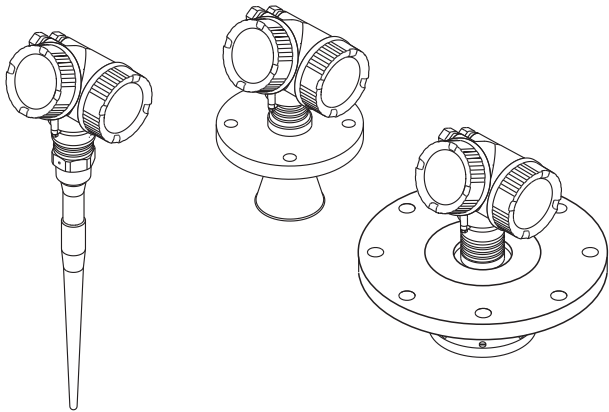


Brief Operating Instructions Micropilot FMR53, FMR54

Level radar



These Instructions are Brief Operating Instructions; they do not replace the Operating Instructions included in the scope of supply.

For detailed information, refer to the Operating Instructions and other documentation on the CD-ROM provided or visit "www.endress.com/deviceviewer".





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


1 Important document information

1.1 Document conventions




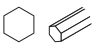

1.1.1 Safety symbols

Symbol	Meaning
 <small>A0011189-EN</small>	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 <small>A0011190-EN</small>	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 <small>A0011191-EN</small>	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 <small>A0011192-EN</small>	NOTICE! This symbol contains information on procedures and other facts which do not result in personal injury.








1.1.2 Electrical symbols

Symbol	Meaning
 <small>A0011197</small>	Direct current A terminal to which DC voltage is applied or through which direct current flows.
 <small>A0011198</small>	Alternating current A terminal to which alternating voltage is applied or through which alternating current flows.
 <small>A0017381</small>	Direct current and alternating current <ul style="list-style-type: none"> ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
 <small>A0011200</small>	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
 <small>A0011199</small>	Protective ground connection A terminal which must be connected to ground prior to establishing any other connections.
 <small>A0011201</small>	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 practice.

1.1.3 Tool symbols



 A0011219	 A0011220	 A0013442	 A0011221	 A0011222
Cross-head screwdriver	Flat blade screwdriver	Torx screwdriver	Allen key	Hexagon wrench

1.1.4 Symbols for certain types of information



Symbol	Meaning
 A0011182	Allowed Indicates procedures, processes or actions that are allowed.
 A0011183	Preferred Indicates procedures, processes or actions that are preferred.
 A0011184	Forbidden Indicates procedures, processes or actions that are forbidden.
 A0011193	Tip Indicates additional information.
 A0011194	Reference to documentation Refers to the corresponding device documentation.
 A0011195	Reference to page Refers to the corresponding page number.
 A0011196	Reference to graphic Refers to the corresponding graphic number and page number.
1., 2., 3. ...	Series of steps
✓	Result of a sequence of actions

1.1.5 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
1., 2., 3. ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

Symbol	Meaning
 <small>A0011187</small>	Hazardous area Indicates a hazardous area.
 <small>A0011188</small>	Safe area (non-hazardous area) Indicates a non-hazardous location.

1.1.6 Symbols at the device

Symbol	Meaning
	Safety instructions Observe the safety instructions contained in the associated Operating Instructions.
	Temperature resistance of the connection cables Specifies the minimum value of the temperature resistance of the connection cables.

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements for its tasks:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task
- ▶ Are authorized by the plant owner/operator
- ▶ Are familiar with federal/national regulations
- ▶ Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- ▶ Following instructions and basic conditions

2.2 Designated use

Application and measured materials

The measuring device described in these Operating Instructions is intended for the continuous, contactless level measurement of liquids, pastes and sludge. Because of its operating frequency of about 6 GHz, a maximum radiated pulsed power of 12.03 mW and an average power output of 0.024 mW, the operation is completely harmless to humans and animals.

Observing the limit values specified in the "Technical data" and listed in the Operating Instructions and supplementary documentation, the measuring device may be used for the following measurements only:

- ▶ Measured process variables: level, distance, signal strength
- ▶ Calculated process variables: Volume or mass in arbitrarily shaped vessels; flow through measuring weirs or flumes (calculated from the level by the linearization functionality)

To ensure that the measuring device remains in proper condition for the operation time:

- ▶ Use the measuring device only for measured materials against which the process-wetted materials are adequately resistant.
- ▶ Observe the limit values in "Technical data".

Incorrect use

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

Verification for borderline cases:

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

Residual risk

The electronics housing and its built-in components such as display module, main electronics module and I/O electronics module may heat to 80 °C (176 °F) during operation through heat transfer from the process as well as power dissipation within

the electronics. During operation the sensor may assume a temperature near the temperature of the measured material.

Danger of burns due to heated surfaces!

- ▶ For high process temperatures: Install protection against contact in order to prevent burns.

2.3 Workplace safety

For work on and with the device:

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

2.4 Operational safety

Risk of injury.

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

Conversions to the device

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

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

Repair

To ensure continued operational safety and reliability,

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

Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):

- ▶ Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.5 Product safety

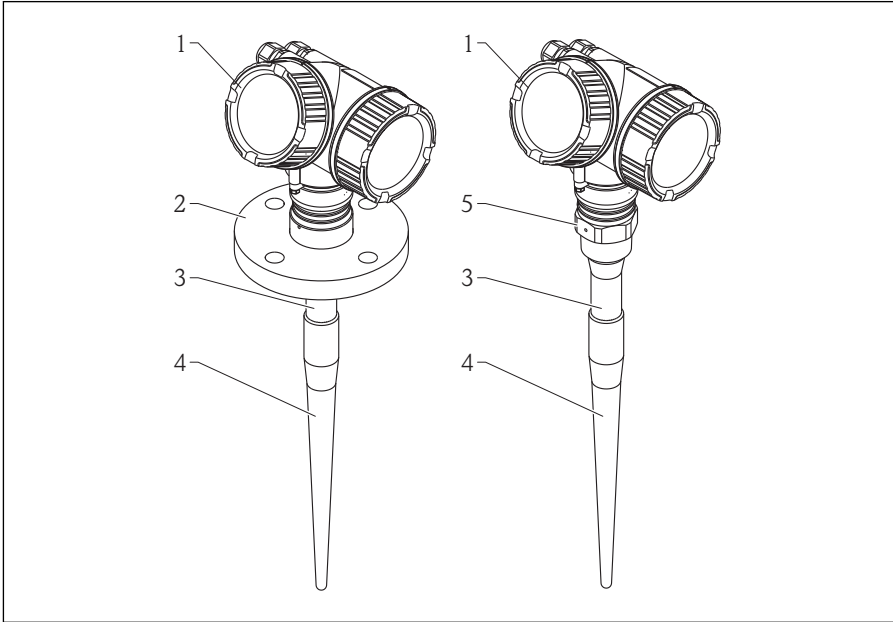
This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate.

It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Product description

3.1 Product design

3.1.1 Micropilot FMR53

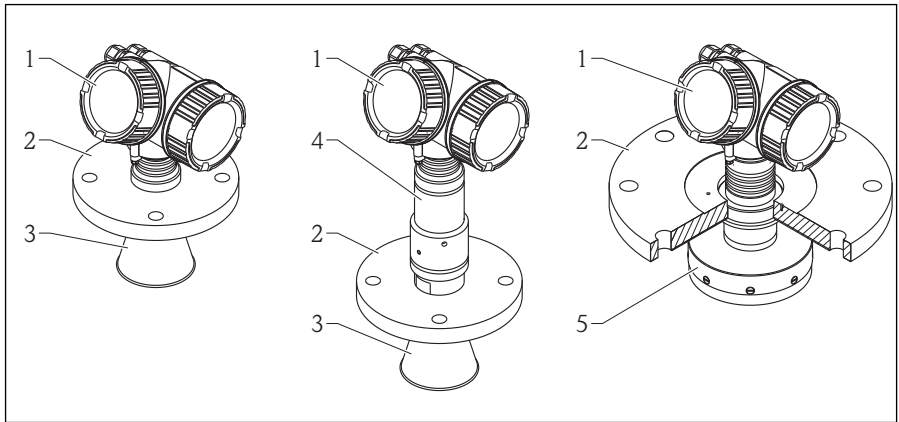


A0016790

1 Design of the Micropilot FMR53 (6 GHz)

- 1 Electronics housing
- 2 Flange
- 3 Inactive length
- 4 Active part of the antenna
- 5 Process connection (Thread)

3.1.2 Micropilot FMR54

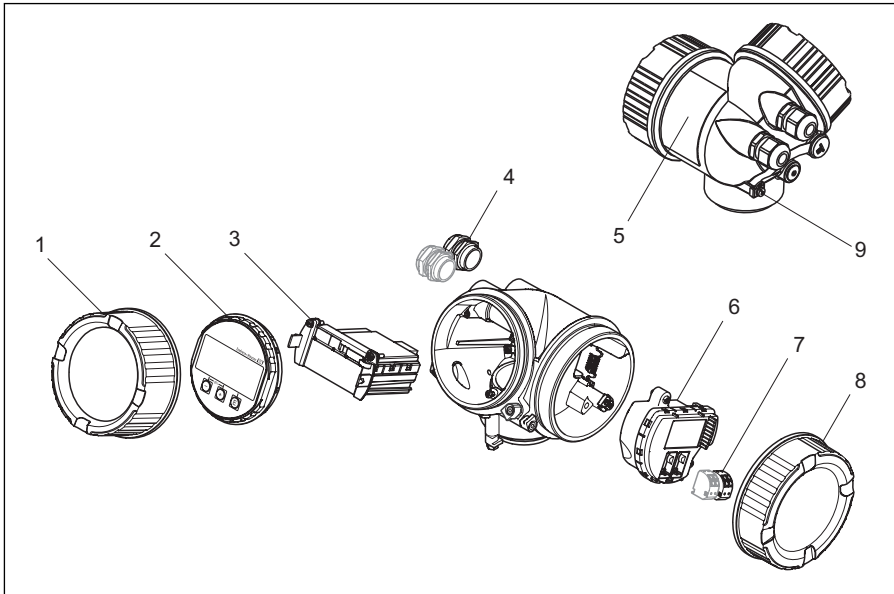


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2 Design of the Micropilot FMR54 (6 GHz)

- 1 Electronics housing
- 2 Flange
- 3 Horn antenna
- 4 High temperature antenna fitting
- 5 Planar antenna

3.1.3 Electronics housing



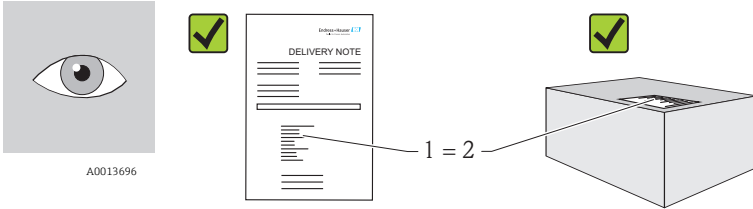
A0012422

3 Design of the electronics housing

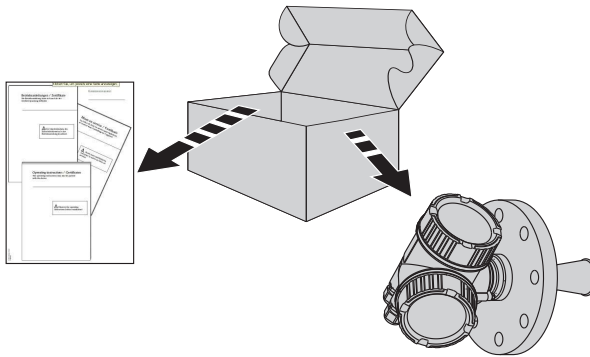
- 1 Electronics compartment cover
- 2 Display module
- 3 Main electronics module
- 4 Cable glands (1 or 2, depending on instrument version)
- 5 Nameplate
- 6 I/O electronics module
- 7 Terminals (pluggable spring terminals)
- 8 Connection compartment cover
- 9 Grounding terminal

4 Incoming acceptance and product identification

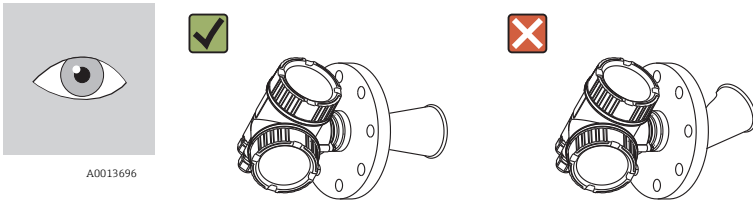
4.1 Incoming acceptance



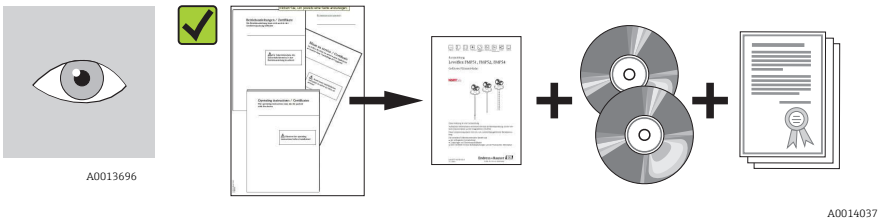
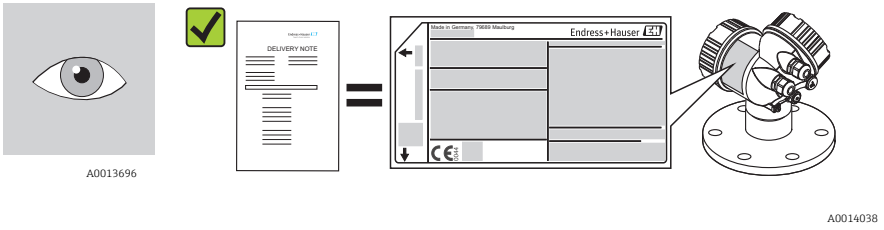
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 If one of the conditions does not comply, contact your Endress+Hauser distributor.

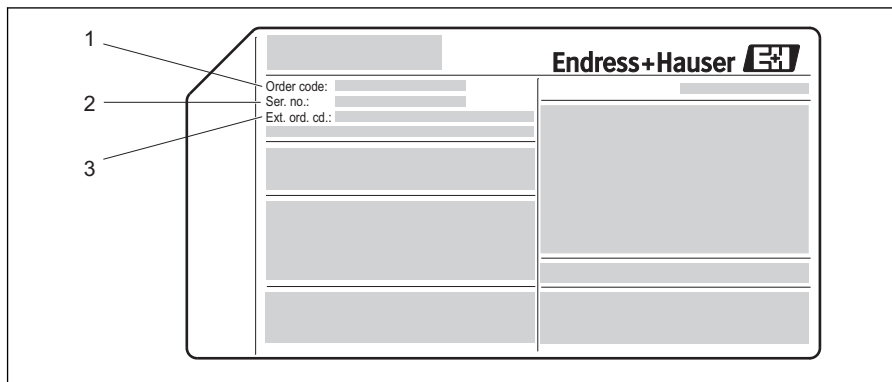
4.2 Product identification

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

- Nameplate specifications
- Extended 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.

For an overview of the scope of the Technical Documentation provided, refer to the following: enter serial numbers from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer)

4.2.1 Nameplate




A0014103

 4 Example of a nameplate

- 1 Order code
- 2 Serial number (Ser. no.)
- 3 Extended order code (Ext. ord. cd.)

 For detailed information about interpreting the nameplate specifications, refer to the Operating Instructions for the device on the CD-ROM provided.

 Only 33 digits of the extended order code can be indicated on the nameplate. If the extended order code exceeds 33 digits, the rest will not be shown. However, the complete extended order code can be viewed in the operating menu of the device (Diagnostics → Device info → Extended order code 1/2/3).

5 Storage, Transport

5.1 Storage conditions

- Permitted storage temperature: -40 to $+80$ °C (-40 to $+176$ °F)
- Use the original packaging.

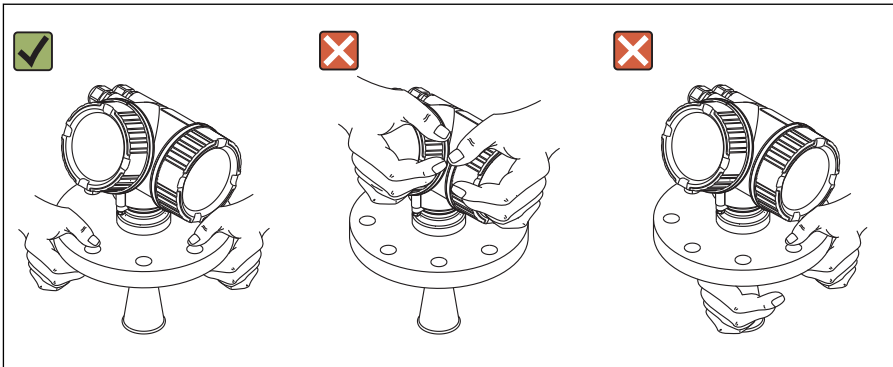
5.2 Transport product to the measuring point

NOTICE

Housing or antenna horn may be damaged or break away.

Risk of injury!

- ▶ Transport the measuring device to the measuring point in its original packaging or at the process connection.
- ▶ Do not fasten lifting devices (hoisting slings, lifting eyes etc.) at the housing or the antenna horn but at the process connection. Take into account the mass center of the device in order to avoid unintended tilting.
- ▶ Comply with the safety instructions, transport conditions for devices over 18kg (39.6lbs).

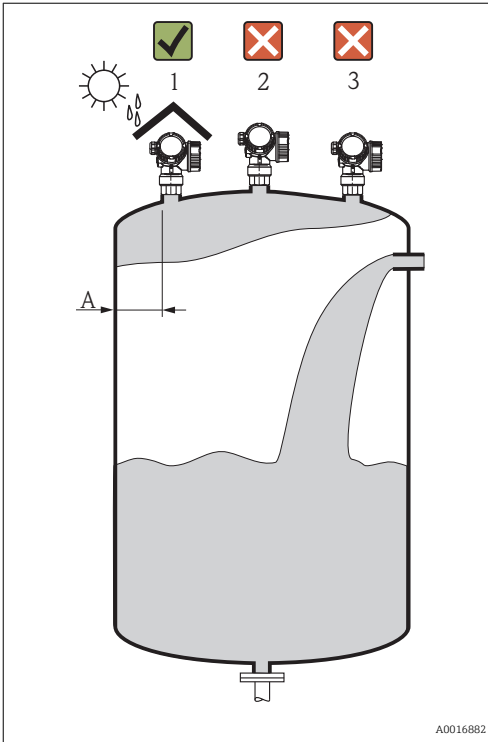


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6 Installation

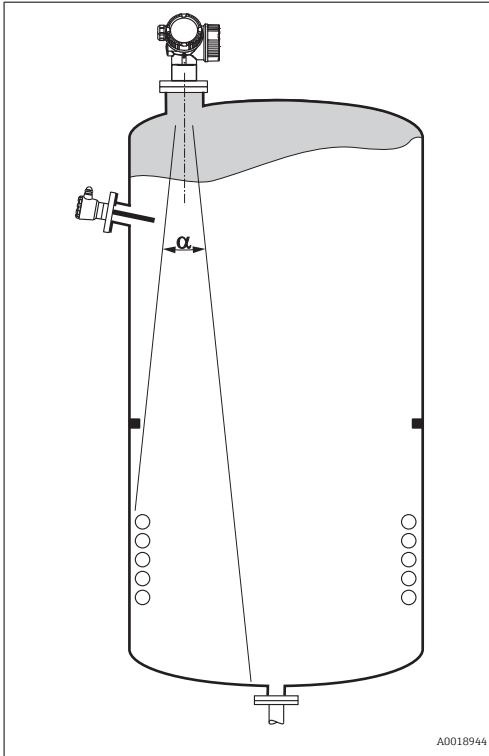
6.1 Installation conditions

6.1.1 Mounting position



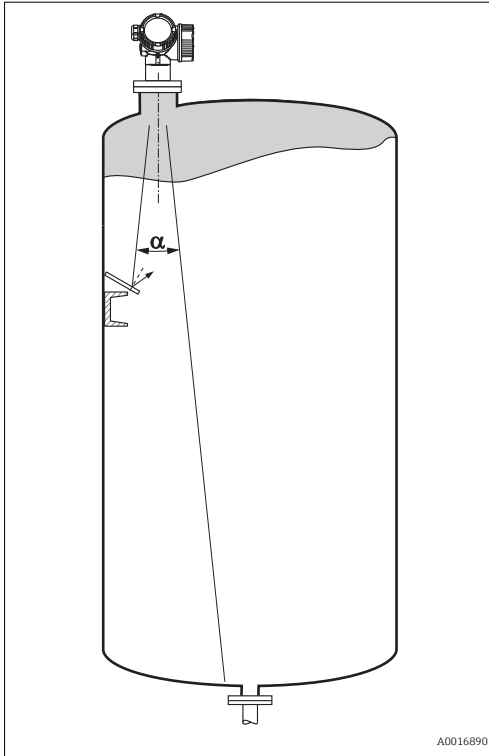
- Recommended distance **A** from wall to outer edge of nozzle: $\sim 1/6$ of tank diameter. Nevertheless the device should not be installed closer than 30 cm (11.8 in) to the tank wall.
- Not in the center (2), as interference can cause signal loss.
- Not above the fill stream (3).
- It is recommended to use a weather protection cover (1) in order to protect the device from direct sun or rain.

6.1.2 Vessel installations



Avoid any installations (limit switches, temperature sensors, braces, vacuum rings, heating coils, baffles etc.) inside the signal beam. Take into account the beam angle (\rightarrow 20).

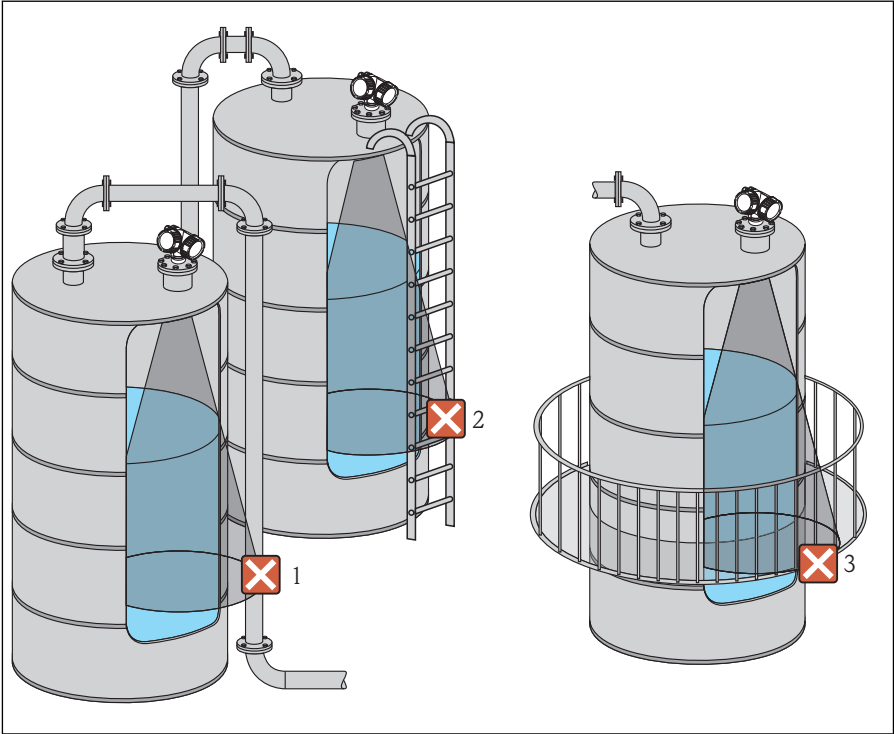
6.1.3 Reduction of interference echoes



Metallic screens mounted at a slope spread the radar signal and can, therefore, reduce interference echoes.





6.1.4 Measurement in a plastic vessel

If the outer wall of the vessel is made of a non-conductive material (e.g. GRP), microwaves can also be reflected off interfering installations outside the signal beam (e.g. metallic pipes (1), ladders (2), grates (3), ...). Therefore, there should be no such interfering installations in the signal beam. Please contact Endress+Hauser for further information.

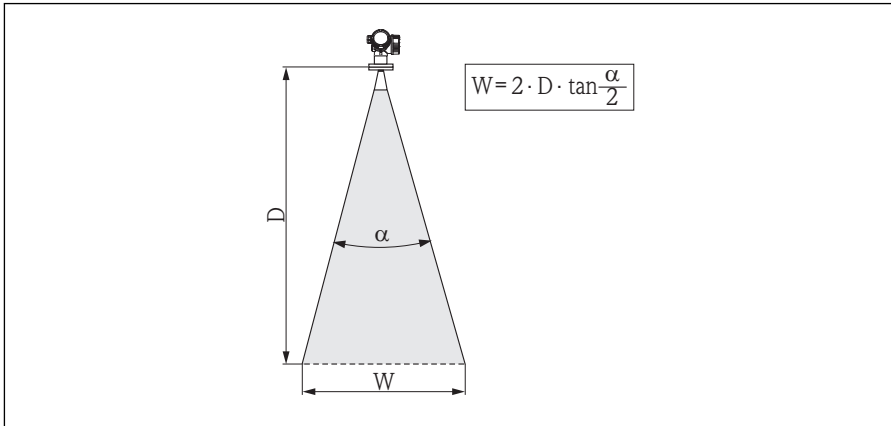


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6.1.5 Optimization options

- Antenna size
The bigger the antenna, the smaller the beam angle α and the fewer interference echoes (→  20).
- Mapping
The measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment
Take into account the marker on the flange or threaded connection (→  24) (→  27) .
- Stilling well
A stilling well can be applied to avoid interferences (→  30).
- Metallic screens mounted at a slope
They spread the radar signals and can, therefore, reduce interference echoes.

6.1.6 Beam angle



A0016891

5 Relationship between beam angle α , distance D and beamwidth diameter W

The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy density (3-dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations.

Beam diameter W as a function of beam angle α and measuring distance D :

FMR53	
Beam angle α	23°
Measuring distance (D)	Beamwidth diameter W
3 m (9.8 ft)	1.22 m (4 ft)
6 m (20 ft)	2.44 m (8 ft)
9 m (30 ft)	3.66 m (12 ft)
12 m (39 ft)	4.88 m (16 ft)
15 m (49 ft)	6.1 m (20 ft)
20 m (66 ft)	8.14 m (27 ft)

FMR54 - Horn antenna			
Antenna size	150 mm (6 in)	200 mm (8 in)	250 mm (10 in)
Beam angle α	23°	19°	15°
Measuring distance (D)	Beamwidth diameter W		

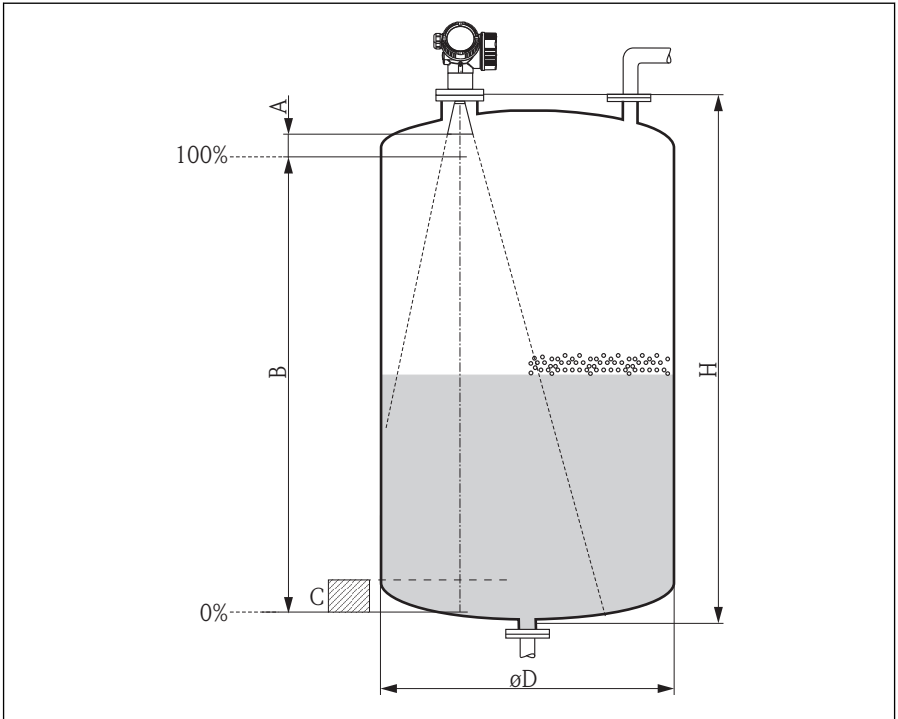
3 m (9.8 ft)	1.22 m (4 ft)	1 m (3.3 ft)	0.79 m (2.6 ft)
6 m (20 ft)	2.44 m (8 ft)	2.01 m (6.6 ft)	1.58 m (5.2 ft)
9 m (30 ft)	3.66 m (12 ft)	3.01 m (9.9 ft)	2.37 m (7.8 ft)
12 m (39 ft)	4.88 m (16 ft)	4.02 m (13 ft)	3.16 m (10 ft)
15 m (49 ft)	6.1 m (20 ft)	5.02 m (16 ft)	3.95 m (13 ft)
20 m (66 ft)	8.14 m (27 ft)	6.69 m (22 ft)	5.27 m (17 ft)

6.2 Measuring conditions

- In case of **boiling surfaces**, **bubbling** or tendency for **foaming** use FMR53 or FMR54. Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions. For FMR50, FMR51 and FMR52, the additional option "Advanced dynamics" is recommended in these cases (feature 540: "Application Package", option EM).
- In case of heavy **steam development** or **condensate**, the maximum measuring range of FMR50, FMR51 and FMR52 may decrease depending on density, temperature and composition of the steam → use FMR53 or FMR54.
- For the measurement of absorbing gases such as **ammonia NH₃** or some **fluorocarbons**¹⁾, please use Levelflex or Micropilot FMR54 in a stilling well.
- The measuring range begins, where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets the level cannot be detected below this point.
- For stilling well applications, the zero should be positioned at the end of the tube, as the electromagnetic waves do not propagate completely outside the tube. It must be taken into account that the accuracy may be reduced in the area **C**. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **C** above the end of the tube (see figure).
- In case of media with a low dielectric constant ($\epsilon_r = 1.5$ to 4)²⁾ the tank bottom can be visible through the medium at low levels (low height **C**). Reduced accuracy has to be expected in this range. If this is not acceptable, we recommend positioning the zero point at a distance **C** (see figure) above the tank bottom in these applications.
- In principle it is possible to measure up to the tip of the antenna with FMR51, FMR53 and FMR54. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than **A** (see figure) to the tip of the antenna.
- When using FMR54 with planar antenna, especially for media with low dielectric constants, the end of the measuring range should not be closer than 1 m (3.28 ft) to the flange.
- The smallest possible measuring range **B** depends on the antenna version (see figure).
- The tank height should be at least **H** (see table).

1) Affected compounds are e.g. R134a, R227, Dymel 152a.

2) Dielectric constants of important media commonly used in the industry are summarized in the document SD106F, which can be downloaded from the Endress+Hauser web page (www.endress.com).



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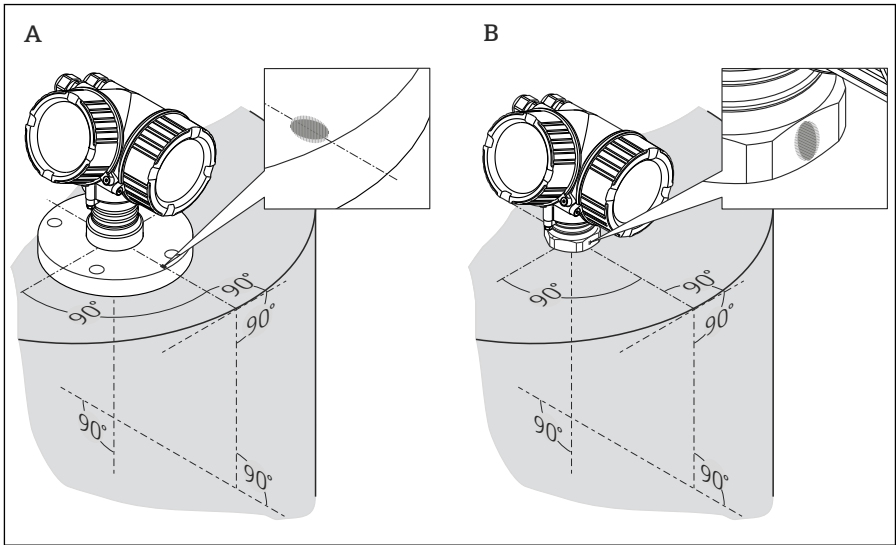
Device	A [mm (in)]	B [m (ft)]	C [mm (in)]	H [m (ft)]
FMR53	50(1.97)	> 0.5 (1.6)	150 to 300 (5.91 to 11.8)	> 1.5 (4.9)
FMR54				

6.3 Installation in vessel (free space)

6.3.1 Rod antenna (FMR53)

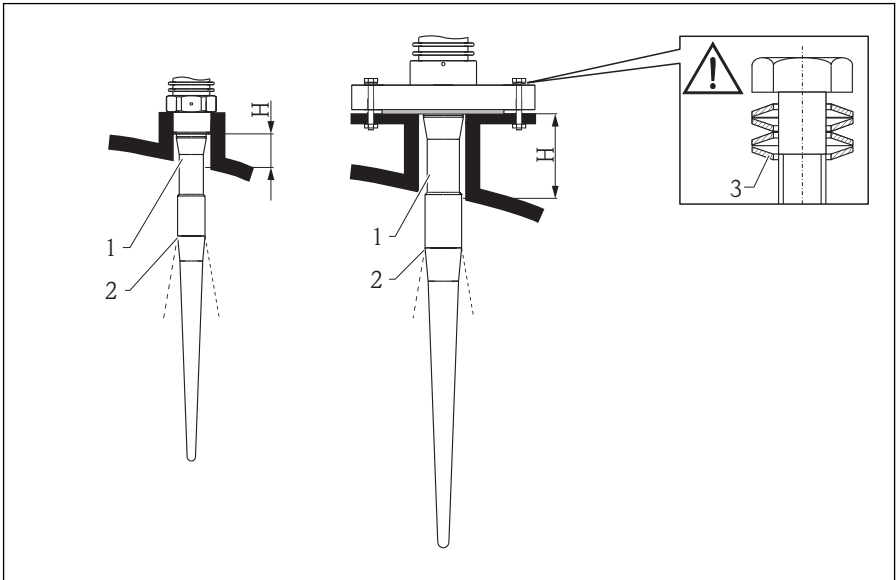
Alignment

- Align the antenna vertically to the product surface.
- A marking at the flange (somewhere between the flange holes) or the boss enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.



A0018974

Nozzle mounting



A0016821

6 Nozzle height an diameter for the rod antenna (FMR53)

- 1 Inactive length of the antenna
- 2 Beam launched here
- 3 Spring washers

Antenna length	390 mm (15.4 in)	540 mm (21.3 in)
H	< 100 mm (3.94 in)	< 250 mm (9.84 in)

- i** The inactive part (1) of the rod antenna must extend below the nozzle.
- i** For flanges with PTFE cladding: Use spring washers (see figure) to compensate for the sagging of the cladding.
It is recommended to tighten the flange bolts periodically, depending on process temperature and pressure.
Recommended torque: 60 to 100 Nm (44.25 to 73.75 lbf ft)
- i** The thickness of the PTFE flange cladding is 4 mm (0.16 in). This corresponds to the maximum adjustment distance of the spring washers.
- i** Usually, the PTFE flange cladding also serves as a seal between the nozzle and the device flange.

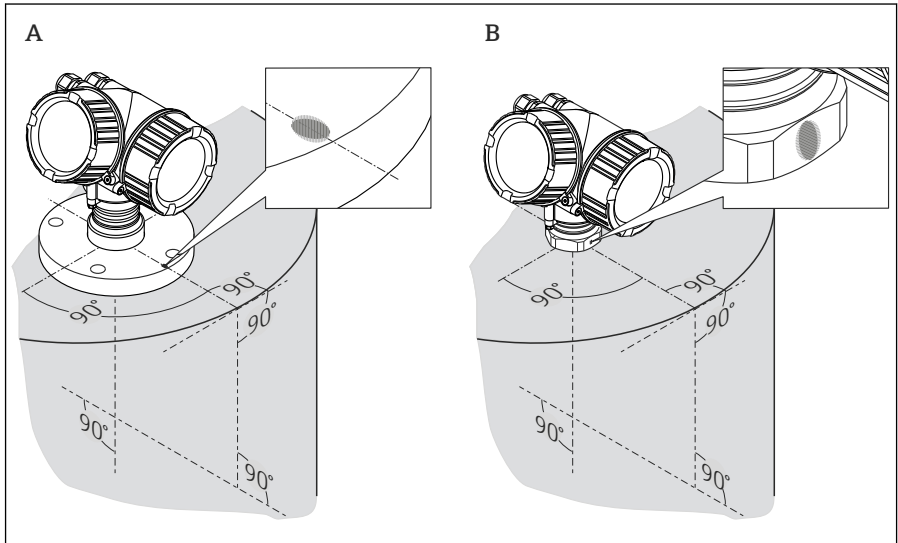
Threaded connection

- Tighten with the hexagonal nut only.
- Tool : Hexagonal wrench 55 mm
- Maximum permissible torque:
 - Thread PVDF: 35 Nm (26 lbf ft)
 - Thread 316L: 60 Nm (44 lbf ft)

6.3.2 Horn antenna (FMR54)

Alignment

- Align the antenna vertically to the product surface.
- A marking at the flange (somewhere between the flange holes) enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.

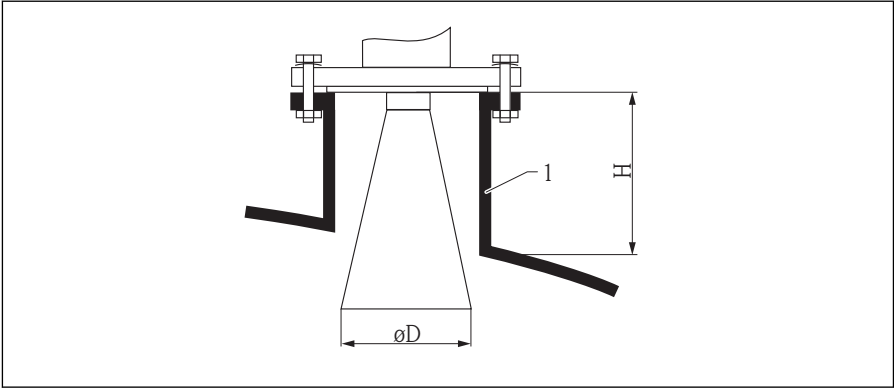


A0018974

Nozzle mounting

The horn antenna must extend below the nozzle; if necessary select the device version with antenna extension 100 to 400 mm (4 to 16 in)³⁾.

3) See product structure: feature 610 "Accessory Mounted", options OM, ON, OR, OS.



A0016822

7 Nozzle height and diameter for the horn antenna (FMR54)

1 Mounting nozzle

Antenna size	150 mm (6 in)	200 mm (8 in)	250 mm (10 in)
D	146 mm (5.75 in)	191 mm (7.52 in)	241 mm (9.49 in)
H	< 205 mm (8.07 in)	< 290 mm (11.4 in)	< 380 mm (15 in)


Measurement from the outside through plastic walls

- If possible use the 250 mm (10 in) antenna.
- The distance between the lower edge of the antenna and the tank should be about 100 mm (4 in).
- If possible, avoid mounting location where condensation or build-up might occur.
- In case of outdoor mounting, the space between antenna and vessel has to be protected from the elements.
- Do not mount any potential reflectors (e.g. pipes) outside the tank in the signal beam.

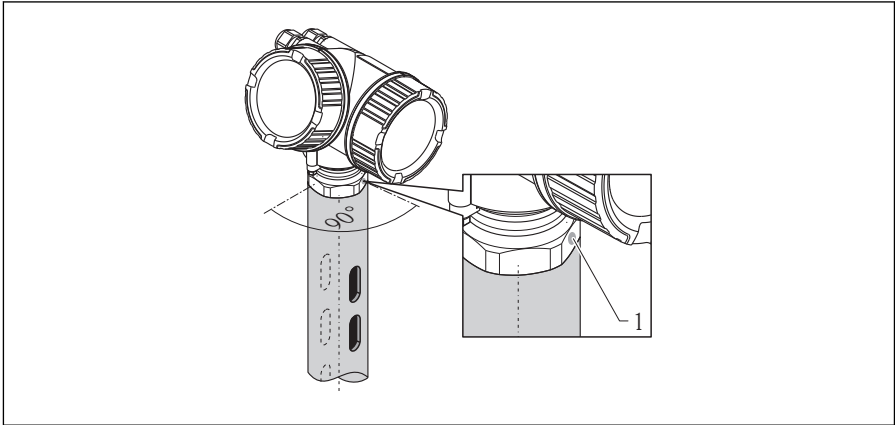
Suitable thickness of the tank ceiling

Penetrated material	PE	PTFE	PP	Plexiglas
DK / ϵ_r	2.3	2.1	2.3	3.1
Optimum thickness	16 mm (0.65 in)	17 mm (0.68 in)	16 mm (0.65 in)	14 mm (0.56 in)

6.3.3 Planar antenna (FMR54)

The planar antenna is only suited for stilling well applications (→  30). It can not be used for free space applications.


6.4 Installation in stilling well



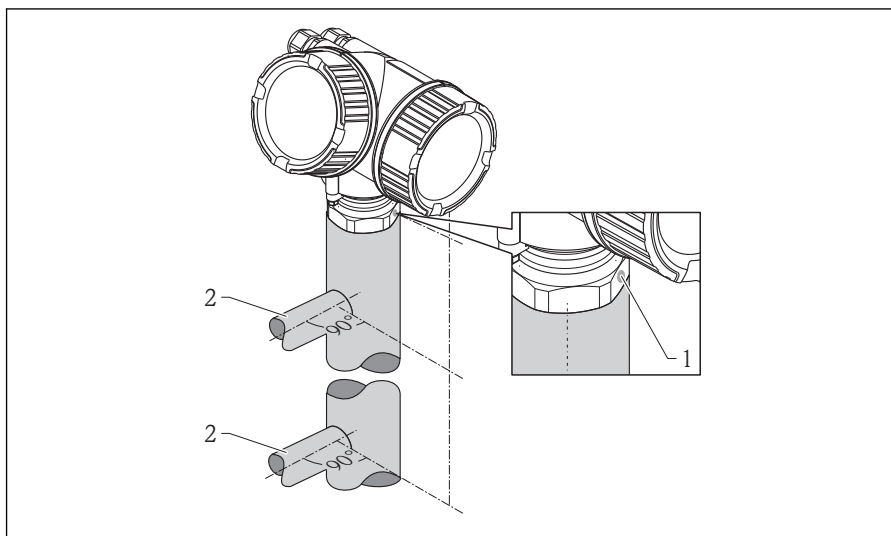
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8 Installation in stilling well

1 Marking for antenna alignment

- For horn antenna: Align the marking towards the slots of the stilling well.
- No alignment is required for planar antennas.
- Measurements can be performed through an open full bore ball valve without any problems.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment (→  32).

6.5 Installation in bypass




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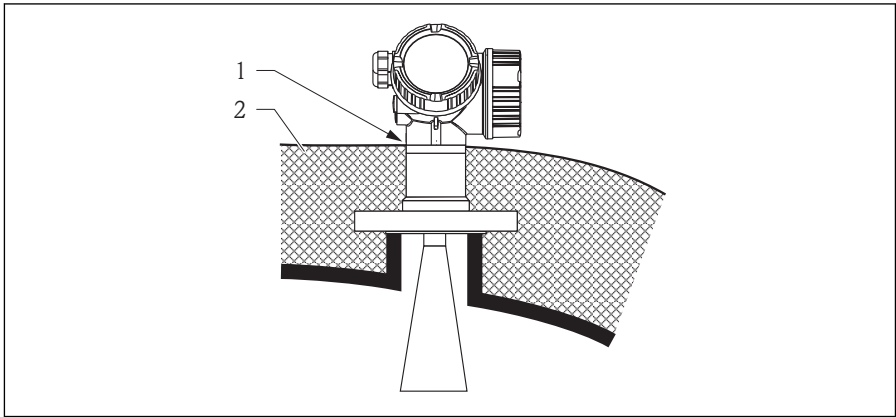
9 Installation in bypass

1 Marking for antenna alignment

2 Tank connectors

- Align the marker perpendicular (90°) to the tank connectors.
- Measurements can be performed through an open full bore ball valve without any problems.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment (→  32).

6.6 Vessels with heat insulation

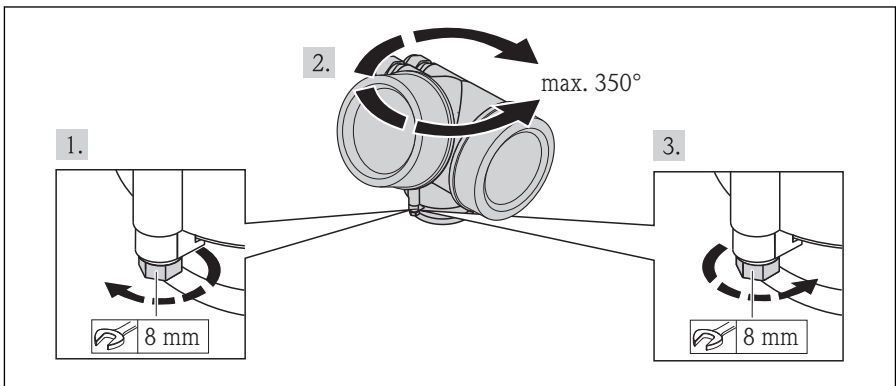


A0019142

If process temperatures are high, the device must be included in normal tank insulation to prevent the electronics heating up as a result of heat radiation or convection. The insulation may not exceed beyond the neck of the housing.

6.7 Turning the transmitter housing

To provide easier access to the connection compartment or display module, the transmitter housing can be turned:

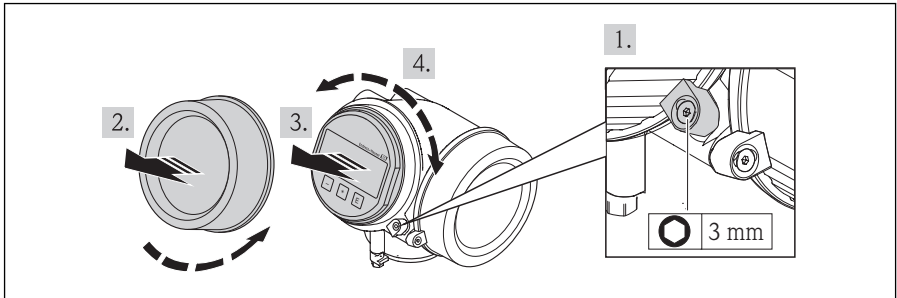


A0013713

1. Unscrew the securing screw using an open-ended wrench.
2. Rotate the housing in the desired direction.

3. Tighten the securing screw (1,5 Nm for plastics housing; 2,5 Nm for aluminium or stainless steel housing).

6.8 Turning the display module



A0013905

1. Loosen the screw of the securing clamp of the electronics compartment cover using an Allen key and turn the clamp 90° counterclockwise.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Pull out the display module with a gentle rotation movement.
4. Rotate the display module into the desired position: Max. $8 \times 45^\circ$ in each direction.
5. Feed the spiral cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment until it engages.
6. Screw the cover of the electronics compartment firmly back onto the transmitter housing.
7. Tighten the securing clamp again using the Allen key.

6.9 Post-installation check

<input type="radio"/>	Is the device undamaged (visual inspection)?
<input type="radio"/>	Does the device conform to the measuring point specifications? For example: <ul style="list-style-type: none"> ■ Process temperature ■ Process pressure (refer to the chapter on "Material load curves" of the "Technical Information" document) ■ Ambient temperature range ■ Measuring range
<input type="radio"/>	Are the measuring point identification and labeling correct (visual inspection)?

<input type="radio"/>	Is the device adequately protected from precipitation and direct sunlight?
<input type="radio"/>	Are the securing screw and securing clamp tightened securely?

7 Electrical connection

7.1 Connection conditions

7.1.1 Cable specification

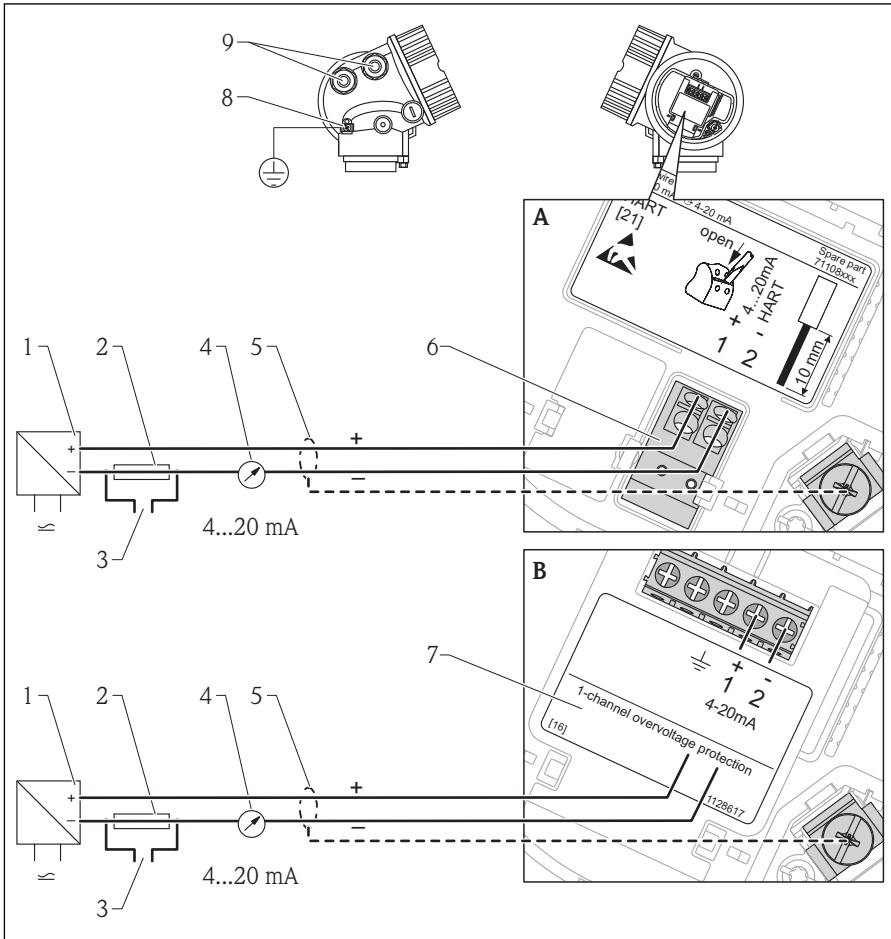
For ambient temperature $T_U \geq 60\text{ °C}$ (140 °F): use cable for temperature $T_U + 20\text{ K}$.

HART

- A normal device cable suffices if only the analog signal is used.
- A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- For 4-wire devices: Standard device cable is sufficient for the power line.

7.1.2 Terminal assignment

2-wire: 4-20mA HART



A0011294

10 Terminal assignment 2-wire; 4-20mA HART

A Without integrated overvoltage protection

B With integrated overvoltage protection

1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage (→ 48)

2 HART communication resistor ($\geq 250 \Omega$): Observe maximum load (→ 48)

3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)

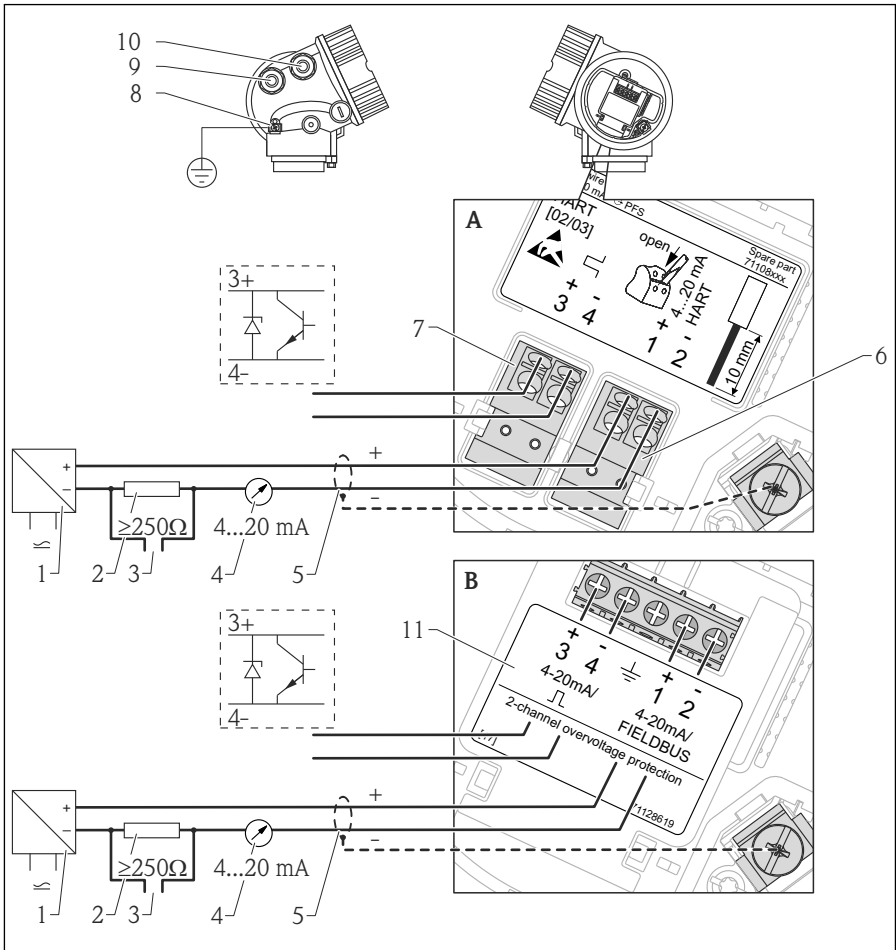
4 Analog display device: Observe maximum load (→ 48)

5 Cable screen; observe cable specification (→ 35)

6 Terminals for 4-20mA HART (passive)

- 7 *Overvoltage protection module*
- 8 *Terminal for potential equalization line*
- 9 *Cable entry*

2-wire: 4-20mA HART, switch output



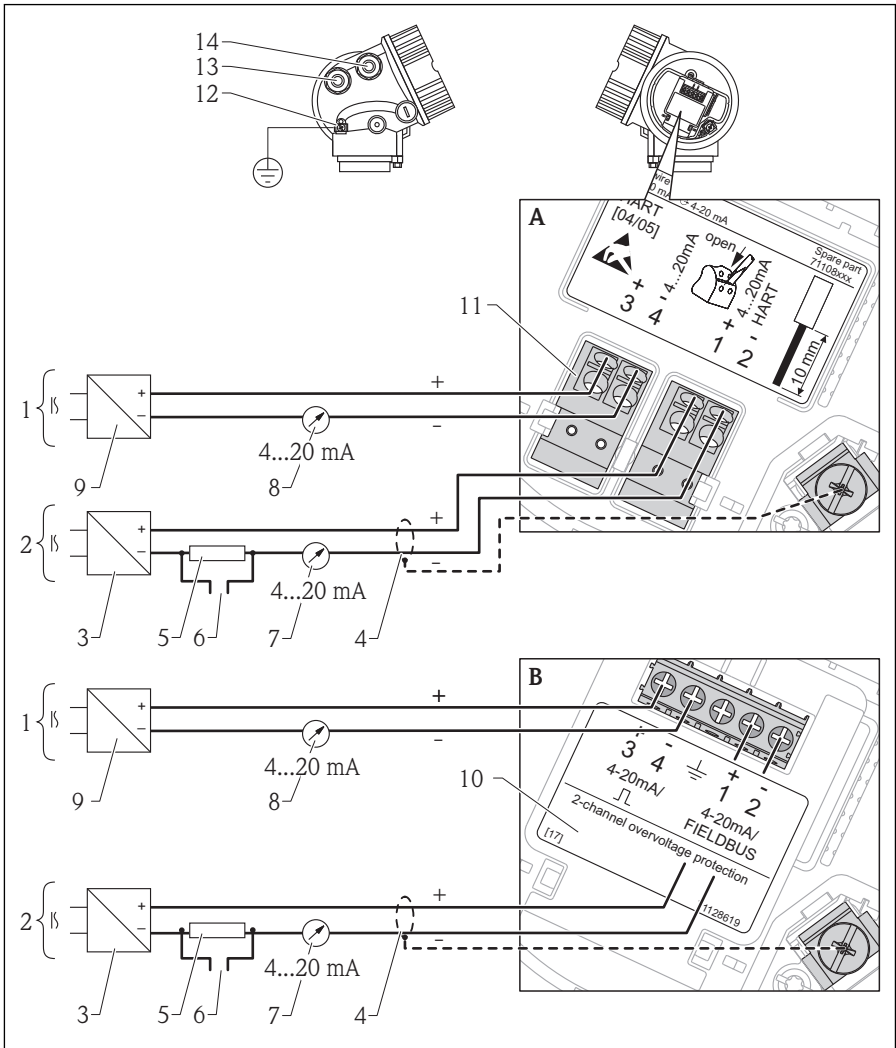
A0013759

11 Terminal assignment 2-wire; 4-20mA HART, switch output

- A Without integrated overvoltage protection
- B With integrated overvoltage protection
- 1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage (→ 48)
- 2 HART communication resistor (≥250 Ω): Observe maximum load (→ 48)
- 3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
- 4 Analog display device: Observe maximum load (→ 48)
- 5 Cable screen; observe cable specification (→ 35)
- 6 Terminals for 4-20mA HART (passive)
- 7 Terminals for switch output (open collector)
- 8 Terminal for potential equalization line

- 9 *Cable entry for 4-20mA HART line*
- 10 *Cable entry for switch output line*
- 11 *Overvoltage protection module*

2-wire: 4-20mA HART, 4-20mA



A0013923

12 Terminal assignment 2-wire, 4-20 mA HART, 4...20mA

A Without integrated overvoltage protection

B With integrated overvoltage protection




1 Connection current output 2

2 Connection current output 1

3 Supply voltage for current output 1 (e.g. RN221N); Observe terminal voltage (→ 48)

4 Cable screen; observe cable specification (→ 35)

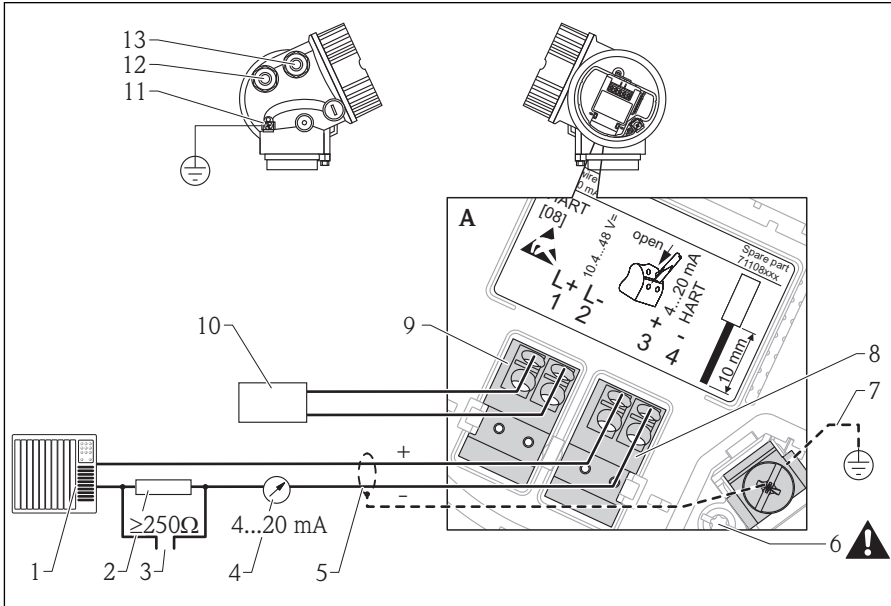
5 HART communication resistor ($\geq 250 \Omega$); Observe maximum load (→ 48)

- 6 *Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)*
- 7 *Analog display device ; observe maximum load (→  48)*
- 8 *Analog display device ; observe maximum load (→  48)*
- 9 *Supply voltage for current output 2 (e.g. RN221N); Obesrve terminal voltage (→  48)*
- 10 *Overvoltage protection module*
- 11 *Terminals for current output 2*
- 12 *Terminal for the potential equalization line*
- 13 *Cable entry for current output 1*
- 14 *Cable entry for current output 2*



This version is also suited for single-channel operation. In this case, current output 1 (terminals 1 and 2) must be used.

4-wire: 4-20mA HART (10.4 to 48 V_{DC})



A0011340




13 Terminal assignment 4-wire; 4-20mA HART (10.4 to 48 VDC)

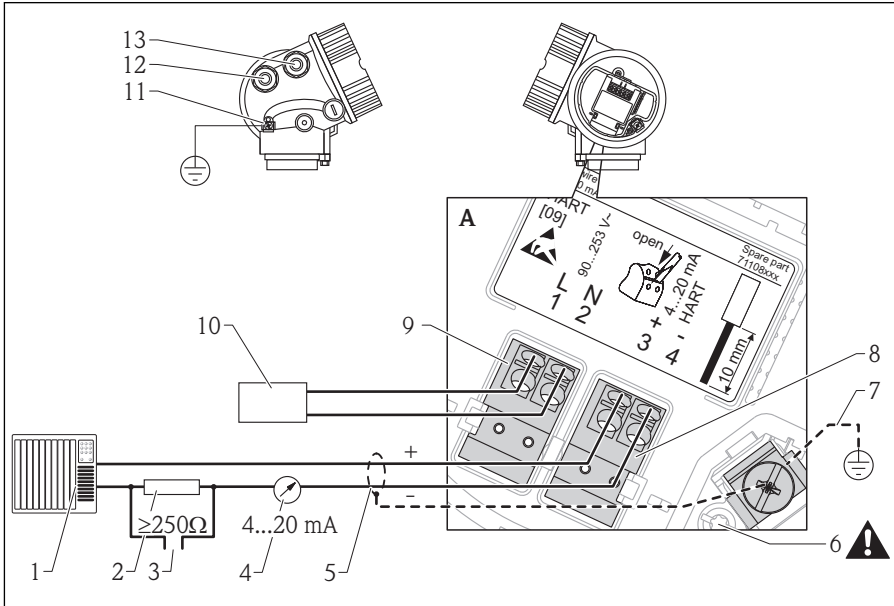
- 1 Evaluation unit, e.g. PLC
- 2 HART communication resistor ($\geq 250 \Omega$): Observe maximum load (\rightarrow 51)
- 3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
- 4 Analog display device: Observe maximum load (\rightarrow 51)
- 5 Signal cable including screening (if required), observe cable specification (\rightarrow 35)
- 6 Protective connection; do not disconnect!
- 7 Protective earth, observe cable specification (\rightarrow 35)
- 8 Terminals for 4...20mA HART (active)
- 9 Terminals for supply voltage
- 10 Supply voltage: Observe terminal voltage (\rightarrow 51), observe cable specification (\rightarrow 35)
- 11 Terminal for potential equalization
- 12 Cable entry for signal line
- 13 Cable entry for power supply

CAUTION

To ensure electrical safety:

- ▶ Do not disconnect the protective connection (7).
- ▶ Disconnect the supply voltage before disconnecting the protective earth (8).

-  Connect protective earth to the internal ground terminal (8) before connecting the supply voltage. If necessary, connect the potential matching line to the external ground terminal (12).
-  In order to ensure electromagnetic compatibility (EMC): Do not only ground the device via the protective earth conductor of the supply cable. Instead, the functional grounding must also be connected to the process connection (flange or threaded connection) or to the external ground terminal.
-  An easily accessible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN61010).

4-wire: 4-20mA HART (90 to 253 V_{AC})




A0018965

14 Terminal assignment 4-wire; 4-20mA HART (90 to 253 VAC)

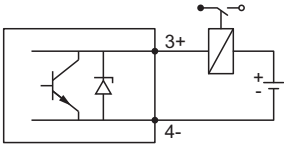
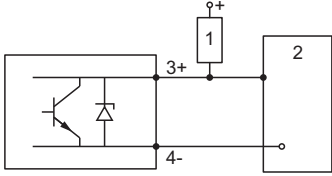
- 1 Evaluation unit, e.g. PLC
- 2 HART communication resistor ($\geq 250 \Omega$): Observe maximum load (\rightarrow 51)
- 3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
- 4 Analog display device: Observe maximum load (\rightarrow 51)
- 5 Signal cable including screening (if required), observe cable specification (\rightarrow 35)
- 6 Protective connection; do not disconnect!
- 7 Protective earth, observe cable specification (\rightarrow 35)
- 8 Terminals for 4...20mA HART (active)
- 9 Terminals for supply voltage
- 10 Supply voltage: Observe terminal voltage (\rightarrow 51), observe cable specification (\rightarrow 35)
- 11 Terminal for potential equalization
- 12 Cable entry for signal line
- 13 Cable entry for power supply

CAUTION**To ensure electrical safety:**

- ▶ Do not disconnect the protective connection (7).
- ▶ Disconnect the supply voltage before disconnecting the protective earth (8).

-  Connect protective earth to the internal ground terminal (8) before connecting the supply voltage. If necessary, connect the potential matching line to the external ground terminal (12).
-  In order to ensure electromagnetic compatibility (EMC): Do not only ground the device via the protective earth conductor of the supply cable. Instead, the functional grounding must also be connected to the process connection (flange or threaded connection) or to the external ground terminal.
-  An easily accessible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN61010).

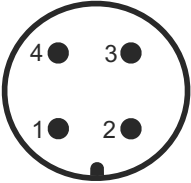
Connection examples for the switch output

 <p style="text-align: right;">A0015909</p> <p>15 Connection of a relay</p> <p>Suitable relays (examples):</p> <ul style="list-style-type: none">■ Solid-state relay: Phoenix Contact OV-24DC/480AC/5 with mounting rail connector UMK-1 OM-R/AMS■ Electromechanical relay: Phoenix Contact PLC-RSC-12DC/21	 <p style="text-align: right;">A0015910</p> <p>16 Connection of a digital input</p> <ol style="list-style-type: none">1 Pull-up resistor2 Digital input
--	--

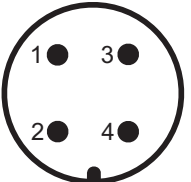
7.1.3 Device plug connectors

i For the versions with fieldbus plug connector (M12 or 7/8"), the signal line can be connected without opening the housing.

Pin assignment of the M12 plug connector

 <p style="text-align: right; font-size: small;">A0011175</p>	Pin	Meaning
	1	Signal +
	2	not connected
	3	Signal -
	4	Ground

Pin assignment of the 7/8" plug connector

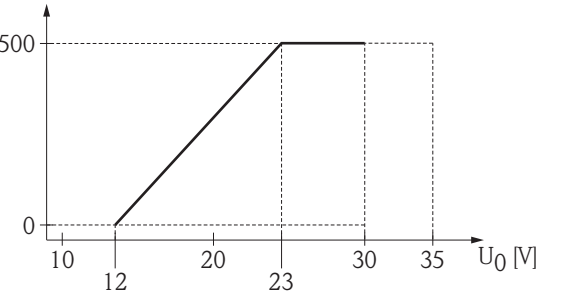
 <p style="text-align: right; font-size: small;">A0011176</p>	Pin	Meaning
	1	Signal -
	2	Signal +
	3	Screen
	4	Not connected

7.1.4 Supply voltage

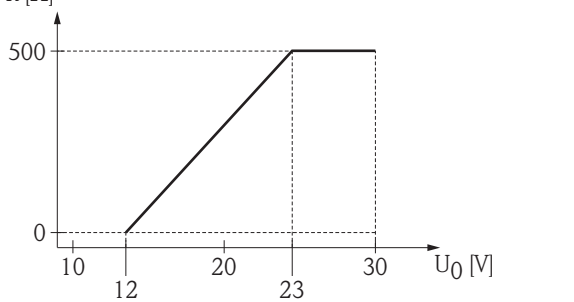
2-wire, 4-20mA HART, passive

"Power Supply, Output" ¹⁾	"Approval" ²⁾	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U ₀ at the supply unit
A: 2-wire; 4-20mA HART	<ul style="list-style-type: none"> ▪ Non-Ex ▪ Ex nA ▪ Ex ic ▪ CSA GP 	10.4 to 35 V ³⁾	<p style="text-align: right; font-size: small;">A0017140</p>
	Ex ia / IS	10.4 to 30 V ³⁾	
	<ul style="list-style-type: none"> ▪ Ex d(ia) / XP ▪ Ex ic(ia) ▪ Ex nA(ia) ▪ Ex ta / DIP 	12 to 35 V ⁴⁾	<p style="text-align: right; font-size: small;">A0019136</p>
	Ex ia + Ex d(ia) / IS + XP	12 to 30 V ⁴⁾	

- 1) Feature 020 of the product structure
- 2) Feature 010 of the product structure
- 3) For ambient temperatures $T_a \leq -20\text{ °C}$ (-4 °F) a minimum voltage of 15 V is required for the start-up of the device at the MIN error current (3,6 mA). The start-up current can be parametrized. If the device is operated with a fixed current $I \geq 5,5\text{ mA}$ (HART multidrop mode), a voltage of $U \geq 10,4\text{ V}$ is sufficient throughout the entire range of ambient temperatures.
- 4) For ambient temperatures $T_a \leq -20\text{ °C}$ (-4 °F) a minimum voltage of 16 V is required for the start-up of the device at the MIN error current (3.6 mA).

"Power Supply, Output" ¹⁾	"Approval" ²⁾	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U ₀ at the supply unit
B: 2-wire; 4-20 mA HART, switch output	<ul style="list-style-type: none"> ▪ Non-Ex ▪ Ex nA ▪ Ex nA(ia) ▪ Ex ic ▪ Ex ic(ia) ▪ Ex d(ia) / XP ▪ Ex ta / DIP ▪ CSA GP 	12 to 35 V ³⁾	
	<ul style="list-style-type: none"> ▪ Ex ia / IS ▪ Ex ia + Ex d(ia) / IS + XP 	12 to 30 V ³⁾	A0019136

- 1) Feature 020 of the product structure
- 2) Feature 010 of the product structure
- 3) For ambient temperatures T_a ≤ -30 °C (-22 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

"Power Supply, Output" ¹⁾	"Approval" ²⁾	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U ₀ at the supply unit
C: 2-wire; 4-20mA HART, 4-20mA	any	12 to 30 V ³⁾	
			A0017055

- 1) Feature 020 of the product structure
- 2) Feature 010 of the product structure
- 3) For ambient temperatures T_a ≤ -30 °C (-22 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

Polarity reversal protection	Yes
Admissible residual ripple at f = 0 to 100 Hz	$U_{SS} < 1 \text{ V}$
Admissible residual ripple at f = 100 to 10000 Hz	$U_{SS} < 10 \text{ mV}$

4-wire, 4-20mA HART, active

"Power supply; Output" ¹⁾	Terminal voltage	Maximum load R_{\max}
K: 4-wire 90-253VAC; 4-20mA HART	90 to 253 V _{AC} (50 to 60 Hz), overvoltage category II	500 Ω
L: 4-wire 10,4-48VDC; 4-20mA HART	10.4 to 48 V _{DC}	

1) Feature 020 of the product structure

7.1.5 Overvoltage protection

If the measuring device is used for level measurement in flammable liquids which requires the use of overvoltage protection according to DIN EN 60079-14, standard for test procedures 60060-1 (10 kA, pulse 8/20 μ s), overvoltage protection has to be ensured by an integrated or external overvoltage protection module.

Integrated overvoltage protection

An integrated overvoltage protection module is available for 2-wire HART as well as PROFIBUS PA and FOUNDATION Fieldbus devices.

Product structure: Feature 610 "Accessory mounted", option NA "Overvoltage protection".

Technical data	
Resistance per channel	2 * 0.5 Ω max
Threshold DC voltage	400 to 700 V
Threshold impulse voltage	< 800 V
Capacitance at 1 MHz	< 1.5 pF
Nominal arrest impulse voltage ($^{8/20}$ μ s)	10 kA

External overvoltage protection

HAW562 or HAW569 from Endress+Hauser are suited as external overvoltage protection.



For detailed information please refer to the following documents:

- HAW562: TI01012K
- HAW569: TI01013K

7.2 Connecting the measuring device

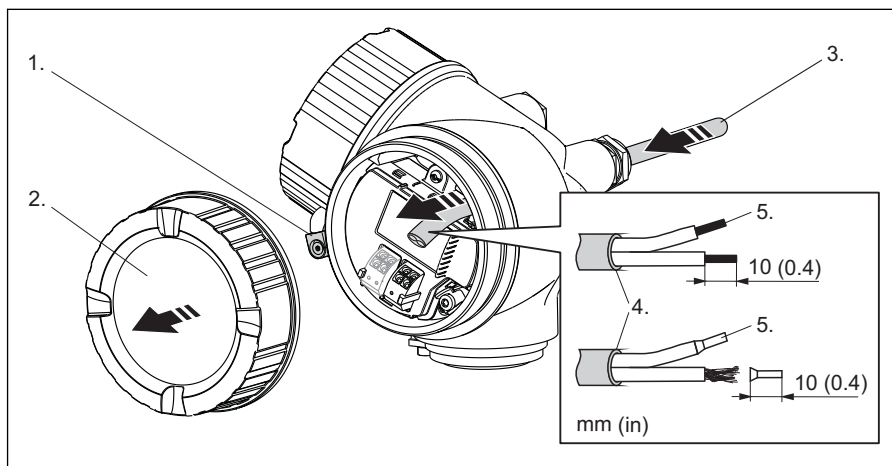
⚠ WARNING

Explosion hazard!

- ▶ Comply with the relevant national standards.
- ▶ Observe the specifications in the Safety Instructions (XA).
- ▶ Only use the specified cable glands.
- ▶ Check whether the supply voltage matches the specifications on the nameplate.
- ▶ Before connecting the device: Switch the supply voltage off.
- ▶ Before switching on the supply voltage: Connect the potential bonding line to the exterior ground terminal.

Required tools and accessories:

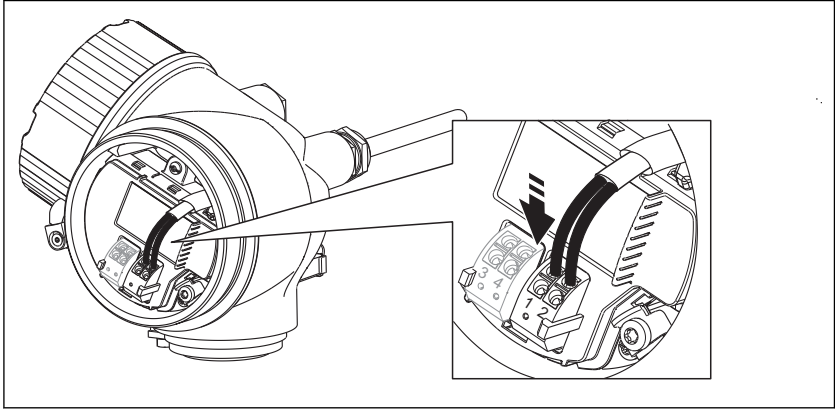
- For instruments with safety pin for the lid: AF 3 Allen key
- Wire stripping pliers
- When using stranded wires: Wire end sleeves.




A0012619

1. Loosen the screw of the securing clamp of the connection compartment cover and turn the clamp 90° counterclockwise.
2. Unscrew the connection compartment cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable.
5. Strip the cable ends 10 mm (0.4 in). For stranded cables, also attach wire end ferrules.
6. Firmly tighten the cable glands.

7.



A0013637

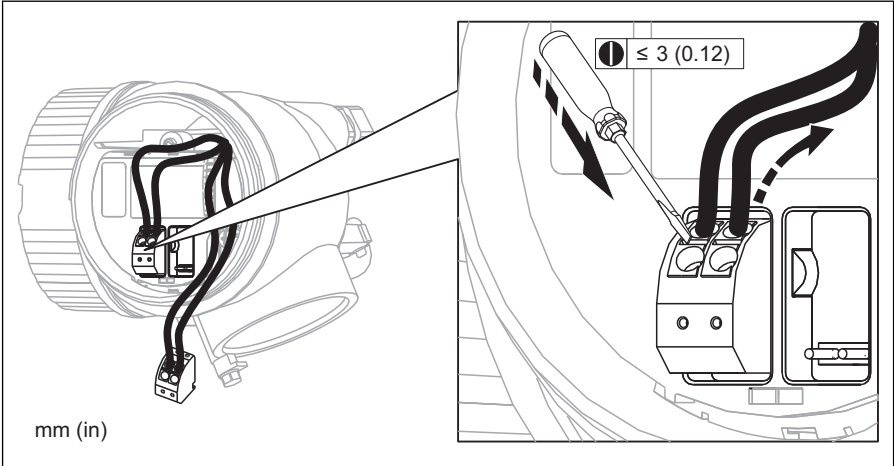
Connect the cable in accordance with the terminal assignment (→  36).

8. When using screened cable: Connect the cable screen to the ground terminal.
9. Screw the cover onto the connection compartment.
10. For instruments with safety pin for the lid: Adjust the safety pin so that its edge is over the edge of the display lid. Tighten the safety pin.

Pluggable spring-force terminals

Instruments without integrated overvoltage protection have pluggable spring-force terminals. Rigid conductors or flexible conductors with cable sleeve can directly be inserted and are contacted automatically.

To remove cables from the terminal: Press on the groove between the terminals using a flat-tip screwdriver ≤ 3 mm (0.12 inch) while pulling the cables out of the terminals.



7.3 Post-connection check

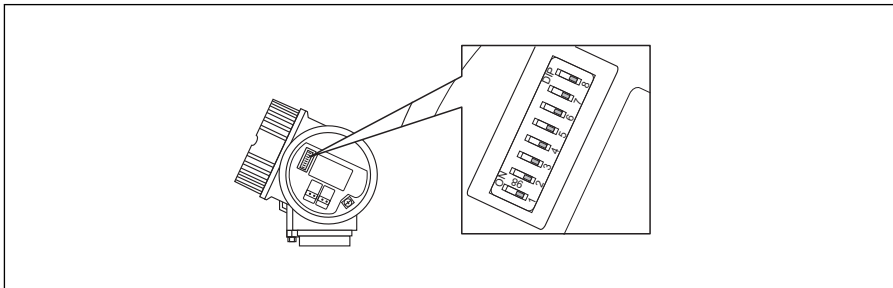
<input type="radio"/>	Are cables or the device undamaged (visual inspection)?
<input type="radio"/>	Do the cables comply with the requirements?
<input type="radio"/>	Do the cables have adequate strain relief?
<input type="radio"/>	Are all cable glands installed, firmly tightened and correctly sealed?
<input type="radio"/>	Does the supply voltage match the specifications on the transmitter nameplate?
<input type="radio"/>	Is the terminal assignment correct (→ 36)?
<input type="radio"/>	If required: Is the protective earth connected correctly (→ 36)?
<input type="radio"/>	If supply voltage is present: Is the device ready for operation and do values appear on the display module?
<input type="radio"/>	Are all housing covers installed and firmly tightened?
<input type="radio"/>	Is the securing clamp tightened correctly?

8 Integration into a PROFIBUS network


8.1 Overview of the device database files (GSD)

Manufacturer ID	17 (0x11)
Ident number	0x1559
Profile version	3.02
GSD file	Information and files under:
GSD file version	<ul style="list-style-type: none"> ▪ www.endress.com ▪ www.profibus.org

8.2 Set device address



A0015686

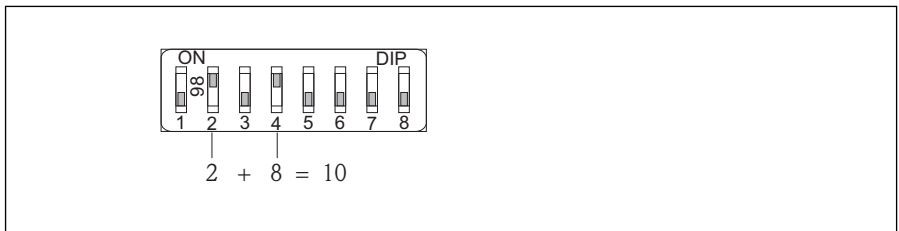
 17 Address switches in terminal compartment

8.2.1 Hardware addressing

1. Set switch 8 to "OFF".
2. Define the address with switches 1 to 7 according to the table below.

The address change becomes effective after 10 seconds. The device restarts automatically.

Switch	1	2	3	4	5	6	7
Value in position "ON"	1	2	4	8	16	32	64
Value in position "OFF"	0	0	0	0	0	0	0

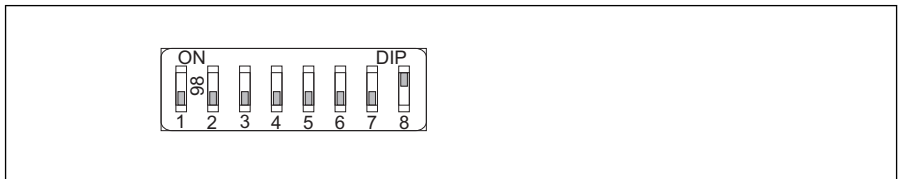


A0015902

- 18 Example of hardware addressing; switch 8 is in position "OFF"; switches 1 to 7 define the address.

8.2.2 Software addressing

1. Set switch 8 to "ON".
2. The device restarts automatically. The address remains the same as before (factory setting: 126).
3. Set the required address via the operating menu: Setup → Device address



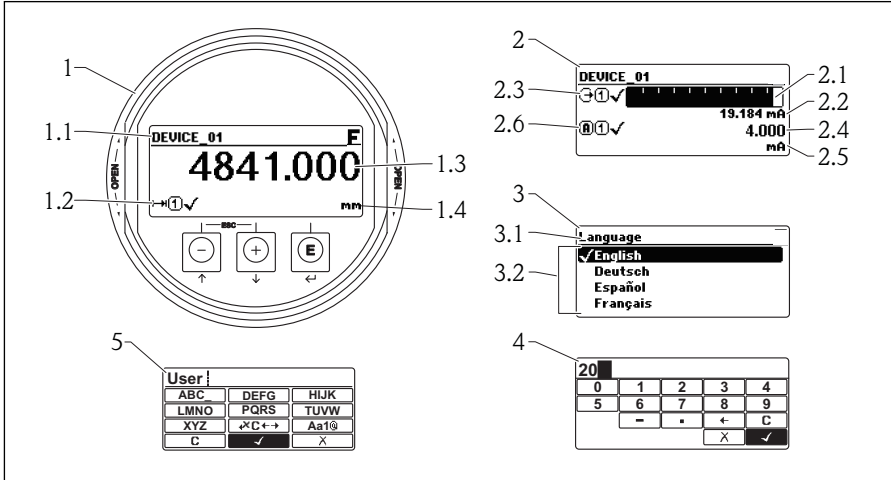
A0015903

- 19 Example of software addressing; switch 8 is in position "ON"; the address is defined in the operating menu (Setup → Device address)

9 Commissioning

9.1 Display and operating module

9.1.1 Display appearance










A0012635

20 Appearance of the display and operation module for on-site operation

- 1 Measured value display (1 value max. size)
- 1.1 Header containing tag and error symbol (if an error is active)
- 1.2 Measured value symbols
- 1.3 Measured value
- 1.4 Unit
- 2 Measured value display (1 bargraph + 1 value)
- 2.1 Bargraph for measured value 1
- 2.2 Measured value 1 (including unit)
- 2.3 Measured value symbols for measured value 1
- 2.4 Measured value 2
- 2.5 Unit for measured value 2
- 2.6 Measured value symbols for measured value 2
- 3 Representation of a parameter (here: a parameter with selection list)
- 3.1 Header containing parameter name and error symbol (if an error is active)
- 3.2 Selection list; marks the current parameter value.
- 4 Input matrix for numbers
- 5 Input matrix for alphanumeric and special characters

9.1.2 Operating elements

Key	Meaning
 A0013969	Minus key <i>For menu, submenu</i> Moves the selection bar upwards in a picklist. <i>For text and numeric editor</i> In the input mask, moves the selection bar to the left (backwards).
 A0013970	Plus key <i>For menu, submenu</i> Moves the selection bar downwards in a picklist. <i>For text and numeric editor</i> In the input mask, moves the selection bar to the right (forwards).
 A0013952	Enter key <i>For measured value display</i> <ul style="list-style-type: none"> ■ Pressing the key briefly opens the operating menu. ■ Pressing the key for 2 s opens the context menu. <i>For menu, submenu</i> <ul style="list-style-type: none"> ■ Pressing the key briefly Opens the selected menu, submenu or parameter. ■ Pressing the key for 2 s for parameter: If present, opens the help text for the function of the parameter. <i>For text and numeric editor</i> <ul style="list-style-type: none"> ■ Pressing the key briefly <ul style="list-style-type: none"> - Opens the selected group. - Carries out the selected action. ■ Pressing the key for 2 s confirms the edited parameter value.
 A0013971	Escape key combination (press keys simultaneously) <i>For menu, submenu</i> <ul style="list-style-type: none"> ■ Pressing the key briefly <ul style="list-style-type: none"> - Exits the current menu level and takes you to the next higher level. - If help text is open, closes the help text of the parameter. ■ Pressing the key for 2 s returns you to the measured value display ("home position"). <i>For text and numeric editor</i> Closes the text or numeric editor without applying changes.
 A0013953	Minus/Enter key combination (press and hold down the keys simultaneously) Reduces the contrast (brighter setting).
 A0013954	Plus/Enter key combination (press and hold down the keys simultaneously) Increases the contrast (darker setting).
 A0013955	Minus/Plus/Enter key combination (press and hold down the keys simultaneously) <i>For measured value display</i> Enables or disables the keypad lock.

9.2 Operating menu

Parameter/Submenu	Meaning	Description
Language ¹⁾	Defines the operating language of the on-site display.	BA01150F (FMR53/FMR54, HART)
Setup	When appropriate values have been assigned to all setup parameters, the measured should be completely configured in a standard application.	
Setup → Mapping	Interference echo suppression	
Setup → Advanced setup	Contains further submenus and parameters: <ul style="list-style-type: none"> ▪ to adapt the device to special measuring conditions. ▪ to process the measured value (scaling, linearization). ▪ to configure the signal output. 	
Diagnostics	Contains the most important parameters needed to detect and analyze operational errors.	
Expert ²⁾	Contains all parameters of the device (including those which are already contained in one of the above submenus). This menu is organized according to the function blocks of the device.	GP01014F/00/DE (Description of Device Parameters, FMR5x, HART)

- 1) In case of operation via operating tools (e.g. FieldCare), the "Language" parameter is located at "Setup → Advanced Setup → Display"
- 2) On entering the "Expert" menu, a access code is always requested. If a customer specific access code has not been defined, "0000" has to be entered.

9.3 Unlock the device

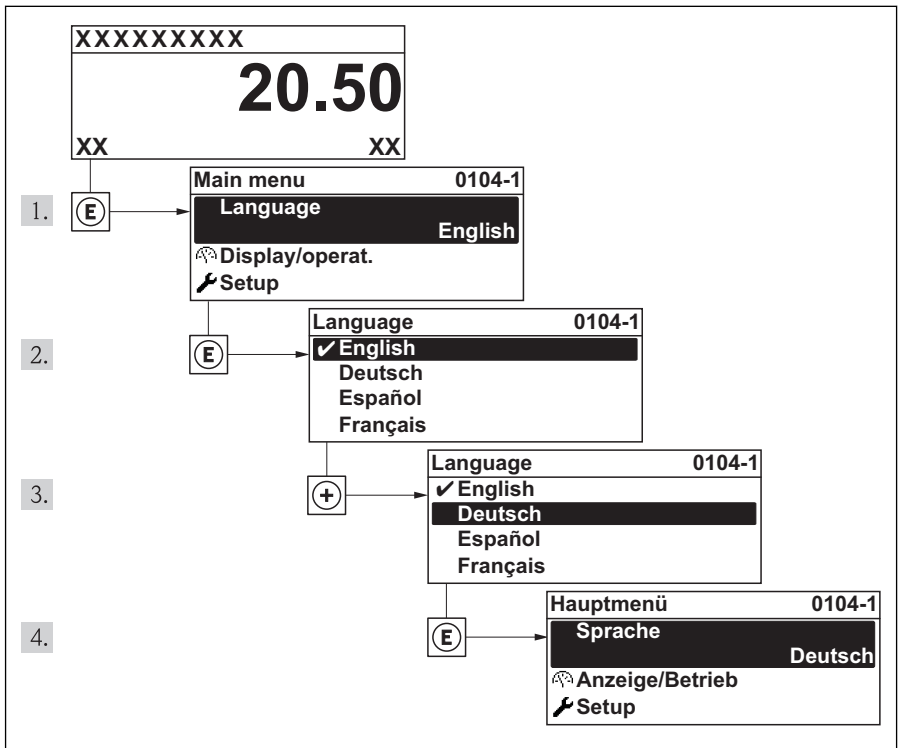
If the device has been locked, it must be unlocked before the measurement can be configured.



For details refer to the Operating Instructions of the device:
BA01150F (FMR53/FMR54, HART)

9.4 Setting the operating language

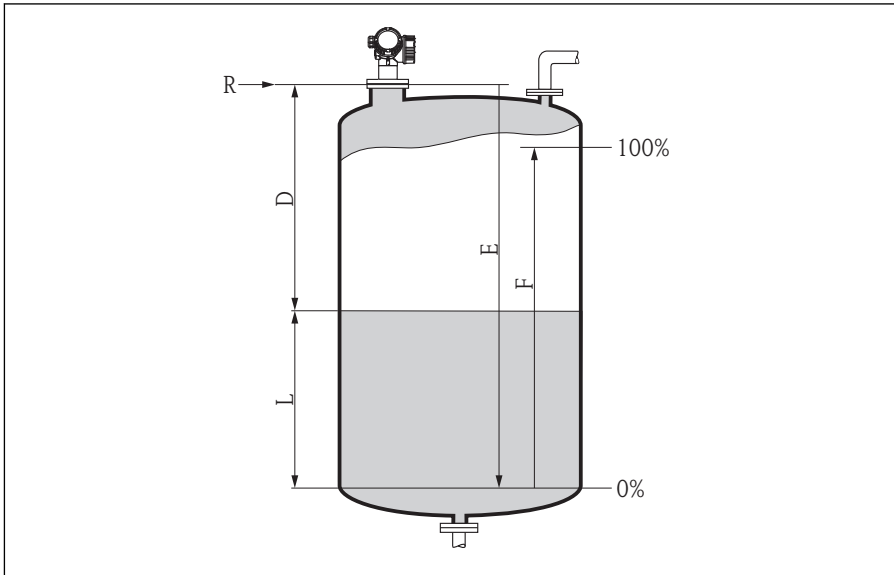
Factory setting: English or ordered local language



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21 Taking the example of the local display

9.5 Configuration of a level measurement



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1. **Setup → Device tag**
↳ Enter device tag.
2. **Setup → Distance unit**
↳ Select distance unit.
3. **Setup → Tank type**
↳ Select tank type.
4. **Setup → Tube diameter** (only for "Tank type" = "Bypass/pipe")
↳ Enter the diameter of the stilling well or bypass.
5. **Setup → Medium group**
↳ Specify medium group ("Water based": $DC > 4$ or "Others": $DC > 1,9$)
6. **Setup → Empty calibration**
↳ Enter empty distance E (Distance from reference point R to the 0% level)⁴⁾.
7. **Setup → Full calibration**
↳ Enter full distance F (Distance from the 0% to the 100% level).

4) If, for example, the measuring range covers only an upper part of the tank ($E \ll$ tank height), it is mandatory to enter the actual tank height into the "Setup → Advanced Setup → Level → Tank/silo height" parameter.

8. **Setup → Level**
 - ↳ Indicates the measured level L.
9. **Setup → Distance**
 - ↳ Indicates the measured distance from the reference point R to the level L.
10. **Setup → Signal quality**
 - ↳ Indicates the quality of the evaluated level echo.
11. **Setup → Mapping → Confirm distance**
 - ↳ Compare distance indicated on the display to real distance in order to start the recording of an interference echo map.
12. **Setup → Advanced setup → Level → Level unit**
 - ↳ Select level unit: %, m, mm, ft, in (Factory setting: %)



The response time of the device is preset by the **Tank type** parameter. An enhanced setting is possible in the **Advanced setup** submenu.

9.6 User-specific applications



For details of setting the parameters of user-specific applications, see separate documentation:

BA01150F (Operating Instructions, FMR53/FMR54, HART)



For the **Expert** submenu refer to:

GP01014F/00/EN (Description of Device Parameters, FMR5x, HART)



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