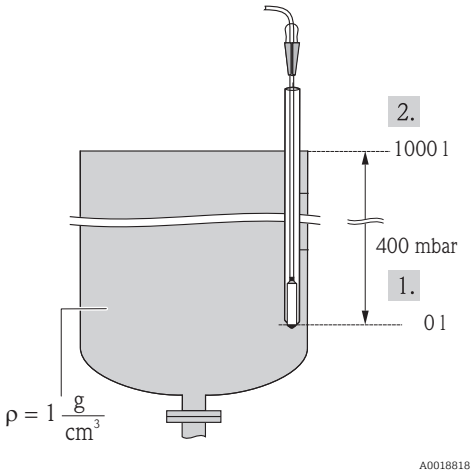
7.4.3 "In pressure" level selection Calibration without reference pressure (dry calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a pressure of 400 mbar (6 psi). The minimum volume of 0 liters corresponds to a pressure of 0 mbar since the process isolating diaphragm of the probe is at the start of the level measuring range.

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the pressure and volume values for the lower and upper calibration point must be known.

- The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment → 26.

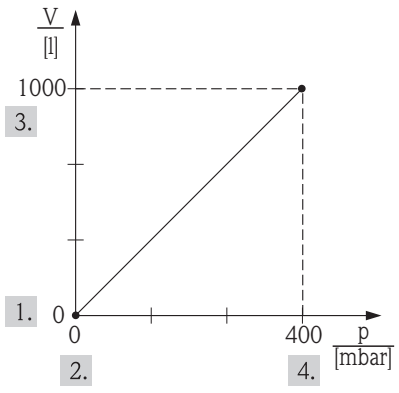
	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit
5	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
6	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.
7	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, here "0 mbar" for example. Menu path: Setup → Extended setup → Level → Empty pressure



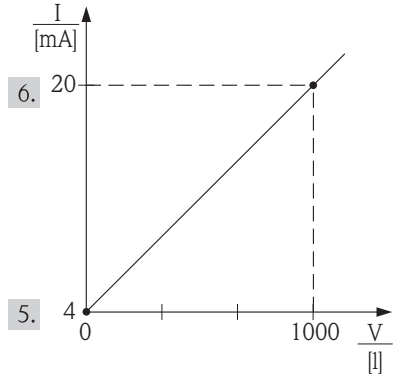
Calibration without reference pressure – dry calibration

1 See Table, Steps 6 and 7.
2 See Table, Steps 8 and 9.

	Description
8	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
9	Enter the pressure value for the upper calibration point via the "Full pressure" parameter, here "400 mbar" (6.0 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure
10	"Adjust density" contains the factory setting 1.0 but can be changed if required. The value pairs subsequently entered must correspond to this density. Menu path: Setup → Extended setup → Level → Adjust density The process density can only be changed if automatic density correction is switched off (see Step 14).
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
13	If the process uses a medium other than the medium on which the calibration was based, the new density must be specified in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 14).
14	If density correction is required [1] : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Level → Auto density corr.
15	Result: The measuring range is set for 0 to 1000 l.



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Calibration with reference pressure – wet calibration

1 See Table, Step 6.
2 See Table, Step 7.
3 See Table, Step 8.
4 See Table, Step 9.
5 See Table, Step 11.
6 See Table, Step 12.

[1] A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 10) and "Density process" (Step 13) parameters are not used here.

The measured variables %, level, volume and mass are available for this level mode. See Section 13.2 "Output unit".

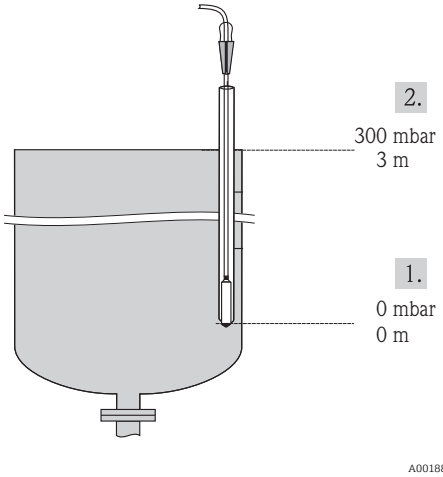
7.4.4 "In pressure" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the level in a tank should be measured in "m". The maximum level is 3 m (9.8 ft). The pressure range is set to 0 to 300 mbar (4.5 psi).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

	Description
1	Perform "position adjustment" → 26.
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode → Level
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
5	If density correction is required [1] : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.
6	Select a level unit via the "Output unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Output unit
7	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode

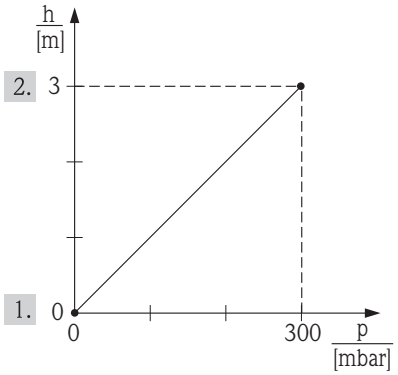


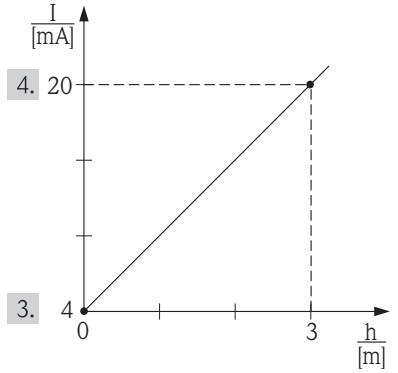
Calibration with reference pressure – wet calibration

1 See Table, Step 9.
2 See Table, Step 10.

[1] A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 8) and "Density process" (Step 13) parameters are not used here.

	Description
8	If the calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter. Menu path: Setup → Extended setup → Level → Adjust density The process density can only be changed if automatic density correction is switched off (see Step 5).
9	The hydrostatic pressure for the lower calibration point is present at the device, here "0 mbar" for example.
	Select the "Empty calib." parameter. Menu path: Setup → Extended setup → Level → Empty calib.
	Enter the level value, here "0 m" for example. Confirming the value means you assign the pressure value present to the lower level value.
10	The hydrostatic pressure for the upper calibration point is present at the device, here "300 mbar" (4.5 psi) for example.
	Select the "Full calib." parameter. Menu path: Setup → Extended setup → Level → Full calib.
	Enter the level value, here "3 m" (9.8 ft) for example. Confirming the value means you assign the pressure value present to the upper level value.
11	Set the level value for the lower current value (4 mA) by means of "Set LRV", here "0 m" for example. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the level value for the upper current value (20 mA) by means of "Set URV", here "3 m" (9.8 ft) for example. Menu path: Setup → Extended setup → Current output → Set URV.
13	If the calibration was performed with a medium other than the process medium, enter the density of the process medium in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 5).
14	Result: The measuring range is set for 0 to 3 m (9.8 ft).





Calibration with reference pressure – wet calibration

1 See Table, Step 9.
2 See Table, Step 10.
3 See Table, Step 11.
4 See Table, Step 12.

The measured variables %, level, volume and mass are available for this level mode. See → 64 "Output unit".

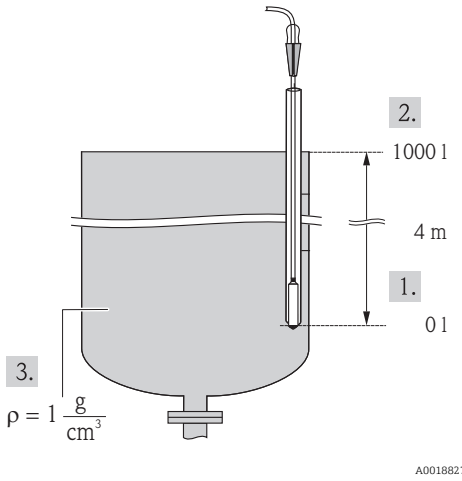
7.4.5 "In height" level selection Calibration without reference pressure (dry calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m since the process isolating diaphragm of the probe is at the start of the level measuring range.

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the height and volume values for the lower and upper calibration point must be known.

- The values entered for "Empty calib./Full calib.", "Empty height/Full height" and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment → 26.

	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	If density correction is required [1] : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.
5	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit
6	Select a height unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit
7	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode

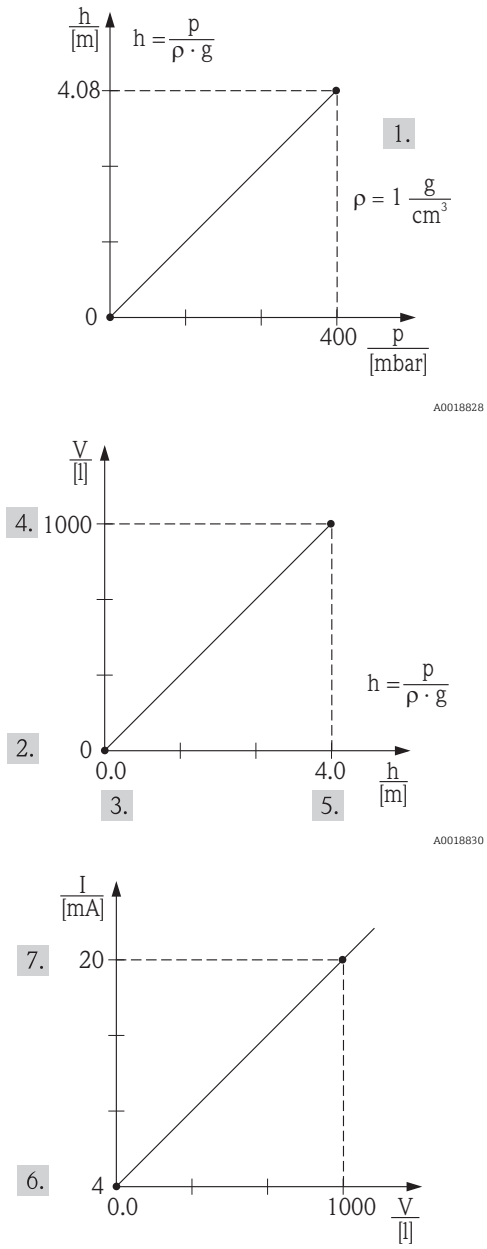


Calibration without reference pressure – dry calibration

1 See Table, Step 10 and 11.
2 See Table, Steps 13 and 14.
3 See Table, Steps 12.

[1] A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 12) and "Density process" (Step 15) parameters are not used here.

	Description
8	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.
9	Enter the height value for the lower calibration point via the "Empty height" parameter, here "0 m" for example. Menu path: Setup → Extended setup → Level → Empty height
10	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
11	Enter the height value for the upper calibration point via the "Full height" parameter, here "4 m" (13 ft) for example. Menu path: Setup → Extended setup → Level → Full height
12	Enter the density of the medium via the "Adjust density" parameter, here "1 g/cm³" for example. Menu path: Setup → Extended setup → Level → Adjust density
13	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
14	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
15	If the process uses a medium other than the medium on which the calibration was based, the new density must be specified in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 4).
16	Result: The measuring range is set for 0 to 1000 l.



Calibration with reference pressure – wet calibration

1 See Table, Step 12.
2 See Table, Step 8.
3 See Table, Step 9.
4 See Table, Step 10.
5 See Table, Step 11.
6 See Table, Step 13.
7 See Table, Step 14.

The measured variables %, level, volume and mass are available for this level mode → Chap. 13.2 "Output unit".

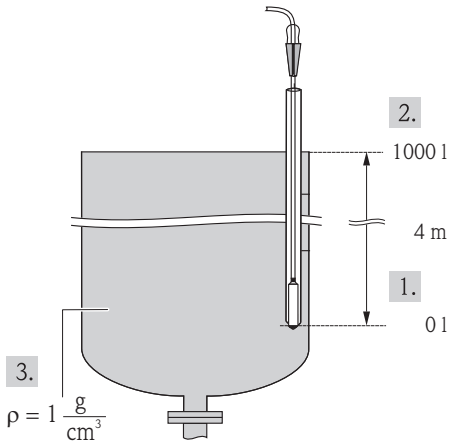
7.4.6 "In height" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m since the process isolating diaphragm of the probe is at the start of the level measuring range. The density of the fluid is 1 g/cm^3.

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

	Description
1	Perform position adjustment. See → 26.
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	If density correction is required [1] : assign the temperature probe in the "Auto density corr." parameter. Menu path: Expert → Application → Auto density corr.
5	Select a pressure unit via the "Press eng. unit" parameter, here mbar for example. Menu path: Setup → Press. eng. unit
6	Select a volume unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit
7	Select a height unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit

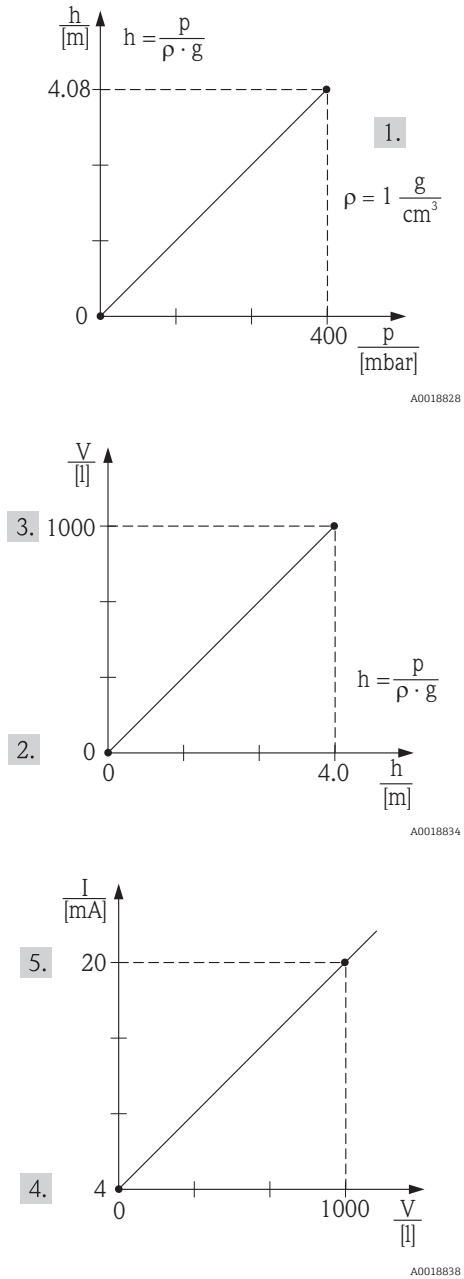


Calibration with reference pressure – wet calibration

1 See Table, Step 9.
2 See Table, Step 10.
3 See Table, Step 11.

[1] A density correction is only possible for water. A temperature-density curve that is saved in the device is used. For this reason, the "Adjust density" (Step 11) and "Density process" (Step 14) parameters are not used here.

	Description
8	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
9	The hydrostatic pressure for the lower calibration point is present at the device, here "0 mbar" for example.
	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.
10	The hydrostatic pressure for the upper calibration point is present at the device, here "400 mbar" (6.0 psi) for example.
	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
11	If the calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter. Here "1 g/cm³" for example. Menu path: Setup → Extended setup → Level → Adjust density The process density can only be changed if automatic density correction is switched off (see Step 4).
12	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
13	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
14	If the calibration was performed with a medium other than the process medium, enter the density of the process medium in the "Density process" parameter. Menu path: Setup → Extended setup → Level → Density process The process density can only be changed if automatic density correction is switched off (see Step 4).
15	Result: The measuring range is set for 0 to 1000 l.



Calibration with reference pressure – wet calibration

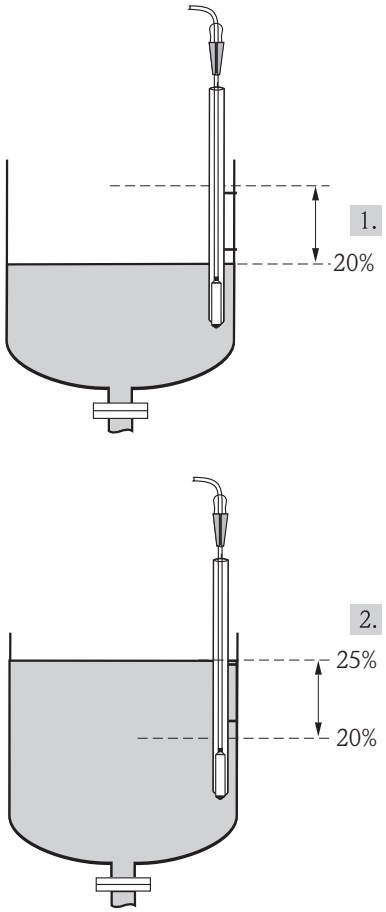
1 See Table, Step 11.
2 See Table, Step 9.
3 See Table, Step 10.
4 See Table, Step 12.
5 See Table, Step 13.

The measured variables %, level, volume and mass are available for this level mode, → Chap. 13.2 "Output unit".

7.4.7 Calibration with partially-filled tank (wet calibration)

Example:
In this example a wet calibration is shown when it is not possible to empty the vessel and then fill it up to 100%. Here a 20% filling is used as “Empty” and a “25%” filling is used as “Full” calibration point. The calibration is then extended to 0% ... 100% and LRV / URV are adjusted accordingly.

Prerequisite:
The default value in the level mode for calibration mode is “Wet”.
However, it can be changed via: Setup → Extended Setup → Level → Calibration mode

	Description	
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	
2	Set value for "Empty calib." with acting pressure for Level e.g. 20%. Menu path: Setup → Extended Setup → Level → Empty calibration	
3	Set value for "Full calib." with acting pressure for Level e.g. 25%. Menu path: Setup → Extended Setup → Level → Full calibration	
4	The values for pressure for full or empty vessels are measured automatically at adjustment. As the transmitter automatically sets the pressure values that suit to empty and full calibration to min and max pressure that cause the output current, it is necessary to set the right upper range value (URV) and lower range value (LRV).	

Calibration with partially-filled tank

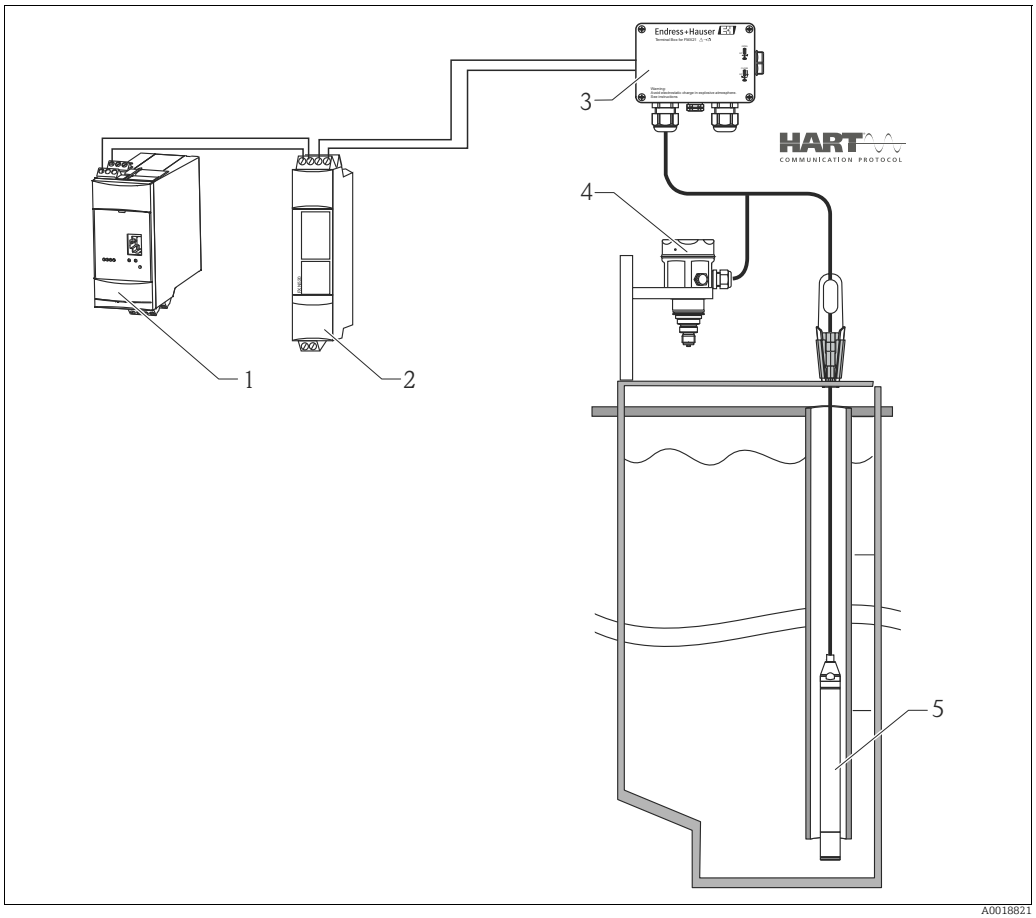
1 See Table, Step 2
2 See Table, Step 3

It is also possible to use different liquids for the adjustment. In this case you have to enter the appropriate densities at following menu path:

- Setup → Ext. Setup → Level → Adjust density (e.g. 1.0 kg/l for water)
- Setup → Ext. Setup → Level → Process density (e.g. 0.8 kg/l for oil)

7.4.8 Level measurement with absolute pressure probe and external pressure signal (electrical differential pressure)

Example:
In this example, a Waterpilot FMX21 and a Cerabar M device (each with an absolute pressure measuring cell) are combined via the common communication bus. The level can thus be measured in the deep well, while the influence of the atmospheric pressure is compensated for at the same time.



1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 Terminal box can be ordered as an accessory
4 Cerabar M absolute pressure (atmospheric pressure)
5 Waterpilot absolute pressure (level)

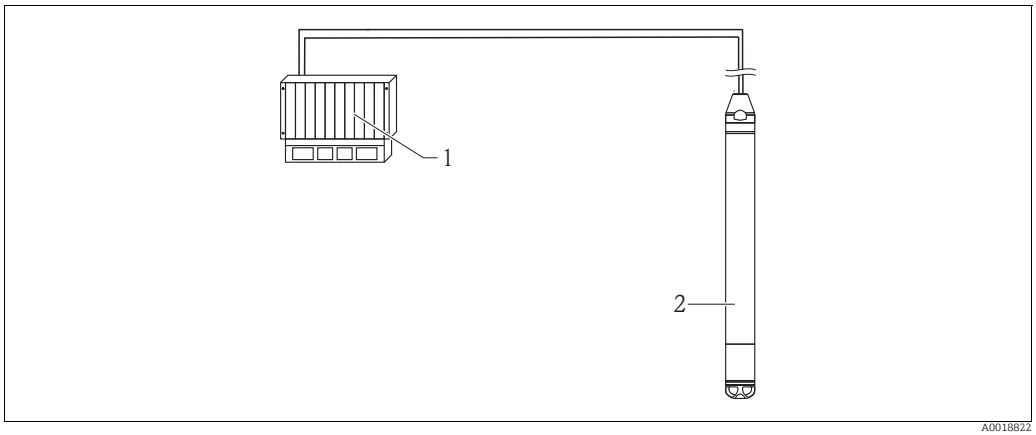
	Description Adjustment of the level sensor (Waterpilot)
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 📄 26).
4	Switch on burst mode via the "Burst mode" parameter Menu path: Expert → Communication → HART Config.
5	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter Menu path: Expert → Communication → HART Config.
6	Configure an address ≠ 0 using the "Bus address" parameter, e.g. bus address = 1. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.

	Description Adjustment of the level sensor (Waterpilot)
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 📄 26).
4	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter Menu path: Expert → Communication → HART Config.
5	Configure an address ≠ 0 using the "Bus address" parameter, e.g. bus address = 2. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.
6	Activate the reading of a value sent externally in burst mode via the "Electr. Delta P" parameter Menu path: Expert → Application
7	Perform level adjustment (wet or dry), → 📄 32 ff.
8	Result: The measured value output by the atmospheric pressure sensor equals the level in the deep well (differential signal) and can be read out by means of a HART request of the address of the atmospheric pressure sensor.

- It is not permitted to reverse the assignment of the measuring points to the direction of communication.
- The measured value of the transmitting device (via burst) must always be greater than the measured value of the receiving device (via the "Electr. Delta P" mode).
- Adjustments that result in an offset of the pressure values (e.g. position adjustment, trim) must always be performed in accordance with the individual sensor and its orientation, irrespective of the "Electr. Delta P" application.
- Other settings result in non-permitted use of the "Electr. Delta P" mode and can lead to incorrect measured values.

7.4.9 Automatic density compensation with the internally measured sensor temperature

Example:
In this example, a Waterpilot FMX21 is used for level measurement in water. The change in the water density caused by changing temperatures is automatically factored into the level signal by activating automatic density compensation.

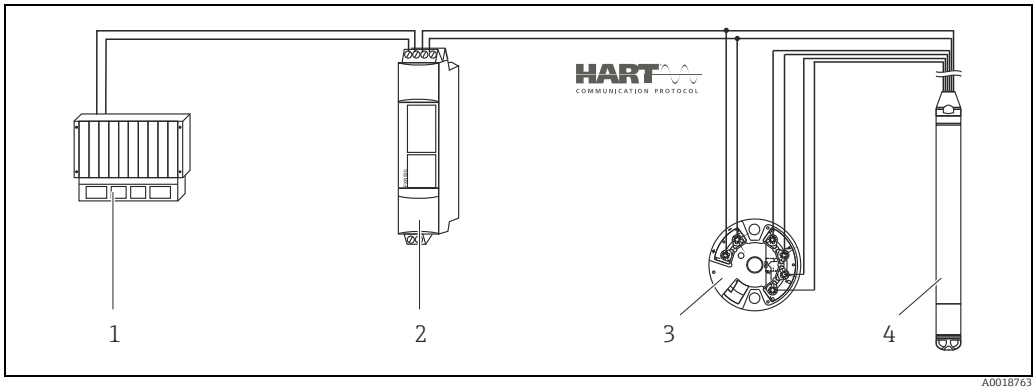


1 HART-Master, e.g. PLC (programmable logic controller)
2 Waterpilot FMX21

	Description **Adjustment of the Waterpilot for level measurement**
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the "Auto density corr." parameter to Sensor temperature. Menu path: Expert → Application
5	Perform level adjustment (wet or dry), → 32 ff.
6	Result: The measured value output by the Waterpilot equals the level in the deep well corrected by means of the density characteristic line of the water.

7.4.10 Automatic density compensation using an integrated Pt100 value for calculation in a suitable HART master (e.g. PLC)

Example:
In this example, the FMX21 with an integrated Pt100 and a temperature head transmitter with HART communication (e.g. TMT182) are combined via the common communication bus. The temperature and pressure signal is transmitted to the HART master (e.g. PLC) where a corrected level value can be generated using a stored linearization table or the density function (of a chosen medium). A pressure signal and a temperature signal can thus be generated with a chosen density function to compensate for a level.

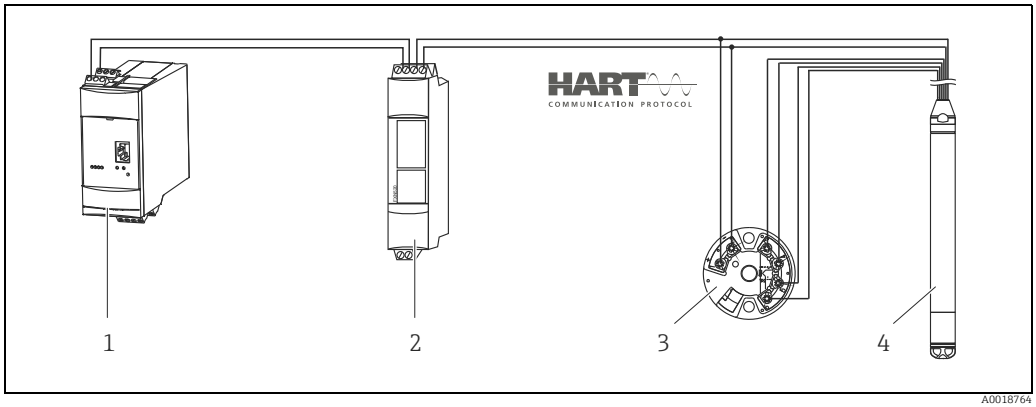


1 HART-Master, e.g. PLC (programmable logic controller)
2 Multidrop-Connector FXN520
3 TMT182 Temperature head transmitter
4 Waterpilot FMX21

	Description **Adjustment of the Waterpilot for pressure measurement**
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 📄 26).
4	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter. Menu path: Expert → Communication → HART Config.
5	Perform level adjustment (wet or dry), → 📄 32 ff.
6	Configure an address ≠ 0 using the "Bus address" parameter, e.g. bus address =1. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config. ℹ The output current of the temperature transmitter used must also be set to Fixed and a HART address other than zero (e.g. address = 2) is configured.
7	Result: A corrected level value can be determined for a chosen medium using a suitable density function by calculating the pressure signal and temperature signal in a suitable HART master (e.g. PLC).

7.4.11 Automatic density compensation using an external temperature value for calculation in the FMX21

Example:
In this example, the FMX21 with an integrated Pt100 and a HART-compliant temperature transmitter are combined via the common communication bus. In this case, the signal of the Pt100 is analyzed using a HART-compliant (at least HART 5.0) temperature head transmitter that supports burst mode. The change in the water density caused by changing temperatures is automatically factored into the level signal by activating automatic density compensation.



1 Fieldgate FXA520
2 Multidrop-Connector FXN520
3 TMT182 Temperature head transmitter (burst mode)
4 Waterpilot FMX21

	Description **Configuring the HART-compliant temperature head transmitter (min. HART 5.0) with burst function**
	The output current of the temperature head transmitter used should be set to Fixed and must have a HART address other than zero (e.g. address = 1) configured. The burst function must then be switched on with HART command 1. This step should be performed before the procedure described below in order to avoid a HART input error of the FMX21 being output during commissioning.
	Adjustment of the Waterpilot for level measurement
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The sensor is unpressurized, perform position adjustment (→ 26).
4	Set the "Auto density corr." parameter to "External value". Menu path: Expert → Application
5	Perform level adjustment (wet or dry), → 32 ff.
6	Result: The measured value output by the Waterpilot equals the level in the deep well corrected by means of the density characteristic line of the water.

Temperature head transmitter TMT182 is not suitable for this configuration.

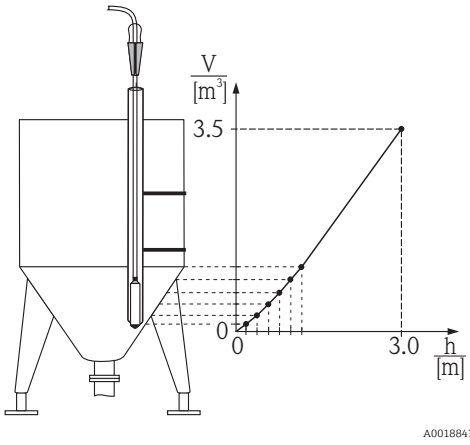
7.5 Linearization

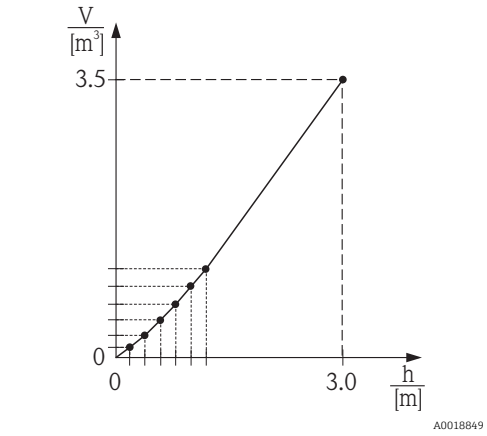
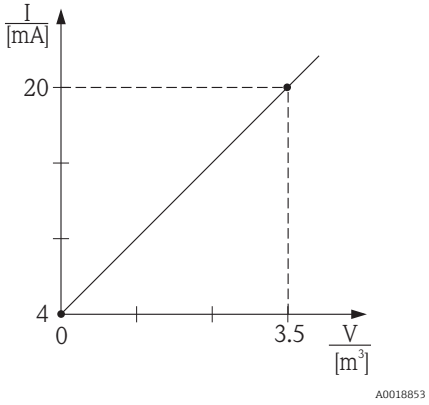
7.5.1 Semiautomatic entry of the linearization table

Example:
In this example, the volume in a tank with a conical outlet should be measured in "m^3".

Prerequisite:
- The tank can be filled or be emptied. The linearization characteristic must rise continuously.
- The "Level" operating mode has been selected.

For a description of the parameters mentioned → 64.

	Description	
1	Select the "Semiautom. entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
2	Select the volume/mass unit via the "Unit after lin." parameter, e. g. "m^3". Menu path: Setup → Extended setup → Linearization → Unit after lin.	
3	Fill the tank to the height of the 1st point.	

	Description	
4	Enter the number of the point in the table via the "Line-numb." parameter. Menu path: Setup → Extended setup → Linearization → Line-numb	
	The current level is displayed via the "X-value" parameter. Menu path: Setup → Extended setup → Linearization → X-value	
	Using the "Y-value" parameter, enter the associated volume value, here "0 m³" for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value	
5	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 4. Menu path: Setup → Extended setup → Linearization → Edit table	
6	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
7	Result: The measured value after linearization is displayed.	

Semiautomatic entry of the linearization table

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the lowest pair of values in the table.
   The 100% value (= 20 mA) is defined by the maximum pair of values point in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

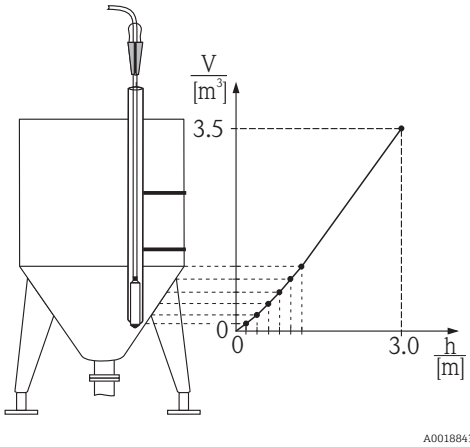
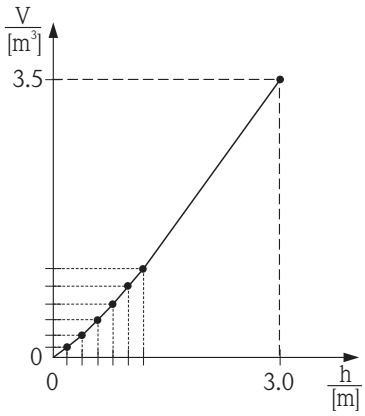
7.5.2 Manual entry of the linearization table

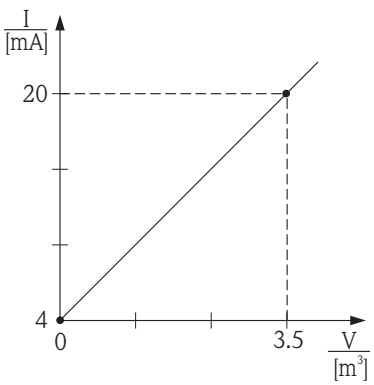
Example:
In this example, the volume in a tank with a conical outlet should be measured in "m^3".

Prerequisite:

- This is a theoretical calibration, i.e. the points for the linearization table are known.
- The "Level" operating mode has been selected.
- A level calibration has been performed.

For a description of the parameters mentioned → 64.

	Description	
1	Select the "Manual entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	 A0018843
2	Select the volume/mass unit via the "Unit after lin." parameter, e. g. "m^3". Menu path: Setup → Extended setup → Linearization → Unit after lin.	
3	Enter the number of the point in the table via the "Line-numb." parameter. Menu path: Setup → Extended setup → Linearization → Line-numb	
	The level (e.g. "0 m") is entered via the "X-value" parameter. Confirm your entry. Menu path: Setup → Extended setup → Linearization → X-value	
	Using the "Y-value" parameter, enter the associated volume value, here "0 m^3" for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value	 A0018849

	Description	
4	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 3. Menu path: Setup → Extended setup → Linearization → Edit table	 *Manual entry of the linearization table*
5	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
6	Result: The measured value after linearization is displayed.	

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the lowest pair of values in the table.
   The 100% value (= 20 mA) is defined by the maximum pair of values in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

8 Troubleshooting

8.1 Messages

The following table lists the messages that can occur. The Diagnostic code parameter shows the message with the highest priority. The device has four different status information codes according to NE107:

- F = failure
- M (warning) = maintenance required
- C (warning) = function check
- S (warning) = outside specification (deviations from the permitted ambient or process conditions determined by the device with the self-monitoring function, or errors in the device itself indicate that the measuring uncertainty is greater than what would be expected under normal operating conditions).

For support and further information, please contact Endress+Hauser Service.

Diagnostic code	Error message	Cause	Remedial action
0	No error	–	–
C412	Backup in prog.	– Downloading.	Wait for download to complete
C482	Current simul.	– Current output simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C484	Error simul.	– Fault state simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C485	Measure simul.	– Simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C824	Process pressure	– Overpressure or low pressure present. – This message normally only appears briefly. – Electromagnetic effects are greater than specified in the technical data.	1. Check the pressure value 2. Restart the device 3. Perform a reset
F002	Unknown sensor	– Sensor does not suit the device (electronic sensor nameplate).	Contact Endress+Hauser Service.
F062	Sensor conn.	– Cable connection between the sensor and main electronics is disconnected. – Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly.	Check the sensor cable
F081	Initialization	– Cable connection between the sensor and main electronics is disconnected. – Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly.	1. Perform a reset 2. Check the sensor cable
F083	Permanent mem.	– Sensor defective. – Electromagnetic effects are greater than specified in the technical data. This message normally only appears briefly.	1. Restart the device

Diagnostic code	Error message	Cause	Remedial action
F140	Working range P	– Overpressure or low pressure present. – Electromagnetic effects are greater than specified in the technical data. – Sensor defective.	1. Check the process pressure 2. Check the sensor range
F261	Electronics	– Main electronics defective. – Fault in the main electronics.	Restart the device
F282	Data memory	– Fault in the main electronics. – Main electronics defective.	Restart the device
F283	Permanent mem.	– Main electronics defective. – Electromagnetic effects are greater than specified in the technical data. – The supply voltage is disconnected when writing. – An error occurred when writing.	Perform a reset
F411	Up-/download	– The file is defective. – During the download, the data are not correctly transmitted to the processor, e.g. due to open cable connections, spikes (ripple) on the supply voltage or electromagnetic effects.	1. Download again 2. Use another file 3. Perform a reset
F510	Linearization	– The linearization table is being edited.	1. Complete your entries 2. Select "linear"
F511	Linearization	– The linearization table consists of less than 2 points.	1. Table too small 2. Correct the table 3. Accept the table
F512	Linearization	– The linearization table is not monotonic increasing or decreasing.	1. Tab. not monotonic 2. Correct the table 3. Accept the table
F841	Sensor range	– Overpressure or low pressure present. – Sensor defective.	1. Check the pressure value 2. Contact Endress+Hauser Service.
F882	Input signal	– External measured value is not received or displays a failure status.	1. Check the bus 2. Check the source device 3. Check the setting
M002	Unknown sensor	– Sensor does not suit the device (electronic sensor nameplate). Device continues measuring.	Contact Endress+Hauser Service.
M283	Permanent mem.	– Cause as indicated for F283. – Correct measurement can continue as long as you do not need the peakhold indicator function.	Perform a reset
M431	Adjustment	– The adjustment performed would cause the sensor nominal range to be undershot or overshot.	1. Check the measuring range 2. Check position adjustment 3. Check the setting
M434	Scaling	– Values for calibration (e.g. lower-range value and upper-range value) are too close together. – The lower-range value and/or upper-range value undershoot or exceed the sensor range limits. – The sensor was replaced and the customer-specific configuration does not suit the sensor. – Unsuitable download carried out.	1. Check the measuring range 2. Check the setting 3. Contact Endress+Hauser Service.
M438	Data record	– The supply voltage is disconnected when writing. – An error occurred when writing.	1. Check the setting 2. Restart the device

Diagnostic code	Error message	Cause	Remedial action
M882	Input signal	– External measured value displays a warning status.	1. Check the bus 2. Check the source device 3. Check the setting
S110	Working range T	– High temperature or low temperature present. – Electromagnetic effects are greater than specified in the technical data. – Sensor defective.	1. Check the process temperature 2. Check the temperature range
S140	Working range P	– Overpressure or low pressure present. – Electromagnetic effects are greater than specified in the technical data. – Sensor defective.	1. Check the process pressure 2. Check the sensor range
S822	Process temp.	– The temperature measured in the sensor is higher than the upper nominal temperature of the sensor. – The temperature measured in the sensor is lower than the lower nominal temperature of the sensor.	1. Check the temperature 2. Check the setting
S841	Sensor range	– Overpressure or low pressure present. – Sensor defective.	1. Check the pressure value 2. Contact Endress+Hauser Service.
S971	Adjustment	– The current is outside the permitted range of 3.8 to 20.5 mA. – The pressure present is outside the set measuring range (but might be within the sensor range). – The adjustment performed would cause the sensor nominal range to be undershot or overshot.	1. Check the pressure value 2. Check the measuring range 3. Check the setting

8.2 Malfunctions of Waterpilot FMX21 with optional Pt100

Error description	Cause	Measures
No measuring signal	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	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 → 14, Section 5.1.
	Waterpilot defective	Replace the Waterpilot.
Temperature measured value is inaccurate/incorrect (only for Waterpilot FMX21 with Pt100)	Pt100 connected in 2-wire circuit, cable resistance was not compensated	– Compensate cable resistance. – Connect Pt100 as 3-wire or 4-wire circuit.

8.3 Malfunctions of TMT182 temperature head transmitter

Error description	Cause	Remedial action
No measuring signal	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	No power supplied via the 4 to 20 mA cable	Check current loop.
	Supply voltage too low (min. 11.5 V DC)	– Check supply voltage. – Overall resistance greater than max. load resistance → 14, Section 5.1.
Error current ≤ 3.6 mA or ≥ 21 mA	Pt100 not connected correctly	Connect device in accordance with → 14, Section 5.1.
	4 to 20 mA cable not connected correctly	Connect device in accordance with → 14, Section 5.1.
	Pt100 resistance thermometer defective	Replace the Waterpilot.
	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	– Compensate cable resistance. – Connect Pt100 as 3-wire or 4-wire circuit.

8.4 Firmware history

Date	Firmware version	Software modifications	Dokumentationen
05.2009	01.00.zz	Original software. Compatible with: – FieldCare version 2.02.00 or higher – Field Communicator DXR375 with Device Rev.: 1, DD Rev.: 1	BA380P/00/EN/08.09

9 Maintenance

No special maintenance work is required for the Waterpilot and for the optional TMT182 temperature head transmitter.

Terminal box: Keep the pressure compensation tube and GORE-TEX® filter free from contamination.

9.1 Exterior cleaning

Please note the following points when cleaning the devices externally:
- The cleaning agents used should not corrode the housing surface and the seals. Information on this can be found on the nameplate (→ 6).
- Mechanical damage to the process isolating diaphragm or the extension cable must be avoided.
- Only clean the terminal box with water or with a cloth dampened with very diluted ethanol.

10 Repair

10.1 Spare parts

In the W@M Device Viewer (www.endress.com/deviceviewer) all spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

10.2 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at: www.services.endress.com/return-material

10.3 Disposal

When disposing, separate and recycle the device components based on the materials.

11 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the Waterpilot, see also → Technical Information TI00431P/00/EN, "Ordering information" section.

11.1 Mounting clamp

- Endress+Hauser offers a mounting clamp for easy Waterpilot mounting (→ 10).
- Material: 316L (1.4404) and fiberglass reinforced PA (polyamide)
- Order number: 52006151

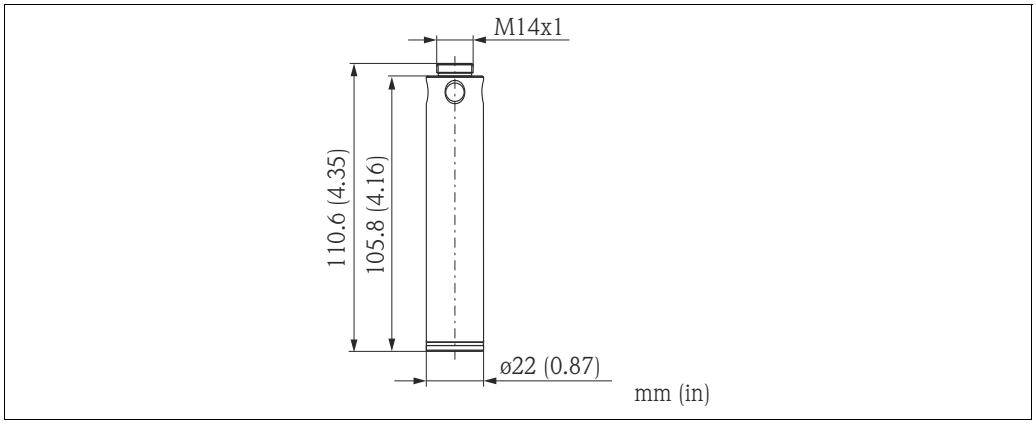
11.2 Terminal box

- IP66/IP67 terminal boxes with GORE-TEX® filter incl. integrated terminals.
- The terminal box is also suitable for installing a temperature head transmitter (order number: 51001023) or for four additional terminals (order number: 52008938), → 12.

The terminal box is not intended for the FMX21 with Ex nA explosion protection in the hazardous area. When using the terminal box in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

11.3 Additional weight for Waterpilot with outer diameter of 22 mm (0.87 in) and 29 mm (1.14 in)

Endress+Hauser offers additional weights to prevent sideways movement that results in measuring errors, or to make it easier to lower the device in a guide tube.
You can screw several weights together. The weights are then attached directly to the Waterpilot. For the Waterpilot with an outer diameter of 29 mm (1.14 in), version with a plastic insulation, a maximum of 5 weights may be attached.



A0018748

- Material: 316L (1.4435)
- Weight: 300 g (10.5 oz)
- Order number: 52006153

In combination with the Ex nA approval, for FMX21 with an outer diameter of 29 mm (1.14 in) a maximum of 1 additional weight may be attached.

11.4 TMT182 temperature head transmitter (4 to 20 mA HART)

- 2-wire temperature head transmitter, configured for a measuring range from −20 to +80 °C (−4 to +176 °F).
  This setting offers a temperature range of 100K which can be easily mapped.
  Please note that the Pt100 resistance thermometer is designed for a temperature range from −10 to +70 °C (−14 to +158 °F) → 12.
- Order number: 51001023

⚠ WARNING
Explosion hazard!
▶ Not for use of the Waterpilot FMX21 in hazardous areas.

11.5 Extension cable mounting screw

Endress+Hauser offers extension cable mounting screws to ease Waterpilot mounting and to seal the measuring aperture (→ 11).

Extension cable mounting screw
- Order number G 1½" A: 52008264
- Order number NPT 1½": 52009311
- Material: 304 (1.4301)

11.6 Terminals

- Four terminals in strip for FMX21 terminal box, suitable for wire cross-sections: 0.08 to 2.5 mm² (28 to 14 AWG)
- Order number: 52008938

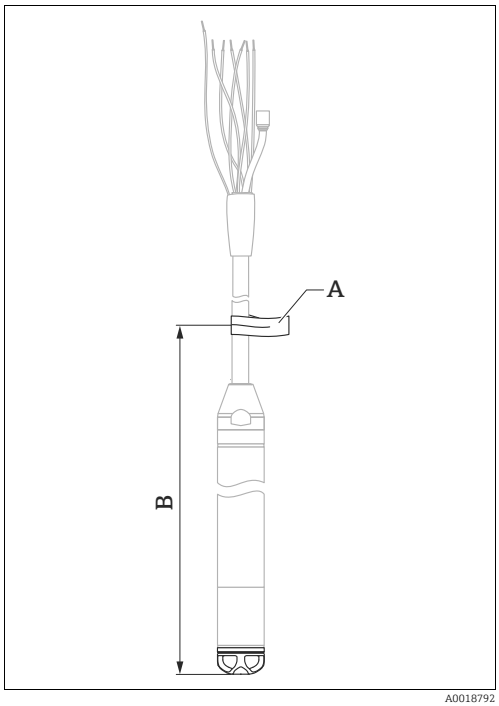
⚠ WARNING

Explosion hazard!

▶ The 4-terminal strip is not designed for use in hazardous areas incl. CSA: GP.

11.7 Cable marking

To make installation easier, Endress+Hauser marks the customer-specific length on the extension cable, see Technical Information TI00431P/00/EN, "Ordering information" section.



A Cable marking
B Cable marking tolerance

- Cable marking tolerance (distance to the lower end of the cable probe):
  Cable length
  < 5 m (16 ft): ±17,5 mm (0.69 in)
  > 5 m (16 ft): ±0,2 %
- Material: PET, Adhesive: acrylic
- Immunity to temperature change: −30 to +100 °C (-22 to 212 °F)

NOTICE

The mark is only for installation purposes.

▶ It 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.

⚠ WARNING

Explosion hazard!

▶ Not for use in hazardous areas.

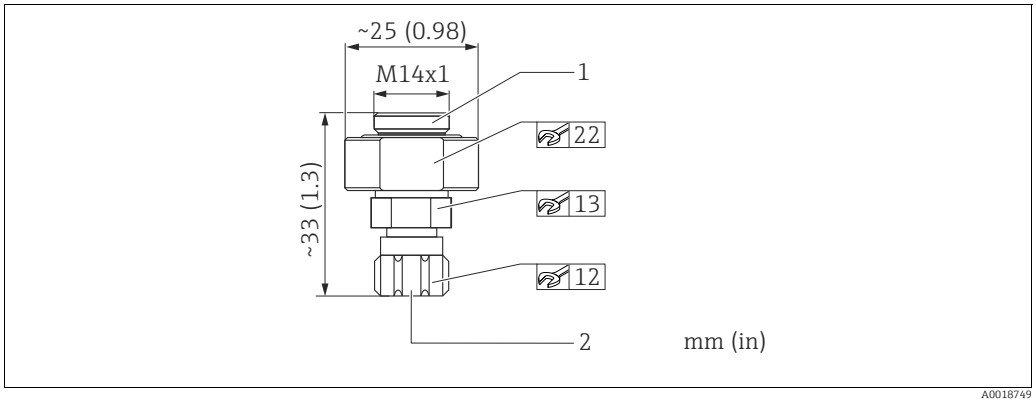
11.8 Cable shortening kit

The cable shortening kit is used to easily and professionally shorten a cable, see Technical Information TI00431P/00/EN, "Ordering information" section, and documentation SD00552P/00/A6.

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

11.9 Testing adapter for FMX21 with outer diameter of 22 mm (0.87 in) and outer diameter of 29 mm (1.14 in)

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



1 Connection suitable for Waterpilot
2 Compressed air hose connection, internal diameter of quick coupling piece 4 mm (0.16 in)

- Observe the maximum pressure for the compressed air hose and the maximum overload for the level probe. (For the maximum overload of the cable probe, see Technical Information TI00431P/00/EN or go to www.endress.com → Select Country → Download → Media Type: Documentation)
- Maximum pressure of the quick coupling piece supplied: 10 bar (145 psi)
- Adapter material: 304 (1.4301)
- Quick coupling piece material: anodized aluminum
- Adapter weight: 39 g (1.37 oz)
- Order number: 52011868

12 Technical data

For the technical data, please refer to Technical Information TI00431P/00/EN (→ see also: www.endress.com → Select Country → Download → Media Type: Documentation).

13 Appendix

The entire operating menu is depicted on the following pages.

The operating menu has a different structure depending on the measuring mode selected. This means that some function groups are only displayed for one measuring mode, e.g. the "Linearization" function group for the "Level" measuring mode. In addition, there are also parameters that are only displayed if other parameters are appropriately configured.

13.1 Overview of the operating menu

All the parameters are listed in the following table. This overview contains the levels with the associated parameters for the Pressure and Level measuring modes.

The page number refers to where a description of the parameter can be found.

Level 1	Level 2	Level 3	Level 4	Page
Setup				
	Measuring mode			65
	Press. eng. unit			66
	Corrected press.			67
	Position adjustment (relative pressure sensor) Position offset (absolute pressure sensor)			66
	Empty calibration			69
	Full calibration			69
	Set LRV			67
	Set URV			67
	Damping value			66
	Level before lin			70
	Pressure after damping			67
	Extended setup			
		Code definition		64
		Device tag		64
		Operator code		64

Level 1	Level 2	Level 3	Level 4	Page
Setup				
	Extended setup			
		Level		
			Level selection	68
			Output unit	68
			Height unit	68
			Calibration mode	68
			Empty calib.	69
			Empty pressure	69
			Empty height	69
			Full calib.	69
			Full pressure	69
			Full height	69
			Adjust density	70
			Process density	70
			Level before lin	70
		Linearization		
			Lin. mode	70
			Unit after lin.	70
			Line-numb.	71
			X-value	71
			Y-value	71
			Edit table	71
			Tank description	71
			Tank content	71
		Current output		
			Alarm behav. P	72
			Output fail mode	72
			High alarm curr.	72
			Set min. current	73
			Output current	72
			Get LRV (pressure measuring mode)	73
			Set LRV	73
			Get URV (pressure measuring mode)	73
			Set URV	73

Level 1	Level 2	Level 3	Level 4	Page
Diagnosis				
	Diagnostic code			77
	Last diag. code			78
	Min. meas. press.			77
	Max. meas. press.			77
	Diagnostic list			
		Diagnostic 1		78
		Diagnostic 2		78
		Diagnostic 3		78
		Diagnostic 4		78
		Diagnostic 5		78
		Diagnostic 6		78
		Diagnostic 7		78
		Diagnostic 8		78
		Diagnostic 9		78
		Diagnostic 10		78
	Event logbook			
		Last diag. 1		78
		Last diag. 2		78
		Last diag. 3		78
		Last diag. 4		78
		Last diag. 5		78
		Last diag. 6		78
		Last diag. 7		78
		Last diag. 8		78
		Last diag. 9		78
		Last diag. 10		78
	Instrument info			
		Firmware version		64
		Serial number		64
		Ext. order code		64
		Order identifier		64
		Cust. tag number		64
		Device tag		64
		ENP version		64
		Config. counter		78
		Lower range limit		72
		URL sensor		72
		Manufacturer ID		75
		Device type code		75
		Device revision		75

Level 1	Level 2	Level 3	Level 4	Page
Diagnosis				
	Measured values			
		Level before lin		70
		Tank content		71
		Meas. pressure		67
		Sensor pressure		67
		Corrected press.		67
		Pressure after damping		67
		Sensor temp.		66
	Simulation			
		Simulation mode		79
		Sim. pressure		79
		Sim. level		79
		Sim. tank cont.		79
		Sim. current		79
		Sim. alarm/warning		79
	Enter reset code			
		Enter reset code		65
Expert				
	System			
		Code definition		64
		Operator code		64
		Instrument info		
			Cust. tag number	64
			Device tag	64
			Serial number	64
			Firmware version	64
			Ext. order code	64
			Order identifier	64
			ENP version	64
			Electr. serial no.	64
			Sensor serial no.	64
		Management		
			Enter reset code	65

Level 1	Level 2	Level 3	Level 4	Page
Expert				
	Measurement			
		Measuring mode		65
		Basic setup		
			Pos. zero adjust	66
			Calib. offset	66
			Damping value	66
			Press. eng. unit	66
			Temp. eng. unit	66
			Sensor temp.	66
		Pressure		
			Set LRV	67
			Set URV	67
			Meas. pressure	67
			Sensor pressure	67
			Corrected press.	67
			Pressure after damping	67
		Level		
			Level selection	68
			Output unit	68
			Height unit	68
			Calibration mode	68
			Empty calib.	69
			Empty pressure	69
			Empty height	69
			Full calib.	69
			Full pressure	69
			Full height	69
			Density unit	69
			Adjust density	70
			Process density	70
			Level before lin	70
		Linearization		
			Lin. mode	70
			Unit after lin.	70
			Line-numb.	71
			X-value	71
			Y-value	71
			Edit table	71
			Tank description	71
			Tank content	71

Level 1	Level 2	Level 3	Level 4	Page
Expert				
	Measurement			
		Sensor limits		
			Lower range limit	72
			URL sensor	72
		Sensor trim		
			Lo trim measured	72
			Hi Trim measured value	72
			Lo Trim sensor	72
			Hi Trim sensor	72
	Output			
		Current output		
			Output current	72
			Alarm behavior	72
			Output fail mode	72
			High alarm curr.	72
			Set min. current	73
			Get LRV (pressure measuring mode)	73
			Set LRV	73
			Get URV (pressure measuring mode)	73
			Set URV	73
			Start current	73
			Curr. trim 4mA	73
			Curr. trim 20mA	74
			Offset trim 4mA	74
			Offset trim 20 mA	74
	Communication			
		HART config.		
			Burst mode	74
			Burst option	74
			Current mode	74
			Bus address	74
			Preamble number	75
		HART info		
			Device type code	75
			Device revision	75
			Manufacturer ID	75
			HART version	75
			Description	75
			HART message	75
			HART date	75

Level 1	Level 2	Level 3	Level 4	Page
Expert				
	Communication			
		HART output		
			Primary value is	75
			Primary value	75
			Secondary val. is	75
			Secondary value	75
			Third value is	75
			Third value	76
			4th value is	76
			4th value	76
		HART input		
			HART input value	76
			HART input stat.	76
			HART input unit	76
			HART input form.	76
	Application			
		Electr. delta P		76
		Fixed ext. value		77
		Auto dens. corr.		77
	Diagnosis			
		Diagnostic code		77
		Last diag. code		77
		Reset logbook		77
		Min. meas. press.		77
		Max. meas. press.		77
		Reset peakhold		77
		Operating hours		78
		Config. counter		78
		Diagnostic list		
			Diagnostic 1	78
			Diagnostic 2	78
			Diagnostic 3	78
			Diagnostic 4	78
			Diagnostic 5	78
			Diagnostic 6	78
			Diagnostic 7	78
			Diagnostic 8	78
			Diagnostic 9	78
			Diagnostic 10	78

Level 1	Level 2	Level 3	Level 4	Page
Expert				
	Diagnosis			
		Event logbook		
			Last diag. 1	78
			Last diag. 2	78
			Last diag. 3	78
			Last diag. 4	78
			Last diag. 5	78
			Last diag. 6	78
			Last diag. 7	78
			Last diag. 8	78
			Last diag. 9	78
			Last diag. 10	78
		Simulation		
			Simulation mode	79
			Sim. pressure	79
			Sim. level	79
			Sim. tank cont.	79
			Sim. current	79
			Sim. alarm/warning	79

13.2 Description of parameters

This section describes the parameters in the order as they appear in the "Expert" operating menu in FieldCare.

13.2.1 System

Expert → System

Parameter name	Description
Operator code Entry	Use this function to enter a code to lock or unlock operation. Options: ▪ To lock operation: enter a number ≠ the unlocking code. ▪ To unlock operation: enter the unlocking code. The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code will be visible and unlocked by entering the number "5864". Factory setting: 0
Code definition Entry	Use this function to enter a release code with which the device can be unlocked. Options: ▪ A number between 0 and 9999 Factory setting: 0

Expert → System → Instrument info

Parameter name	Description
Cust. tag number Entry	Enter device tag e.g. TAG number (max. 8 alphanumeric characters). Factory setting: no entry or as per order specifications
Device tag Entry	Enter device tag e.g. TAG number (max. 32 alphanumeric characters). Factory setting: no entry or as per order specifications
Serial number Display	Displays the serial number of the device (11 alphanumeric characters).
Firmware version Display	Displays the firmware version.
Ext. order code Entry	Enter the extended order code. Factory setting: as per order specifications
Order identifier Entry	Enter the order identifier. Factory setting: as per order specifications
ENP version Display	Displays the ENP version (ENP = electronic nameplate)
Electr. serial no. Display	Displays the serial number of the main electronics (11 alphanumeric characters).
Sensor serial no. Display	Displays the serial number of the sensor (11 alphanumeric characters).

Expert → System → Management

Parameter name	Description
Enter reset code Entry	Reset parameters completely or partially to the factory values or order configuration, → 23, "Resetting to factory settings (reset)". Factory setting: 0

13.2.2 Measurement

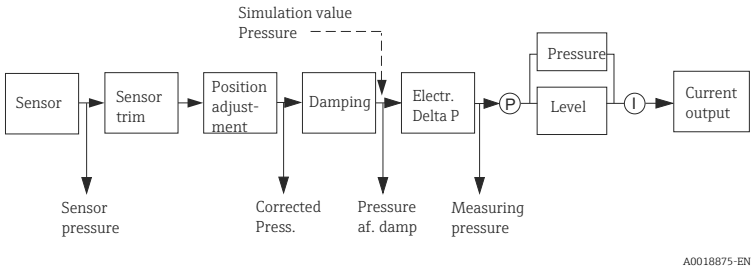
Expert → Measurement

Parameter name	Description
Measuring mode Selection	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. If the measuring mode is changed, no conversion takes place. The device has to be recalibrated or as per if the measuring mode is changed. Options: ▪ Pressure ▪ Level Factory setting: Pressure or as per order specifications

Expert → Measurement → Basic setup

Parameter name	Description
Pos. zero adjust (relative pressure sensor) Selection	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. Example: – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. Options: ▪ Confirm ▪ Abort Factory setting: Abort
Calib. offset (absolute pressure sensor) Entry	Position adjustment – the pressure difference between the set point and the measured pressure must be known. Example: – Measured value = 982.2 mbar (15 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Position offset" parameter. This means that you assign the value 980.0 (15 psi) to the pressure present. – Measured value (after pos. zero adjust) = 980.0 mbar (15 psi) – The current value is also corrected. Factory setting: 0.0
Damping value Entry	Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure. Input range: 0.0 to 999.0 s Factory setting: 2.0 as per order specifications
Press. eng. unit Selection	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. Options: ▪ mbar, bar ▪ mmH2O, mH2O, inH2O ▪ ftH2O ▪ Pa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ kgf/cm^2 Factory setting: mbar or bar depending on the sensor nominal measuring range, or as per order specifications
Temp. eng. unit Selection	Select the unit for the temperature measured values. The setting affects the unit for the "Sensor temp." parameter. Options: ▪ °C ▪ °F ▪ K Factory setting: °C
Sensor temp. Display	Displays the temperature currently measured in the sensor. This can deviate from the process temperature.

Expert → Measurement → Pressure

Parameter name	Description
Set LRV Entry	Set the lower-range value – without reference pressure. Enter the pressure value for the lower current value (4 mA). Factory setting: 0.0 or as per order specifications
Set URV Entry	Set the upper-range value – without reference pressure. Enter the pressure value for the upper current value (20 mA). Factory setting: Upper-range limit sensor (→ see "Lower range limit") or as per order specifications
Meas. pressure Display	Displays the measured pressure after sensor trim, position adjustment and damping. 
Sensor pressure Display	Displays the measured pressure before the sensor trim.
Corrected press. Display	Displays the measured pressure after sensor trim and position adjustment.
Pressure after damping Display	Displays the measured pressure after sensor trim, position adjustment and damping.

Expert → Measurement → Level

Parameter name	Description
Level selection Selection	Select the method for calculating the level Options: ▪ In pressure If this option is selected, specify two pressure/level value pairs. The level value is displayed directly in the unit that you select via the "Output unit" parameter. ▪ In height If this option is selected, specify two height/level value pairs. From the measured pressure, the device first calculates the height using the density. This information is then used to calculate the level in the "Output unit" selected using the two value pairs specified. Factory setting: In pressure
Output unit Selection	Select the unit for the measured value display for the level before linearization. The unit selected is only used to describe the measured value. This means that the measured value is not converted when a new output unit is selected. Example: ▪ Current measured value: 0.3 ft ▪ New output unit: m ▪ New measured value: 0.3 m Options: ▪ % ▪ mm, cm, dm, m ▪ ft, inch ▪ m^3, in^3 ▪ l, hl ▪ ft^3 ▪ gal, Igal ▪ kg, t ▪ lb Factory setting: %
Height unit Selection	Select the height unit. The measured pressure is converted to the selected height unit using the "Adjust density" parameter. Prerequisite: "Level selection" = "In height" Options: ▪ mm ▪ m ▪ inch ▪ ft Factory setting: m
Calibration mode Selection	Select the calibration mode. Options: ▪ Wet Wet calibration takes place by filling and emptying the container. With two different levels, the level, volume, mass or percentage value entered is assigned to the pressure measured at this point in time ("Empty calibration" and "Full calibration" parameters). ▪ Dry Dry calibration is a theoretical calibration. For this calibration, you specify two pressure/level value pairs via the following parameters: "Empty calib.", "Empty pressure", "Full calib.", "Full pressure". Factory setting: Wet

Parameter name	Description
Empty calib. Entry	Enter the output value for the lower calibration point (container empty). The unit defined in "Output unit" must be used. In the case of wet calibration, the level (e.g. container empty or partially-filled) must actually be available. The associated pressure is then automatically recorded by the device. In the case of dry calibration, the level (container empty) does not have to be available. The associated pressure has to be entered in the "Empty pressure" parameter for the "In pressure" level selection. The associated height has to be entered in the "Empty height" parameter for the "In height" level selection. Factory setting: 0.0
Empty pressure Entry/display	Enter the pressure value for the lower calibration point (container empty). → See also "Empty calib.". Prerequisite ▪ "Level selection" = "In pressure" "Calibration mode" = Wet (display only), Dry (entry) Factory setting: 0.0
Empty height Entry/display	Enter the height value for the lower calibration point (container empty). Select the unit via the "Height unit" parameter. Prerequisite: ▪ "Level selection" = In height "Calibration mode" = Wet (display only), Dry (entry) Factory setting: 0.0
Full calib. Entry	Enter the output value for the upper calibration point (container full). The unit defined in "Output unit" must be used. In the case of wet calibration, the level (e.g. container full or partially-filled) must actually be available. The associated pressure is then automatically recorded by the device. In the case of dry calibration, the level (container full) does not have to be available. The associated pressure has to be entered in the "Full pressure" parameter for the "In pressure" level mode. The associated height has to be entered in the "Empty height" parameter for the "In height" level selection. Factory setting: 100.0
Full pressure Entry/display	Enter the pressure value for the upper calibration point (container full). → See also "Empty calib.". Prerequisite ▪ "Level selection" = In pressure "Calibration mode" = Wet (display only), Dry (entry) Factory setting: Upper-range limit (URL) of the sensor
Full height Entry/display	Enter the height value for the upper calibration point (container full). Select the unit via the "Height unit" parameter. Prerequisite: ▪ "Level selection" = In height "Calibration mode" = Wet (display only), Dry (entry) Factory setting: Upper-range limit (URL) is converted to a height unit
Density unit Display	Displays the density unit. The measured pressure is converted to a height using the "Height unit" and "Adjust density" parameters. Setting: ▪ g/cm^3

Parameter name	Description
Adjust density Entry/display	Enter the density of the medium. The measured pressure is converted to a height using the "Height unit" and "Adjust density" parameters. User input: ▪ Auto dens. corr. = Off Display: ▪ Auto dens. corr. ≠ Off Factory setting: 1.0
Process density Entry/display	Enter a new density value for density correction. The calibration was carried out with water as the medium, for example. Now the container is to be used for another medium with another density. The calibration is corrected appropriately by entering the new density value in the "Process density" parameter. If you change to dry calibration after a wet calibration via the "Calibration mode" parameter, the density must be entered for the "Adjust density" and "Process density" parameters before you switch calibration mode. User input: ▪ Auto dens. corr. = Off Display: ▪ Auto dens. corr. ≠ Off Factory setting: 1.0
Level before lin Display	Displays the level value prior to linearization.

Expert → Measurement → Linearization

Parameter name	Description
Lin. mode Selection	Select the linearization mode. Options: ▪ Linear: The level is output without being converted beforehand. "Level before lin." is output. ▪ Erase table: The existing linearization table is deleted. ▪ Manual entry (sets the table to the edit mode, an alarm is output): The value pairs of the table (X-value and Y-value) are entered manually. ▪ Semiautomatic entry (sets the table to the edit mode, an alarm is output): The container is emptied or filled gradually in this entry mode. The device automatically records the level value (X-value). The associated volume, mass or %-value is entered manually (Y-value). ▪ Activate table The table entered is activated and checked with this option. The device shows the level after linearization. Factory setting: Linear
Unit after lin. Selection	Select the volume unit (unit of the Y-value). Options: ▪ % ▪ cm, dm, m, mm ▪ hl ▪ in^3, ft^3, m^3 ▪ l ▪ in, ft ▪ kg, t ▪ lb ▪ gal ▪ Igal Factory setting: %

Parameter name	Description
Line-numb. Entry	Enter the number of the current point in the table. The subsequent entries for "X-value" and "Y-value" refer to this point. Input range: ▪ 1 to 32
X-value Display/entry	Enter the level value for the specific point in the table and confirm. If "Lin. mode" = "Manual", the level value has to be entered. If "Lin. mode" = "Semiautomatic" the level value is displayed and has to be confirmed by entering the associated Y-value.
Y-value Entry	Enter the output value for the specific point in the table. The unit is determined by "Unit after lin.". The linearization table must be monotonic (monotonic increasing or decreasing).
Edit table Selection	Select the function for entering the table. Options: ▪ Next point: enter the next point. ▪ Current point: stay on the current point to correct a mistake for example. ▪ Previous point: skip back to the previous point to correct a mistake for example. ▪ Insert point: insert an additional point (see example below). ▪ Delete point: delete the current point (see example below). Example: Add a point - in this case between the 4th and 5th point for example – Select point 5 via the "Line-numb." parameter. – Select the "Enter point" option via the "Edit table" parameter. – Point 5 is displayed for the "Line-numb." parameter. Enter new values for the "X-value" and "Y-value" parameters. Example: Delete a point - in this case the 5th point for example – Select point 5 via the "Line-numb." parameter. – Select the "Delete point" option via the "Edit table" parameter. – The 5th point is deleted. All of the subsequent points are moved up one number i.e. following deletion, the 6th point becomes Point 5. Factory setting: current point
Tank description Entry	Enter the tank description (max. 32 alphanumeric characters)
Tank content Display	Displays the level value after linearization.

Expert → Measurement → Sensor limits

Parameter name	Description
Lower range limit Display	Displays the lower-range limit of the sensor.
URL sensor Display	Displays the upper-range limit of the sensor.

Expert → Measurement → Sensor trim

Parameter name	Description
Lo trim measured Display	Displays the reference pressure present to be accepted for the lower calibration point.
Hi trim measured Display	Displays the reference pressure present to be accepted for the upper calibration point.
Lo trim sensor Entry	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the lower calibration point.
Hi trim sensor Entry	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the upper calibration point.

13.2.3 Current output

Expert → Output → Current output

Parameter name	Description
Output current Display	Displays the current value of the current.
Alarm behav. P Selection	Configure the current output for when the sensor limits are undershot or overshot. Options: ▪ Warning The device continues measuring. An error message is displayed. ▪ Alarm The output signal assumes a value that can be specified by the "Output fail mode" function. Factory setting: Warning
Output fail mode Selection	Select the output fail mode. In the event of an alarm, the current assumes the current value specified with this parameter. Options: ▪ Max: can be set from 21 and 23 mA → see also "High alarm curr." ▪ Hold: last measured value is held. ▪ Min: 3.6 mA Factory setting: Max
High alarm curr. Entry	Enter the current value for the high alarm current. → See also "Output fail mode". Input range: 21 to 23 mA Factory setting: 22 mA

Parameter name	Description
Set min. current Entry	Enter the lower current limiting value. Some switching units do not accept current values lower than 4.0 mA. Options: ▪ 3.8 mA ▪ 4.0 mA Factory setting: 3.8 mA
Get LRV Entry	Set the lower-range value – reference pressure is present at the device. The pressure for the lower current value (4 mA) is present at the device. With the "Confirm" option, you assign the lower current value to the pressure value present. Prerequisite: pressure measuring mode Options: ▪ Abort ▪ Confirm Factory setting: Abort
Set LRV Entry	Set the measure value for the lower current value (4 mA). Factory setting: 0.0 (%) in the level measuring mode; 0.0 or in accordance with ordering specifications in the pressure measuring mode
Get URV Entry	Set the upper-range value – reference pressure is present at the device. The pressure for the upper current value (20 mA) is present at the device. With the "Confirm" option, you assign the upper current value to the pressure value present. Prerequisite: pressure measuring mode Options: ▪ Abort ▪ Confirm Factory setting: Abort
Set URV Entry	Set the measure value for the upper current value (20 mA). Factory setting: 100.0 (%) in the level measuring mode; URL sensor or in accordance with ordering information in the pressure measuring mode.
Startcurrent Entry	Use this function to enter the start current. This setting affects the HART Multidrop mode as well. Options: ▪ Min. alarm ▪ 12 mA Factory setting: 12 mA
Curr. trim 4mA Entry	Enter the current value for the lower point (4 mA) of the current linear regression line. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 20mA". Perform the current trim for the upper point as follows: 1. Select the "Current" option in the "Simulation mode" parameter. 2. Set the 4 mA value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 4mA" parameter. Input range: Measured current ±0.2 mA Factory setting: 4 mA

Parameter name	Description
Curr. trim 20mA Entry	Enter the current value for the upper point (20 mA) of the current linear regression line. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 4mA". Perform the current trim for the upper point as follows: 1. Select the "Current" option in the "Simulation mode" parameter. 2. Set the "20 mA" value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 20mA" parameter. Input range: Measured current ±1.0 mA Factory setting: 20 mA
Offset trim 4mA Display/Entry	Displays/Entry the difference between 4 mA and the value entered for the "Curr. trim 4mA" parameter. Factory setting: 0
Offset trim 20mA Display/Entry	Displays/Entry the difference between 20 mA and the value entered for the "Curr. trim 20mA" parameter. Factory setting: 0

13.2.4 Communication

Expert → Communication → HART config

Parameter name	Description
Burst mode Selection	Switch the burst mode on and off. Options: ▪ On ▪ Off Factory setting Off
Burst option Entry	Use this parameter to specify what HART command is sent to the master. Factory setting: 1 (HART command 1)
Current mode Selection	Configure the current mode for HART communication. Options: ▪ Signaling Measured value transmitted by the current value ▪ Fixed current 4.0 mA (multidrop mode) (measured value only transmitted via HART digital communication) Factory setting Signaling
Bus address Entry	Enter the address for exchanging data via the HART protocol. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Factory setting: 0

Parameter name	Description
Preamble number Entry	Enter the number of preambles in the HART protocol. (Synchronization of the modem modules along a transmission path, each modem module could "swallow" one byte; at least 2 bytes must arrive at the end.) Input range: 2 to 20 Factory setting: 5

Expert → Communication → HART info

Parameter name	Description
Device type code Display	Displays the numeric ID of the device. For Waterpilot FMX21: 36
Device revision Display	Displays the device revision. e.g.: 1
Manufacturer ID Display	Displays the manufacturer number in decimal numerical format. Here: 17 (Endress+Hauser)
HART revision Display	Displays the HART revision. Here: 6
Description Entry	Enter the tag description (max. 16 alphanumeric characters).
HART message Entry	Enter a message (max. 32 alphanumeric characters). This message is sent via the HART protocol at the request of the master.
HART date Entry	Enter the date of the last change in configuration. Factory setting: DD/MM/YY (date of the final test)

Expert → Communication → HART output

Parameter name	Description
Primary value is Display	Indicates which measured variable is transmitted as the primary process value via the HART protocol. The variable displayed depends on the "measuring mode" selected: – Pressure measuring mode: "Meas. pressure" – Level measuring mode → "Linear" lin. mode: "Level before lin." – Level measuring mode → "Activate table" lin. mode: "Tank content"
Primary value Display	Displays the primary process value.
Secondary val. is Display	Indicates which measured variable is transmitted as the secondary process value via the HART protocol. The following process values can be displayed depending on the measuring mode selected: – "Meas. pressure" – "Sensor pressure" – "Corrected press." – "Pressure after damping" – "Sensor temp." – "Level before lin" – "Tank content" – "Process density" (corrected)
Secondary value Display	Displays the secondary process value.
Third value is Display	Indicates which measured variable is transmitted as the third process value via the HART protocol. The variable displayed depends on the "measuring mode" selected. See the list for "Secondary val. is"

Parameter name	Description
Third value Display	Displays the third process value.
Fourth value is Display	Indicates which measured variable is transmitted as the fourth process value via the HART protocol. The variable displayed depends on the "measuring mode" selected. See the list for "Secondary val. is"
4th value Display	Displays the fourth process value.

Expert → Communication → HART input

Parameter name	Description
HART input value Display	Displays the HART input value.
HART input stat. Display	Displays the HART input status Bad / Uncertain / Good
HART input unit Selection	Select the HART input value. Options: ▪ Unknown ▪ mbar, bar ▪ mmH2O, ftH2O, inH2O ▪ Pa, hPa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ Torr ▪ g/cm^2, kg/cm^2 ▪ lb/ft^2 ▪ atm ▪ °C, °F, K, R Factory setting: unknown
HART input form. Selection	Specify the format for displaying the HART input value. Options: ▪ x.x (default) ▪ x.xx ▪ x.xxx ▪ x.xxxx ▪ x.xxxxx Factory setting: x.x

13.2.5 Application

Expert → Application

Parameter name	Description
Electr. delta P Entry	For switching the electr. delta P application on or off with an external or constant value. Options: Off External value Constant Factory setting: Off

Parameter name	Description
Fixed ext. value Entry	Use this function to enter the constant value. The value refers to "HART input unit" Factory setting: 0.0
Auto dens. corr. Selection	For switching the auto dens. corr. application on or off with an external or internal temperature value. Before performing a calibration (dry or wet), auto-density compensation must be switched on if this function is to be used. As soon as "Auto-dens. corr." is switched on, the field for entering the "Process density" and "Adjust density" is disabled. The calibration density remains the last value until it is overwritten by a calibration. The process density remains the last value until it is overwritten when the system recalculates the value. Automatic density compensation is performed for the 0 to 70 °C (32...158 °F) temperature range. The density values for water are used for this density compensation. Options: Off Sensor temperature External value (only if the option selected for Electr. delta P is Off or Constant) Prerequisite ▪ Level mode Factory setting: Off

13.2.6 Diagnosis

Expert → Diagnosis

Parameter name	Description
Diagnostic code Display	Displays the diagnostic message with the highest priority currently present.
Last diag. code Display	Displays the last diagnostic message that occurred and was rectified. Digital communication: the last message is displayed. The messages listed in the "Last diag. code" parameter can be deleted via the "Reset logbook" parameter.
Reset logbook Selection	With this parameter, you reset all the messages of the "Last diag. code" parameter and the "Last diag. 1" to "Last diag. 10" event log. Options: ▪ Abort ▪ Confirm Factory setting: Abort
Min. meas. press. Display	Displays the lowest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Max. meas. press. Display	Displays the highest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Reset peakhold Selection	You can reset the "Min. meas. press." and "Max. meas. press." indicators with this parameter. Options: ▪ Abort ▪ Confirm Factory setting: Abort

Parameter name	Description
Operating hours Display	Displays the hours of operation. This parameter cannot be reset.
Config. counter Display	Displays the configuration counter. This counter is increased by one every time a parameter or group is changed. The counter counts up to 65535 and then starts again at zero.

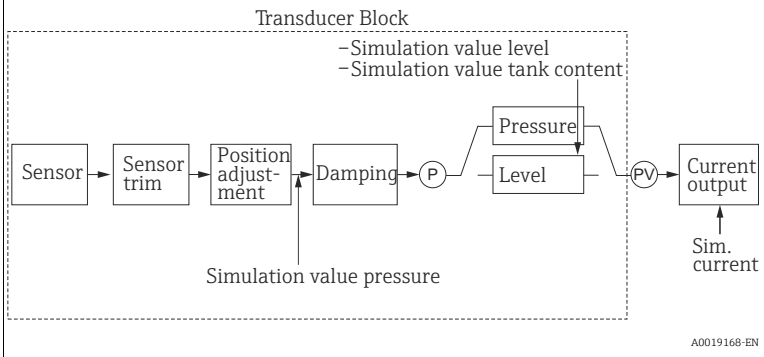
Expert → Diagnosis → Diagnostic list

Parameter name	Description
Diagnostic 1 Diagnostic 2 Diagnostic 3 Diagnostic 4 Diagnostic 5 Diagnostic 6 Diagnostic 7 Diagnostic 8 Diagnostic 9 Diagnostic 10	These parameters contain up to ten diagnosis messages that are currently pending, arranged in order of priority.

Expert → Diagnosis → Event logbook

Parameter name	Description
Last diag. 1 Last diag. 2 Last diag. 3 Last diag. 4 Last diag. 5 Last diag. 6 Last diag. 7 Last diag. 8 Last diag. 9 Last diag. 10	These parameters contain the last 10 diagnosis messages to occur and be rectified. They can be reset with the "Reset logbook" parameter. Errors which have occurred several times are indicated only once.

Expert → Diagnosis → Simulation

Parameter name	Description
Simulation mode Selection	Switch on simulation and select the simulation mode. Any simulation running is switched off if the measuring mode or level selection ("in pressure" or "in height" is changed. Option: ▪ None ▪ Pressure → see also this table, "Sim. pressure" parameter ▪ Level → see this table, "Sim. level" parameter ▪ Tank content → see this table, "Sim. tank cont." parameter ▪ Current → see this table, "Sim. current" parameter ▪ Alarm/warning → see this table, "Sim. error no." parameter  Factory setting: None
Sim. pressure Entry	Enter the simulation value. → See also "Simulation mode". Prerequisite: ▪ "Simulation mode" = Pressure Factory setting: Current pressure measured value
Sim. level Entry	Enter the simulation value. → See also "Simulation mode". Prerequisite: ▪ "Measuring mode" = Level and "Simulation mode" = Level
Sim. tank cont. Entry	Enter the simulation value. → See also "Simulation mode". Prerequisites: ▪ "Measuring mode" = Level, "Activate table" lin. mode and "Simulation mode" = Tank content.
Sim. current Entry	Enter the simulation value. → See also "Simulation mode". Prerequisite: ▪ "Simulation mode"= Current value Factory setting: Current value of the current
Sim. alarm/warning Entry	Enter the diagnostic message number. → See also "Simulation mode". Prerequisite: ▪ "Simulation mode"= Alarm/warning Factory setting: 484 (simulation active)

Index

A
Accessories 52
Additional weight 53
Adjust density 70
Alarm behavior 72
Auto dens. corr. 77

B
Basic settings 25
Burst mode 74
Burst option 74
Bus address. 74

C
Cable marking 54
Cable specification 16
Calibration mode 68
Code definition 23, 64
Config. counter 78
Configuring the damping 26
Connecting Commubox FXA195 19
Connecting Field Xpert SFX 19
Connecting the device 14
Connection data 15
Corrected press. 67
Curr. trim 20mA 74
Curr. trim 4mA. 73
Current consumption 16
Current mode 74

D
Damping value 66
Density unit 69
Description 75
Device revision 75
Device tag 64
Device type code. 75
Diagnostic 78
Diagnostic code 77

E
Edit table. 71
Electr. delta P 76
Electr. serial no. 64
Empty calib. 69
Empty height 69
Empty pressure 69
ENP version 64
Enter reset code 65
Ext. order code 64

F
Factory setting 23
FieldCare 22
Firmware version 64
Fixed ext. value 77
Full calib.. 69
Full height 69
Full pressure 69

G
Get LRV. 73
Get URV 73

H
HART config. 74
HART date 75
HART input 76
HART input form. 76
HART input stat. 76
HART input unit 76
HART input value 76
HART message 75
HART output 75
HART revision 75
Height unit 68
Hi trim measured 72
Hi trim sensor 72
High alarm curr. 72

I
Incoming acceptance and product identification. 6
Installation 9

L
Last diag. code 77
Last diagnostic. 78
Level before lin 70
Level measurement. 29
Level selection 68
Lin. mode 70
Linearization 44
Line-numb.. 71
Lo trim measured 72
Lo trim sensor 72
Load 17
Locking 23
Lower range limit 72

M
Manufacturer ID 75
Max. meas. press. 77
Meas. pressure. 67
Measuring mode 25, 65
Min. meas. press. 77
Mounting the extension cable mounting screw 11
Mounting the mounting clamp 10
Mounting the terminal box 12
Mounting the TMT182 temperature transmitter 12

N
Nameplate 6

O
Offset trim 20mA 74
Offset trim 4mA 74
Operating hours 78
Operating menu 56
Operator code 23, 64
Order identifier 64
Output current 72
Output fail mode 72
Output unit 68
Overvoltage protection 18

P
Pos. zero adjust 66
Position adjustment 26
Power consumption 16
Preamble number 75
Press. eng. unit 25, 66
Pressure after damping 67
Pressure measurement 27
Process density 70
Process value 75
Product identification 6

R
Reset 23
Reset logbook 77
Reset peakhold 77
Return 52

S
Safety instructions 5
Sensor pressure 67
Sensor serial no. 64
Sensor temp. 66
Serial number 64
Set LRV 67, 73
Set min. current 73
Set URV 67, 73
Sim. current 79
Sim. error no. 79
Sim. level 79
Sim. pressure 79
Sim. tank cont. 79
Simulation mode 79
Software history 51
Spare parts 52
Start current 73
Supply voltage 16
symbols and safety icons 3

T
Tank content 71
Tank description 71
Temp. eng. unit 66
Transport 8
Troubleshooting 48

U
Unit after lin 70
Unlocking 23
URL sensor 72

X
X-value 71

Y
Y-value 71



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