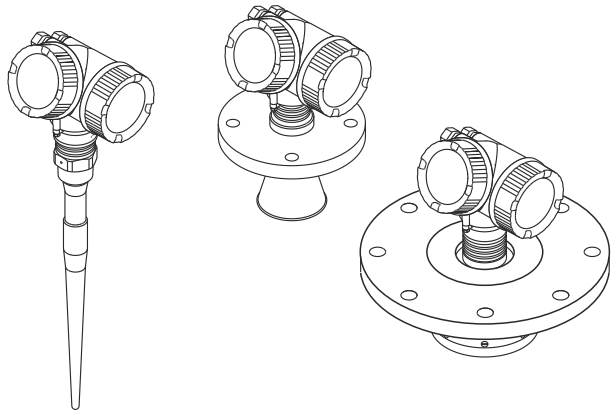


Brief Operating Instructions Micropilot FMR53, FMR54 HART

Free space radar



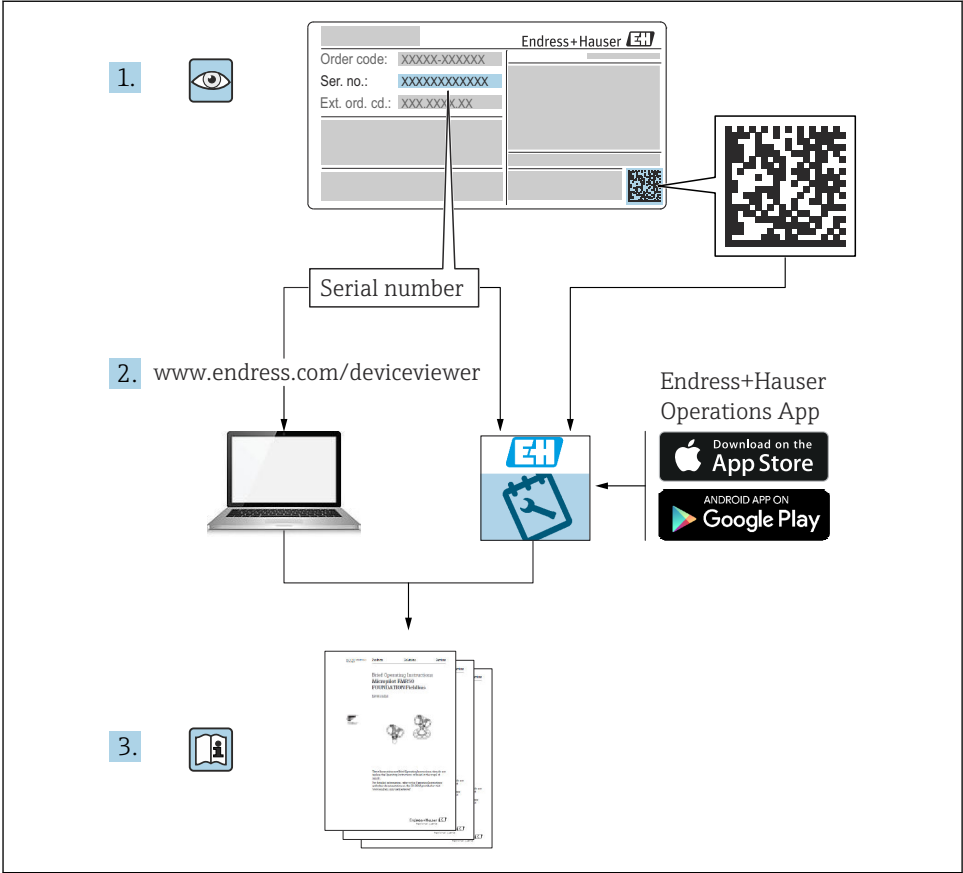
These Instructions are Brief Operating Instructions; they are not a substitute for the Operating Instructions pertaining to the device.

Detailed information about the device can be found in the Operating Instructions and the other documentation:

Available for all device versions via:

- Internet: www.endress.com/deviceviewer
- Smart phone/tablet: *Endress+Hauser Operations App*

1 Associated documentation



A0023555

2 About this document

2.1 Symbols used

2.1.1 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.

ℹ NOTICE

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

2.1.2 Electrical symbols

**Protective earth (PE)**

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

The ground terminals are located on the inside and outside 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.

2.1.3 Tool symbols

Tool symbols

Flat-blade screwdriver



Allen key



Open-ended wrench

2.1.4 Symbols for certain types of information and graphics

**Permitted**

Procedures, processes or actions that are permitted

**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



Visual inspection

1, 2, 3, ...

Item numbers

A, B, C, ...

Views

3 Basic safety instructions

3.1 Requirements for the personnel

Personnel must meet the following requirements to perform their tasks:

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

3.2 Intended use

Application and media

The measuring device described in these Operating Instructions is intended for continuous, non-contact level measurement in liquids, pastes and sludges. Due to its operating frequency of approx. 6 GHz, a maximum radiated pulsed power of 12.03 mW and an average power output of 0.024 mW, operation is completely harmless to humans or animals.

If the limit values specified in the "Technical data" and the conditions listed in the instructions and additional documentation are observed, the measuring device may be used only for the following measurements:

- ▶ Measured process variables: level, distance, signal strength
- ▶ Calculated process variables: volume or mass in vessels of any shape; flow rate through measuring weirs or channels (calculated based on the level using the linearization functionality)

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

- ▶ Use the measuring device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Observe the limit values in the "Technical data".

Incorrect use

The manufacturer is not liable for damage caused by using the device incorrectly or for purposes for which it was not intended.

Clarification in the case of borderline cases:

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

Residual risks

Due to heat transfer from the process as well as power loss in the electronics, the temperature of the electronics housing and the assemblies contained therein (e.g. display module, main electronics module and I/O electronics module) may rise up to 80 °C (176 °F). When in operation, the sensor may reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!

- ▶ In the event of elevated fluid temperatures, ensure protection against contact to prevent burns.

3.3 Workplace safety

When working on and with the device:

- ▶ Wear the required personal protective equipment as per national regulations.

3.4 Operational safety

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for ensuring trouble-free operation of the device.

Hazardous area

To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):

- ▶ Check the nameplate to verify if the device ordered can be put to its intended use in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of these instructions.

3.5 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 it is safe to operate. It meets the general safety standards and legal requirements.

NOTICE**Loss of degree of protection by opening of the device in humid environments**

- ▶ If the device is opened in a humid environment, the degree of protection indicated on the nameplate is no longer valid. This may also impair the safe operation of the device.

3.5.1 CE mark

The measuring system meets the legal requirements of the applicable EU directives. These are listed in the corresponding EU Declaration of Conformity together with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the CE mark.

3.5.2 EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity along with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the EAC mark.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during incoming acceptance:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Does the data on the nameplate match the order specifications on the delivery note?
- Is the DVD with the operating tool present?

If required (see nameplate), have the Safety Instructions (XA) been provided?



If one of these conditions is not met, please contact your Endress+Hauser sales office.

4.2 Storage and transport

4.2.1 Storage conditions

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

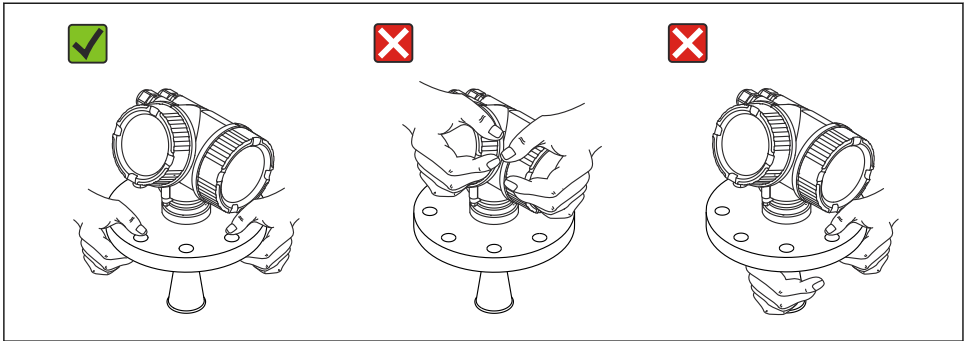
4.2.2 Transporting the product to the measuring point

NOTICE

Housing or antenna horn may become damaged or break off.

Risk of injury!

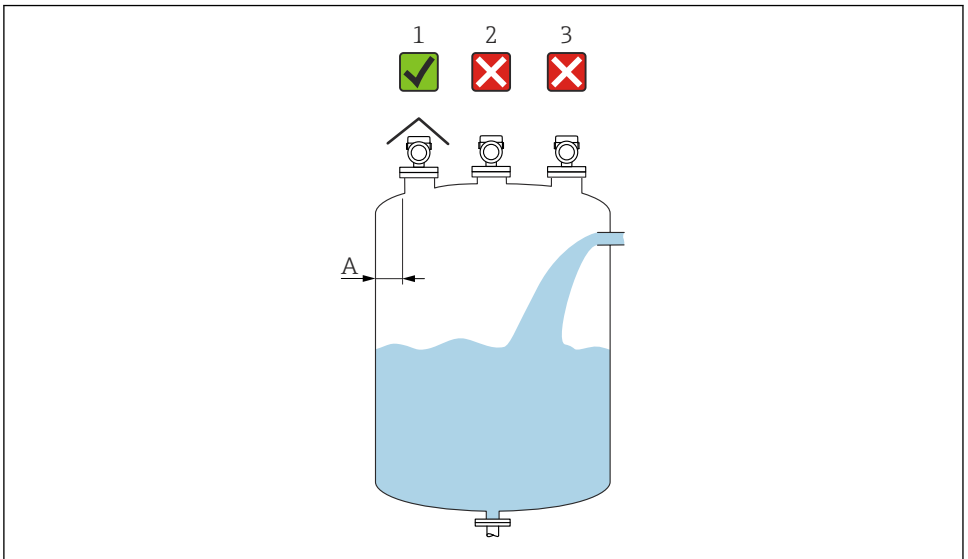
- ▶ Transport the measuring device to the measuring point in its original packaging or by the process connection.
- ▶ Always secure lifting equipment (slings, eyes, etc.) to the process connection and never to the electronic housing or antenna horn. Pay attention to the center of gravity of the device so that it does not tilt or slip unintentionally.
- ▶ Follow the safety instructions and transport conditions for devices over 18 kg (39.6 lbs), (IEC61010).



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5 Mounting

5.1 Mounting location

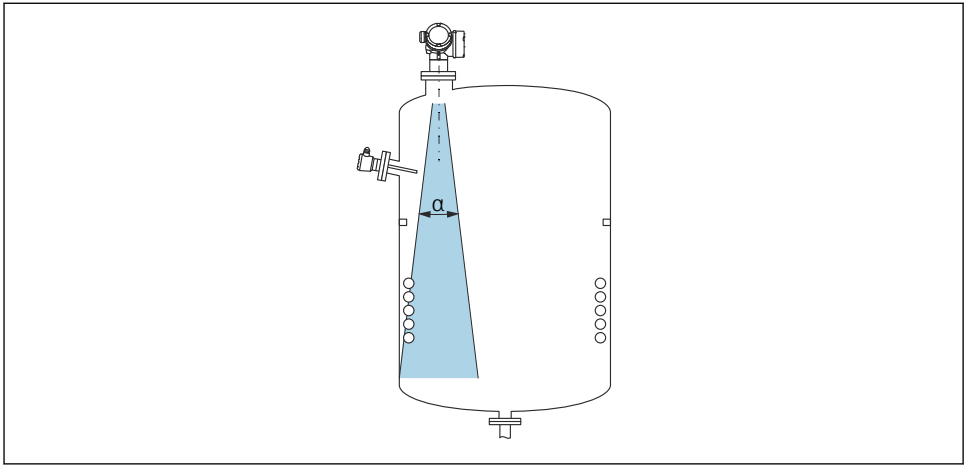


A0016882

- A Recommended distance from wall to nozzle outer edge $\sim 1/6$ of the vessel diameter. However, the device must not under any circumstances be mounted closer than 15 cm (5.91 in) to the tank wall.
- 1 Use of a weather protection cover; protection from direct sunlight or rain
 - 2 Installation in the center, interference can cause signal loss
 - 3 Do not install above the filling curtain

5.2 Orientation

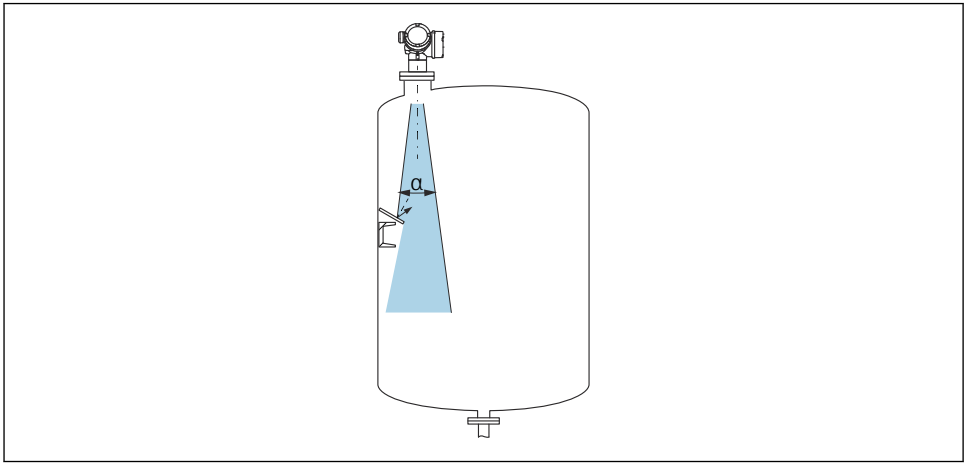
5.3 Internal vessel fittings



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Avoid the location of internal fittings (limit switches, temperature sensors, struts, vacuum rings, heating coils, baffles etc.) inside the signal beam. Take into account the beam angle.

5.4 Avoiding interference echoes

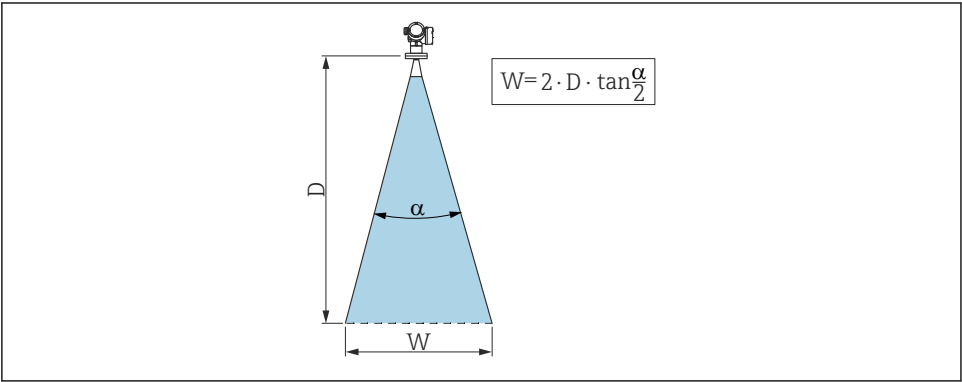


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Metal orifice plates installed at an angle to scatter the radar signals help prevent interference echoes.


5.5 Beam angle

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



A0016891

 1 Relationship between beam angle α , distance D and beam diameter W

 The beamwidth diameter **W** depends on the beam angle α and the distance **D**.

FMR53	
Beam angle α	23°
Distance (D)	Beam 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)

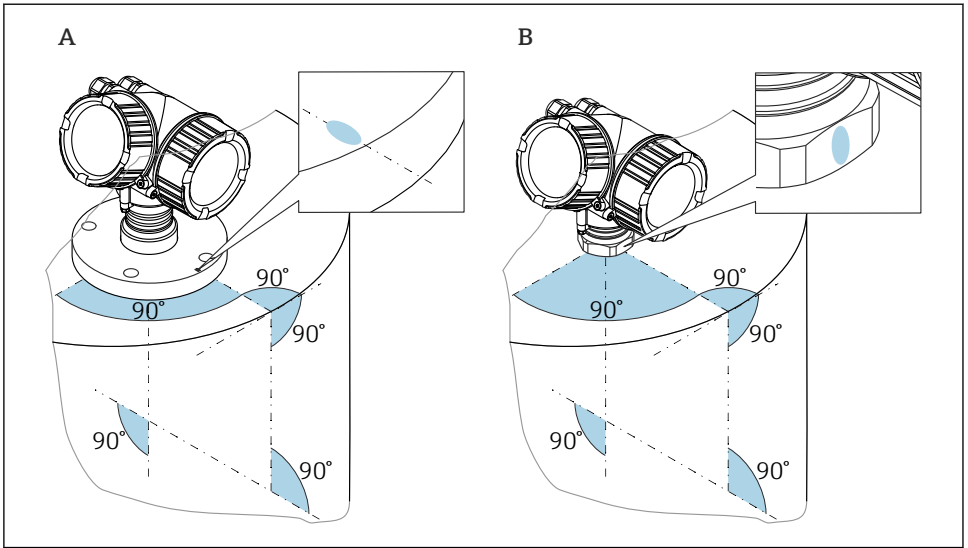
FMR54 - horn antenna			
Antenna size	150 mm (6 in)	200 mm (8 in)	250 mm (10 in)
Beam angle α	23°	19°	15°
Distance (D)	Beam diameter W		
3 m (9.8 ft)	1.22 m (4 ft)	1 m (3.3 ft)	0.79 m (2.6 ft)
6 m (20 ft)	2.44 m (8 ft)	2.01 m (6.6 ft)	1.58 m (5.2 ft)
9 m (30 ft)	3.66 m (12 ft)	3.01 m (9.9 ft)	2.37 m (7.8 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)

5.6 Free-space installation in vessel

5.6.1 Rod antenna (FMR53)

Alignment

- Align the antenna perpendicular to the product surface.
- A marking is provided on the flange (at a point between the flange holes) or the gland to aid the alignment. This marking must be aligned towards the tank wall as much as possible.

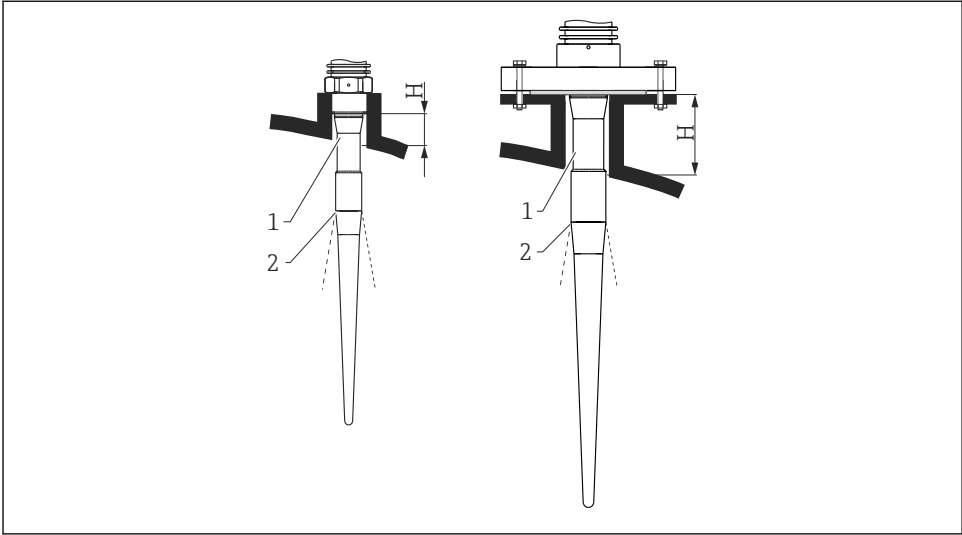


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Depending on the device version the marking may be a circle or two parallel lines.

Information concerning nozzles



A0016821

2 Nozzle height for rod antenna (FMR53)

- 1 Antenna inactive length
- 2 Beam exit from here

Length of antenna	390 mm (15.4 in)	540 mm (21.3 in)
Nozzle height H	< 100 mm (3.94 in)	< 250 mm (9.84 in)

i The inactive part (1) of the rod antenna must project out of the nozzle.

- i** For flanges with PTFE cladding: Observe the instructions for mounting cladded flanges
- The PTFE flange cladding normally acts simultaneously as a seal between the nozzle and the device flange

Information concerning threaded connections

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

Mounting cladded flanges



Note the following for cladded flanges:

- Use the same number of flange screws as the number of flange bores provided.
- Tighten the screws with the necessary torque (see Table).
- Retighten after 24 hours or after the first temperature cycle.
- Depending on the process pressure and temperature, check and retighten the screws, where necessary, at regular intervals.

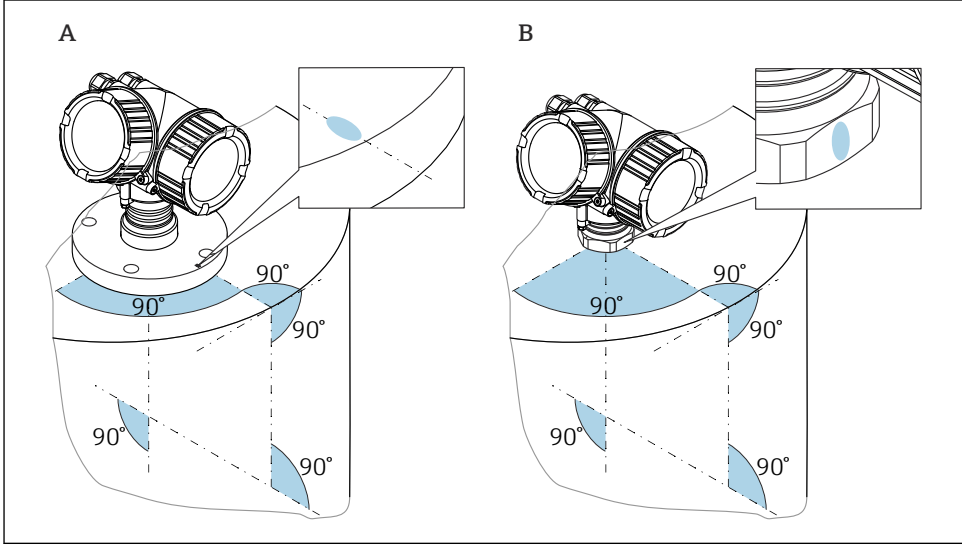
The PTFE flange cladding normally acts simultaneously as a seal between the nozzle and the device flange.

Flange size	Number of screws	Tightening torque
EN		
DN50 PN10/16	4	45 to 65 Nm
DN50 PN25/40	4	45 to 65 Nm
DN80 PN10/16	8	40 to 55 Nm
DN80 PN25/40	8	40 to 55 Nm
DN100 PN10/16	8	40 to 60 Nm
DN100 PN25/40	8	55 to 80 Nm
DN150 PN10/16	8	75 to 115 Nm
ASME		
NPS 2" Cl.150	4	40 to 55 Nm
NPS 2" Cl.300	8	20 to 30 Nm
NPS 3" Cl.150	4	65 to 95 Nm
NPS 3" Cl.300	8	40 to 55 Nm
NPS 4" Cl.150	8	45 to 70 Nm
NPS 4" Cl.300	8	55 to 80 Nm
NPS 6" Cl.150	8	85 to 125 Nm
NPS 6" Cl.300	12	60 to 90 Nm
NPS 8" Cl.150	8	115 to 170 Nm
NPS 8" Cl.300	12	90 to 135 Nm
JIS		
10K 50A	4	40 to 60 Nm
10K 80A	8	25 to 35 Nm
10K 100A	8	35 to 55 Nm
10K 150A	8	75 to 115 Nm


5.6.2 Horn antenna (FMR54)

Alignment

- Align the antenna perpendicular to the product surface.
- A marking is provided on the flange (at a point between the flange holes) to aid the alignment. This marking must be aligned towards the tank wall as much as possible.

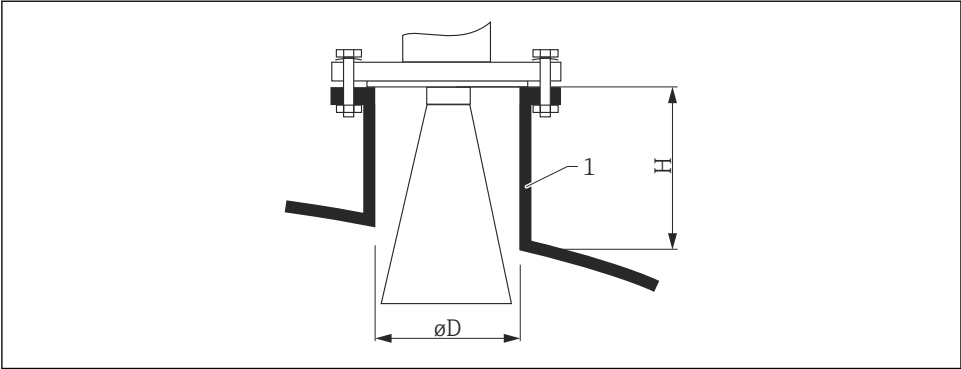


A0018974

 Depending on the device version the marking may be a circle or two parallel lines.

Information concerning nozzles

The horn antenna should project out of the nozzle; if necessary, select the version with antenna extension 100 to 400 mm (4 to 16 in) (accessory).



3 Nozzle height and diameter for horn antenna

1 Mounting nozzle

Antenna	ØD	Maximum nozzle height H_{max} (Antenna without antenna extension)
150mm/6"	146 mm (5.75 in)	185 mm (7.28 in)
200mm/8"	191 mm (7.52 in)	268 mm (10.6 in)
250mm/10"	241 mm (9.49 in)	360 mm (14.2 in)

i Antenna versions < 150mm/6" are not suitable for free-space installation in the tank. They should only be used in bypasses or stilling wells.

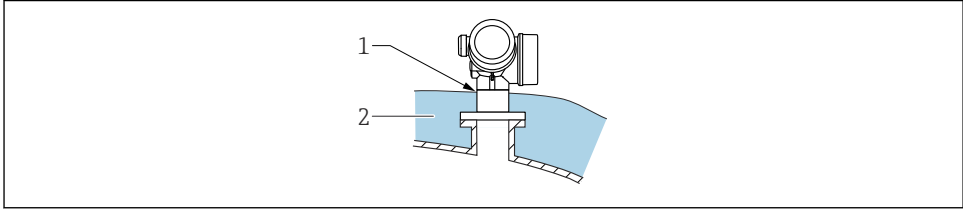
Measurement from the outside through plastic walls

- Dielectric constant of the medium: $\epsilon_r > 10$
- Use an antenna 250 mm (10 in) if possible.
- The distance from the tip of the antenna to the tank should be approx. 100 mm (4 in).
- If possible, avoid installation positions in which condensate or buildup can form between the antenna and the vessel.
- In the case of outdoor installations, ensure that the area between the antenna and the tank is protected from the weather.
- Do not install any fittings or attachments between the antenna and the tank that could reflect the signal.

Suitable thickness of the tank ceiling:

Penetrated material	PE	PTFE	PP	Plexiglass
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)

5.7 Container with heat insulation

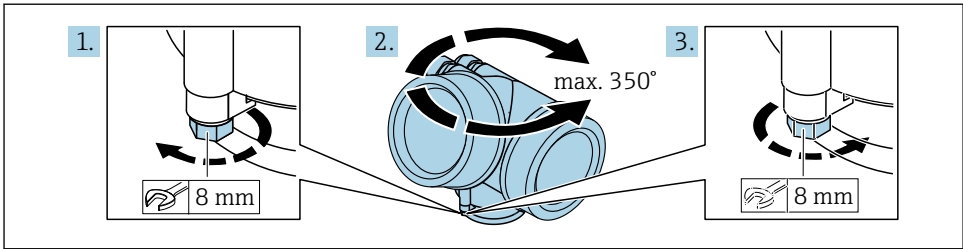


A0032207

If process temperatures are high, the device should be included in the usual container insulation system (2) to prevent the electronics from heating as a result of thermal radiation or convection. The insulation should not be higher than the neck of the device (1).

5.8 Turning the transmitter housing

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

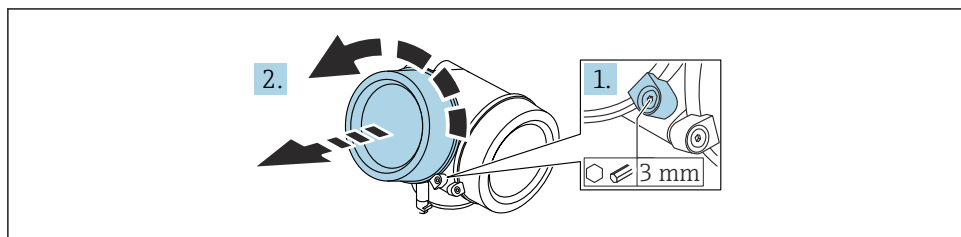


A0032242

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 plastic housing; 2.5 Nm for aluminum or stainless steel housing).

5.9 Turning the display

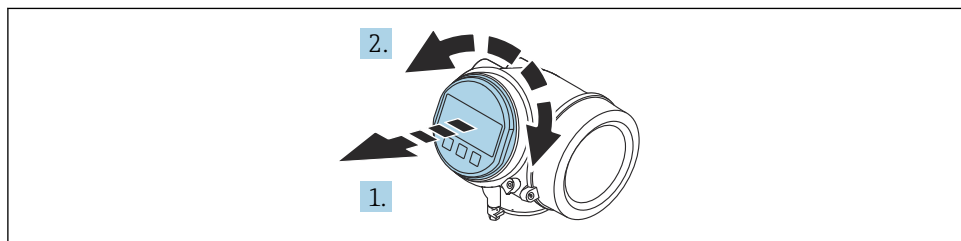
5.9.1 Opening the cover



A0021430

1. Loosen the screw of the securing clamp of the electronics compartment cover using an Allen key (3 mm) and turn the clamp 90 ° counterclockwise.
2. Unscrew the electronics compartment cover and check the cover seal; replace it if necessary.

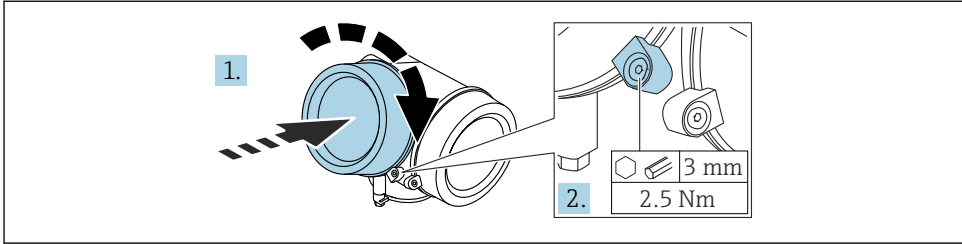
5.9.2 Turning the display module



A0036401

1. Pull out the display module with a gentle rotational movement.
2. Turn the display module to the desired position: Max. $8 \times 45^\circ$ in each direction.
3. Feed the coiled cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment until it engages.

5.9.3 Closing the cover of the electronics compartment



A0021451

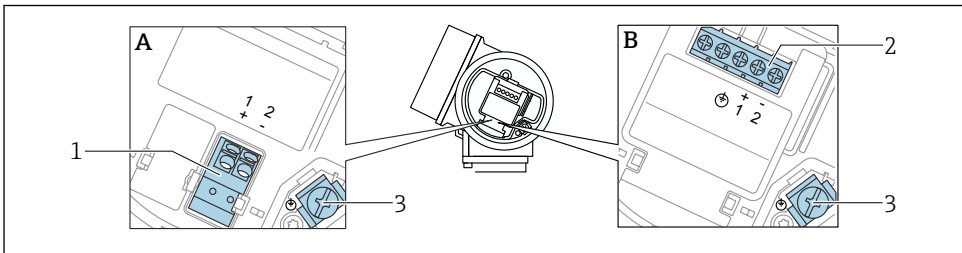
1. Screw down the cover of the electronics compartment.
2. Turn the securing clamp 90 ° in the clockwise direction and, using an Allen key (3 mm), tighten the screw of the securing clamp on the electronics compartment cover with 2.5 Nm.

6 Electrical connection

6.1 Connecting requirements

6.1.1 Terminal assignment

Terminal assignment, 2-wire: 4 to 20 mA HART



A0036498

4 Terminal assignment, 2-wire: 4 to 20 mA HART

A Without integrated overvoltage protection

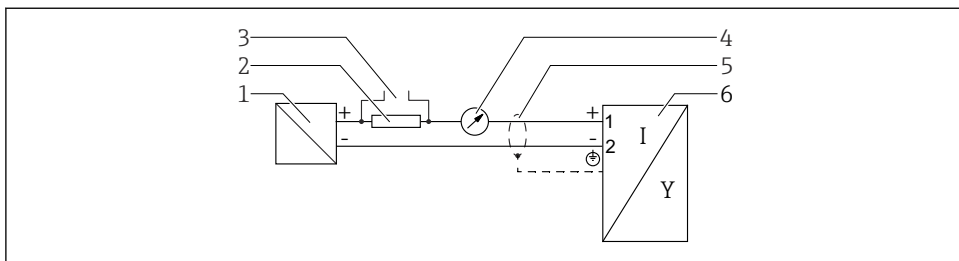
B With integrated overvoltage protection

1 Connection 4 to 20 mA, HART passive: terminals 1 and 2, without integrated overvoltage protection

2 Connection 4 to 20 mA, HART passive: terminals 1 and 2, with integrated overvoltage protection

3 Terminal for cable shield

Block diagram, 2-wire: 4 to 20 mA HART

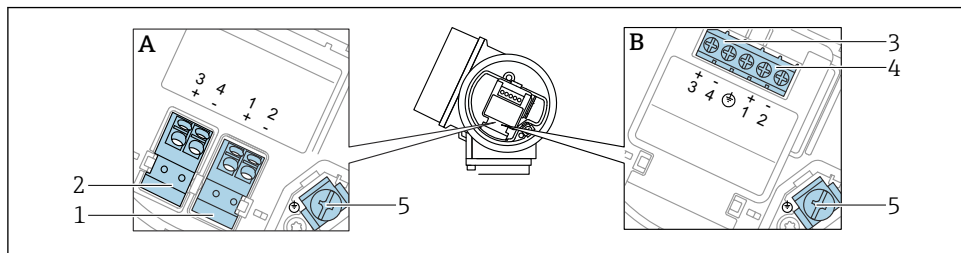


A0036499

 5 *Block diagram, 2-wire: 4 to 20 mA HART*

- 1 Active barrier for power supply (e.g. RN221N); observe terminal voltage
- 2 Resistor for HART communication ($\geq 250 \Omega$); observe maximum load
- 3 Connection for Commubox FXA195 or FieldExpert SFX350/SFX370 (via VIATOR Bluetooth modem)
- 4 Analog display unit; observe maximum load
- 5 Cable screen; observe cable specification
- 6 Measuring device

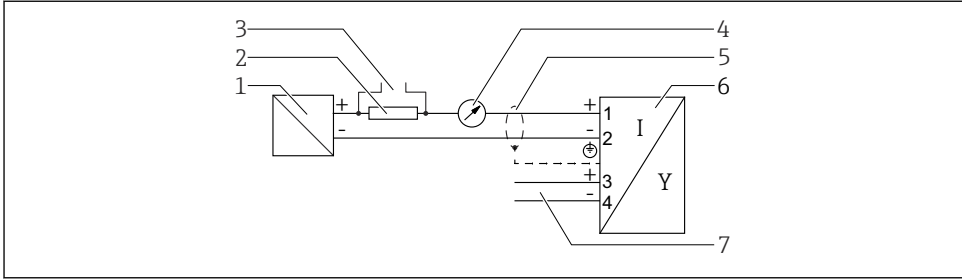
Terminal assignment, 2-wire: 4 to 20 mA HART, switch output



A0036500

6 Terminal assignment, 2-wire: 4 to 20 mA HART, switch output

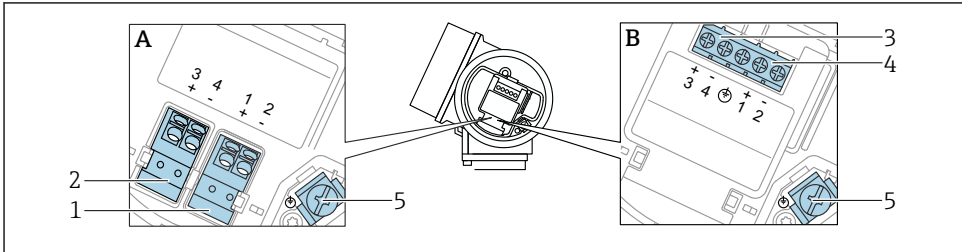
- | | |
|---|--|
| A | Without integrated overvoltage protection |
| B | With integrated overvoltage protection |
| 1 | Connection 4 to 20 mA, HART passive: terminals 1 and 2, without integrated overvoltage protection |
| 2 | Connection, switch output (open collector): terminals 3 and 4, without integrated overvoltage protection |
| 3 | Connection, switch output (open collector): terminals 3 and 4, with integrated overvoltage protection |
| 4 | Connection 4 to 20 mA, HART passive: terminals 1 and 2, with integrated overvoltage protection |
| 5 | Terminal for cable shield |

Block diagram, 2-wire: 4 to 20 mA HART, switch output

A0036501

7 Block diagram, 2-wire: 4 to 20 mA HART, switch output

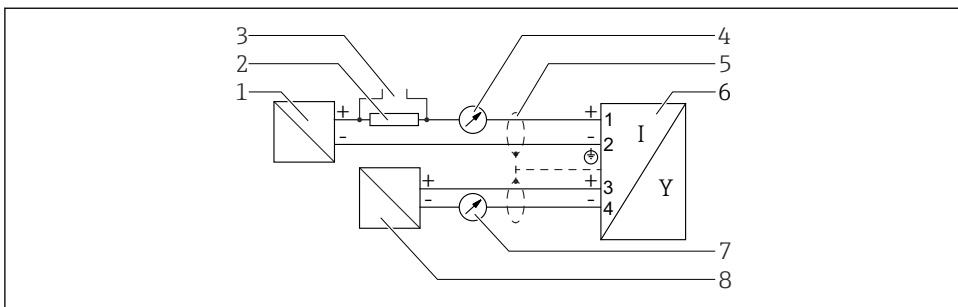
- 1 Active barrier for power supply (e.g. RN221N); observe terminal voltage
- 2 Resistor for HART communication ($\geq 250 \Omega$); observe maximum load
- 3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
- 4 Analog display unit; observe maximum load
- 5 Cable screen; observe cable specification
- 6 Measuring device
- 7 Switch output (open collector)

Terminal assignment, 2-wire: 4 to 20 mA HART, 4 to 20 mA

A0036500

8 Terminal assignment, 2-wire: 4 to 20 mA HART, 4 to 20 mA

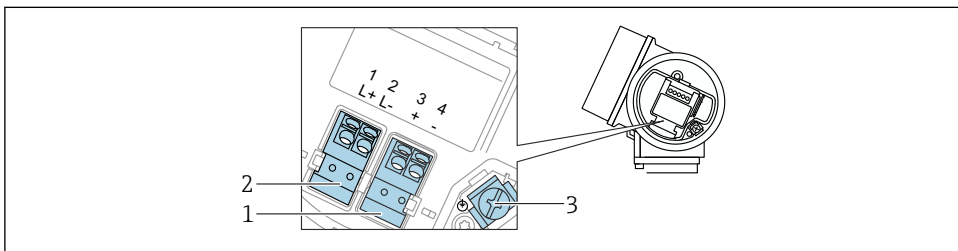
- A Without integrated overvoltage protection
- B With integrated overvoltage protection
- 1 Connection current output 1, 4 to 20 mA HART passive: terminals 1 and 2, without integrated overvoltage protection
- 2 Connection current output 2, 4 to 20 mA: terminals 3 and 4, without integrated overvoltage protection
- 3 Connection current output 2, 4 to 20 mA: terminals 3 and 4, with integrated overvoltage protection
- 4 Connection current output 1, 4 to 20 mA HART passive: terminals 1 and 2, with integrated overvoltage protection
- 5 Terminal for cable shield

Block diagram, 2-wire: 4 to 20 mA HART, 4 to 20 mA

A0036502

9 Block diagram, 2-wire: 4 to 20 mA HART, 4 to 20 mA

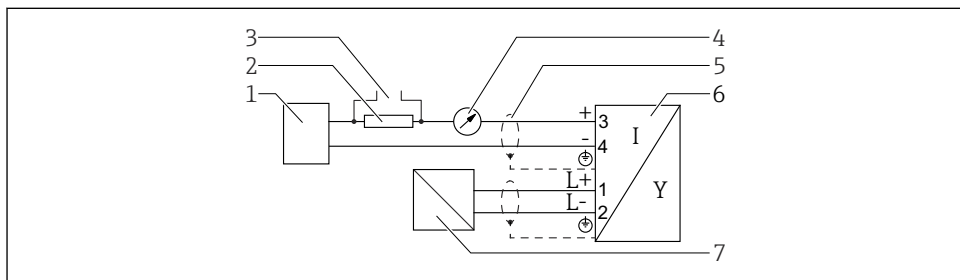
- 1 Active barrier for power supply (e.g. RN221N), current output 1; observe terminal voltage
- 2 Resistor for HART communication ($\geq 250 \Omega$); observe maximum load
- 3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
- 4 Analog display unit; observe maximum load
- 5 Cable screen; observe cable specification
- 6 Measuring device
- 7 Analog display unit; observe maximum load
- 8 Active barrier for power supply (e.g. RN221N), current output 2; observe terminal voltage

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

A0036516

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

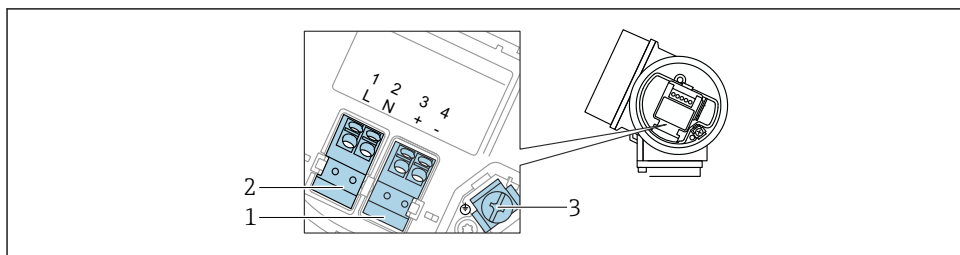
- 1 Connection 4 to 20 mA HART (active): terminals 3 and 4
- 2 Connection, supply voltage: terminals 1 and 2
- 3 Terminal for cable shield

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

A0036526

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

- 1 Evaluation unit, e.g. PLC
- 2 Resistor for HART communication ($\geq 250 \Omega$); observe maximum load
- 3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
- 4 Analog display unit; observe maximum load
- 5 Cable screen; observe cable specification
- 6 Measuring device
- 7 Supply voltage; observe terminal voltage, observe cable specification

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

A0036519




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

- 1 Connection 4 to 20 mA HART (active): terminals 3 and 4
- 2 Connection, supply voltage: terminals 1 and 2
- 3 Terminal for cable shield

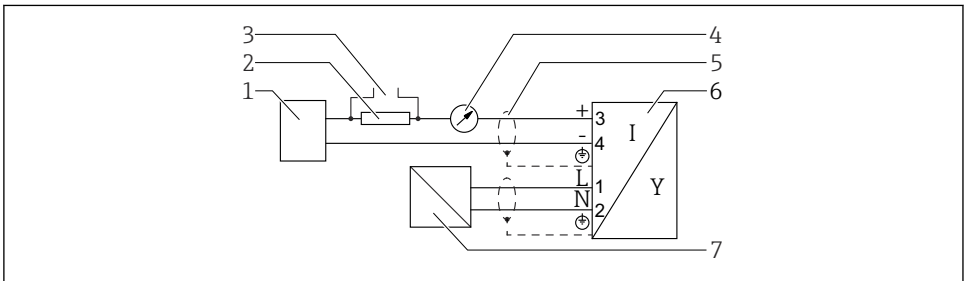
CAUTION

To ensure electrical safety:

- ▶ Do not disconnect the protective ground connection.
- ▶ Disconnect the device from the supply voltage before disconnecting the protective ground.

-  Connect protective ground to the inner ground terminal (3) before connecting the supply voltage. If necessary, connect the potential matching line to the outer ground terminal.
-  In order to ensure electromagnetic compatibility (EMC): do **not** ground the device exclusively via the protective ground 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).

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

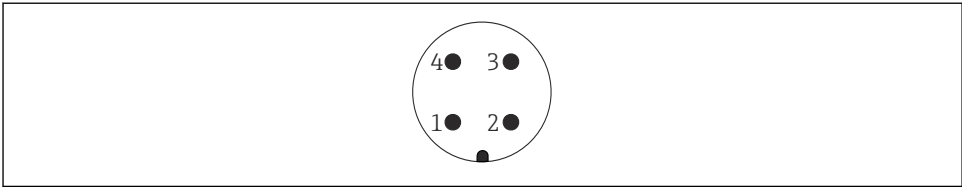


 13 Block diagram, 4-wire: 4 to 20 mA HART (90 to 253 V_{AC})

- 1 Evaluation unit, e.g. PLC
- 2 Resistor for HART communication ($\geq 250 \Omega$); observe maximum load
- 3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
- 4 Analog display unit; observe maximum load
- 5 Cable screen; observe cable specification
- 6 Measuring device
- 7 Supply voltage; observe terminal voltage, observe cable specification

6.1.2 Device plug

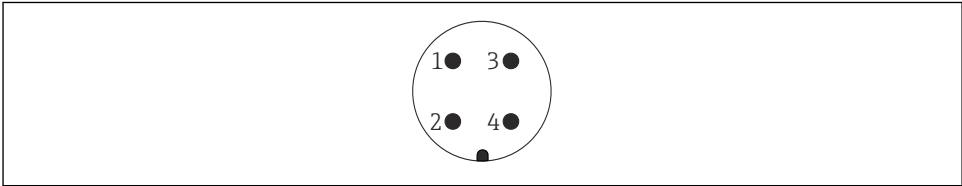
-  In the case of the device versions with a plug, the housing does not need to be opened to connect the signal cable.



A0011175

14 Pin assignment of M12 plug

- 1 Signal +
- 2 Not assigned
- 3 Signal -
- 4 Ground



A0011176

15 Pin assignment of 7/8" plug

- 1 Signal -
- 2 Signal +
- 3 Not assigned
- 4 Shielding

6.1.3 Supply voltage

2-wire, 4-20mA HART, passive

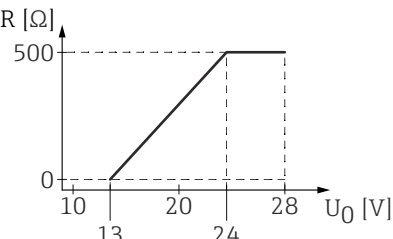
"Power supply, output" 1)	"Approval" 2)	Terminal voltage U at device	Maximum load R, depending on the supply voltage U ₀ of the power supply unit
A: 2-wire; 4-20mA HART	<ul style="list-style-type: none">Non-ExEx nAEx icCSA GP	10.4 to 35 V 3) 4) 5)	
	Ex ia / IS	10.4 to 30 V 3) 4) 5)	

"Power supply, output" ¹⁾	"Approval" ²⁾	Terminal voltage U at device	Maximum load R _i depending on the supply voltage U ₀ of the power supply unit
	<ul style="list-style-type: none"> ■ Ex d(ia) / XP ■ Ex ic(ia) ■ Ex nA(ia) ■ Ex ta / DIP 	13 to 35 V ^{5) 6)}	
	Ex ia + Ex d(ia) / IS + XP	13 to 30 V ^{5) 6)}	

- 1) Feature 020 in the product structure
- 2) Feature 010 in the product structure
- 3) At ambient temperatures $T_a \leq -20^\circ\text{C}$, a terminal voltage $\geq U\ 15\text{ V}$ is required to start the device with the minimum error current (3.6 mA). The start-up current can be configured. If the device is operated with a fixed current of $I \geq 5.5\text{ mA}$ (HART Multidrop mode), a voltage $U \geq 10.4\text{ V}$ is sufficient in the entire ambient temperature range.
- 4) In the current simulation mode, a voltage $U \geq 12.5\text{ V}$ is required.
- 5) When using the Bluetooth module, the minimum supply voltage increases by 3 V.
- 6) At ambient temperatures $T_a \leq -20^\circ\text{C}$, a terminal voltage $\geq U\ 16\text{ V}$ is required to start the device with the minimum error current (3.6 mA).

"Power supply, output" ¹⁾	"Approval" ²⁾	Terminal voltage U at device	Maximum load R _i depending on the supply voltage U ₀ of the power 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 	13 to 35 V ^{3) 4)}	
	<ul style="list-style-type: none"> ■ Ex ia / IS ■ Ex ia + Ex d(ia) / IS + XP 	13 to 30 V ^{3) 4)}	

- 1) Feature 020 in the product structure
- 2) Feature 010 in the product structure
- 3) At ambient temperatures $T_a \leq -30^\circ\text{C}$, a terminal voltage $\geq U\ 16\text{ V}$ is required to start the device with the minimum error current (3.6 mA).
- 4) When using the Bluetooth module, this minimum supply voltage increases by 3 V.

"Power supply, output" ¹⁾	"Approval" ²⁾	Terminal voltage U at device	Maximum load R _i depending on the supply voltage U ₀ of the power supply unit
C: 2-wire; 4-20mA HART, 4-20mA	all	13 to 28 V ³⁾ 4)	

- 1) Feature 020 in the product structure
- 2) Feature 010 in the product structure
- 3) At ambient temperatures $T_a \leq -30\text{ }^{\circ}\text{C}$, a terminal voltage $\geq U\text{ }16\text{ V}$ is required to start the device with the minimum error current (3.6 mA).
- 4) When using the Bluetooth module, this minimum supply voltage increases by 3 V.

Integrated polarity reversal protection	Yes
Permitted residual ripple with f = 0 to 100 Hz	$U_{SS} < 1\text{ V}$
Permitted residual ripple with f = 100 to 10000 Hz	$U_{SS} < 10\text{ mV}$

4-wire, 4-20mA HART, active

"Power supply; output" ¹⁾	Terminal voltage U	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 in the product structure

6.2 Connecting the device

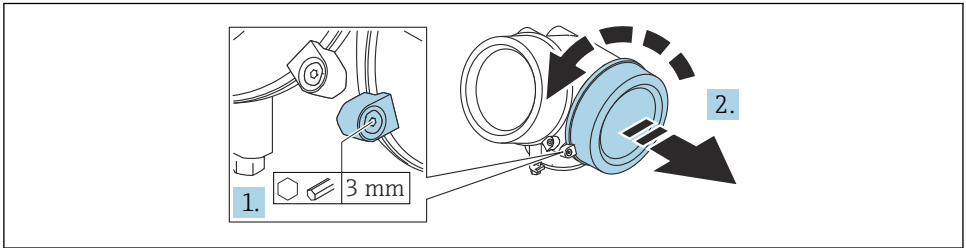
⚠ WARNING

Explosion Hazard!

- Observe applicable national standards.
- Comply with the specifications in the Safety Instructions (XA).
- Use specified cable glands only.
- Check to ensure that the power supply matches the information on the nameplate.
- Switch off the power supply before connecting the device.
- Connect the potential matching line to the outer ground terminal before applying the power supply.

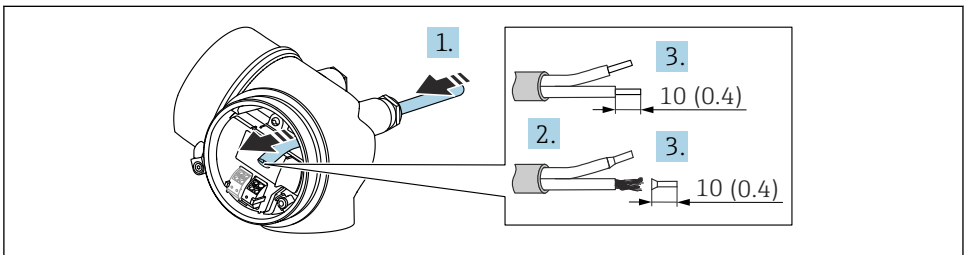
Required tools/accessories:

- For devices with a cover lock: Allen key AF3
- Wire stripper
- When using stranded cables: One ferrule for every wire to be connected.

6.2.1 Opening cover

A0021490

1. Loosen the screw of the securing clamp of the connection compartment cover using an Allen key (3 mm) and turn the clamp 90 ° counterclockwise.
2. Unscrew the connection compartment cover and check the cover seal; replace it if necessary.

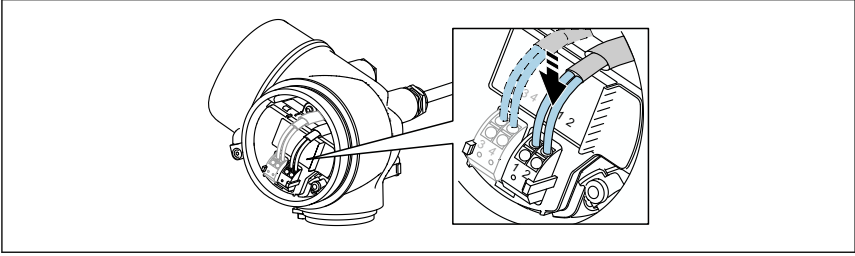
6.2.2 Connecting

A0036418

16 Engineering unit: mm (in)

1. Push the cable through the cable entry . To ensure tight sealing, do not remove the sealing ring from the cable entry.
2. Remove the cable sheath.
3. Strip the cable ends 10 mm (0.4 in). In the case of stranded cables, also fit ferrules.
4. Firmly tighten the cable glands.

5. Connect the cable according to the terminal assignment.

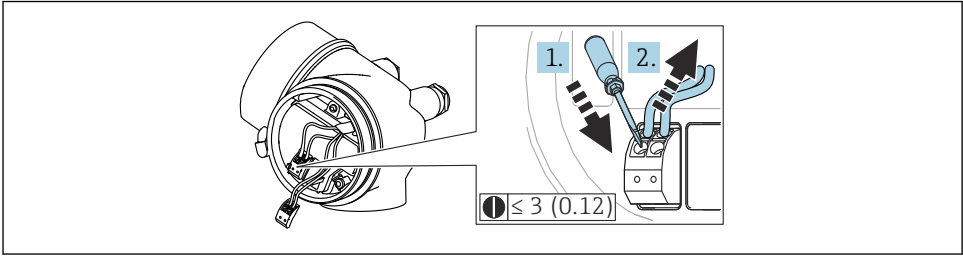


A0034662

6. If using shielded cables: Connect the cable shield to the ground terminal.

6.2.3 Plug-in spring-force terminals

The electrical connection of device versions without an integrated overvoltage protection is via plug-in spring-force terminals. Rigid conductors or flexible conductors with ferrules can be inserted directly into the terminal without using the lever, and create a contact automatically.



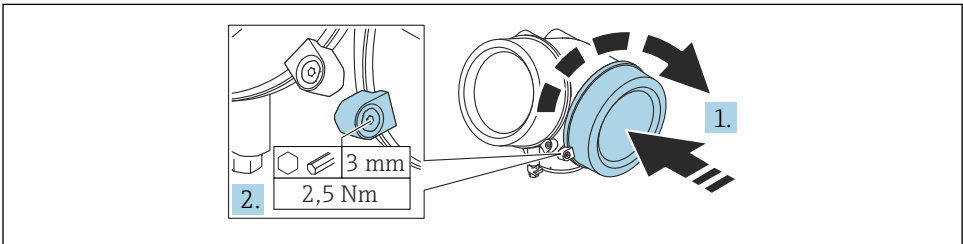
A0013661

17 Engineering unit: mm (in)

To remove the cable from the terminal again:

1. Using a flat-blade screwdriver ≤ 3 mm, press down on the slot between the two terminal holes
2. Simultaneously pull the cable end out of the terminal.

6.2.4 Closing the cover of the connection compartment



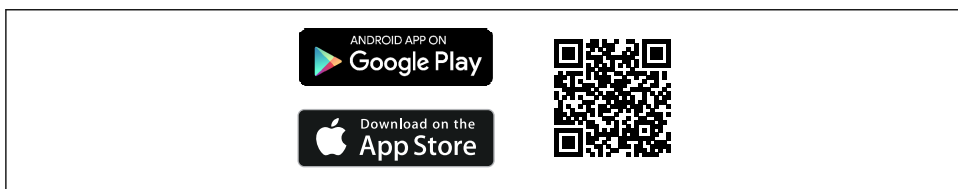
A0021491

1. Screw down the cover of the connection compartment.
2. Turn the securing clamp 90 ° in the clockwise direction and, using an Allen key (3 mm), tighten the screw of the securing clamp on the connection compartment cover with 2.5 Nm.

7 Operation options

The device can be operated as follows:

- Operation via operating menu (display)
- DeviceCare / FieldCare, see Operating Instructions
- SmartBlue (app), Bluetooth (optional), see Operating Instructions



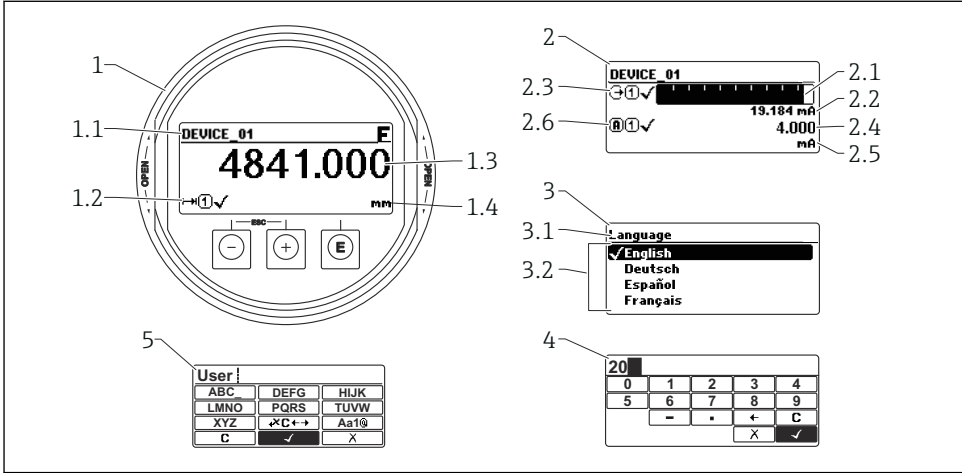
A0033202

 18 *Download link*


8 Commissioning

8.1 Structure and function of the operating menu

8.1.1 Display



A0012635

 19 Display format on the display and operating module

- 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 (bar graph + 1 value)
 - 2.1 Bar graph 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 Visualization of a parameter (here: parameter with picklist)
 - 3.1 Header containing parameter name and error symbol (if an error is active)
 - 3.2 Picklist; ☒ marks the current parameter value.
- 4 Input matrix for numbers
- 5 Input matrix for alphanumeric and special characters

8.1.2 Operating elements

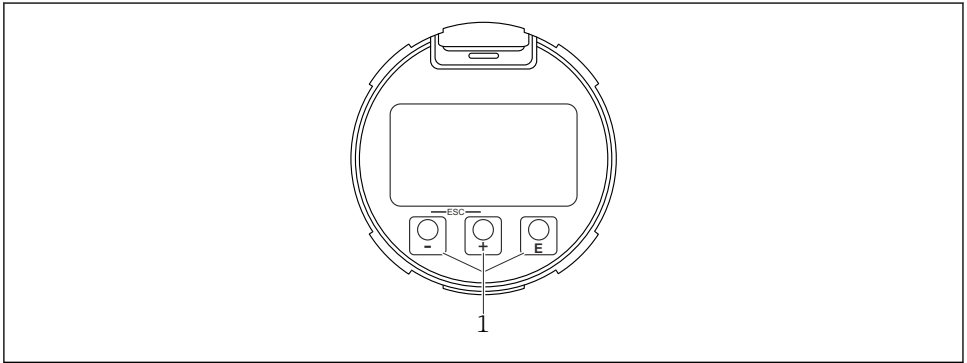
Functions

- Display of measured values and fault and notice messages
- Background lighting, which switches from green to red in the event of an error
- The device display can be removed for easier operation



The device displays are available with the additional option of Bluetooth® wireless technology.

Backlighting is switched on or off depending on the supply voltage and the current consumption.






A0039284

20 Display module

1 Operating keys

Key assignment

- Key 
 - Navigate down in the picklist
 - Edit the numerical values or characters within a function
- Key 
 - Navigate up in the picklist
 - Edit the numerical values or characters within a function
- Key 
 - *In the measured value display:* Pressing the key briefly opens the operating menu.
 - Pressing the key for 2 s opens the context menu.
 - *In the menu, submenu:* Pressing the key briefly:
 - Opens the selected menu, submenu or parameter.
 - Pressing the key for 2 s in a parameter:
 - If present, opens the help text for the function of the parameter.
 - *In a text and numeric editor:* Pressing the key briefly:
 - Opens the selected group.
 - Carries out the selected action.
 - Carries out the selected action.

- **⏏** key and **⏏** key (ESC function - press keys simultaneously)
 - *In the menu, submenu:* Pressing the key briefly:
 - 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").
 - *In a text and numeric editor:* Closes the text or numeric editor without applying changes.
 - **⏏** key and **⏏** key (press keys simultaneously)
 - Reduces the contrast (brighter setting).
 - **⏏** key and **⏏** key (press and hold keys simultaneously)
 - Increases the contrast (darker setting).

8.2 Opening the context menu

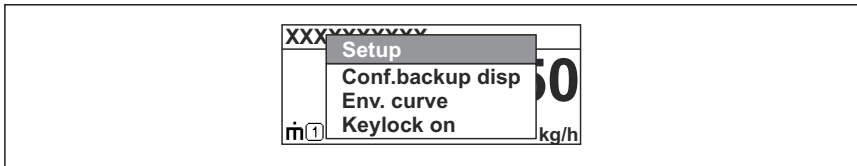
Using the context menu, the user can call up the following menus quickly and directly from the operational display:

- Setup
- Conf. backup disp.
- Envelope curve
- Keylock on

Calling up and closing the context menu

The user is in the operational display.

1. Press **⏏** for 2 s.
 - ↳ The context menu opens.





2. Press **⏏** + **⏏** simultaneously.
 - ↳ The context menu is closed and the operational display appears.

Calling up the menu via the context menu

1. Open the context menu.
2. Press **⏏** to navigate to the desired menu.
3. Press **⏏** to confirm the selection.
 - ↳ The selected menu opens.

8.3 Operating menu

Parameter/submenu	Meaning	Description
Language Setup → Advanced setup → Display → LanguageExpert → System → Display → Language	Defines the operating language of the local display	 BA01150F - Operating Instructions, FMR53/FMR54, HART
Setup	Once values have been set for the setup parameters, the measurement should generally be completely configured.	
Setup→Mapping	Mapping of interference echoes	
Setup→Advanced setup <ul style="list-style-type: none"> ■ For more customized configuration of the measurement (adaptation to special measuring conditions) ■ For converting the measured value (scaling, linearization). ■ For scaling the output signal. 	Contains additional submenus and parameters	
Diagnostics	Contains the most important parameters for diagnosing the condition of the device	 GP01014F - Description of device parameters, FMR5x, HART
Expert menu In the Enter access code parameter enter 0000 if no customer-specific access code has been defined.	Contains all parameters of the device (including those that are already in one of the other menus). This menu is organized according to the function blocks of the device.	

8.4 Disabling write protection

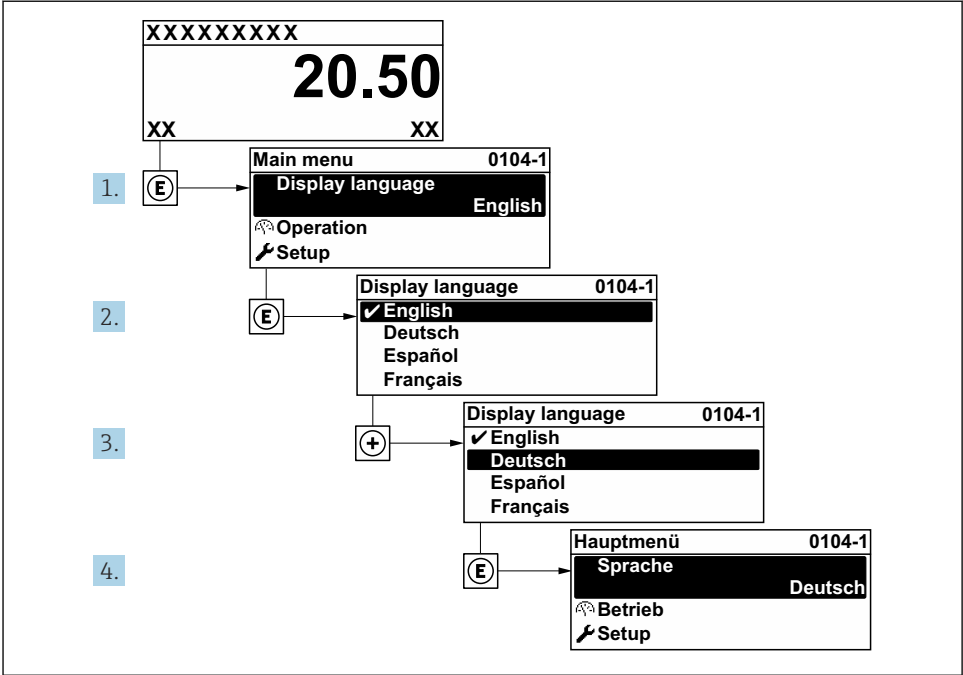
If the device is write-protected, it must first be unlocked, see Operating Instructions.



BA01150F - Operating Instructions, FMR53/FMR54, HART

8.5 Setting the operating language

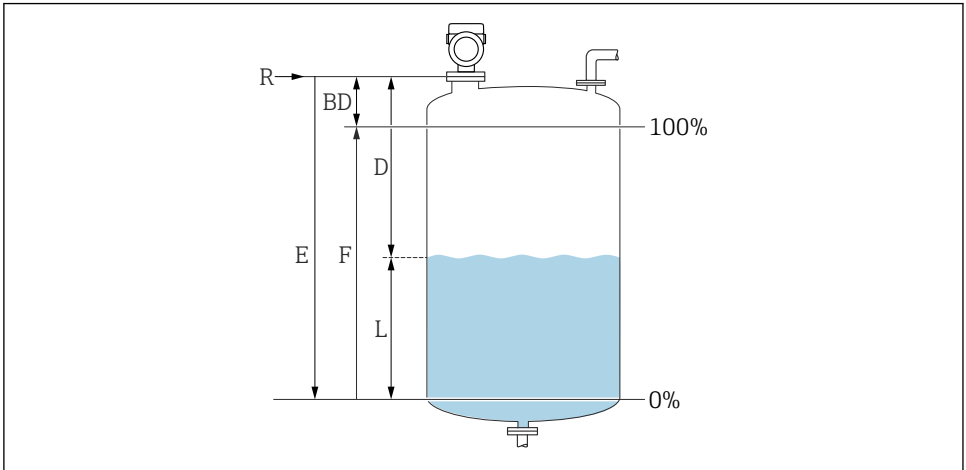
Factory setting: English or ordered local language




A0029420

21 Taking the example of the local display

8.6 Configuring level measurement



A0016933

 22 Configuration parameters for level measurement in liquids

- R Reference point of measurement
- D Distance
- L Level
- E Empty calibration (= zero point)
- F Full calibration (= span)

1. Setup → Device tag
 - ↳ Enter a unique name for the measuring point to identify the device quickly within the plant.
2. Setup → Distance unit
 - ↳ Used for the basic calibration (Empty / Full).
3. Setup → Bin type
 - ↳ Optimizes the signal filters for the respective bin type. Note: 'Workbench test' deactivates all filters. This option should exclusively be used for tests.
4. Setup → Medium group
 - ↳ Specify media group ("aqueous": DK>4 or "other": DK>1.9)
5. Setup → Empty calibration
 - ↳ Specify empty distance E (distance from reference point R to 0% mark). Setup → Advanced setup → Level → Tank/silo height If the parametrized measuring range (Empty calibration) differs significantly from the tank or silo height, it is recommended to enter the tank or silo height in this parameter. Example: Continuous level monitoring in the upper third of a tank or silo. Note: For tanks with conical outlet, this parameter should not be changed as in this type of applications 'Empty calibration' is usually not << the tank or silo height.

6. Setup → Full calibration
 - ↳ Distance between minimum level (0%) and maximum level (100%).
7. Setup → Level
 - ↳ Currently measured level
8. Setup → Distance
 - ↳ Distance between lower edge of flange or thread and medium surface.
9. Setup → Signal quality
 - ↳ Displays the signal quality of the analyzed level echo.
10. Setup → Mapping → Confirm distance
 - ↳ Compare the distance displayed with the actual value to start recording an interference echo map.
11. Setup → Advanced setup → Level → Level unit
 - ↳ Select the level unit: %, m, mm, ft, in (factory setting: %)



The reaction time of the device is preconfigured via the **Tank type** parameter. Advanced configuration is possible in the **Advanced setup** submenu.

8.7 User-specific applications

To configure the parameters for user-specific applications, see:



BA01150F - Operating Instructions, FMR53/FMR54, HART

Also, for the **Expert** submenu:



GP01014F - Description of device parameters, FMR5x, HART



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