Brief Operating Instructions
Liquicap M
FMI51 HART

Capacitive Level Measurement

Endress+Hauser [EH]

People for Process Automation

1.		Order code: XXXXX-XXXXXX
		Ser. no.: XXXXXXXXXXXX
		Ext. ord. cd.: XXX.XXXX.XX

Endress+Hauser

Serial number

2. www.endress.com/deviceviewer

Endress+Hauser
Operations App

Download on the
App Store

ANDROID APP ON
Google Play

3.

A0023555

Table of contents

1   About this document

1.1   Document conventions

1.1.1   Safety symbols

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

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

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

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

1.1.2   Electrical symbols

∼

Alternating current

≂

Direct current and alternating current

⎓

Direct current

⏚

Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

⏚ **Protective earth (PE)**

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:
• Interior ground terminal: protective earth is connected to the mains supply.
• Exterior ground terminal: device is connected to the plant grounding system.

1.1.3   Tool symbols

✚ ✎
Phillips head screwdriver

➖ ✎
Flat blade screwdriver

Torx screwdriver

Allen key

Open-ended wrench

1.1.4   Symbols for certain types of information and graphics

Permitted
Procedures, processes or actions that are permitted

Preferred
Procedures, processes or actions that are preferred

Forbidden
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1. , 2. , 3.
Series of steps

└▶
Result of a step

Operation via operating tool

Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

⚠ → 📖
Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

# 2 Incoming acceptance and product identification

2.1 Incoming acceptance

Check whether the packaging or content is damaged. Check that the goods delivered are complete and compare the scope of delivery with the information in your order.

2.2 Product identification

The measuring device can be identified in the following ways:

- nameplate data
- extended order code with a breakdown of the device features on the delivery note
- the serial number from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer: all of the information on the measuring device is displayed along with an overview of the scope of the technical documentation provided
- the serial number on the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) on the nameplate
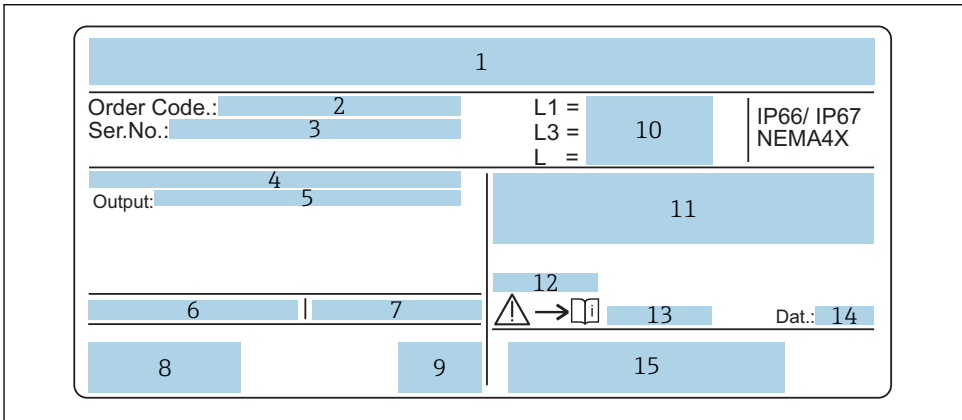
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🖼 *1 The Liquicap M nameplate*

2 Order number
3 Serial number
4 Electronic insert
5 Electronic insert output value
6 Ambient temperature at housing
7 Max. permissible pressure in tank
8 Safety certificates
9 Functional safety
10 Probe length values
11 ATEX approval
12 WHG approval (German Water Resources Act)
13 Safety information
14 Production date
15 Bar code

2.3   Storage and transport

For storage and transportation, pack the device in such a way as to protect it against impact. The original packaging offers the best protection for this. The permitted storage temperature is −50 to +85 ℃ (−58 to +185 ℉) ±5 ℃ (±8 ℉).

# 3   Mounting

3.1   Mounting requirements

3.1.1   Mounting the sensor

The Liquicap M FMI51 can be installed from the top or from the bottom.

Make sure that:
- the probe is not installed in the area of the filling curtain
- the probe is not in contact with the container wall
- the distance from the container floor is ≥10 mm (0.39 in)
- multiple probes are mounted next to each other at the minimum distance between the probes of 500 mm (19.7 in)
- the probe is at a sufficient distance from the agitator if using the probe in agitator tanks
- the rod probes with a ground tube are used in the event of severe lateral load
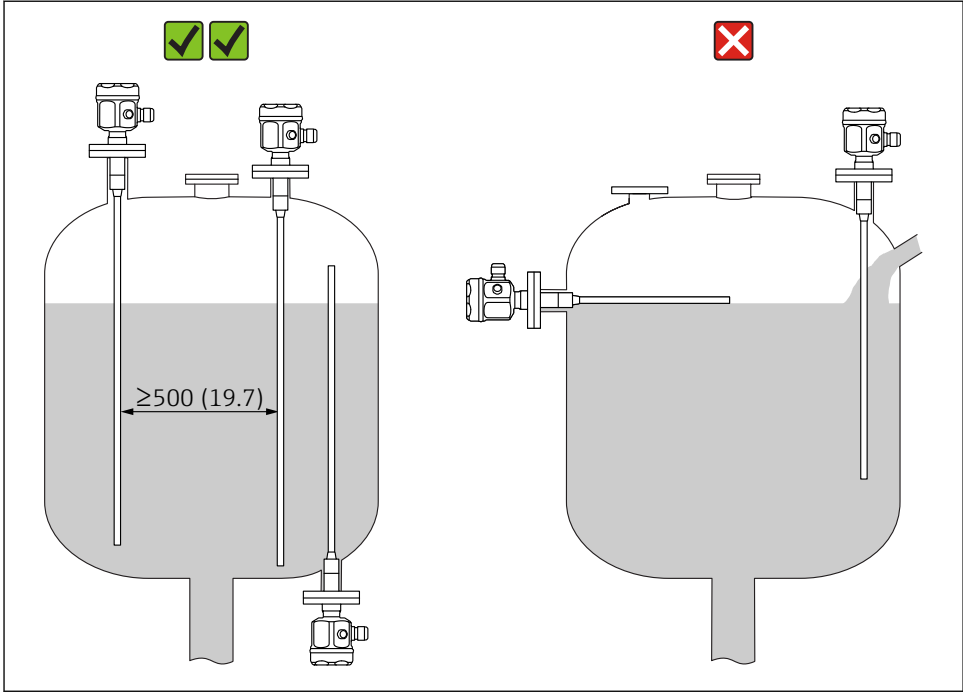
A0040392

Unit of measurement mm (in)

3.1.2   Support with marine approval (GL)

Conductive or nonconductive support can be provided for fully insulated rod probes. Partially insulated rod probes may only be supported with insulation at the uninsulated end of the probe.

ℹ️ Rod probes with a diameter of 10 to 16 mm (0.39 to 0.63 in) and a length ≥ 1 m (3.3 ft) have to be supported, see → 🖹 9
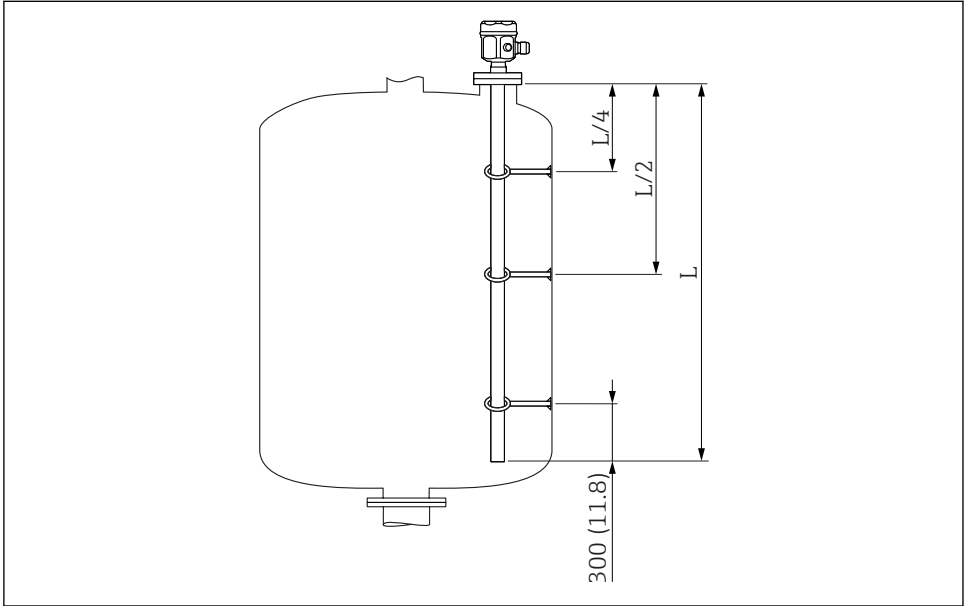
Unit of measurement mm (in)

L/4   ¼ probe length
L/2   ½ probe length
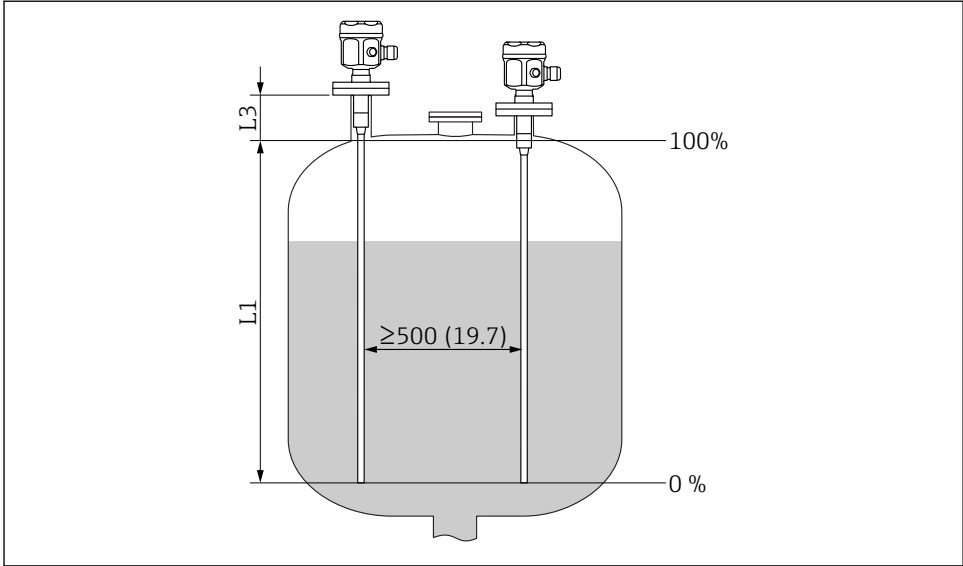*L   Active probe length*

Example of calculating distances
- probe length L = 2 m (6.6 ft)
- L/4 = 500 mm (19.7 in)
- L/2 = 1 m (3.3 ft)
  Measured from the end of the probe rod = 300 mm (11.8 in).

3.2   Measuring condition

Measuring range L1 is possible from the tip of the probe to the process connection.

Particularly suited for small containers.

Use a ground tube for nonconductive media.

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Unit of measurement mm (in)

L1   Measuring range
L3   Inactive length

ℹ️ When installing in a nozzle, use inactive length (L3).

The 0 % and 100 % calibration can be inverted.

3.3   Installation examples

3.3.1   Rod probes

The probe can be installed in:

• conductive tanks made from metal
• nonconductive tanks made from plastic

If the process connection of the probe is insulated from the metal tank using a seal material, then the ground connection on the probe housing must be connected to the tank using a short line.

If the probe is installed in a plastic tank, then a probe with the ground tube must be used. The probe housing must be grounded.

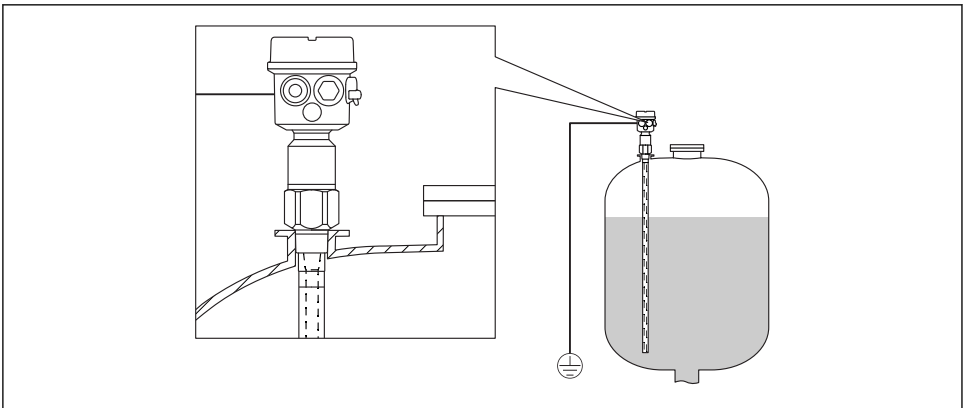ℹ️ A fully insulated rod probe may be neither shortened nor extended.

Damaged insulation of the probe rod causes improper measurements.

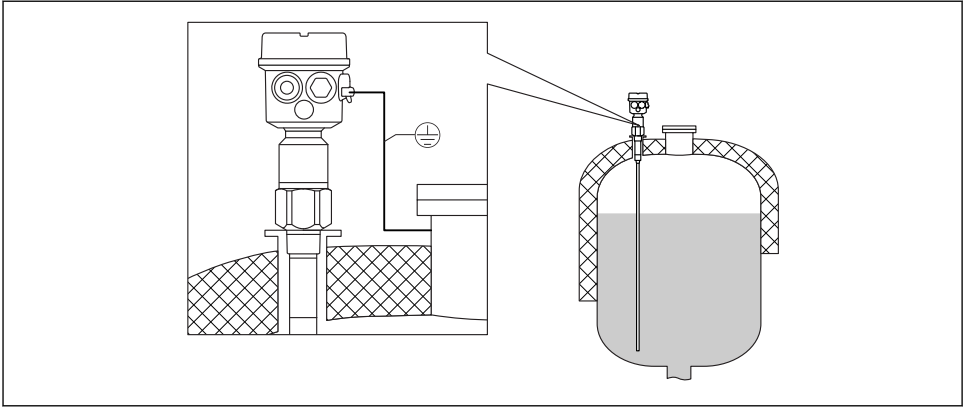The following application examples show the vertical installation for continuous level measurement.
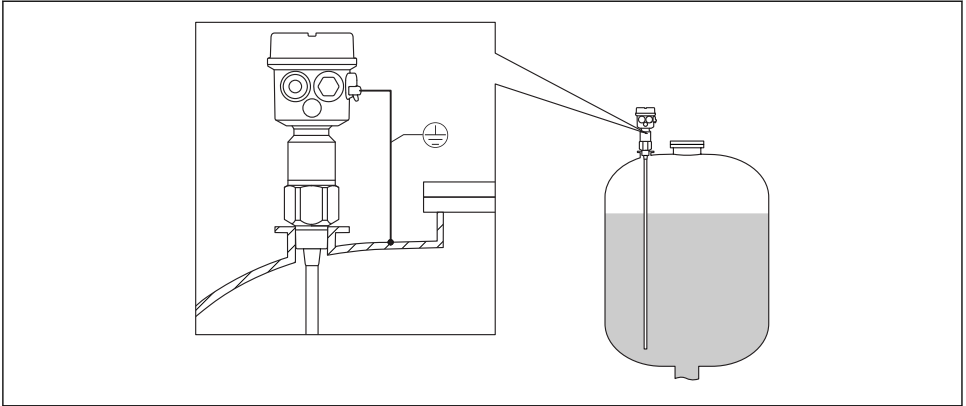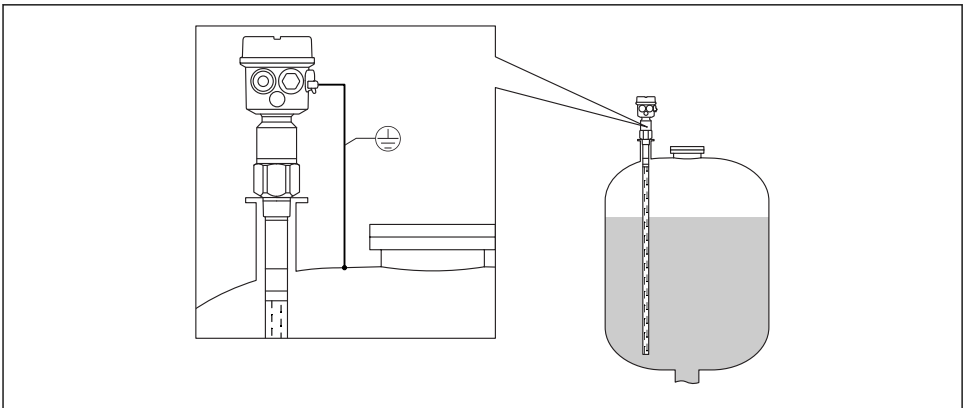
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🖼 *2   A probe with the conductive tanks*

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🖼 *3   A probe with the ground tube for the nonconductive tanks*
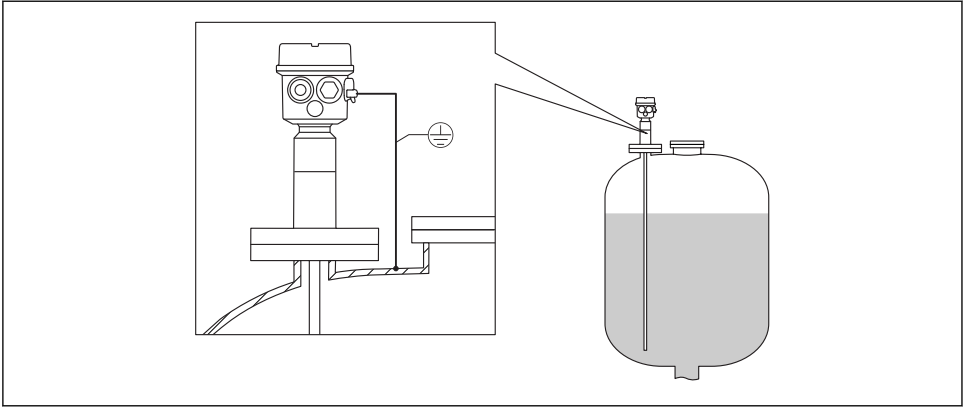
A0040427

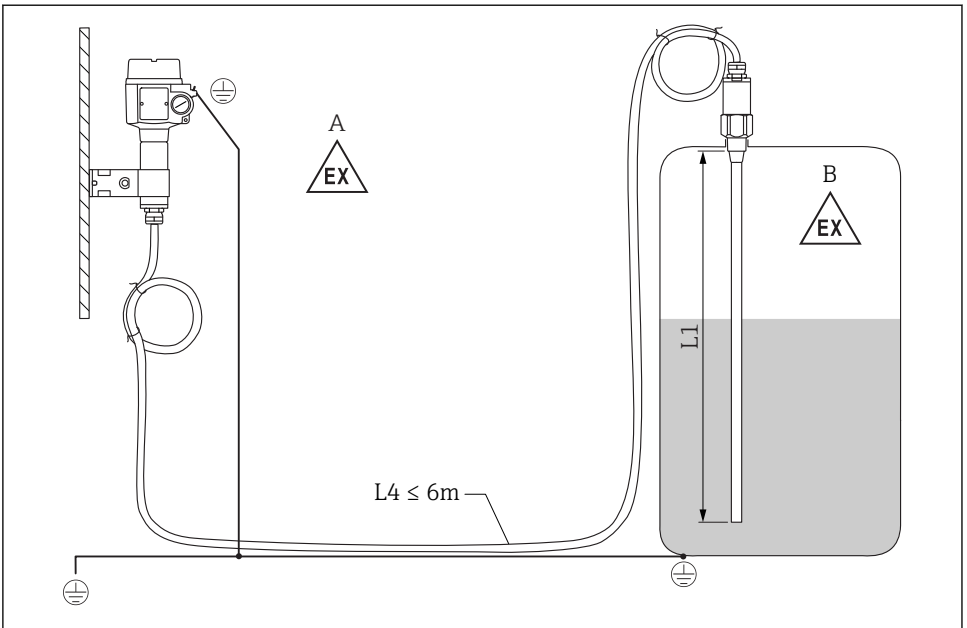🖾 *4   A probe with the inactive length for the insulated tanks*

A0040428

🖾 *5   A probe with ground tube and inactive length for mounting nozzles*

A0040429

🖼 *6   A probe fully insulated with clad flange for aggressive media*

3.4   Probe with separate housing

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🖼 *7   Connection of the probe and separate housing*

A   Explosive zone 1
B   Explosive zone 0
L1   Rod length: max. 4 m (13 ft)
L4   Cable length

The maximum cable length L4 and rod length L1 cannot exceed 10 m (33 ft).

ℹ️ The maximum cable length between the probe and separate housing is 6 m (20 ft). The required cable length must be indicated in the ordering process of a Liquicap M with separate housing.

If the cable connection has to be shortened or led through a wall, then it must be separated from the process connection.

3.4.1   Extension heights: separate housing

ℹ️ The cable has:
- a minimum bending radius of $r \geq 100$ mm (3.94 in)
- diameter $\varnothing$ 10.5 mm (0.14 in)
- outer jacket made of silicone, notch resistance
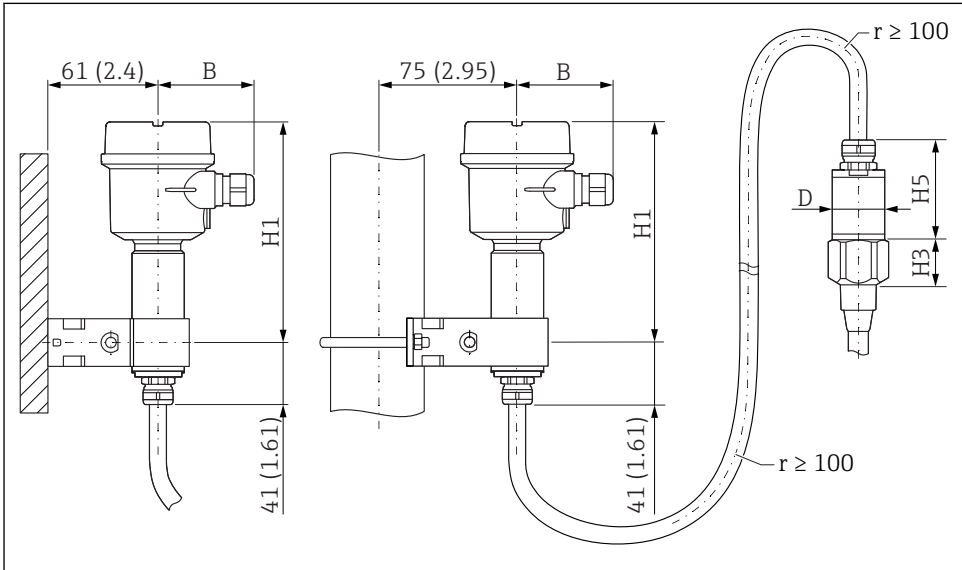
⊡ 8   *Housing side: wall mounting, pipe mounting, and sensor side. Unit of measurement mm (in)*

The parameters value [1]:

---

1)   See parameters on the drawings.

B parameter
- polyester housing (F16)
  76 mm (2.99 in)
- stainless steel housing (F15)
  64 mm (2.52 in)
- aluminum housing (F17)
  65 mm (2.56 in)

H1 parameter
- polyester housing (F16)
  172 mm (6.77 in)
- stainless steel housing (F15)
  166 mm (6.54 in)
- aluminum housing (F17)
  177 mm (6.97 in)

D parameter
- probes Ø10 mm (0.39 in) rod
  38 mm (1.5 in)
- probes Ø16 mm (0.63 in) rod, without fully insulated inactive length
  - 38 mm (1.5 in)
  - threads: G¾", G1", NPT¾", NPT1", Clamp 1", Clamp 1½", Universal Ø44 mm (1.73 in), flange < DN50, ANSI 2", 10K50
- probes Ø16 mm (0.63 in) rod, without fully insulated inactive length
  - 50 mm (1.97 in)
  - threads: G1½", NPT1½", Clamp 2", DIN 11851, flange ≥ DN50, ANSI 2", 10K50
- Probes Ø22 mm (0.87 in) rod, with fully insulated inactive length
  38 mm (1.5 in)

H5 parameter
- probes Ø10 mm (0.39 in) rod
  66 mm (2.6 in)
- probes Ø16 mm (0.63 in) rod, without fully insulated inactive length
  - 66 mm (2.6 in)
  - threads: G¾", G1", NPT¾", NPT1", Clamp 1", Clamp 1½", Universal Ø44 mm (1.73 in), flange < DN50, ANSI 2", 10K50
- probes Ø16 mm (0.63 in) rod, without fully insulated inactive length
  - 89 mm (3.5 in)
  - threads: G1½", NPT1½", Clamp 2", DIN 11851, flange ≥ DN50, ANSI 2", 10K50
- probes Ø22 mm (0.87 in) rod, with fully insulated inactive length
  89 mm (3.5 in)

3.4.2   Wall bracket

The wall bracket is part of the scope of delivery.

The wall bracket must be screwed first to the separate housing before you can use it as a drilling template.
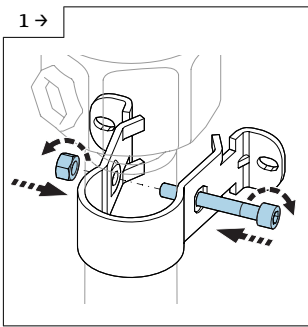
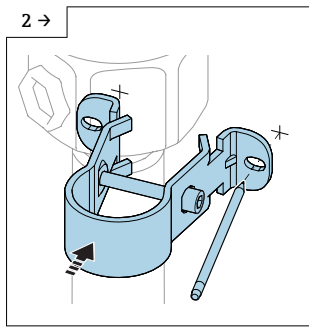The distance between the holes is reduced by screwing it to the separate housing.
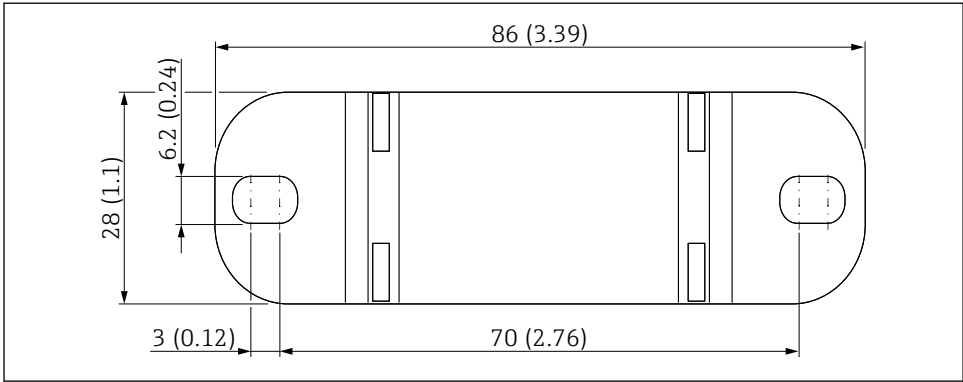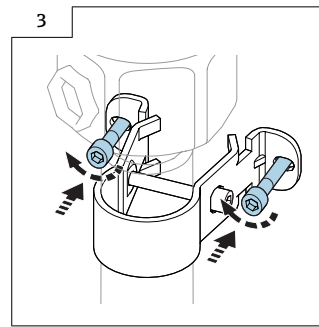
Unit of measurement mm (in)

3.4.3 Wall mounting

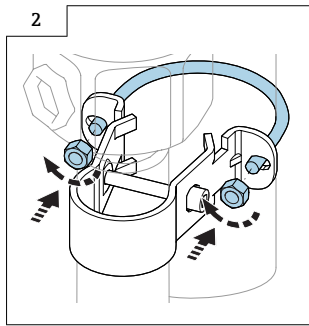### 3.4.4 Pipe mounting

ℹ️ The maximum pipe diameter is 50.8 mm (2 in).
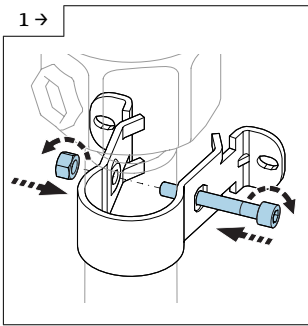
3.4.5   Shortening the connecting cable

NOTICE

Risk of damage to connections and cable.

▶ Make sure that neither the connecting cable nor the probe is turning with the pressing screw!

ℹ️ Recalibration must be performed before commissioning.

The maximum connection length between the probe and the separate housing is 6 m (20 ft).

When ordering a device with separate housing, the desired length must be specified.

If the cable connection has to be shortened or led through a wall, it must be separated from the process connection.

Disconnecting the connection cable

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A0042114   A0042115   A0042116

A0042117

A0042118

A0042119
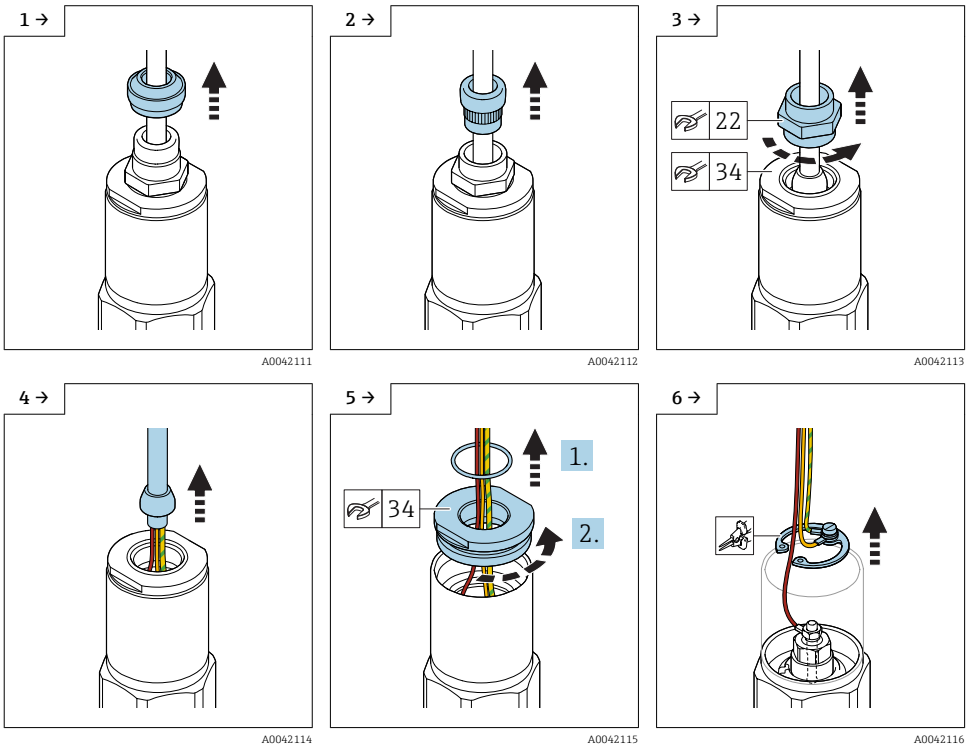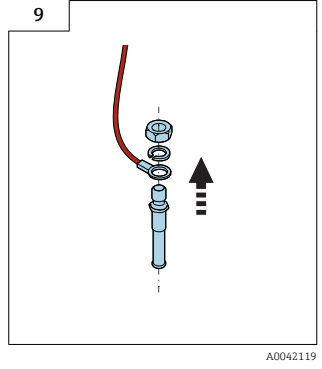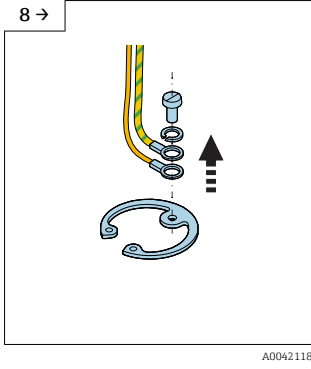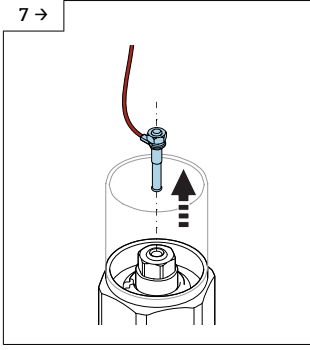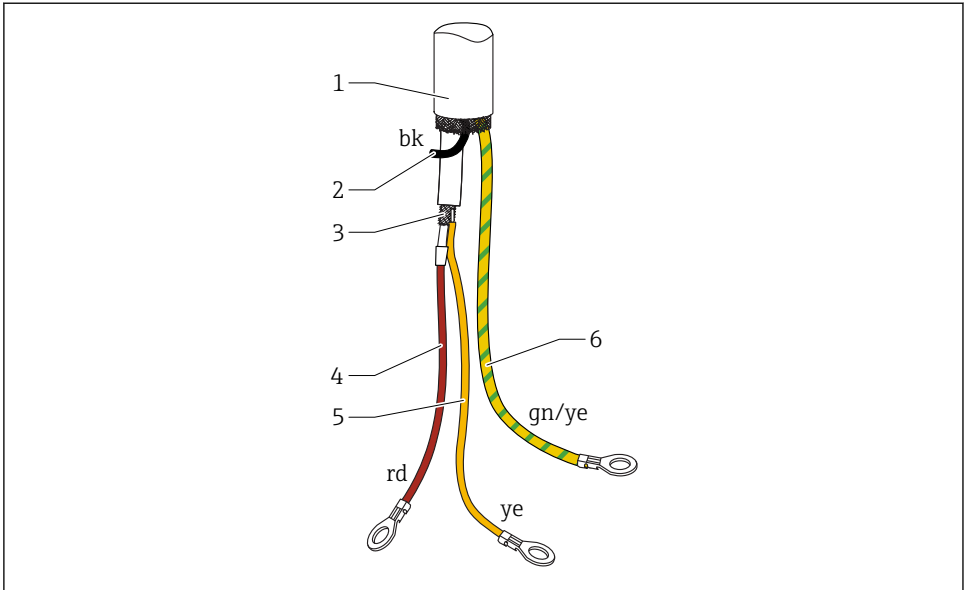
A0040734

⊡ *9   Cable connections*

1   External screening (not required)
2   Strand black (bk) (not required)
3   Coaxial cable with central core a screening
4   Solder the red (rd) strand with the central core of the coaxial cable (probe)
5   Solder the strand with the screening of the yellow (ye) coaxial cable (ground)
6   Strand yellow and green (gn/ye) with a ring terminal

ℹ️   We recommend reusing all strands with ring terminals in case of shortening the connecting cable.

To avoid the risk of short-circuiting when the strands are not to be reused, the connections of the new ring terminals fitted must be isolated with a heat shrinking sleeve.

Use heat-shrink tubes to insulate all soldered joints.

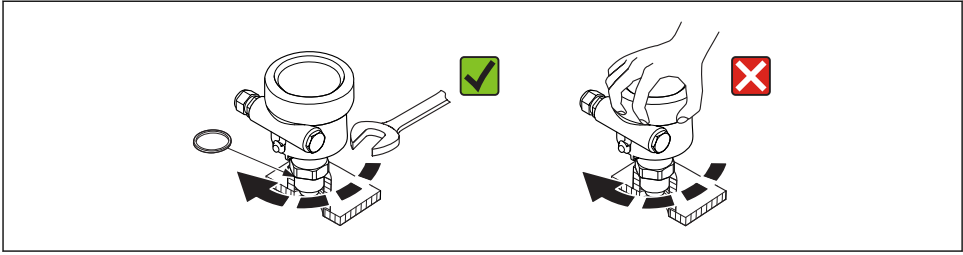## 3.5   Installation instructions

NOTICE

Do not damage the probe insulation during installation!
▶ Check the rod insulation.

NOTICE

Do not screw the probe using the probe housing!
▶ Use an open-end wrench to screw the probe.

3.5.1 Probe installation

Probe with thread

Cylindrical threads G½, G¾, G1, G1½

To be used with the elastomer fiber seal supplied or another chemically resistant seal. Make sure that the temperature resistance of a seal is correct.

ℹ️ The following applies to probes with a parallel thread and supplied seal:

Thread G½
- for pressures up to 25 bar (362.5 psi): 25 Nm (18.4 lbf ft)
- maximum torque: 80 Nm (59.0 lbf ft)

Thread G¾
- for pressures up to 25 bar (362.5 psi): 30 Nm (22.1 lbf ft)
- maximum torque: 100 Nm (73.8 lbf ft)

Thread G1
- for pressures up to 25 bar (362.5 psi): 50 Nm (36.9 lbf ft)
- maximum torque: 180 Nm (132.8 lbf ft)

Thread G1½
- for pressures up to 100 bar (1 450 psi): 300 Nm (221.3 lbf ft)
- maximum torque: 500 Nm (368.8 lbf ft)

Conical threads ½ NPT, ¾ NPT, 1 NPT, 1½ NPT

Wrap the thread with a suitable sealing material. Use conductive sealing material only.

Probe with Tri-Clamp, sanitary connection or flange

The process seal must meet the specifications of the application. Check the seal's resistance to temperature and medium.
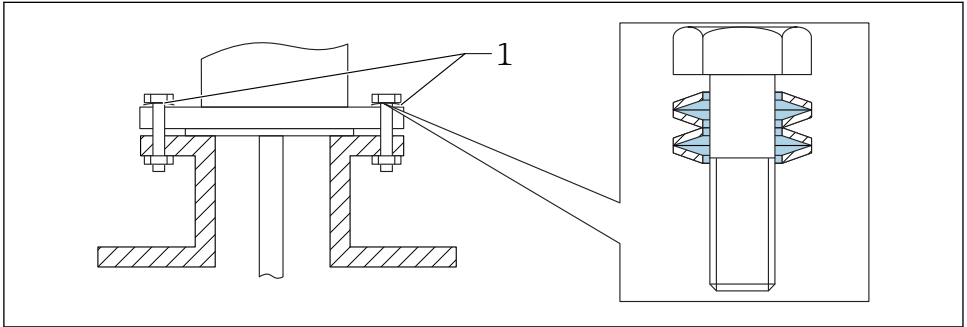
If the flange is PTFE-clad, this generally suffices as the seal up to the permitted operating pressure.

Probe with PTFE-clad flange

ℹ️ Use spring washers!

Depending on process pressure and process temperature, check and re-tighten the screws at regular intervals.

Recommended torque: 60 to 100 Nm (44.3 to 73.8 lbf ft).
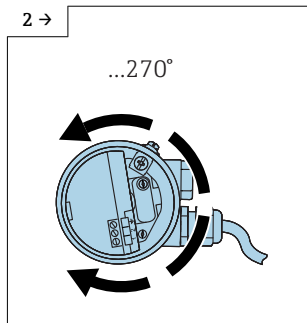

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1   Spring washer

3.5.2   Aligning the housing

The housing can be rotated 270 ˚ to align with the cable entry. To prevent moisture penetration, route the connecting cable downwards in front of the cable gland and secure it with a cable tie. This is particularly recommended for outdoor mounting.

Aligning the housing
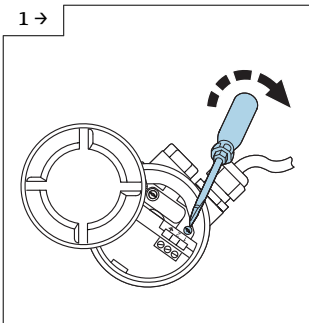
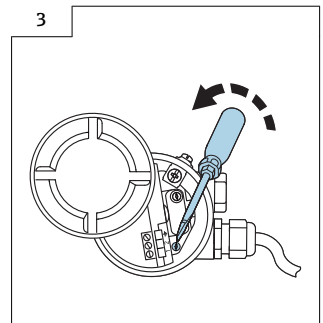A0042107   A0042108   A0042109

> The clamping screw for aligning the housing type T13 is located in the electronics compartment.

3.5.3   Sealing the probe housing

Make sure that the cover is sealed. Water cannot enter into the device when performing installation, connection and configuration tasks. Always seal the housing cover and cable entries securely.

The O-ring seal on the housing cover is shipped with a coat of special lubricant applied. In this way, the cover can be sealed tight and the aluminum thread does not bite when screwing down.

Never use mineral oil-based grease as this destroys the O-ring.

3.6   Post-installation check

After installing the measuring device, carry out the following checks:

❑ Do a visual check for damages.

❑ Does the device meet the specifications at the measuring point with regard to process temperature and pressure, ambient temperature, measuring range?

❑ Has the process connection been tightened with the tightening torque?

❑ Check if the measuring points are correctly labeled.

❑ Is the device adequately protected against precipitation and direct sunlight?

4   Electrical connection

Before connecting the power supply, note the following:
- the supply voltage must match the data specified on the nameplate
- switch off the supply voltage before connecting the device
- connect the potential equalization to the ground terminal on the sensor

When using the probe in hazardous areas, the relevant national standards and the information in the safety instructions (XA) must be observed.

Use the specified cable gland only.

4.1   Connecting requirements

4.1.1   Potential equalization

⚠ DANGER

Risk of explosion!
▸ Connect the cable screen on the sensor side only!

Connect the potential equalization to the outer ground terminal of the housing (T13, F13, F16, F17, F27). In the case of the stainless steel housing F15, the ground terminal can also be located in the housing. For further safety instructions, please refer to the separate documentation for applications in hazardous areas.

4.1.2   Electromagnetic compatibility (EMC)

Interference emission to EN 61326, Electrical Equipment Class B. Interference immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC).

Failure current is accordance to NAMUR NE43: FEI50H = 22 mA.

A standard commercial instrument cable can be used.

📖 Information on connecting shielded cables is provided in Technical Information TI00241 "EMC test procedures".

4.1.3   Cable specification

Connect the electronic inserts by using commercially available instrument cables. If a potential equalization is present, and the shielded instrument cables are used, connect the shielding on both sides to optimize the shielding effect.
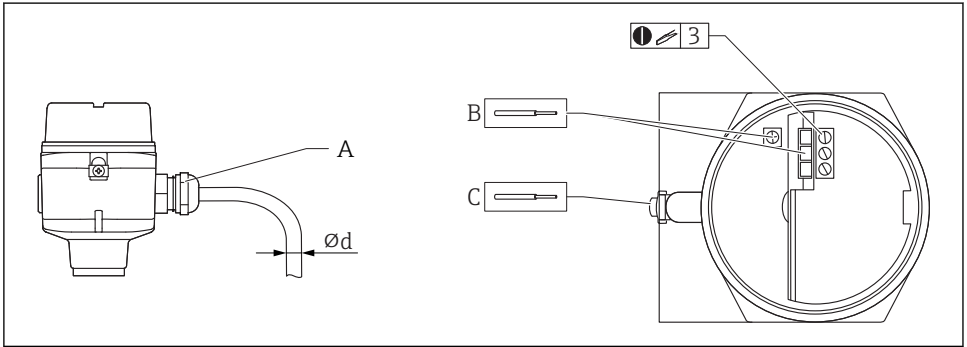
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A   Cable entry
B   Electronic insert connections - cable size max. 2.5 mm² (14 AWG)
C   The ground connection outside the housing, cable size max. 4 mm² (12 AWG)
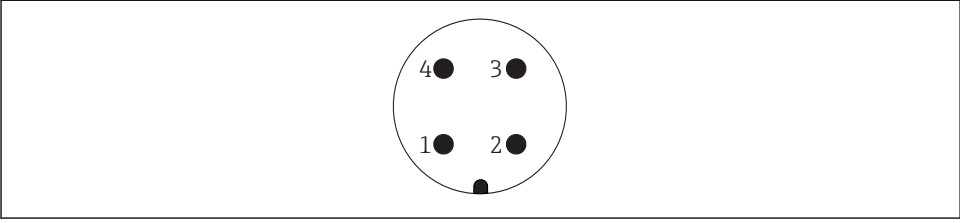*Ød   Cable diameter*

Cable entries
- nickel-plated brass
  Ød = 7 to 10.5 mm (0.28 to 0.41 in)
- synthetic material
  Ød = 5 to 10 mm (0.2 to 0.38 in)
- stainless steel
  Ød = 7 to 12 mm (0.28 to 0.47 in)

4.1.4   Connector

For the version with a connector M12, the housing does not have to be opened for connecting the signal line.

PIN assignment for M12 connector

A0011175

1   Positive potential
2   Not used
3   Negative potential
4   Ground

4.1.5   Supply voltage

All of the following voltages are terminal voltages directly at the device:

- 12.0 to 36.0 V_{DC} in the non-hazardous area
- 12.0 to 30.0 V_{DC} in the Ex ia hazardous area
- 14.4 to 30.0 V_{DC} in the Ex d hazardous area

4.2   Wiring and connecting

4.2.1   Connection compartment

Depending on explosion protection, the connection compartment is available in the following variants:

Standard protection
- polyester housing F16
- stainless steel housing F15
- aluminum housing F17
- aluminum housing F13
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment

Ex ia protection
- polyester housing F16
- stainless steel housing F15
- aluminum housing F17
- aluminum housing F13
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment

Ex d protection
- aluminum housing F13
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment

Gas-tight process seal
- aluminum housing F13
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment
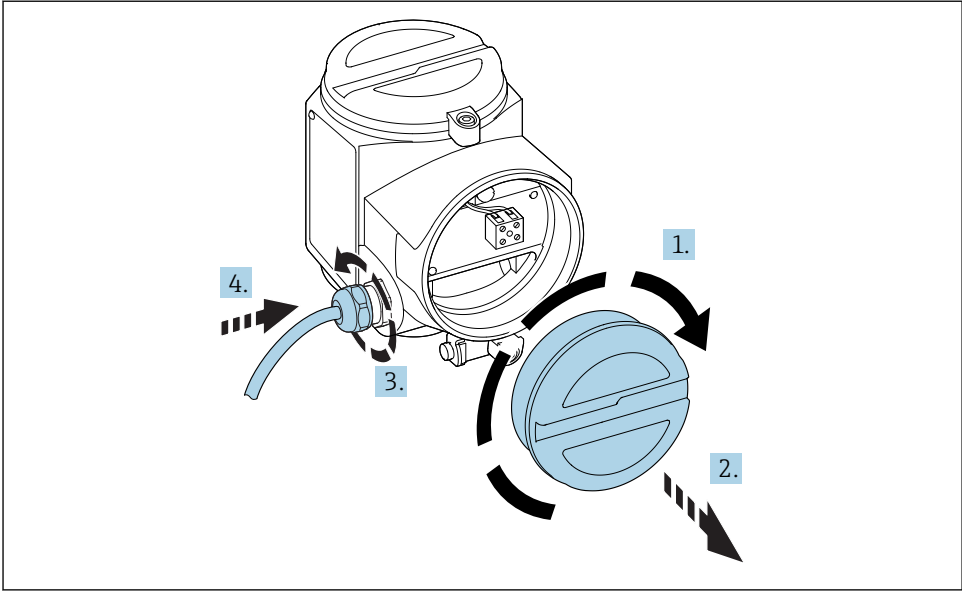
To connect the electronic insert to the power supply:
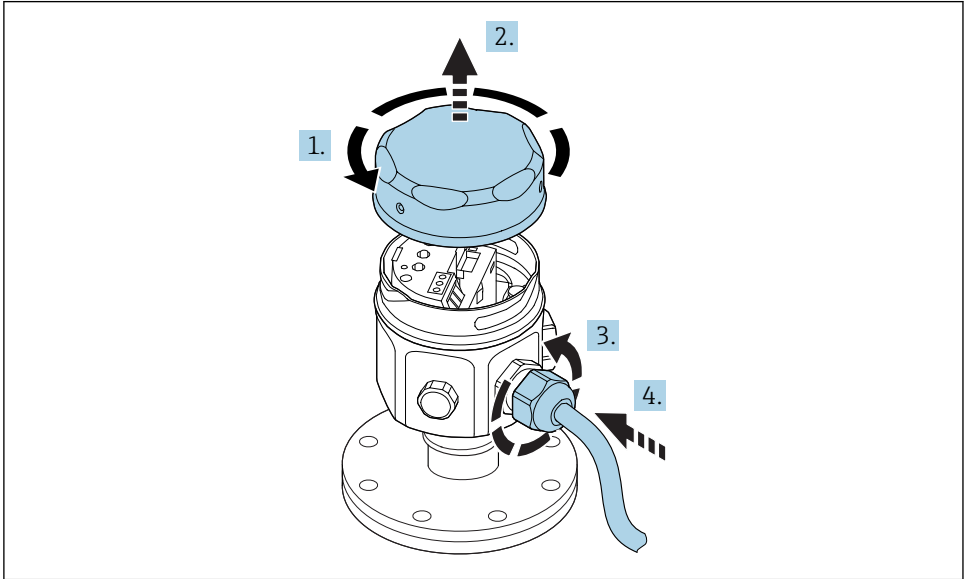
A0040635

1.	Unscrew the housing cover.
2.	Remove the housing cover.
3.	Release the cable gland.
4.	Insert the cable.

ℹ️ Applies to the housing T13.

To connect the electronic insert to the power supply:

A0040637

1.	Unscrew the housing cover.
2.	Remove the housing cover.
3.	Release the cable gland.
4.	Insert the cable.

### 4.2.2   Terminal assignment

2-wire, 4 to 20 mA with HART

The twin-core connecting cable is connected to the screw terminals with conductor cross-section 0.5 to 2.5 mm² (20 to 13 AWG) in the connection compartment at the electronic insert. If the superimposed communication signal (HART) is used, a shielded cable must be used with the shielding connected at the sensor and power supply. Protective circuits against reverse polarity, HF influences, and overvoltage peaks are integrated.
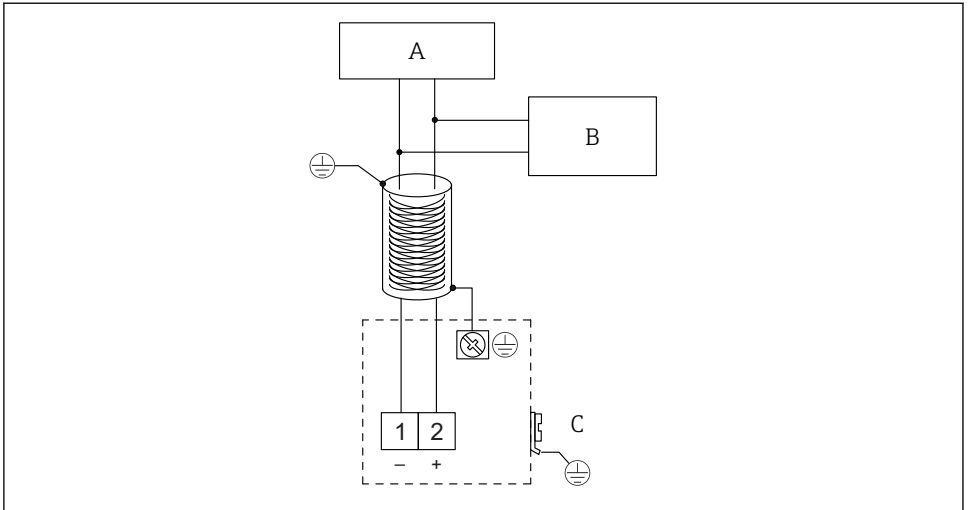
A0040479

A   *Supply voltage, communication resistor 250 Ω*
B   *Commubox FXA195*
C   *Grounding terminal*

4.2.3 Connecting HART with other supply units
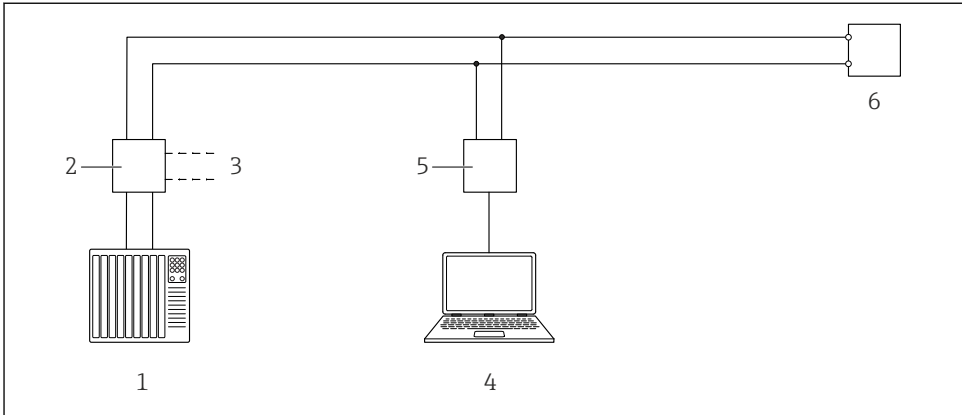
A0040750

⊠ *10   Remote control via HART protocol*

1   PLC
2   Transmitter power supply unit e.g. RN221N with communication resistor
3   Connection output for Commubox FXA191, FXA195
4   Computer with control software (DeviceCare or FieldCare, AMS Device Manager, SIMATIC PDM)
5   Commubox FXA191 (RS232) or FXA195 (USB)
6   Transmitter

> If the HART communication resistor is not integrated with the supply unit, a 250 Ω communication resistor must be included in the 2-wire line.

4.3 Post-connection check

After wiring the measuring device, carry out the following checks:

❑ Is the terminal assignment correct?

❑ Is the cable gland sealed tight?

❑ Is the housing cover fully screwed?

❑ Is the device operational and is the green LED flashing when the device is on?

5 Operation options

5.1 Overview of operation options

This device can operate with:

- the operating elements at the FEI50H electronic insert
- the display and operating module
- the HART protocol with Commubox FXA195 and FieldCare operating program
- the HART handheld terminal DXR375

5.1.1 Display and operating elements at the FEI50H electronic insert
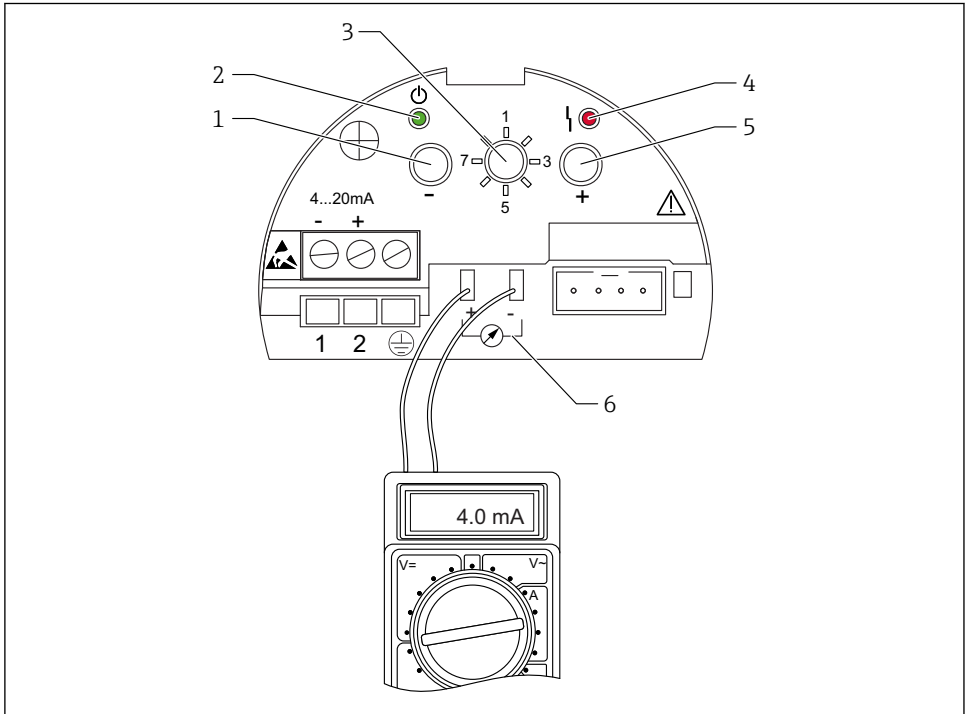
⊡ 11   FEI50H electronic insert

1   Key ⊟
2   Green LED - operational status
3   Mode switch
4   Red LED - fault
5   Key ⊞
6   Current pick-off 4 to 20 mA

Function switch
- 1: Operation
  select for normal operation
- 2: Empty calibration
  select to set empty calibration
- 3: Full calibration
  select to set full calibration
- 4: Measuring modes
  select to choose between operation for media that form buildup (e.g. yogurt) or for media
  without buildup (e.g. water)
- 5: Measuring range
  select the measuring range in pF for:
  - measuring range probe length < 6 m (20 ft) corresponds to 2 000 pF
  - measuring range probe length > 6 m (20 ft) corresponds to 4 000 pF
- 6: Self-test
  select to activate the self-test
- 7: Reset - factory settings
  select to restore the factory settings
- 8: Upload sensor DAT (EEPROM)
  - select to transfer the calibration values in the electronic insert to the sensor DAT
    (EEPROM) if replacing the probe
  - select to transfer the calibration values of the sensor DAT (EEPROM) to the electronics if
    replacing the electronic insert

Red LED - indicates a fault or malfunction
- flashes 5x per second
  capacity at probe is too large, short-circuit at the probe or FEI50H is defective
- flashes 1x per second
  the temperature in the electronic insert is outside the permitted temperature range

Key ⊞
press to execute the functions set via the function switch

Display connector
connector dedicated for optional onsite display and operating module

Current pick-off 4 to 20 mA
connect the multimeter for full or empty calibration without disconnecting the main circuit
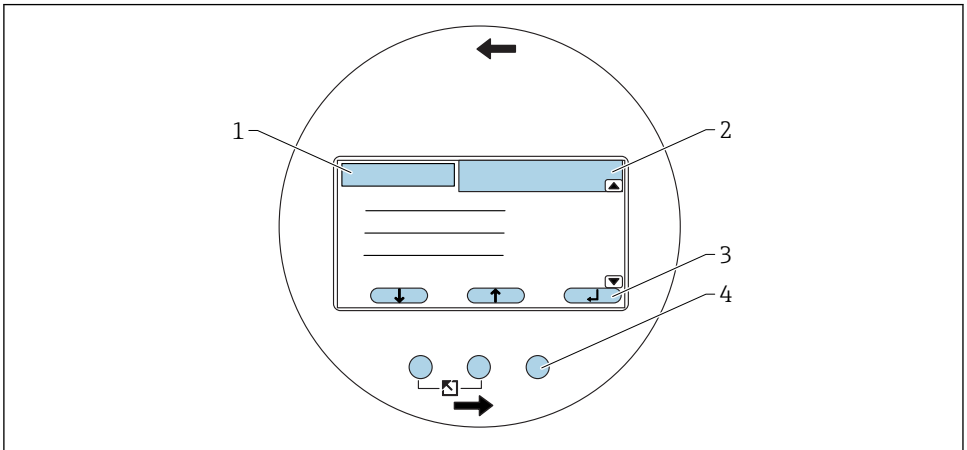
Key ⊟
press to execute the functions set via the function switch

Green LED - indicates operation
- flashes 5x per second
  the device operates
- flashes 1x per second
  the device is in the calibration mode

5.1.2   Operation via the optional display and operating module

Display and operating elements

A0040480

⊡ *12   Display and operating elements*

1   Menu title
2   Item code of a displayed function
3   Key symbols
4   Hardware keys

Symbols on the display

Operating mode of the device
- **User** ⟦🔲⟧
  user parameters can be edited
- **Lock** ⟦🔲⟧
  all parameters are locked
- **Scrollbar** ⟦▽⟧ ⟦△⟧
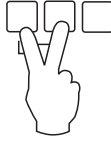 scroll up or down to access more functions

Locking state of the currently displayed parameter
- **Display parameter** ⟦🔲⟧
  the parameter cannot be edited in the current operating mode of the device
- **Write parameter** ⟦🔲⟧
  the parameter can be edited

Hardware key combinations

The following hardware key combinations apply regardless of the menu item in question:

Escape

A0032709

1   Due to editing a function: exits the editing mode for the current function
2   Due to navigating: returns to the next-highest menu level

Increase contrast

A0032710

Increases the contrast of the display module

Decrease contrast

A0032711

Decreases the contrast of the display module

Locking and unlocking

A0032712

1   Locks the device against parameter changes
2   Press all three keys to unlock the device

5.2   Operation via FieldCare Device Setup

5.2.1   Function scope

FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field devices in a system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

📖 For additional information about FieldCare, see Operating Instructions BA00027S and BA00059S

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

5.2.2   Source for device description files

- www.endress.com → Downloads
- CD–ROM (contact Endress+Hauser)
- DVD (contact Endress+Hauser)

6   Commissioning

ℹ️ The device is operated via the electronic insert, the display or with FieldCare. If a display is attached to the electronic insert, the function keys ⊟ or ⊞ and the Mode switch at the electronic insert are deactivated. All other settings can be made using the function keys on the display or with FieldCare.

6.1   Installation and function check

Make sure that the post-installation check and final check have been completed before you start your measuring point:

- go to the chapter "Post-installation check" → 📖 22
- go to the chapter "Post-connection check" → 📖 28

6.2   Setting the operating language

To set the operating language:

1. Go to "Device properties" menu.
2. Go to "Display" submenu.
3. Go to "Language" function.
4. Choose the language from the list.

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