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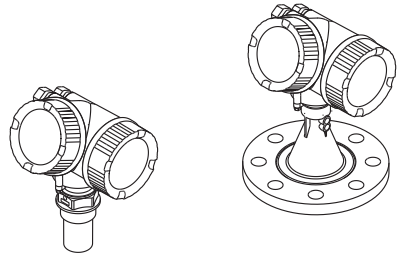
Brief Operating Instructions
Micropilot FMR50
FOUNDATION Fieldbus

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".

Endress+Hauser
People for Process Automation

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1 Important document information

1.1 Document conventions

1.1.1 Safety symbols

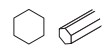
Symbol	Meaning
 A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.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

1.1.2 Electrical symbols

Symbol	Meaning
 A0011197	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
 A0011198	**Alternating current** A terminal to which alternating voltage is applied or through which alternating current flows.
 A0017381	**Direct current and alternating current** ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
 A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Symbol	Meaning
 A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
 A0011201	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of 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
 A0011187	**Hazardous area** Indicates a hazardous area.
 A0011188	**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. The device can also be freely mounted outside closed metal vessels because of its operating frequency of about 26 GHz, a maximum radiated pulsed power of 5.7 mW and an average power output of 0.015 mW (for the version with advanced dynamics: maximum pulse power: 23.3 mW; average power: 0.076 mW). 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

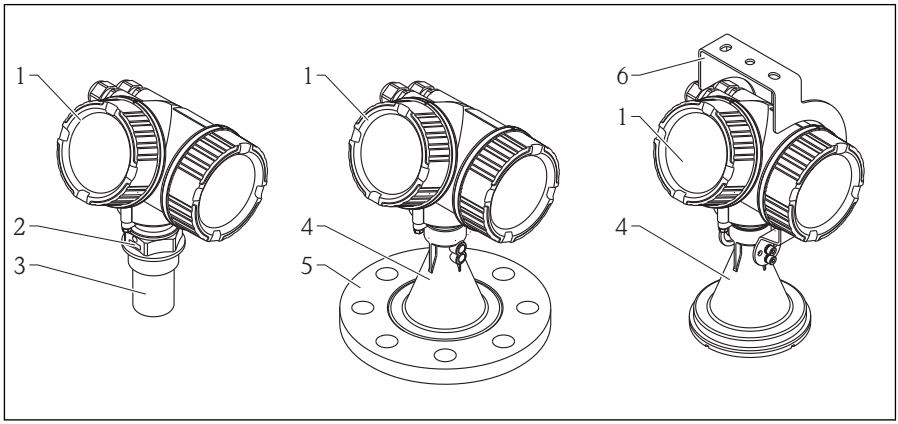
This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate.

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

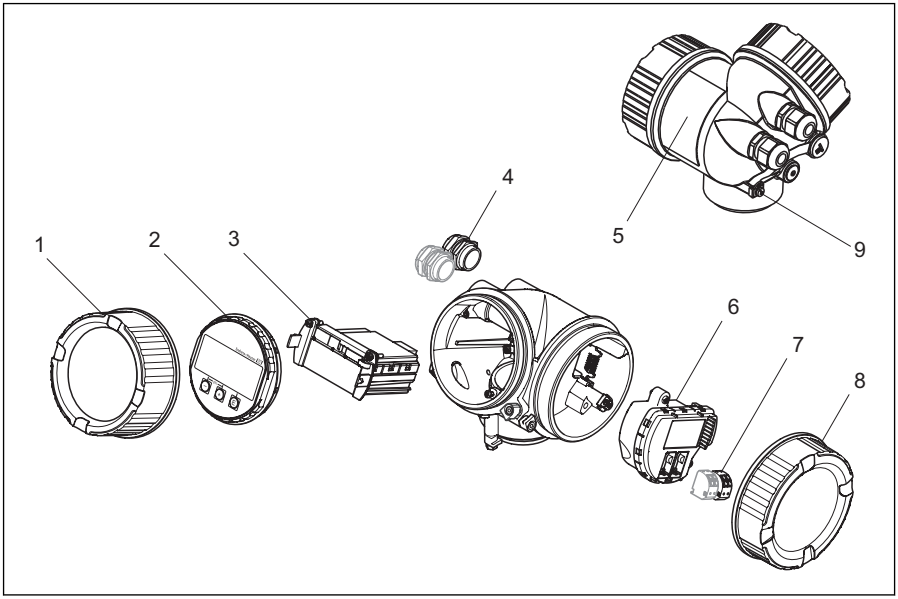
3.1.1 Micropilot FMR50



1 Design of the Micropilot FMR50 (26 GHz)

1 Electronics housing
2 Process connection (Thread)
3 Horn antenna 40 mm (1-1/2 in), PVDF encapsulated
4 Horn antenna 80mm/100 mm (3in/4 in), PP cladded
5 Slip-on flange
6 Mounting bracket

3.1.2 Electronics housing

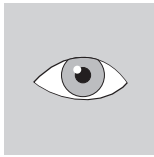


2 Design of the electronics housing

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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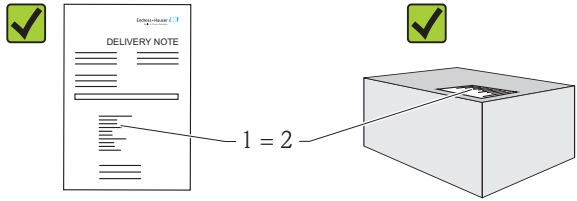

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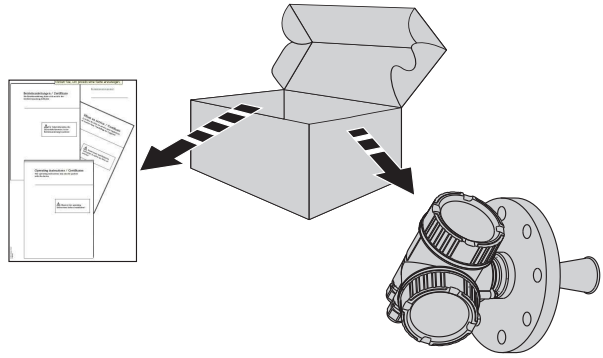

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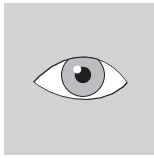

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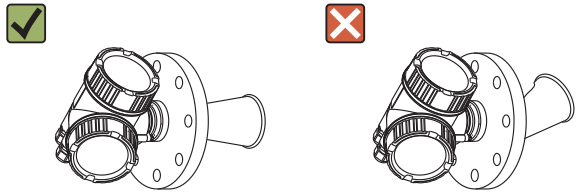

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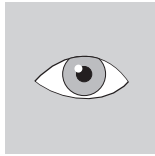

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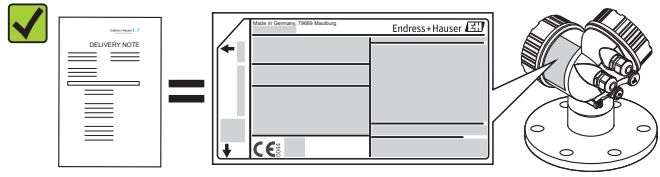

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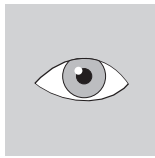

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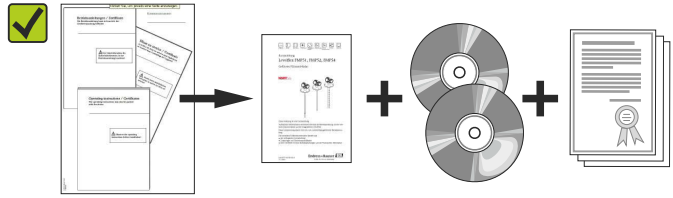

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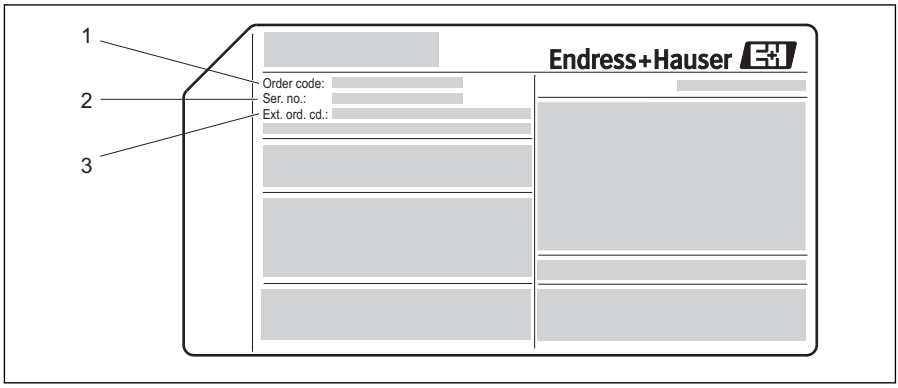
If one of the conditions does not comply, contact your Endress+Hauser distributor.

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



3 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.

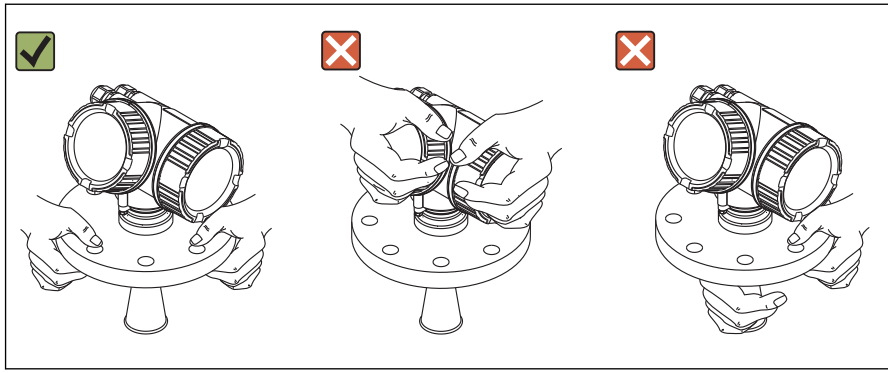
5.2 Transport product to the measuring point

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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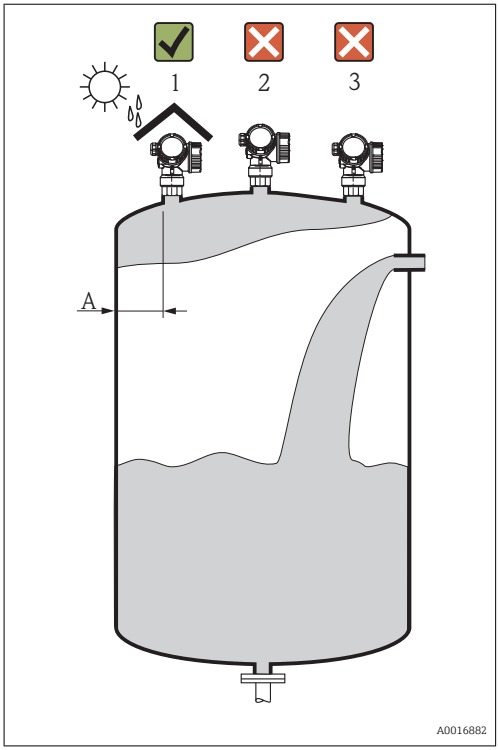
6 Installation

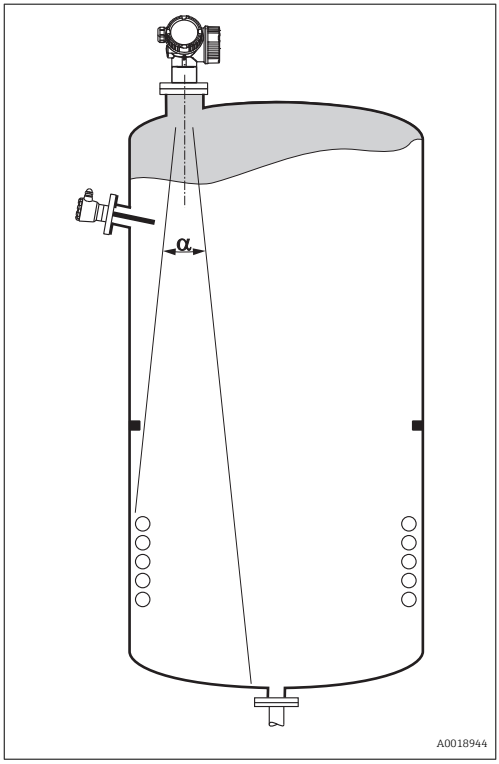
6.1 Installation conditions

6.1.1 Mounting position



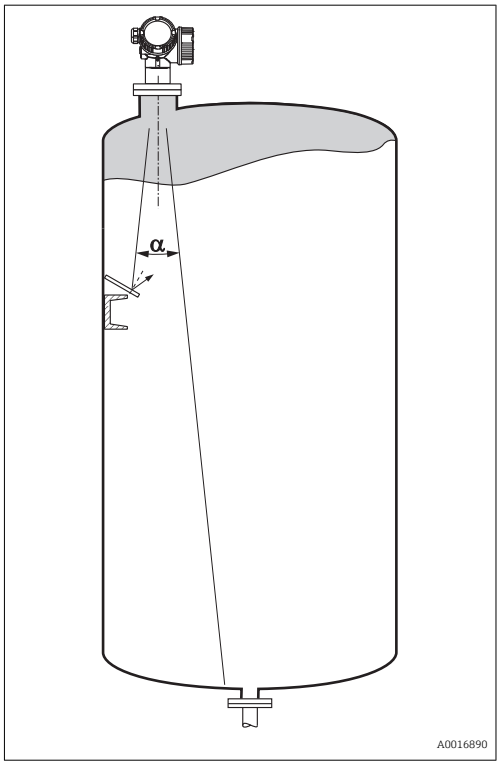
- Recommended distance **A** from wall to outer edge of nozzle: ~ 1/6 of tank diameter. Nevertheless the device should not be installed closer than 15 cm (5.91 in) to the tank wall.
- Not in the center (2), as interference can cause signal loss.
- Not above the fill stream (3).
- It is recommended to us 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 (→ 19).

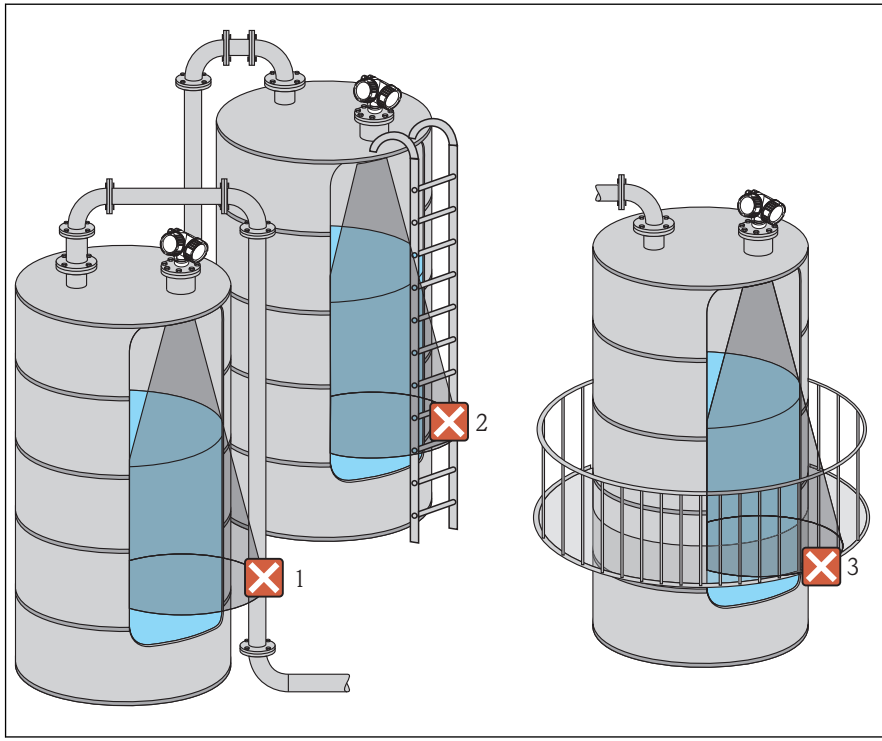
6.1.3 Reduction of interference echoes



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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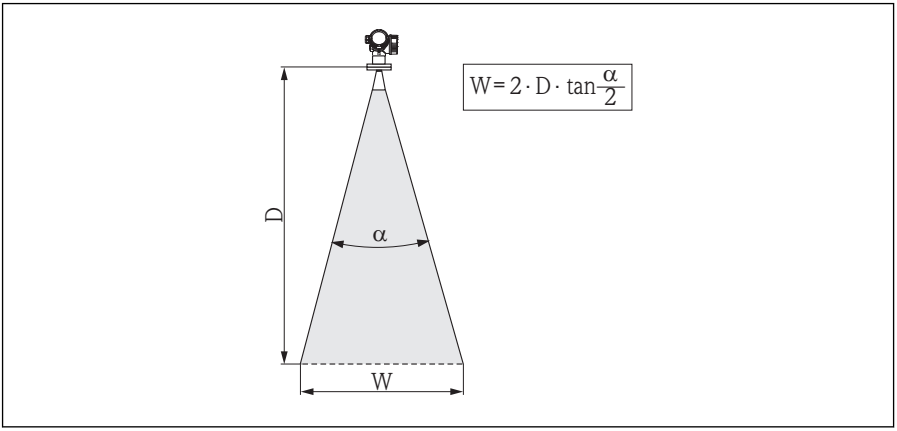
6.1.5 Optimization options

- Antenna size
  The bigger the antenna, the smaller the beam angle α and the fewer interference echoes (→ 🖹 19).
- 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 (→ 🖹 22) (→ 🖹 24) .
- Stilling well
  A stilling well can be applied to avoid interferences (→ 🖹 27).
- Metallic screens mounted at a slope
  They spread the radar signals and can, therefore, reduce interference echoes.

6.1.6 Beam angle



4 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.

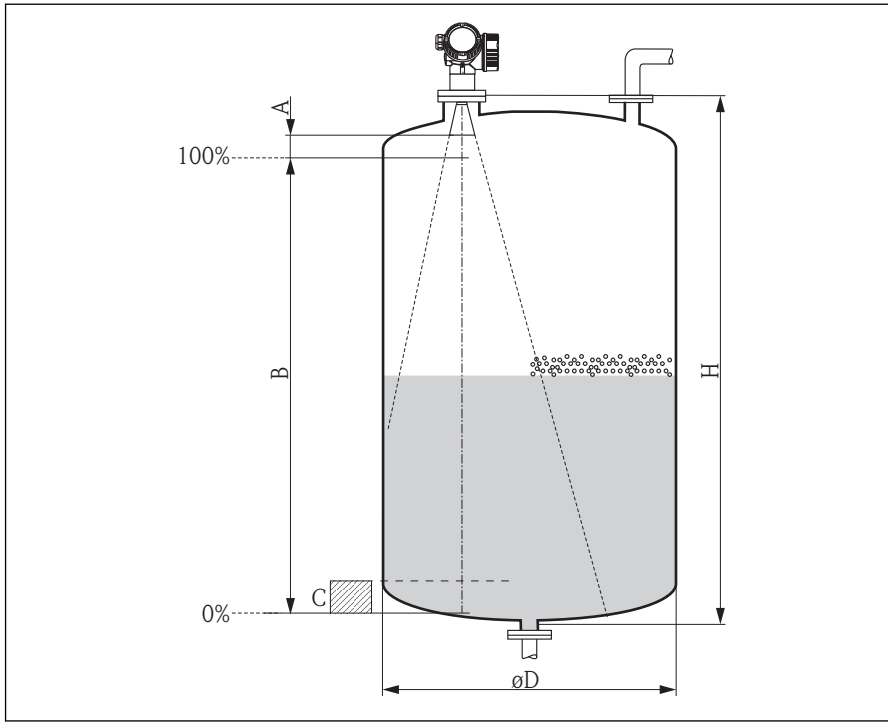
Beam diameter **W** as a function of beam angle **α** and measuring distance **D**:

FMR50			
Antenna size	40 mm (1-½ in)	80 mm (3 in)	100 mm (4 in)
Beam angle α	23°	10°	8°
Measuring distance (D)	**Beamwidth diameter W**		
3 m (9.8 ft)	1.22 m (4 ft)	0.53 m (1.7 ft)	0.42 m (1.4 ft)
6 m (20 ft)	2.44 m (8 ft)	1.05 m (3.4 ft)	0.84 m (2.8 ft)
9 m (30 ft)	3.66 m (12 ft)	1.58 m (5.2 ft)	1.26 m (4.1 ft)
12 m (39 ft)	4.88 m (16 ft)	2.1 m (6.9 ft)	1.68 m (5.5 ft)
15 m (49 ft)	6.1 m (20 ft)	2.63 m (8.6 ft)	2.10 m (6.9 ft)
20 m (66 ft)	8.14 m (27 ft)	3.50 m (11 ft)	2.80 m (9.2 ft)
25 m (82 ft)	10.17 m (33 ft)	4.37 m (14 ft)	3.50 m (11 ft)
30 m (98 ft)	-	5.25 m (17 ft)	4.20 m (14 ft)
35 m (115 ft)	-	6.12 m (20 ft)	4.89 m (16 ft)
40 m (131 ft)	-	7.00 m (23 ft)	5.59 m (18 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 NH_3** 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 (ε_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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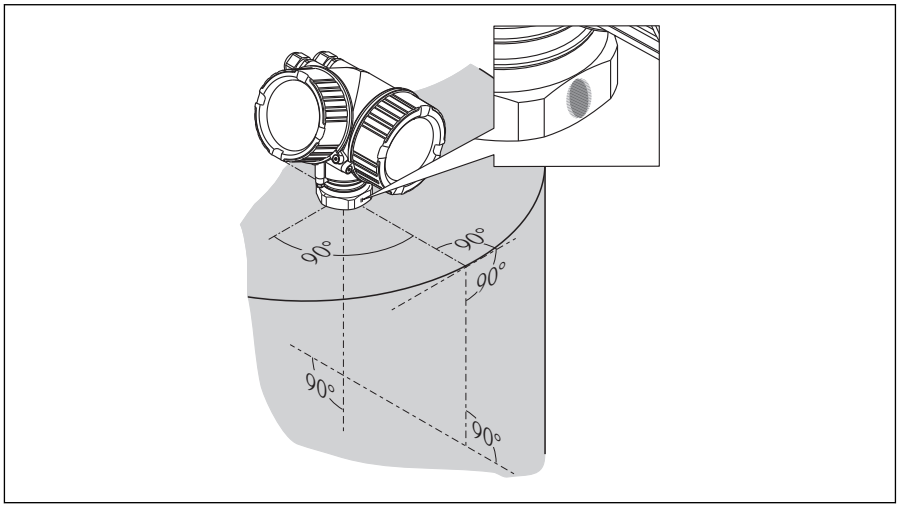
Device	A [mm (in)]	B [m (ft)]	C [mm (in)]	H [m (ft)]
FMR50	150 (5.91)	> 0.2 (0.7)	50 to 250 (1.97 to 9.84)	> 0.3 (1.0)

6.3 Installation in vessel (free space)

6.3.1 Horn antenna encapsulated (FMR50)

Alignment

- Align the antenna vertically to the product surface.
- A marking at the threaded connection enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.



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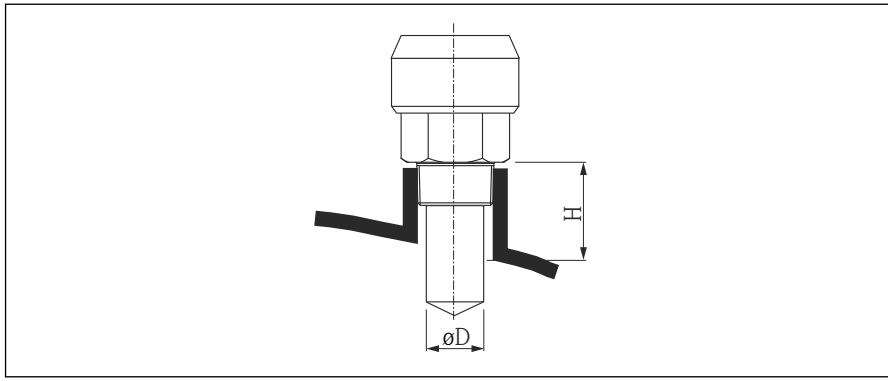
Depending on the device version the marking may be a circle or two short parallel lines.

Nozzle mounting

For optimum measurement, the tip of the antenna should extend below the nozzle. Nozzle heights up to 500 mm (19.7 in) can be accepted if this should not be possible due to mechanical reasons.



5 Nozzle height and diameter for horn antenna, encapsulated (FMR50)

Antenna size	40 mm (1½ in)
D	39 mm (1.54 in)
H	< 60 mm (2.36 in)

Please contact Endress+Hauser for applications with higher nozzle.

Threaded connection

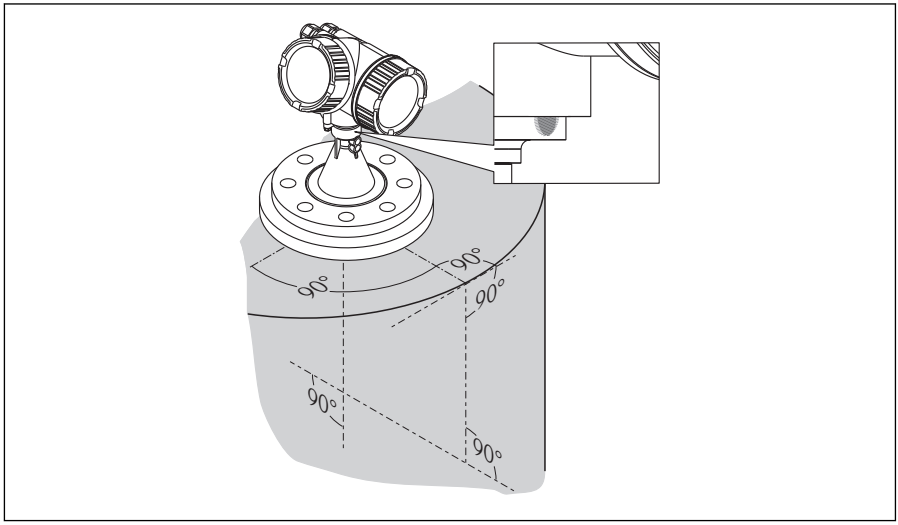
- Tighten with the hexagonal nut only.
- Tool : Hexagonal wrench 50 mm
- Maximum permissible torque: 35 Nm (26 lbf ft)

6.3.2 Horn antenna with slip-on flange (FMR50)

Alignment

When using the Micropilot with a slip-on flange in explosion-hazardous areas, strictly observe all specifications in the relevant Safety Instructions (XA).

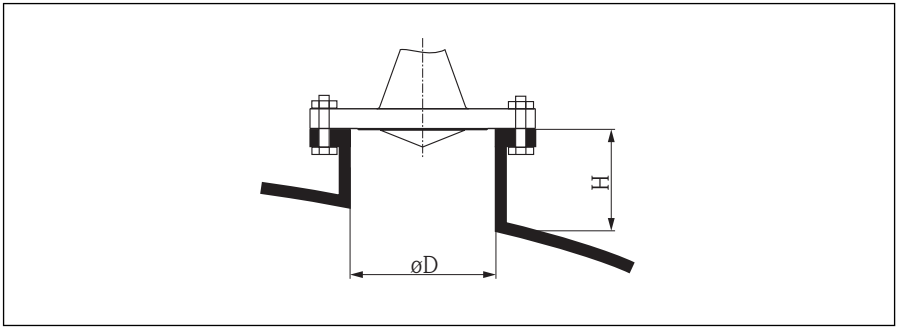
- Align the antenna vertically to the product surface.
  Optionally, a variable flange seal, which is available as an accessory, can be used for alignment (see Technical Information BA01048F, chapter "Accessories").
- A marking at the feedthrough enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.



A0019439

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

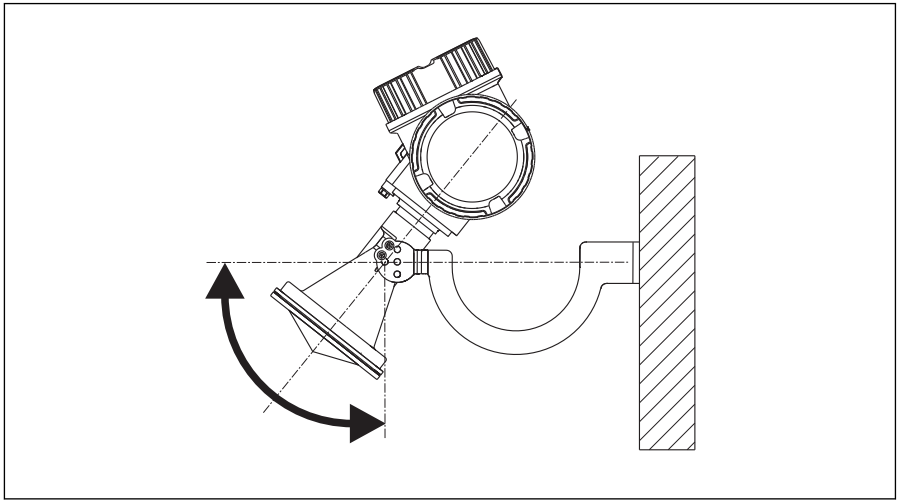
Nozzle mounting



6 Nozzle height and diameter for horn antenna with slip-on flange (FMR50/FMR56)

Antenna size	80 mm (3 in)			100 mm (4 in)	
D	80 mm (3.15 in)	100 mm (3.94 in)	150 mm (5.91 in)	100 mm (3.94 in)	150 mm (5.91 in)
H	< 500 mm (19.7 in)	< 500 mm (19.7 in)	< 500 mm (19.7 in)	< 500 mm (19.7 in)	< 500 mm (19.7 in)

6.3.3 Horn antenna with mounting bracket (FMR50)



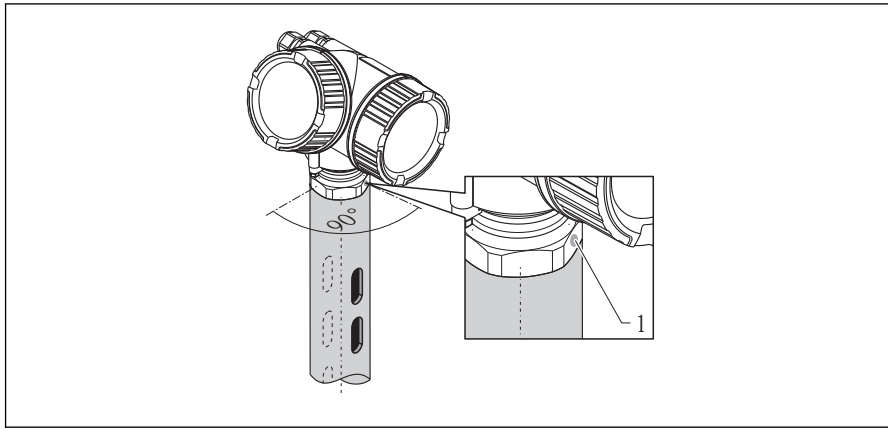
7 Installation of the horn antenna with mounting bracket (FMR50/FMR56)

Align the antenna vertically to the product surface using the mounting bracket.

NOTICE

The mounting bracket has no conductive connection to the transmitter housing.
Danger of electrostatic charge
- ▶ Connect the mounting bracket to the local potential equalization system.

6.4 Installation in stilling well



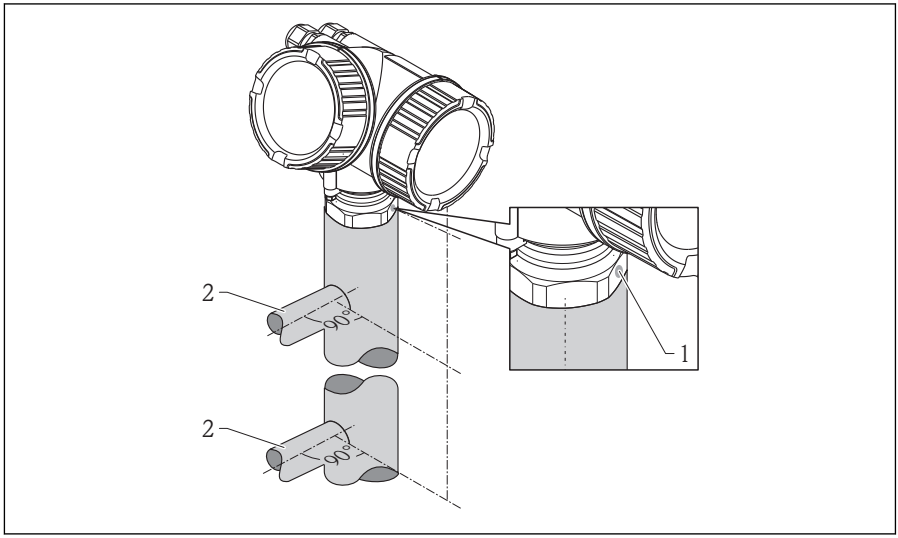
A0016841

8 Installation in stilling well

1 Marking for antenna alignment

- For horn antenna: Align the marking towards the slots of the stilling well.
- 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 (→ 29).

6.5 Installation in bypass

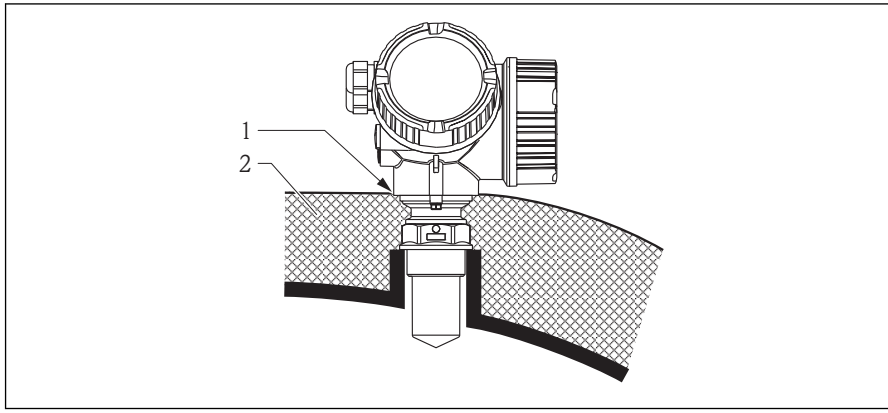


9 Installation in bypass

1 Marking for antenna alignment
2 Tank connectors

- Alighn 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 (→ 29).

6.6 Vessels with heat insulation

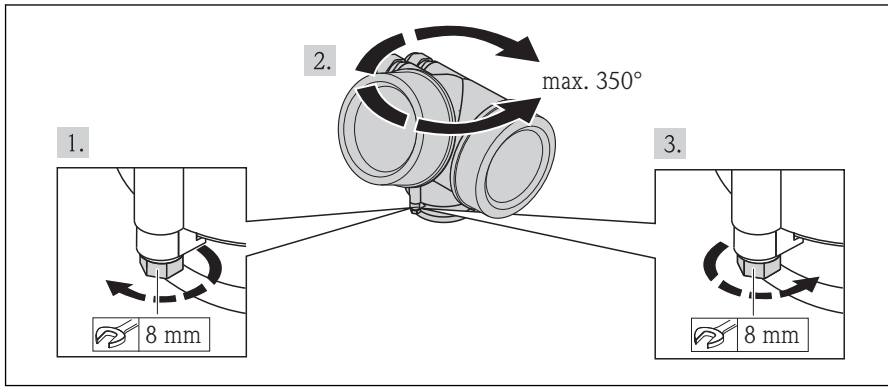


A0019141

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:

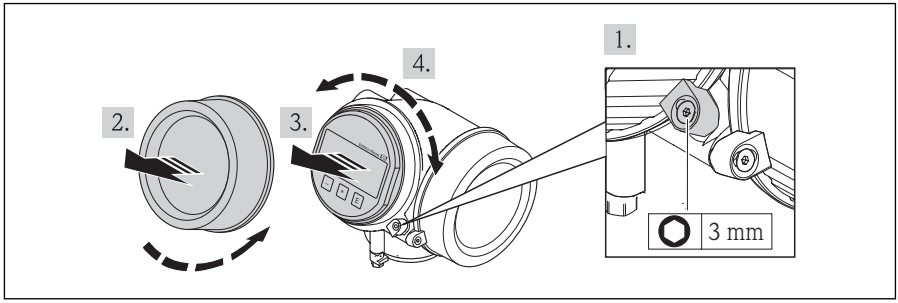


A0013713

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. If present: Loosen the screw of the securing clamp of the electronics compartment cover using an Allen key and turn the clamp 90° conterclockwise.
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 × 45 ° 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

❍	Is the device undamaged (visual inspection)?
❍	Does the device conform to the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure (refer to the chapter on "Material load curves" of the "Technical Information" document) ▪ Ambient temperature range ▪ Measuring range
❍	Are the measuring point identification and labeling correct (visual inspection)?

❍	Is the device adequately protected from precipitation and direct sunlight?
❍	Are the securing screw and securing clamp tightened securely?

7 Electrical connection

7.1 Connection conditions

7.1.1 Cable specification

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

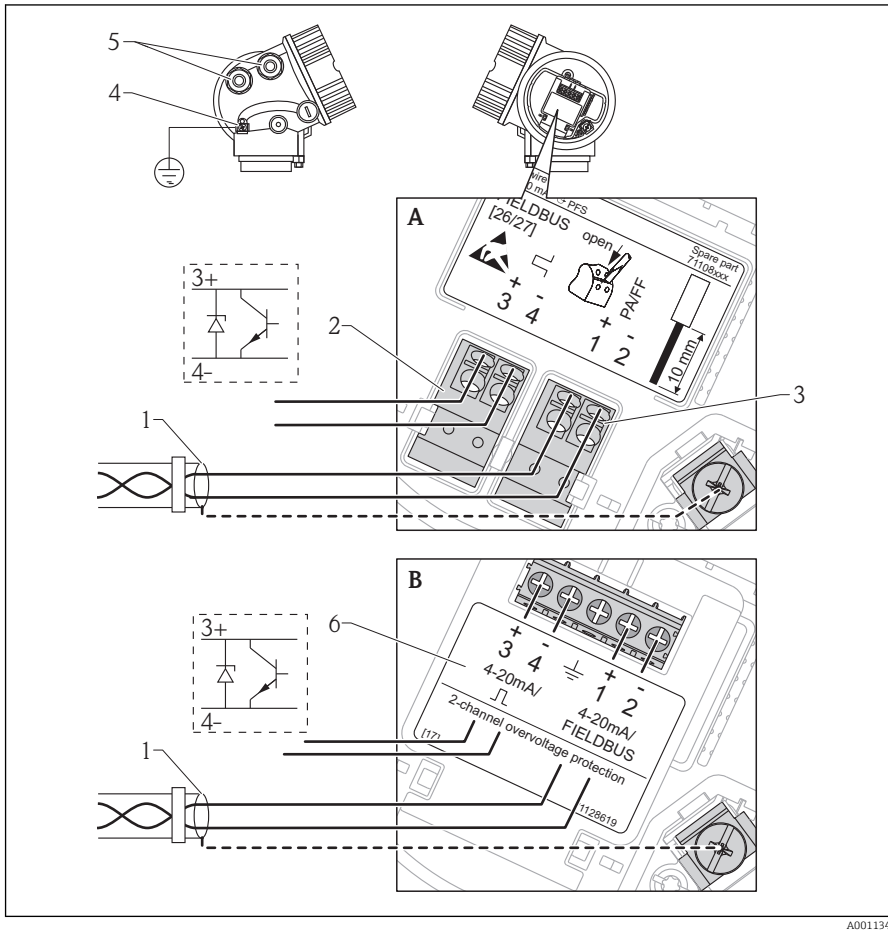
FOUNDATION Fieldbus

Endress+Hauser recommends using twisted, shielded two-wire cables.

For further information on the cable specifications, see Operating Instructions BA00013S "FOUNDATION Fieldbus Overview", FOUNDATION Fieldbus Guideline and IEC 61158-2 (MBP).

7.1.2 Terminal assignment

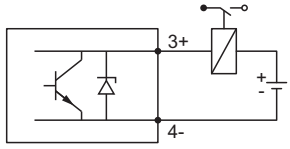
PROFIBUS PA / FOUNDATION Fieldbus



10 *Terminal assignment PROFIBUS PA / FOUNDATION Fieldbus*

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Cable screen: Observe cable specifications
2 Switch output (open collector): Terminals 3 and 4
3 PROFIBUS PA / FOUNDATION Fieldbus: Terminals 1 and 2
4 Terminal for potential equalization line
5 Cable entries
6 Overvoltage protection module

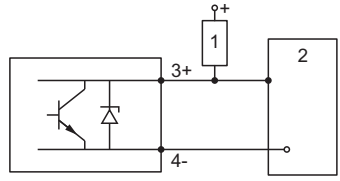
Connection examples for the switch output



A0015909

11 Connection of a relay

Suitable relays (examples):
- 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



A0015910

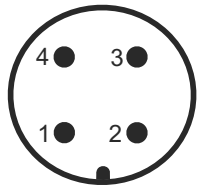
12 Connection of a digital input

1 Pull-up resistor
2 Digital input

7.1.3 Device plug connectors

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

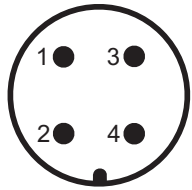
Pin assignment of the M12 plug connector



A0011175

Pin	Meaning
1	Signal +
2	not connected
3	Signal -
4	Ground

Pin assignment of the 7/8" plug connector



A0011176

Pin	Meaning
1	Signal -
2	Signal +
3	Screen
4	Not connected

7.1.4 Supply voltage

PROFIBUS PA, FOUNDATION Fieldbus

"Power supply; Output" [1]	"Approval" [2]	Terminal voltage
E: 2-wire; FOUNDATION Fieldbus, switch output **G:** 2-wire; PROFIBUS PA, switch output	▪ Non-Ex ▪ Ex nA ▪ Ex nA(ia) ▪ Ex ic ▪ Ex ic(ia) ▪ Ex d(ia) / XP ▪ Ex ta / DIP ▪ CSA GP	9 to 32 V [3]
	▪ Ex ia / IS ▪ Ex ia + Ex d(ia) / IS + XP	9 to 30 V [3]

1) Feature 020 of the product structure
2) Feature 010 of the product structure
3) Input voltages up to 35 V will not spoil the device.

Polarity sensitive	No
FISCO/FNICO compliant according to IEC 60079-27	Yes

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 µs), 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 ($^{8}/_{20}$ µs)	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

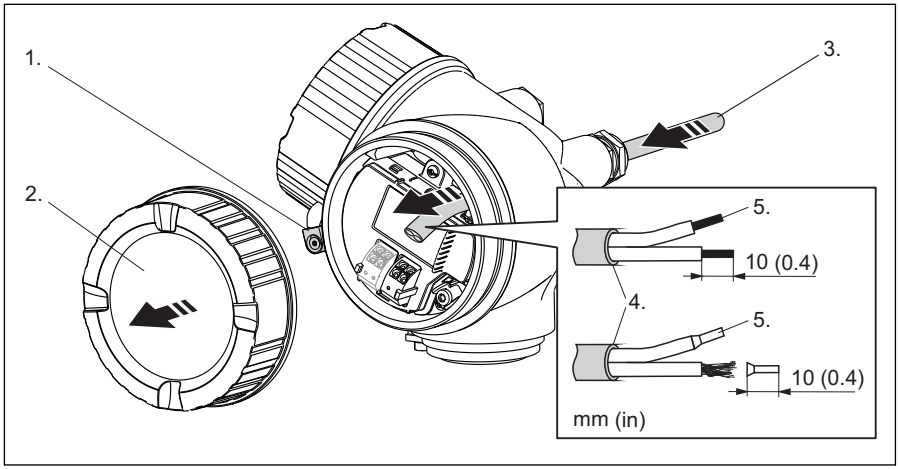
⚠ WARNING

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:

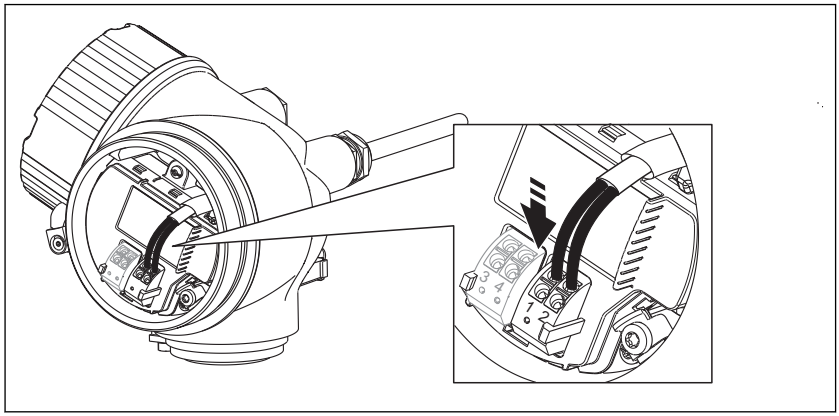
- For instruments with safety pin for the lid: AF 3 Allen key
- Wire stripping pliers
- When using stranded wires: Wire end sleeves.



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.



A0013837

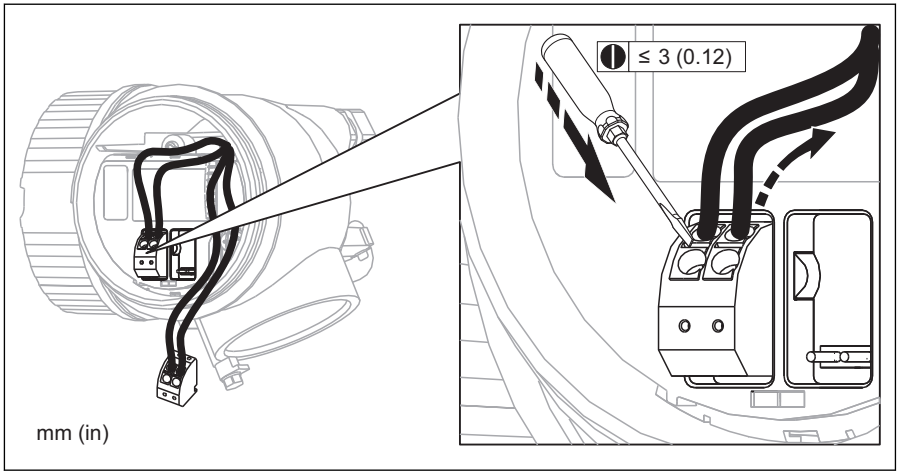
Connect the cable in accordance with the terminal assignment (→ 33).

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.



A0013661

7.3 Post-connection check

❍	Are cables or the device undamaged (visual inspection)?
❍	Do the cables comply with the requirements?
❍	Do the cables have adequate strain relief?
❍	Are all cable glands installed, firmly tightened and correctly sealed?
❍	Does the supply voltage match the specifications on the transmitter nameplate?
❍	Is the terminal assignment correct (→ 🖹 33)?
❍	If required: Is the protective earth connected correctly (→ 🖹 33)?
❍	If supply voltage is present: Is the device ready for operation and do values appear on the display module?
❍	Are all housing covers installed and firmly tightened?
❍	Is the securing clamp tightened correctly?

8 Integration into a FOUNDATION Fieldbus network

8.1 Device Description (DD)

You require the following to configure a device and integrate it into an FF network:
- An FF configuration program
- The Cff file (Common File Format: *.cff)
- The device description (DD) in one of the following formats
  - Device Description format 4 : *sym, *ffo
  - Device Description format 5 : *sy5, *ff5

Information on the device-specific DD

Manufacturer ID	0x452B48
Device Type	0x1028
Device Revision	0x01
DD Revision	Information and files at: ▪ www.endress.com ▪ www.fieldbus.org
CFF Revision	

8.2 Integration into the FOUNDATION Fieldbus network

- For more in-depth information on integrating the device into the FF system, see the description for the configuration software used.
- When integrating the field devices into the FF system, make sure you are using the right files. You can read out the required version by means of the Device Revision/DEV_REV and DD Revision/ DD_REV parameters in the Resource Block.

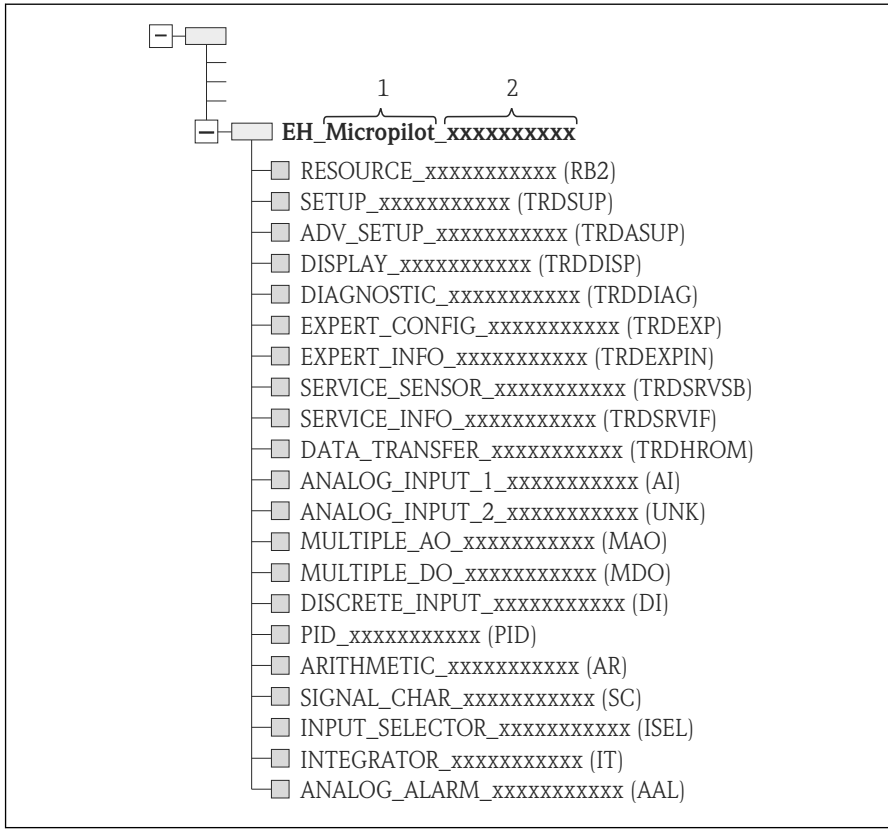
The device is integrated into the FF network as follows:

1. Start the FF configuration program.
2. Download the Cff and device description files (*.ffo, *.sym (for format 4) *ff5, *sy5 (for format 5) to the system.
3. Configure the interface.
4. Configure the device for the measuring task and for the FF system.

8.3 Device identification and addressing

FOUNDATION Fieldbus identifies the device using its ID code (Device ID) and automatically assigns it a suitable field address. The identity code cannot be changed. The device appears in the network display once you have started the FF configuration program and integrated the device into the network. The blocks available are displayed under the device name.

If the device description has not yet been loaded, the blocks report "Unknown" or "(UNK)".



13 Typical display in a configuration program after the connection has been established

1 Device name
2 Serial number

8.4 Block model

8.4.1 Blocks of the device software

The device has the following blocks:
- Resource Block (device block)
- Transducer Blocks
  - Setup Transducer Block (TRDSUP)
  - Advanced Setup Transducer Block (TRDASUP)
  - Display Transducer Block (TRDDISP)
  - Diagnostic Transducer Block (TRDDIAG)
  - Advanced Diagnostic Transducer Block (TRDADVDIAG)
  - Expert Configuration Transducer Block (TRDEXP)
  - Expert Information Transducer Block (TRDEXPIN)
  - Service Sensor Transducer Block (TRDSRVSB)
  - Service Information Transducer Block (TRDSRVIF)
  - Data Transfer Transducer Block (TRDHROM)
- Function Blocks
  - 2 AI Blocks (AI)
  - 1 Discrete Input Block (DI)
  - 1 Multiple Analog Output Block (MAO)
  - 1 Mutliple Discrete Output Block (MDO)
  - 1 PID Block (PID)
  - 1 Arithmetic Block (AR)
  - 1 Signal Characterizer Block (SC)
  - 1 Input Selector Block (ISEL)
  - 1 Integrator Block (IT)
  - 1 Analog Alarm Block (AAL)

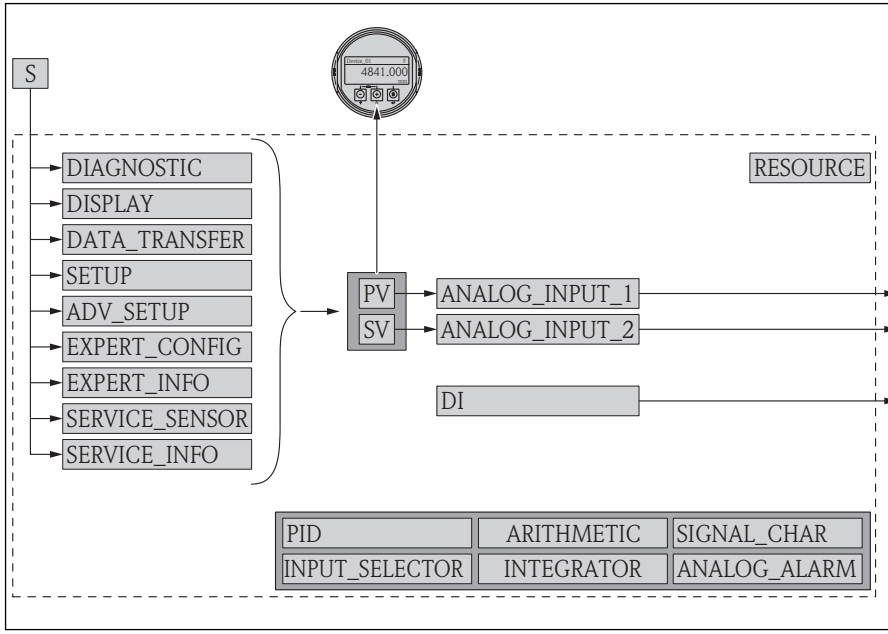
In addition to the pre-instantiated blocks already mentioned, the following blocks can also be instantiated:
- 3 AI Blocks (AI)
- 2 Discrete Input Blocks (DI)
- 1 PID Block (PID)
- 1 Arithemetic Block (AR)
- 1 Signal Characterizer Block (SC)
- 1 Input Selector Block (ISEL)
- 1 Integrator Block (IT)
- 1 Analog Alarm Block (AAL)

Up to 20 blocks can be instantiated in the device altogether, including the blocks already instantiated. For instantiating blocks, see the appropriate Operating Instructions of the configuration program used.

Endress+Hauser Guideline BA00062S.

The guideline provides an overview of the standard function blocks that are described in FOUNDATION Fieldbus Specifications FF 890 - 894. It is designed to help operators use the blocks implemented in the Endress+Hauser field devices.

8.4.2 Block configuration when device is delivered



14 *Block configuration when device is delivered*

S Sensor
PV Primary value: Level linearized
SV Secondary value: Distance

8.5 Assignment of the measured values (CHANNEL) in an AI Block

The input value of an Analog Input Block is defined by the **CHANNEL** parameter.

Channel	Measured value
0	Uninitialized
211	Terminal voltage
773	Analog output advance diagnostics 1
774	Analog output advance diagnostics 2
32786	Absolute echo amplitude
32856	Distance
32885	Elektronic temperature

Channel	Measured value
32949	Level linearized
33044	Relative echo amplitude

8.6 Methods

The FOUNDATION Fieldbus Specification includes the use of methods to make device operation easier. A method is a sequence of interactive steps to be carried out in the specified order so as to configure certain device functions.

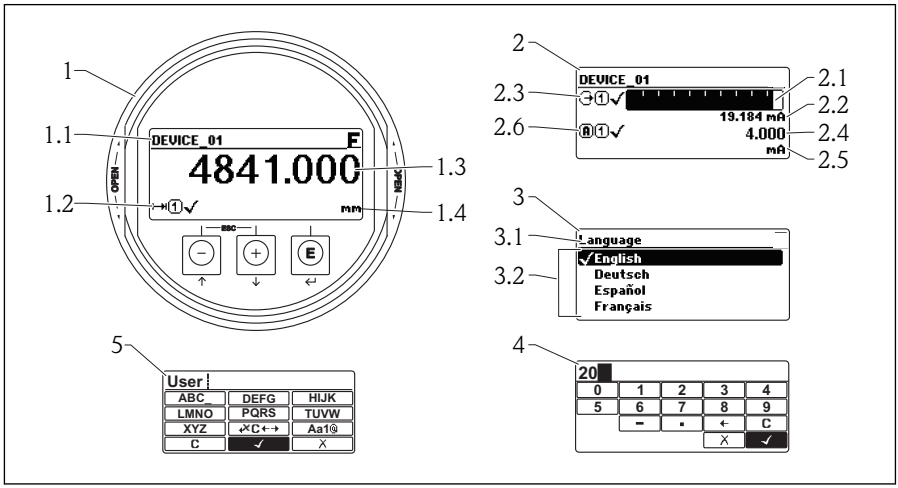
The following methods are available for the device:

- **Restart**
  This method is located in the Resource Block and directly prompts the setting of the **Device reset** parameter. This resets the device configuration to a defined state.
- **ENP Restart**
  This method is located in the Resource Block and directly prompts the setting of the parameters of the Electronic Name Plate (ENP).
- **Setup**
  This method is located in the SETUP Transducer Block and allows to set the most important parameters in this block for device configuration (measuring units, type of tank or vessel, type of medium, empty and full calibration).
- **Linearization**
  This method is located in the ADV_SETUP Transducer Block and allows to manage the linearization table by which the measured value is converted into volume, mass or flow.
- **Self Check**
  This method is located in the EXPERT_CONFIG Transducer Block and prompts the device self check parameters.

9 Commissioning (via operating menu)

9.1 Display and operating module

9.1.1 Display appearance



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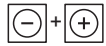
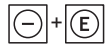
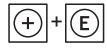
15 Appearance of the display and operation module for on-site operation

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** *For menu, submenu* Moves the selection bar upwards in a picklist. *For text and numeric editor* In the input mask, moves the selection bar to the left (backwards).
 A0013970	**Plus key** *For menu, submenu* Moves the selection bar downwards in a picklist. *For text and numeric editor* In the input mask, moves the selection bar to the right (forwards).
 A0013952	**Enter key** *For measured value display* ▪ Pressing the key briefly opens the operating menu. ▪ Pressing the key for 2 s opens the context menu. *For menu, submenu* ▪ 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. *For text and numeric editor* ▪ Pressing the key briefly – 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)** *For 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"). *For text and numeric editor* 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)** *For measured value display* 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.	BA01120F (FMR50, FOUNDATION Fieldbus)
Setup	When appropriate values have been assigned toall 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: ▪ 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.	GP01017F/00/DE (Description of Device Parameters, FMR5x, FOUNDATION Fieldbus)

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.

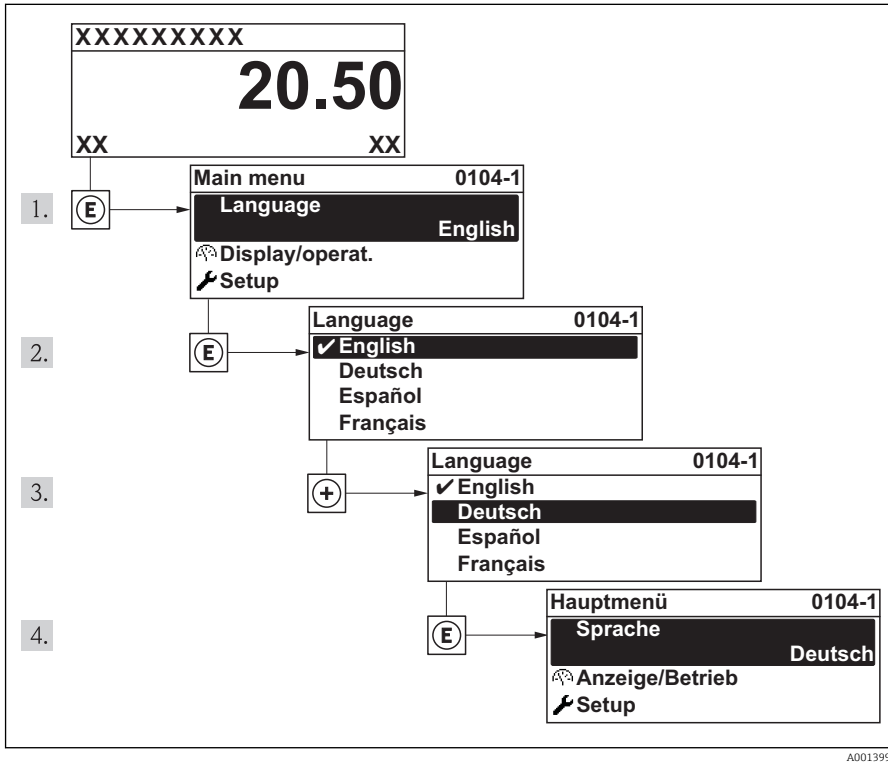
9.3 Unlock the device

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:
BA01120F (FMR50, FOUNDATION Fieldbus)

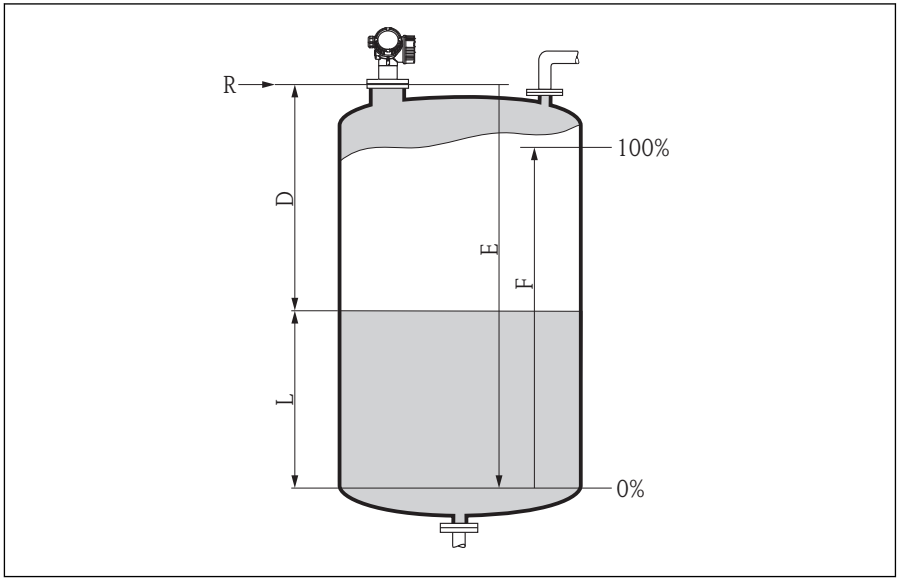
9.4 Setting the operating language

Factory setting: English or ordered local language



16 *Taking the example of the local display*

9.5 Configuration of a level measurement



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) [3].
7. **Setup → Full calibration**
   ↳ Enter full distance F (Distance from the 0% to the 100% level).

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

8. **Setup → Level**
   ↳ Indicates the measrued 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:
BA01120F (Operating Instructions, FMR50, FOUNDATION Fieldbus)

For the **Expert** submenu refer to:
GP01017F/00/EN (Description of Device Parameters, FMR5x, FOUNDATION Fieldbus)

10 Commissioning (block-based operation)

10.1 Block configuration

10.1.1 Preparatory steps

1. Switch on the device.
2. Note the DEVICE_ID (→ 41).
3. Open the FOUNDATION Fieldbus configuration program.
4. Load Cff and device description files into the host system or the configuration program. Make sure you are using the right system files.
5. Identify the device using the **DEVICE_ID** (see Point 2). Assign the desired tag name to the device by means of the **Pd-tag/FF_PD_TAG** parameter.

10.1.2 Configuring the Resource Block

1. Open the Resource Block.
2. If necessary, disable the lock for device operation.
3. If necessary, change the block name. Factory setting: RS-xxxxxxxxxxx (RB2)
4. If necessary, assign a description to the block by means of the **Tag Description/ TAG_DESC** parameter.
5. If necessary, change other parameters as per the requirements.

10.1.3 Configuring the Transducer Blocks

The measurement and the display module are configured using the Transducer Blocks. The general procedure is the same for all Transducer Blocks:

1. If necessary, change the block name.
2. Set the block mode to OOS by means of the **Block Mode/MODE_BLK** parameter, **TARGET** element.
3. Configure the level measurement (→ 58).
4. Set the block mode to **Auto** by means of the **Block Mode/MODE_BLK** parameter, **TARGET** element.

The block mode must be set to **Auto** for the measuring device to function correctly.

10.1.4 Configuring the Analog Input Blocks

The device has 2 permanently instanced Analog Input Blocks that can be assigned as required to the various process variables. If required, up to 5 Analog Input Blocks can be instanced through the FOUNDATION Fieldbus configuration tool.

Default settings	
Analog Input Block	**CHANNEL**
AI 1	32949: Level linearized
AI 2	32856: Distance

1. If necessary, change the block name.
2. Set the block mode to **OOS** by means of the **Block Mode/MODE_BLK** parameter, **TARGET** element.
3. Use the **Channel/CHANNEL** parameter to select the process variable which should be used as the input value for the Analog Input Block.
4. Use the **Transducer Scale/XD_SCALE** parameter to select the desired unit and the block input range for the process variable (→ 56). Make sure that the unit selected suits the process variable selected. If the process variable does not suit the unit, the **Block Error/BLOCK_ERR** parameter reports **Block Configuration Error** and the block mode cannot be set to **Auto**.
5. Use the **Linearization Type/L_TYPE** parameter to select the type of linearization for the input variable (factory setting: **Direct**). Make sure that the settings for the **Transducer Scale/XD_SCALE** and **Output Scale/ OUT_SCALE** parameters are the same for the **Direct** linearization type. If the values and units do not match, the **Block Error/BLOCK_ERR** parameter reports **Block Configuration Error** and the block mode cannot be set to **Auto**.
6. Enter the alarm and critical alarm messages by means of the **High High Limit/ HI_HI_LIM**, **High Limit/HI_LIM**, **Low Low Limit/LO_LO_LIM** and **Low Limit/ LO_LIM** parameters. The limit values entered must be within the value range specified for the **Output Scale/ OUT_SCALE** parameter (→ 56).
7. Specify the alarm priorities by means of the **High High Priority/HI_HI_PRI**, **High Priority/ HI_PRI**, **Low Low Priority/LO_LO_PRI** and **Low Priority/LO_PRI** parameters. Reporting to the field host system only takes place with alarms with a priority greater than 2.
8. Set the block mode to **Auto** using the **Block Mode/MODE_BLK** parameter, **TARGET** element. For this purpose, the Resource Block and the Setup Transducer Block must also be set to the **Auto** block mode.

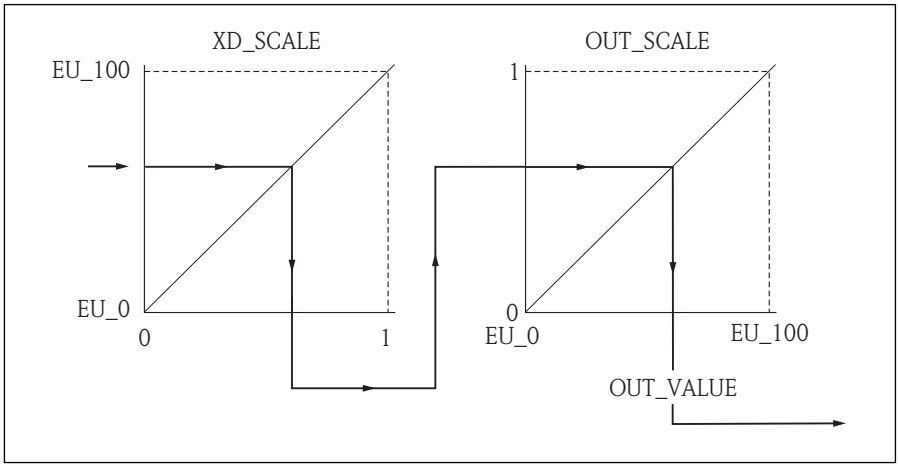
10.1.5 Additional configuration

1. Link the function blocks and output blocks.

2. After specifying the active LAS, download all the data and parameters to the field device.

10.2 Scaling of the measured value in an AI Block

If the type of linearisation **L_TYPE** = **indirect** has been selected in an AI block, the measured value can be scaled within the block. The input range is defined by the **XD_SCALE** parameter through its **EU_0** and **EU_100** elements. This range is mapped linearly to the output ranged defined by the **OUT_SCALE** parameter through its **EU_0** and **EU_100** elements.



17 Scaling of the measured value in an AI Block

- If you have selected the **Direct** mode for the **L_TYPE** parameter, you cannot change the values and units for **XD_SCALE** and **OUT_SCALE**.
- The **L_TYPE**, **XD_SCALE** and **OUT_SCALE** parameters can only be changed in the OOS block mode.

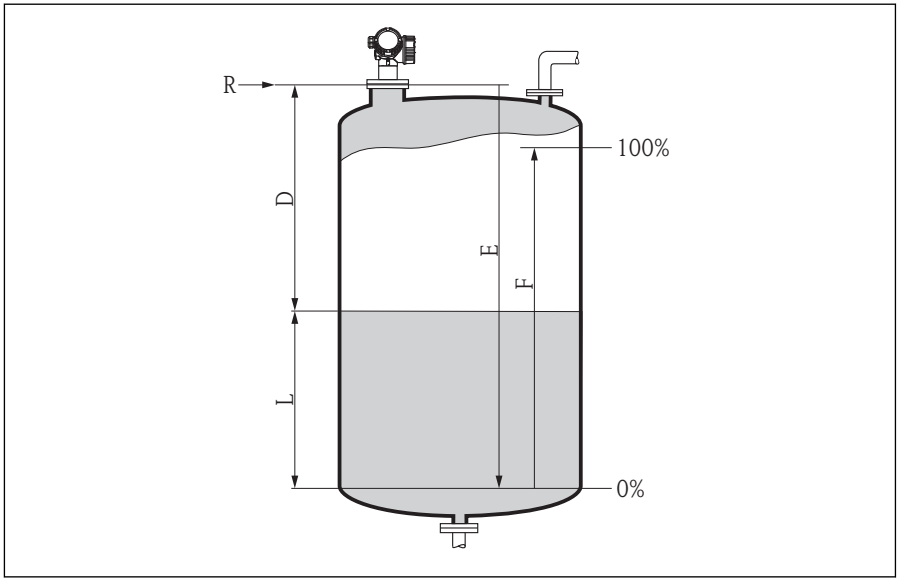
10.3 Language selection

Step	Block	Parameter	Action
1	DISPLAY (TRDDISP)	Language (language)	Select language [1]. **Selection:** ▪ 1268: Swedish ▪ 32805: Arabian ▪ 32824: Chinese simplified ▪ 32842: Czech ▪ 32881: Dutch ▪ 32888: English ▪ 32917: French ▪ 32920: German ▪ 32945: Italian ▪ 32946: Japanese ▪ 32948: Korean ▪ 33026: Polish ▪ 33027: Portuguese ▪ 33062: Russian ▪ 33083: Spanish ▪ 33103: Thai ▪ 33120: Vietnamese ▪ 33155: Bahasa ▪ 33166: Turkish

1) When ordering a device the set of available languages is defined. Refer to the product structure, feature 500 "Additional Operation Language".

10.4 Configuration of a level measurement

The **Setup** method can also be used to configure the measurement. It is called up via the SETUP (TRDSUP) Transducer Block.



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

Step	Block	Parameter	Action	Description
1	SETUP (TRDSUP)	Distance unit (distance_unit)	Select distance unit. **Selection:** ▪ 1010: m ▪ 1013: mm ▪ 1018: ft ▪ 1019: in	BA01120F
2	SETUP (TRDSUP)	Tank type (tank_type)	Select tank type. **Selection:** ▪ 1271: Process vessel with agitator ▪ 1272: Process vessel standard ▪ 1273: Storage vessel ▪ 1274: Wave guide antenna ▪ 1279: Sphere ▪ 32816: Bypass / pipe ▪ 33013: Open channel ▪ 33094: Stilling well	BA01120F
3	SETUP (TRDSUP)	Tube diameter (tube_diameter) [1)]	Enter the diameter of the bypass or stilling well.	BA01120F
4	SETUP (TRDSUP)	Medium group (medium_group)	Select medium group. **Selection:** ▪ 316: water based (DC>4) ▪ 256: other (DC≥ 1.9)	BA01120F
5	SETUP (TRDSUP)	Empty calibration (empty_calibration)	Enter the distance E between the reference point R and the minimum level (0%).	BA01120F
6	SETUP (TRDSUP)	Full calibration (full_calibration)	Enter distance F between the minimum (0%) and maximum (100%) level.	BA01120F
7	SETUP (TRDSUP)	Level (level)	Displays the measured level L.	BA01120F
8	SETUP (TRDSUP)	Distance (filtered_dist_val)	Displays the distance D between the reference point R and the level L.	BA01120F

Step	Block	Parameter	Action	Description
9	SETUP (TRDSUP)	Signal quality (signal_quality)	Displays the signal quality of the level echo.	BA01120F
10	SETUP (TRDSUP)	Confirm distance (confirm_distance)	Compare the displayed distance to the real distance in order to start the recording of the mapping curve. **Selection:** ▪ 179: Manual map ▪ 32847: Factory map ▪ 32859: Distance ok ▪ 32860: Distance too big ▪ 32861: Distance too small ▪ 32862: Distance unknown ▪ 33100: Tank empty	BA01120F

1) only available for "Tank type" = "Bypass/pipe"

10.5 Configuration of the on-site display

10.5.1 Factory settings of the on-site display for level measurements

Parameter	Factory setting
Format display	1 value, max. size
Value 1 display	Level linearized
Value 2 display	None
Value 3 display	None
Value 4 display	None

The on-site display can be adjusted in the **DISPLAY (TRDDISP)** transducer block.

10.6 Configuration management

After commissioning, you can save the current device configuration, copy it to another measuring point or restore the previous device configuration. You can do so using the **Configuration management** parameter and its options.

Navigation path in the operating menu
Setup → Advanced setup → Conf.backup disp → Config. managem.

Block operation
Block: **DISPLAY (TRDDISP)**

Parameter: **Configuration management (configuration_management)**

Functions of the parameter options

Options	Description
33097: Execute backup	A backup copy of the current device configuration in the HistoROM is saved to the display module of the device. The backup copy comprises the transmitter data of the device.
33057: Restore	The last backup copy of the device configuration is copied from the display module to the HistoROM of the device. The backup copy comprises the transmitter data of the device.
33838: Duplicate	The transmitter configuration from another device is duplicated to the device using the display module.
265: Compare	The device configuration saved in the display module is compared to the current device configuration of the HistoROM.
32848: Clear backup data	The backup copy of the device configuration is deleted from the display module of the device.

HistoROM
A HistoROM is a "non-volatile" device memory in the form of an EEPROM.

While this action is in progress, the configuration cannot be edited via the local display and a message on the processing status appears on the display.

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