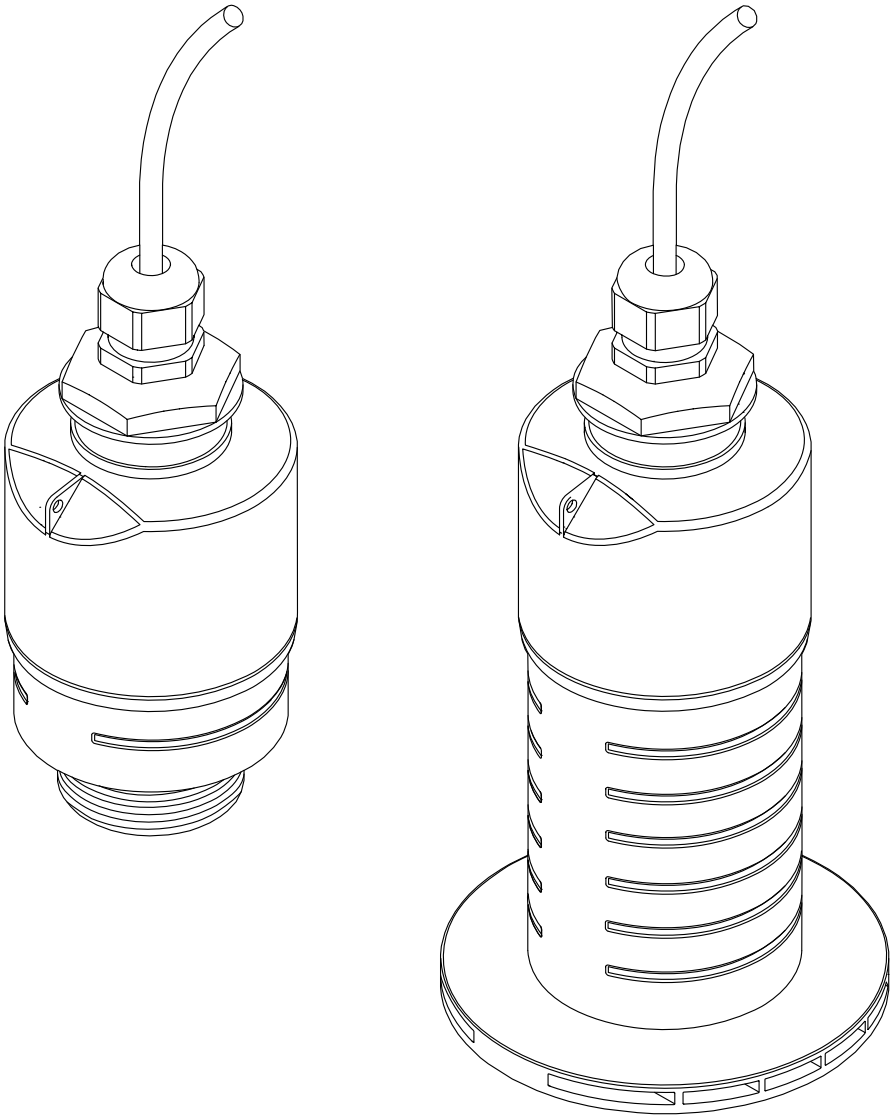
BA01931F/00/EN/03.20
71473149
2020-03-30
01.00.zz (Device firmware)

Operating Instructions
Micropilot FMR20 MODBUS RS485

Free space radar



Endress+Hauser
People for Process Automation

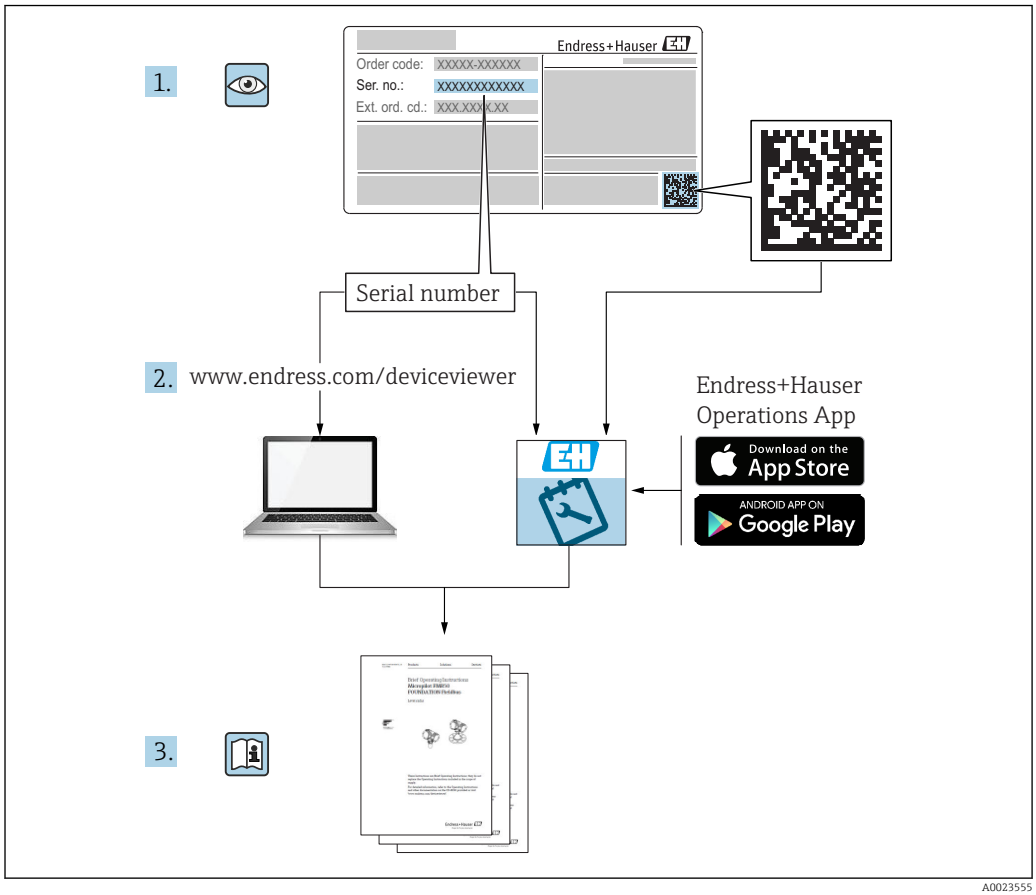

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

1 About this document

1.1 Document function

These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:
- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.2 Symbols used

1.2.1 Safety symbols

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

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

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

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

1.2.2 Symbols for certain types of information and graphics

✓ **Permitted**
Procedures, processes or actions that are permitted

✓✓ **Preferred**
Procedures, processes or actions that are preferred

✗ **Forbidden**
Procedures, processes or actions that are forbidden

ℹ **Tip**
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

Operation via operating tool

Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

1.3 Documentation

The following documentation types are available in the Downloads area of the Endress +Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

1.3.1 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

1.3.2 Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

1.3.3 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.4 Terms and abbreviations

BA
Document type "Operating Instructions"

KA
Document type "Brief Operating Instructions"

TI
Document type "Technical Information"

SD
Document type "Special Documentation"

XA
Document type "Safety Instructions"

PN
Nominal pressure

MWP
MWP (Maximum working pressure/max. process pressure)
The MWP can also be found on the nameplate.

ToF
Time of Flight

ε_r (Dk value)
Relative dielectric constant

Operating tool
The term "operating tool" is used in place of the following operating software:
SmartBlue (app), for operation using an Android or iOS smartphone or tablet

RTU
Remote Transmit Unit

BD
Blocking Distance; no signals are analyzed within the BD.

PLC
Programmable logic controller (PLC)

CDI
Common Data Interface

1.5 Registered trademarks

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

Apple®
Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

Android®
Android, Google Play and the Google Play logo are trademarks of Google Inc.

Bluetooth®
The *Bluetooth*® word mark and logos are registered trademarks owned by the Bluetooth SIG, Inc. and any use of such marks by Endress+Hauser is under license. Other trademarks and trade names are those of their respective owners.

2 Basic safety instructions

2.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/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).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:
- Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Personnel follow the instructions in this manual.

2.2 Designated use

Application and media
The measuring device described in these Operating Instructions is intended for continuous, non-contact level measurement in liquids. Because of its operating frequency of approx. 26 GHz, a maximum radiated pulsed power of 5.7 mW and an average power output of 0.015 mW, use outside of closed, metallic vessels is also permitted. If operated outside of closed vessels, the device must be mounted in accordance with the instructions in the "Installation" section. Operation of the devices does not pose a risk to health or the environment.

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 for the following measurements only:
- Measured process variables: distance
- Calculated process variables: volume or mass in vessels of any shape; flow through measuring weirs or channels (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 media to which the process-wetted materials have an adequate level of resistance.
- Observe the limit values (see "Technical data").

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

Verification for borderline cases:
- With regard to special media and media used for cleaning, please contact the manufacturer. Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials but does not accept any warranty or liability.

Residual risks
Due to heat transfer from the process as well as power dissipation within the electronics, the temperature of the electronics housing and the assemblies contained therein may rise to 80 °C (176 °F) during operation. When in operation, the sensor can 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.

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

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- If modifications are nevertheless 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 the repair of an electrical device.
- Use only original spare parts and accessories from the manufacturer.

Hazardous area

To eliminate the risk of danger to persons or the facility when the device is used in the approval-related area (e.g. explosion protection, pressure equipment safety):
- Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area.
- Observe the specifications in the separate supplementary documentation that is an integral part of this manual.

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

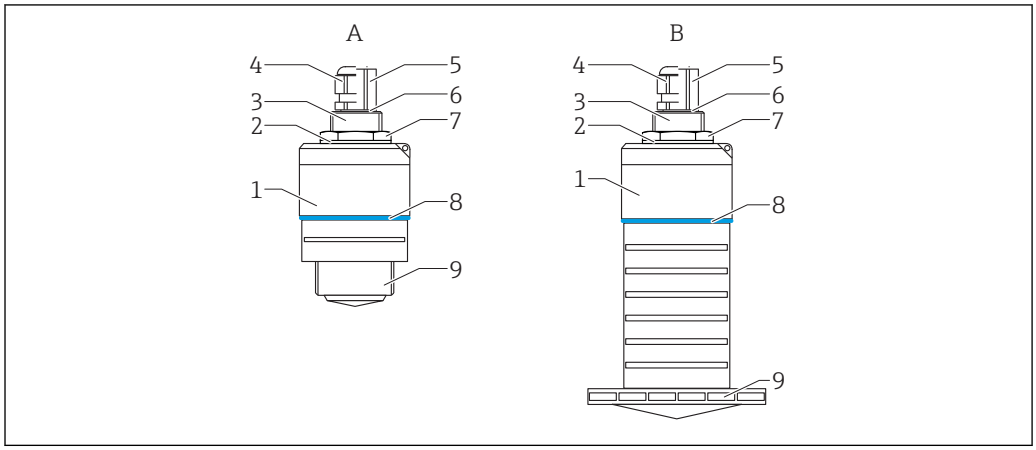
2.5.1 CE mark

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

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

3 Product description

3.1 Product design



1 *Device design*

A Device with 40 mm antenna
B Device with 80 mm antenna
1 Sensor housing
2 Seal
3 Process connection rear side
4 Cable gland
5 Pipe adapter
6 O-ring
7 Counter nut
8 Design ring
9 Process connection front side

4 Incoming acceptance and product identification

4.1 Goods acceptance

Check the following during goods acceptance:
- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the safety instructions (XA) provided?

If one of these conditions is not met, please contact the manufacturer's sales office.

4.2 Product identification

The following options are available for the identification of the measuring device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

- Enter the serial number from the nameplates into *W@M Device Viewer* (www.endress.com/deviceviewer)
  - All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

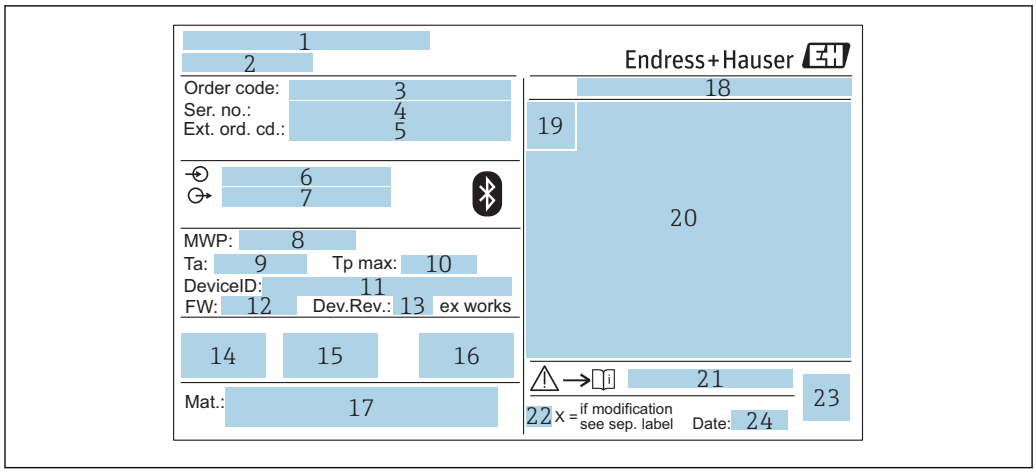
- Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) provided on the nameplate
  - All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

4.3 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

Address of the manufacturing plant: See nameplate.

4.4 Nameplate



2 *Nameplate of Micropilot*

1 *Manufacturer address*
2 *Device name*
3 *Order code*
4 *Serial number (ser. no.)*
5 *Extended order code (ext. ord. cd.)*
6 *Supply voltage*
7 *Signal outputs*
8 *Process pressure*
9 *Allowable ambient temperature (T_a)*
10 *Maximum process temperature*
11 *Device ID*
12 *Firmware version (FW)*
13 *Device revision (Dev.Rev.)*
14 *CE mark*
15 *Additional information about the device version (certificates, approvals)*
16 *C-tick*
17 *Materials in contact with process*
18 *Degree of protection: e.g. IP, NEMA*
19 *Certificate symbol*
20 *Certificate and approval relevant data*
21 *Document number of the Safety Instructions: e.g. XA, ZD, ZE*
22 *Modification mark*
23 *2-D matrix code (QR code)*
24 *Manufacturing date: year-month*

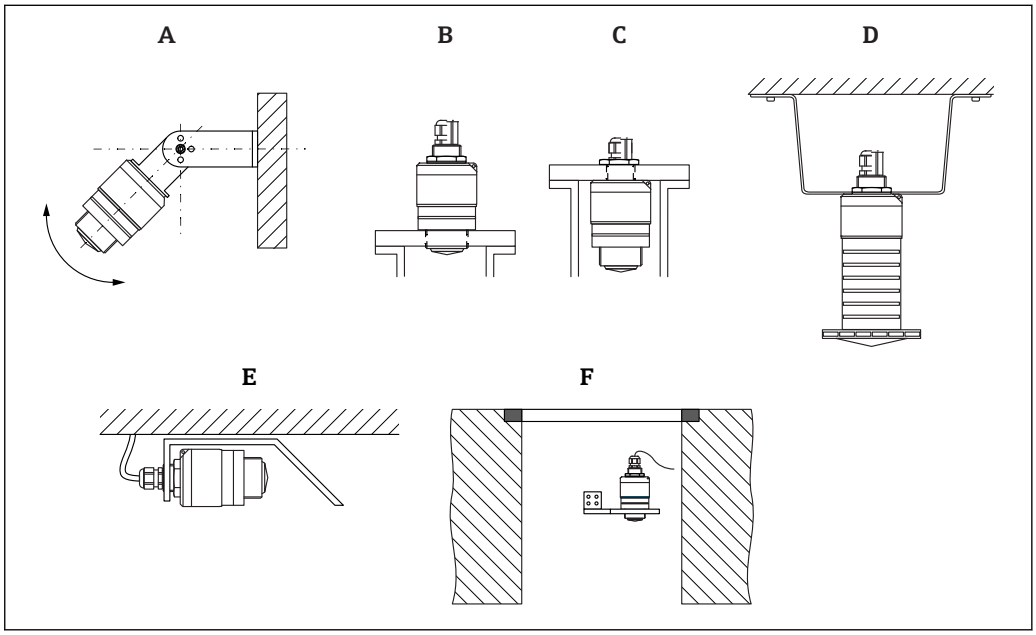
Up to 33 characters of the extended order code are indicated on the nameplate. If the extended order code contains additional characters, these cannot be displayed.

However, the complete extended order code can also be displayed via the device operating menu: **Extended order code 1 to 3** parameter

5 Installation

5.1 Installation conditions

5.1.1 Installation types



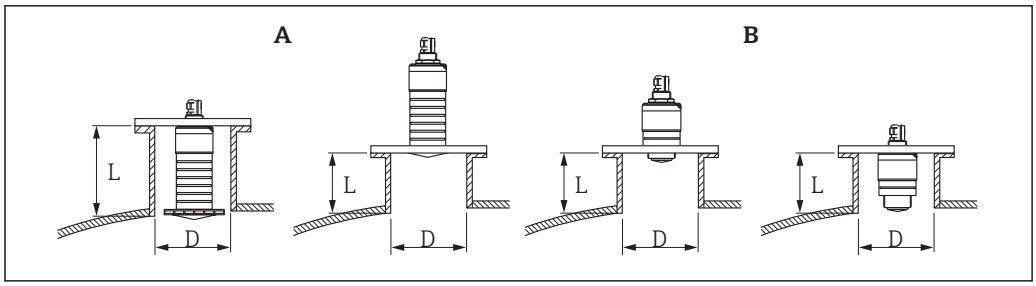
3 *Wall, ceiling or nozzle installation*

A Wall or ceiling mount, adjustable
B Mounted at front thread
C Mounted at rear thread
D Ceiling installation with counter nut (included in delivery)
E Horizontal installation in confined spaces (sewer shaft)
F Shaft wall mounting

Caution!
- The sensor cables are not designed as supporting cables. Do not use them for suspension purposes.
- Always operate the device in a vertical position in free-space applications.

5.1.2 Nozzle installation

The antenna should be located out of the nozzle for optimum measurement. The interior of the nozzle must be smooth and may not contain any edges or welded joints. The edge of the nozzle should be rounded if possible.



4 *Nozzle installation*

A 80 mm (3 in) antenna
B 40 mm (1.5 in) antenna

The maximum length of the nozzle **L** depends on the nozzle diameter **D**.

Please note the limits for the diameter and length of the nozzle.

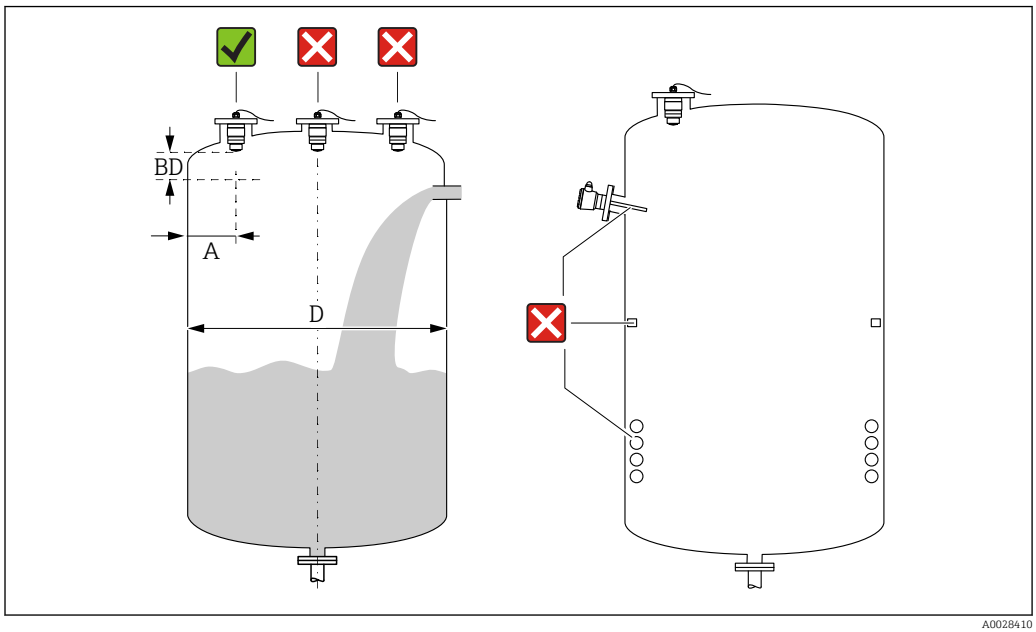
80 mm (3 in) antenna, installation inside nozzle
- D: min. 120 mm (4.72 in)
- L: max. 205 mm (8.07 in) + D × 4.5

80 mm (3 in) antenna, installation outside nozzle
- D: min. 80 mm (3 in)
- L: max. D × 4.5

40 mm (1.5 in) antenna, installation outside nozzle
- D: min. 40 mm (1.5 in)
- L: max. D × 1.5

40 mm (1.5 in) antenna, installation inside nozzle
- D: min. 80 mm (3 in)
- L: max. 140 mm (5.5 in) + D × 1.5

5.1.3 Position for installation on a vessel

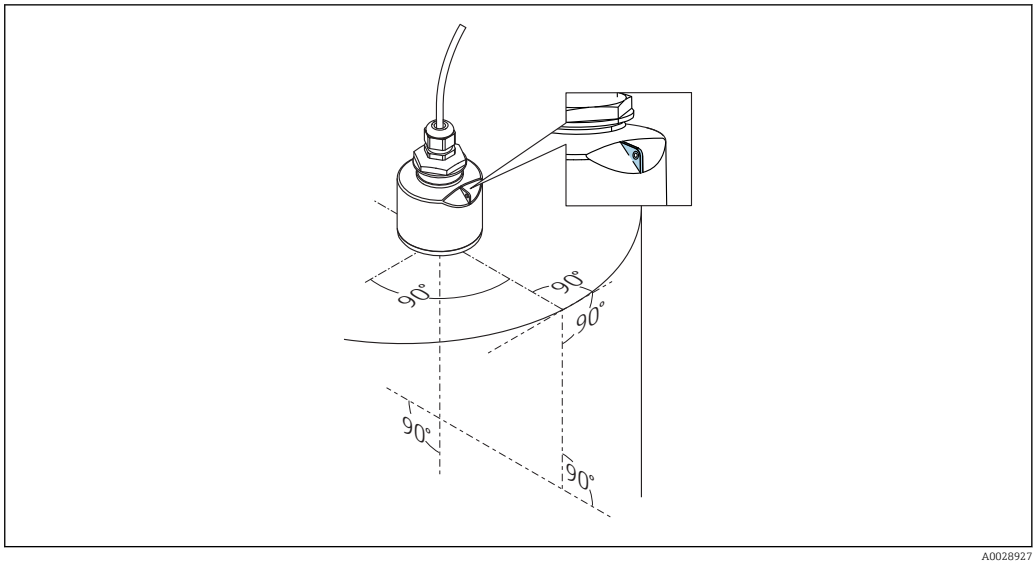


5 *Installation position on a vessel*

- If possible install the sensor so that its lower edge projects into the vessel.
- Recommended distance **A** wall - nozzle outer edge: ~ ⅙ of the vessel diameter **D**. Under no circumstances should the device be mounted closer than 15 cm (5.91 in) to the vessel wall.
- Do not install the sensor in the middle of the vessel.
- Avoid measurements through the filling curtain.
- Avoid equipment such as limit switches, temperature sensors, baffles, heating coils etc.
- No signals are evaluated within the Blocking distance (BD). It can therefore be used to suppress interference signals (e.g. the effects of condensate) in the vicinity of the antenna.
  An automatic Blocking distance of at least 0.1 m (0.33 ft) is configured as standard. However, this can be overwritten manually (0 m (0 ft) is also permitted).
  Automatic calculation:
  Blocking distance = Empty calibration - Full calibration - 0.2 m (0.656 ft).
  Each time a new entry is made in the **Empty calibration** parameter or **Full calibration** parameter, the **Blocking distance** parameter is recalculated automatically using this formula.
  If the result of the calculation is a value < 0.1 m (0.33 ft), the Blocking distance of 0.1 m (0.33 ft) will continue to be used.

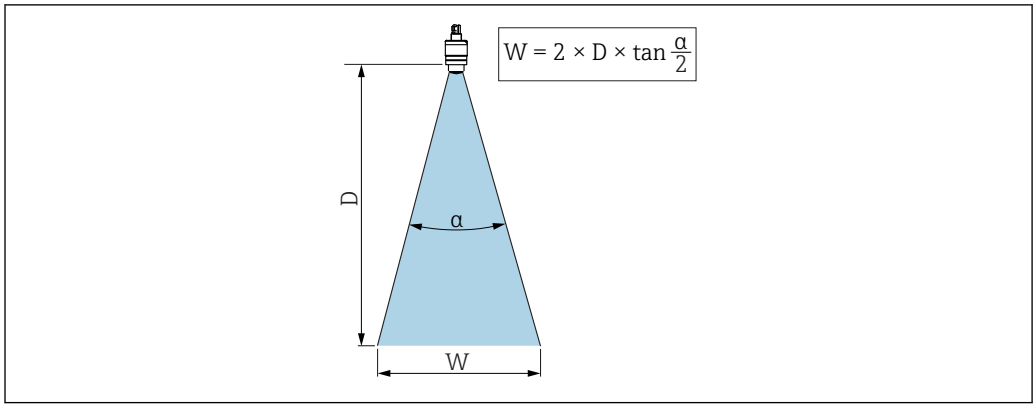
5.1.4 Device alignment for installation on a vessel

- Align the antenna vertically to the product surface.
- Align the eyelet with lug towards the vessel wall as well as possible.



6 *Device alignment for installation on a vessel*

5.1.5 Beam angle



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

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

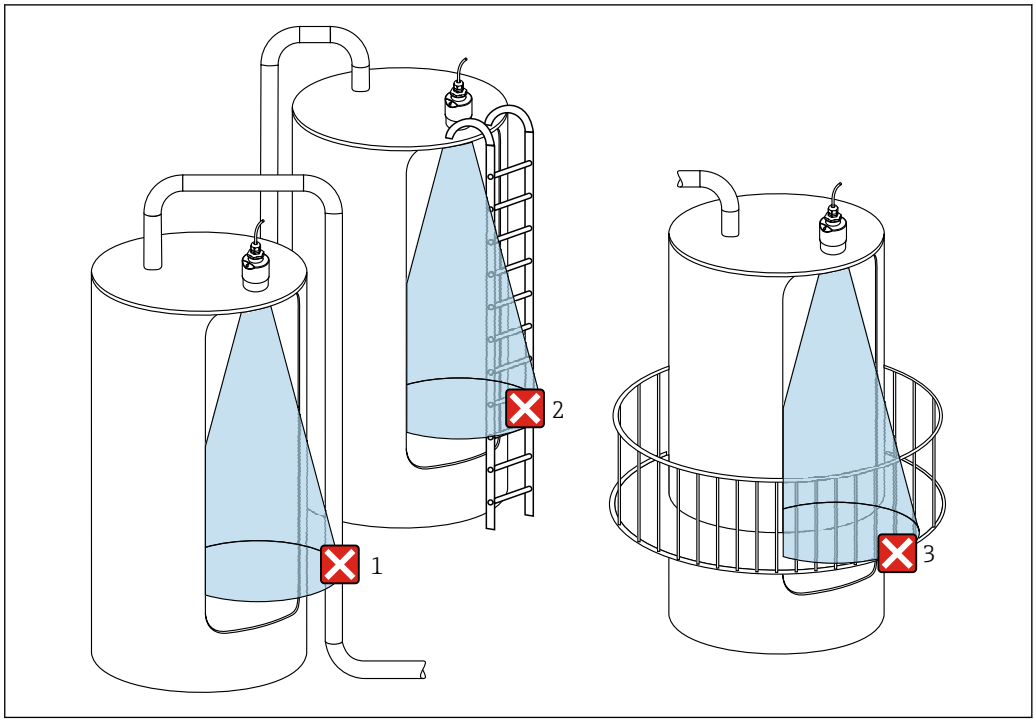
Beam diameter **W** as a function of beam angle **α** and distance **D**.

40 mm (1.5 in) antenna, α 30 °
W = D × 0.54

40 mm (1.5 in) antenna with flooding protection tube, α 12 °
W = D × 0.21

80 mm (3 in) antenna with or without flooding protection tube, α 12 °
W = D × 0.21

5.1.6 Measurement in plastic vessels



8 *Measurement in a plastic vessel with a metallic, interfering installation outside of the vessel*

1 Pipe, tubing
2 Ladder
3 Grate, railing

If the outer wall of the vessel is made of a non-conductive material (e.g. GFR), microwaves can also be reflected by interfering installations outside of the vessel.

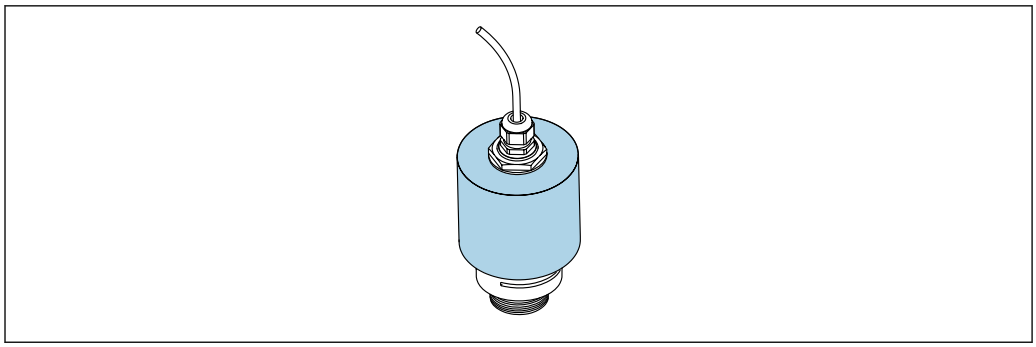
Please ensure there are no interfering installations made of a conductive material in the signal beam (see the beam angle section for information on calculating the beamwidth diameter).

Please contact the manufacturer for further information.

5.1.7 Protective hood

For outdoor use, a protective hood is recommended.

The protective hood can be ordered as an accessory or together with the device via the product structure "Accessory enclosed".



9 *Protective hood, e.g. with 40 mm (1.5") antenna*

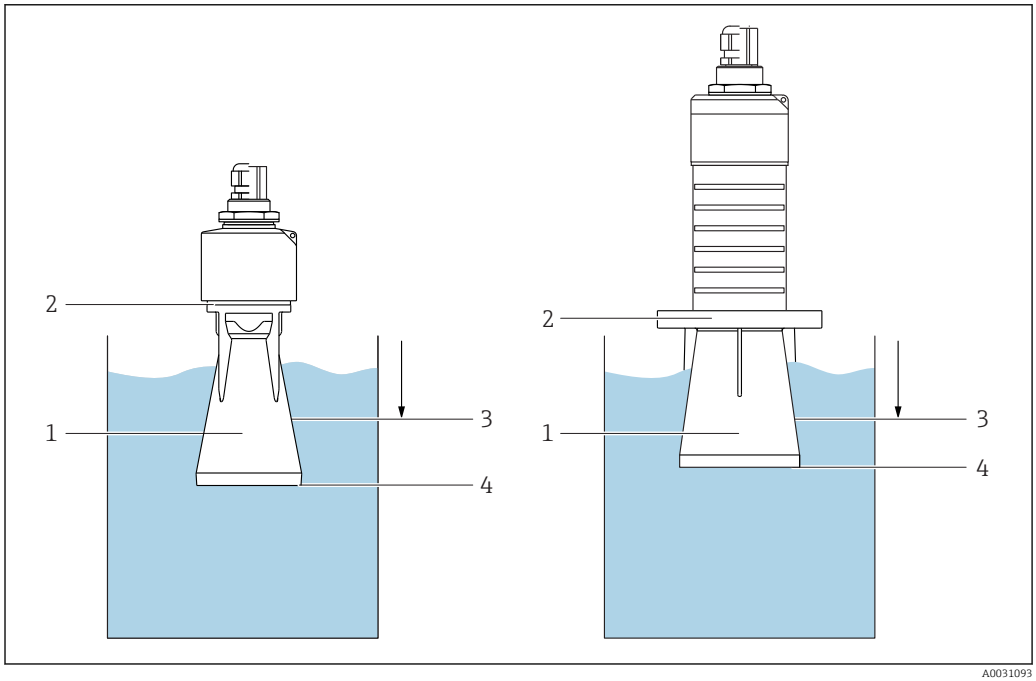
The sensor is not completely covered by the protective hood.

5.1.8 Using the flooding protection tube

The flooding protection tube ensures the sensor measures the maximum level even if it is completely flooded.

In free-field installations and/or in applications where there is a risk of flooding, the flooding protection tube must be used.

The flooding protection tube can be ordered as an accessory or together with the device via the product structure "Accessory enclosed".



10 *Function of flooding protection tube*

1 *Air pocket*
2 *O-ring (EPDM) seal*
3 *Blocking distance*
4 *Max. level*

The tube is screwed directly onto the sensor and seals off the system by means of an O-ring making it air-tight. In the event of flooding, the air pocket that formed in the tube ensures the measurement of the maximum level at the end of the tube. Due to the fact that the Blocking distance is inside the tube, multiple echoes are not analyzed.

Configuration parameters for flooding protection tube

Configuring the blocking distance when using the flooding protection tube

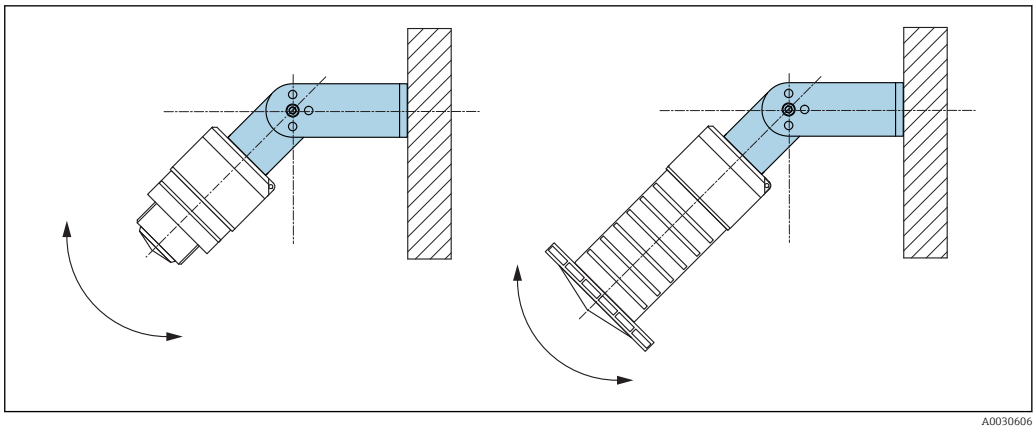
▶ Navigate to: Main menu → Setup → Advanced setup → Blocking distance
↳ Enter 100 mm (4 in).

Perform a mapping after the flooding protection tube has been installed and the blocking distance has been configured

1. Navigate to: Setup → Confirm distance
   ↳ Compare the distance displayed with the actual value in order to start the recording of an interference echo map.
2. Navigate to: Setup → Mapping end point
   ↳ This parameter determines the distance up to which the new mapping is to be recorded.
3. Navigate to: Setup → Present mapping
   ↳ Displays the distance up to which a mapping has already been recorded.

5.1.9 Installation with mounting bracket, adjustable

The mounting bracket can be ordered as an accessory or together with the device via the product structure "Accessory enclosed".



11 *Installation with mounting bracket, adjustable*

- Wall or ceiling installation is possible.
- Using the mounting bracket, position the antenna so that it is perpendicular to the product surface.

NOTICE

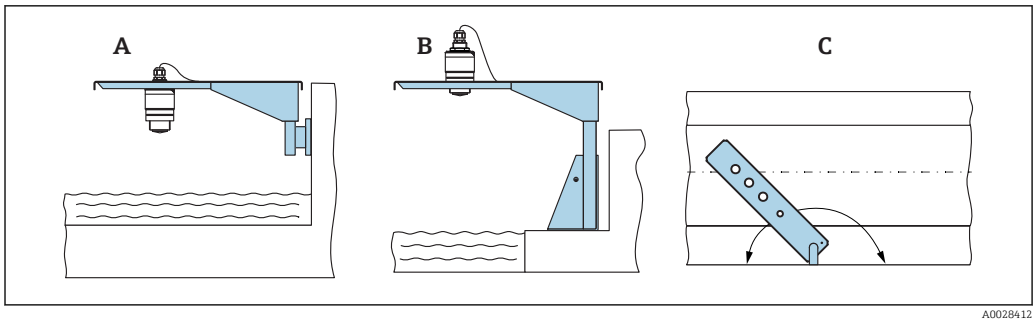
There is no conductive connection between the mounting bracket and transmitter housing.

Electrostatic charging possible.

▶ Integrate the mounting bracket in the local potential equalization system.

5.1.10 Cantilever installation, with pivot

The cantilever, wall bracket and mounting frame are available as accessories.

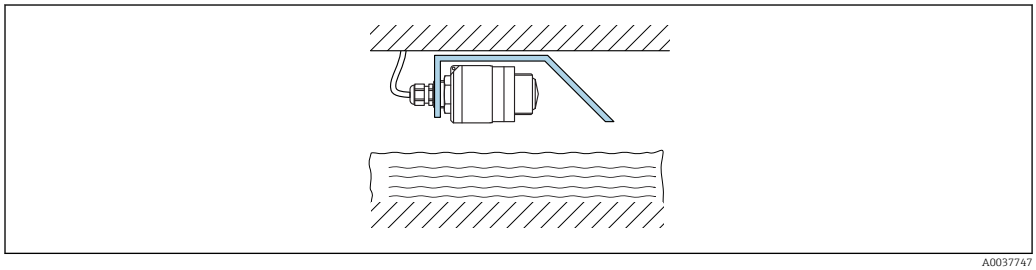


12 *Cantilever installation, with pivot*

A Cantilever with wall bracket
B Cantilever with mounting frame
C Cantilever can be turned (e.g., in order to position the device over the center of the flume)

5.1.11 Installation of horizontal mounting bracket for sewer shafts

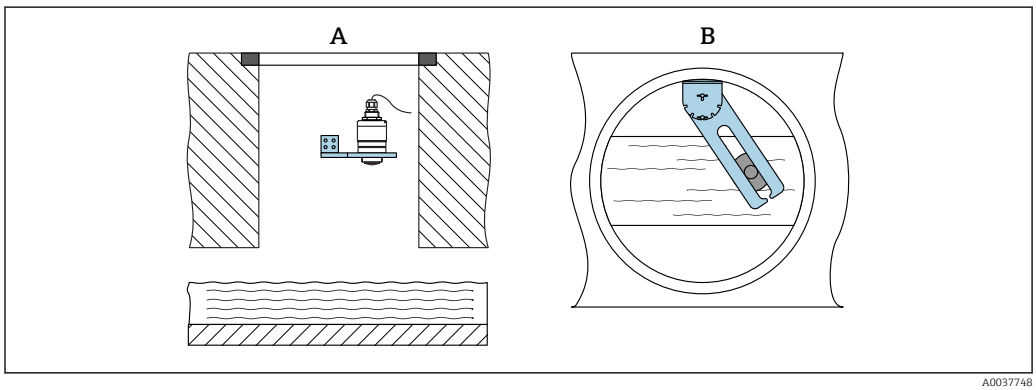
The horizontal mounting bracket for sewer shafts is available as an accessory.



13 *Installation of horizontal mounting bracket for sewer shafts*

5.1.12 Mounting in a shaft

The pivoted mounting bracket is available as an accessory.



14 *Mounting in a shaft, pivotable and adjustable*

A Arm with wall bracket
B Pivotable and adjustable arm (e.g. to align the device with the center of a channel)

5.2 Post-installation check

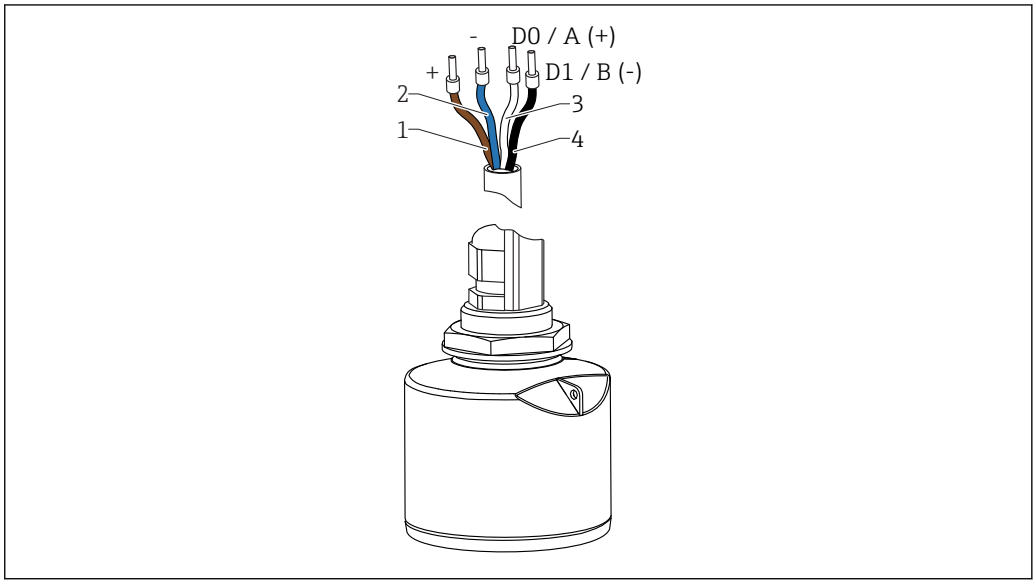
❑ Is the device or cable undamaged (visual inspection)?

❑ Is the device adequately protected from wet conditions and direct sunlight?

❑ Is the device properly secured?

6 Electrical connection

6.1 Cable assignment



15 *FMR20 cable assignment, Modbus*

1 *Plus, brown wire*
2 *Minus, blue wire*
3 *Modbus D0/A (+), white wire*
4 *Modbus D1/B (-), black wire*

6.2 Supply voltage

5 to 30 V_{DC}

An external power supply is necessary.

Battery operation
The sensor's *Bluetooth*® wireless technology communication can be disabled to increase the operating life of the battery.

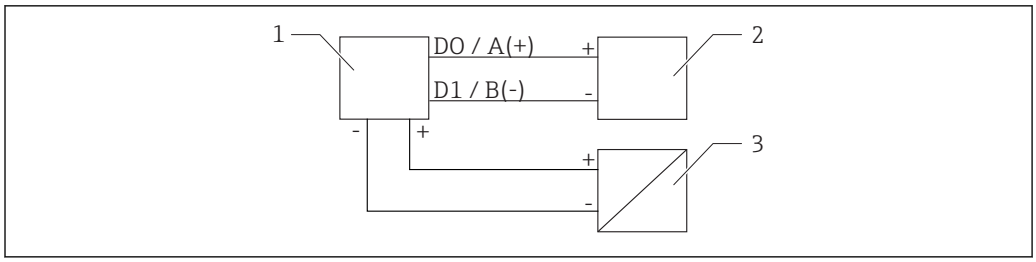
Potential equalization
No special measures for potential equalization are required.

Various power supply units can be ordered as an accessory from Endress+Hauser.

6.3 Connecting the device

6.3.1 Block circuit diagram for Modbus RS485 connection

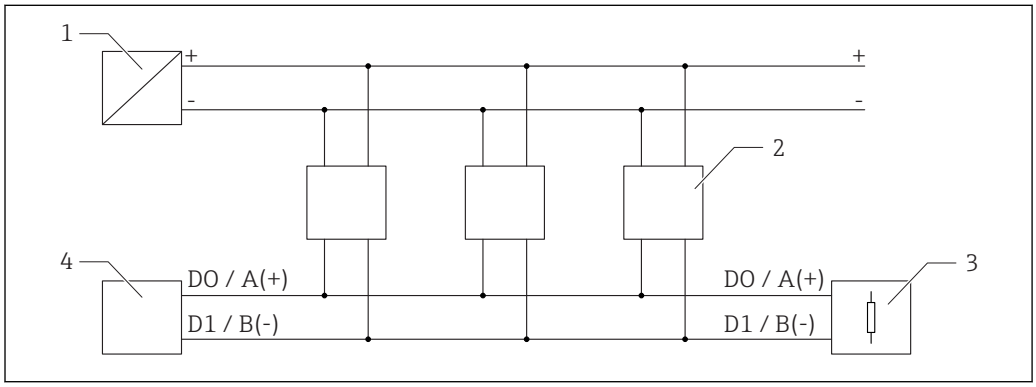
The RS485 connection meets the requirements of the RS485-IS specification for use in hazardous environments.



16 *Block circuit diagram for Modbus RS485 connection*

1 *Device with Modbus communication*
2 *Modbus master/RTU*
3 *Power supply*

Up to 32 users can be connected on the RS485 bus.



17 *Block circuit diagram for Modbus RS485 connection, multiple users*

1 *Power supply*
2 *Device with Modbus communication*
3 *Bus termination*
4 *Modbus master/RTU*

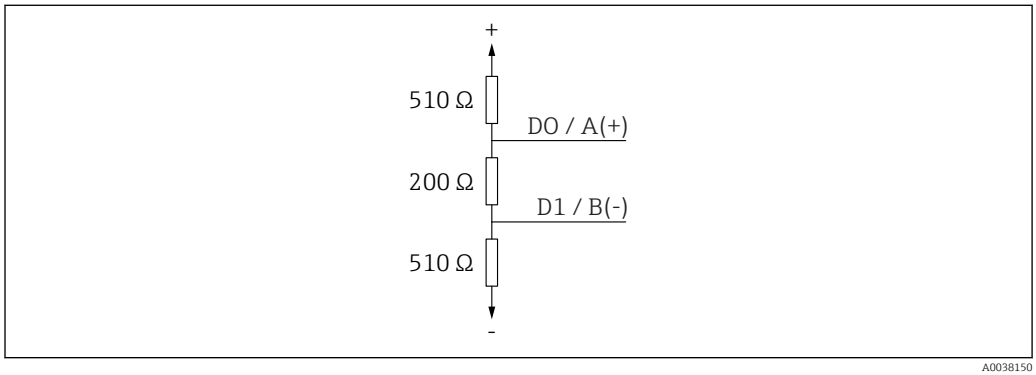
The bus cable should be a type-A fieldbus cable with a maximum length of 1 200 m (3 937 ft).

If the device is installed in a hazardous environment, the cable length may not exceed 1 000 m (3 281 ft).

A terminating resistor must be connected at both ends of the RS485 bus.

6.3.2 Modbus RS485 bus terminating resistor

The bus terminating resistor should be installed as per the RS485-IS specification.



18 *Representation of the bus terminating resistor as per the RS485-IS specification*

6.4 Post-connection check

❑ Is the device or cable undamaged (visual inspection)?

❑ Do the mounted cables have adequate strain relief?

❑ Are the cable glands mounted and firmly tightened?

❑ Does the supply voltage match the specifications on the nameplate?

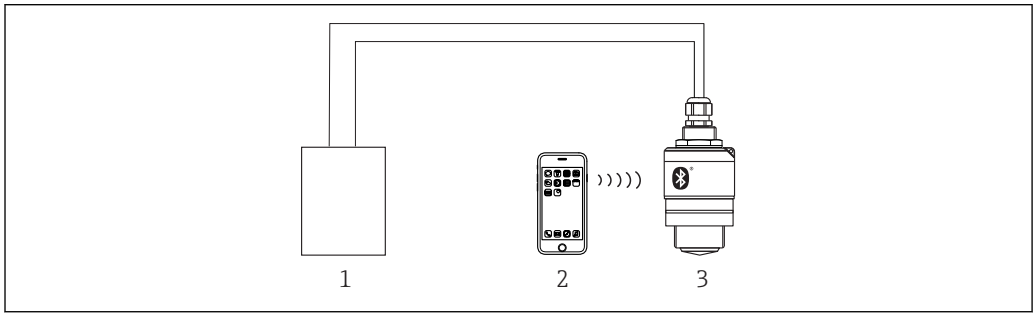
❑ No reverse polarity, is terminal assignment correct?

7 Operability

7.1 Operating concept

- Modbus
- SmartBlue (app) via *Bluetooth*® wireless technology
- Menu guidance with brief explanations of the individual parameter functions in the operating tool

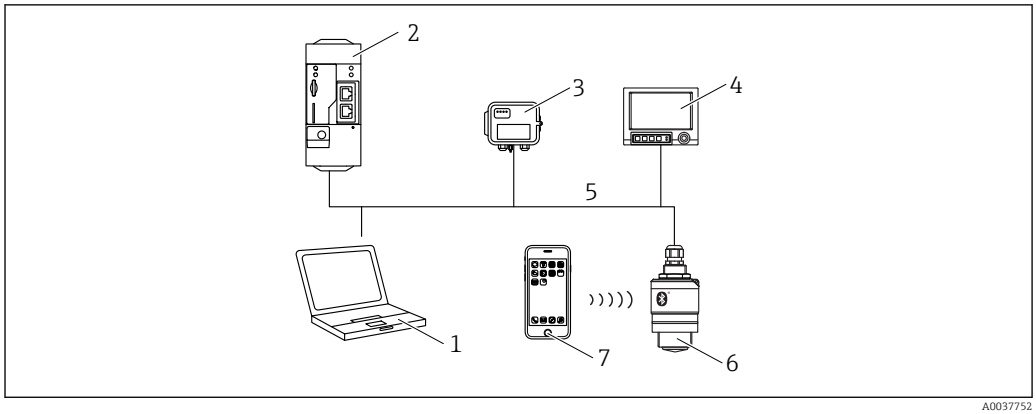
7.2 Operation via Bluetooth® wireless technology



19 Possibilities for remote operation via Bluetooth® wireless technology

1 Transmitter power supply unit
2 Smartphone/tablet with SmartBlue (app)
3 Transmitter with Bluetooth® wireless technology

7.3 Remote operation via Modbus protocol



20 Options for remote operation via Modbus protocol

1 Computer with Modbus operating tool (client application, terminal application, etc.)
2 Remote Transmit Unit (RTU) with Modbus (e.g. Fieldgate FXA42)
3 Connect Sensor FXA30B
4 Memograph M RSG45
5 Modbus RS485
6 Transmitter with Modbus and Bluetooth® wireless technology
7 Smartphone / tablet with SmartBlue (app)

8 System integration via Modbus protocol

8.1 Modbus RS485 information

8.1.1 Modbus settings

The following settings can be customized via Bluetooth and Modbus.

Setting	Options	Default
Data bits	7,8	**8**
Parity	Even, odd, none	**Even**
Stop bits	1,2	**1**
Baud rate	1200, 2400, 4800, 9600, 19200	**9600**
Protocol	RTU, ASCII	**RTU**
Addressing	1 to 200	**200**
Minimum polling interval	500 ms	

8.1.2 Modbus function codes

Function code	Action	Register type	Command type
03 (0x03)	Single / multiple read	Holding Register	Standard
06 (0x06)	Single write	Holding Register	Standard
16 (0x10)	Multiple write	Holding Register	Standard

8.1.3 Modbus exceptions

Exception	Number	Description
MB_EX_ILLEGAL_FUNCTION	01 (0x01)	Function code is not supported
MB_EX_ILLEGAL_DATA_ADDRESS	02 (0x02)	Register address is not available
MB_EX_ILLEGAL_DATA_VALUE	03 (0x03)	Data value is not permitted (e.g. writing of a **float32** to a **char8** register). Also valid for writing to read-only registers.

8.1.4 Modbus special data types

<table>
<tr><th>Data type</th><th>Registers per parameter</th><th colspan="4">Description</th></tr>
<tr><td rowspan="4">float32 (IEEE754)</td><td rowspan="4">2</td><td colspan="4">As a float32 consists of four bytes, a parameter with float32 as the data type must be divided into two 16-bit words that are transmitted via Modbus. To read a float32-type parameter, two consecutive Modbus registers therefore must be read.</td></tr>
<tr><td colspan="2">Modbus register [n]</td><td colspan="2">Modbus register [n+1]</td></tr>
<tr><td>Byte A</td><td>Byte B</td><td>Byte C</td><td>Byte D</td></tr>
<tr><td colspan="4">float32 value</td></tr>
<tr><td rowspan="2">uint32 / int32</td><td rowspan="2">2</td><td colspan="4">The same conditions that apply for float32 data types also apply for uint32 / int32 data types.</td></tr>
<tr><td colspan="2">Modbus register [n]</td><td colspan="2">Modbus register [n+1]</td></tr>
</table>

Data type	Registers per parameter	Description			
		Byte A	Byte B	Byte C	Byte D
		uint32 / Int32 value			
string (char8 array)	0.5	As a single character of a character string only needs one byte, two characters are always packed into a Modbus register. Furthermore, the length of a parameter with **string** as the data type is limited to 60 characters.			
		Modbus register [n]		Modbus register [n+1]	
		char8 [n]	char8 [n+1]	char8 [n+2]	char8 [n+3]

8.2 Measured variables via Modbus protocol

The 8 most important process parameters are mapped as burst parameters to the first addresses in the Modbus address range. This means that these parameters can be read out in one measurement transmission. All parameters are available in the Float32 format.

The register address must be incremented by one (register address +1) when using the Memograph M RSG45 or Fieldgate FXA30b Modbus master. This can also apply for other masters.

Modbus address	Parameter name	Description	SI unit
5000	MODB_PV_VALUE	Level linearized (PV)	Depends on the type of linearization
5002	MODB_SV_VALUE	Distance (SV)	m
5004	MODB_TV_VALUE	Relative echo amplitude (TV)	dB
5006	MODB_QV_VALUE	Temperature (QV)	°C
5008	MODB_SIGNALQUALITY	Signal quality	-
5010	MODB_ACTUALDIAGNOSTICS	Current diagnostics number	-
5012	MODB_LOCATION_LONGITUDE	Longitude coordinate	°
5014	MODB_LOCATION_LATITUDE	Latitude coordinate	°

9 Commissioning and operation

9.1 Installation and function check

Perform the post-installation check and the post-connection check prior to commissioning.

9.1.1 Post-installation check

❑ Is the device or cable undamaged (visual inspection)?

❑ Is the device adequately protected from wet conditions and direct sunlight?

❑ Is the device properly secured?

9.1.2 Post-connection check

❑ Is the device or cable undamaged (visual inspection)?

❑ Do the mounted cables have adequate strain relief?

❑ Are the cable glands mounted and firmly tightened?

❑ Does the supply voltage match the specifications on the nameplate?

❑ No reverse polarity, is terminal assignment correct?

9.2 Commissioning via SmartBlue (App)

9.2.1 Device requirements

Commissioning via SmartBlue is only possible if the device has Bluetooth capability (Bluetooth module installed at the factory prior to delivery or retrofitted).

9.2.2 SmartBlue system requirements

SmartBlue system requirements

SmartBlue is available as a download from the Google Play Store for Android devices and from the iTunes Store for iOS devices.

- Devices with iOS:
  iPhone 4S or higher from iOS 9; iPad 2 or higher from iOS 9; iPod touch 5th generation or higher from iOS 9
- Devices with Android:
  From Android 4.4 KitKat and *Bluetooth*® 4.0

9.2.3 SmartBlue App

1. Scan the QR code or enter "SmartBlue" in the search field of the App Store.

21 Download link

2. Start SmartBlue.
3. Select device from livelist displayed.

4. Enter the login data:
   ↳ User name: admin
   Password: serial number of the device
5. Tap the icons for more information.

After logging in for the first time, change the password!

9.2.4 Envelope curve display in SmartBlue

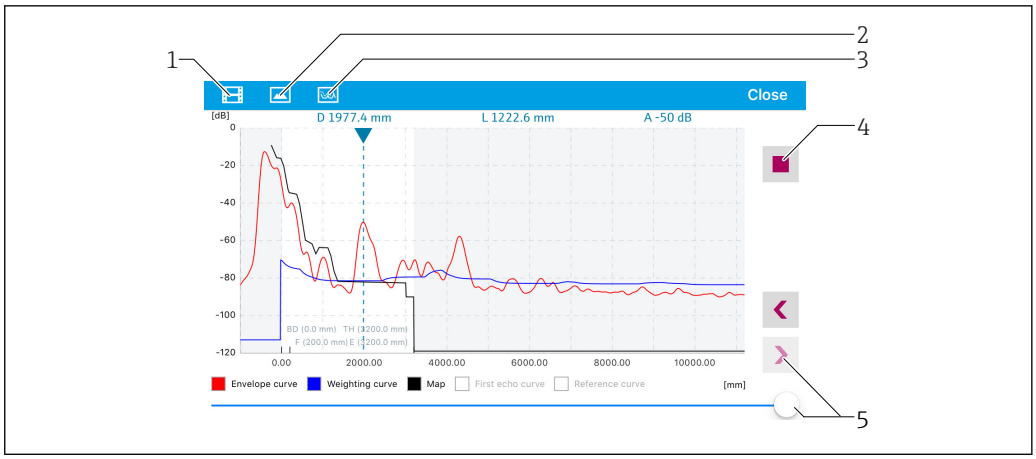
Envelope curves can be displayed and recorded in SmartBlue.

In addition to the envelope curve, the following values are displayed:
- D = Distance
- L = Level
- A = Absolute amplitude

- With screenshots, the displayed section (zoom function) is saved
- With video sequences, the whole area without zoom function is saved all the time

22 *Envelope curve display (sample) in SmartBlue for Android*

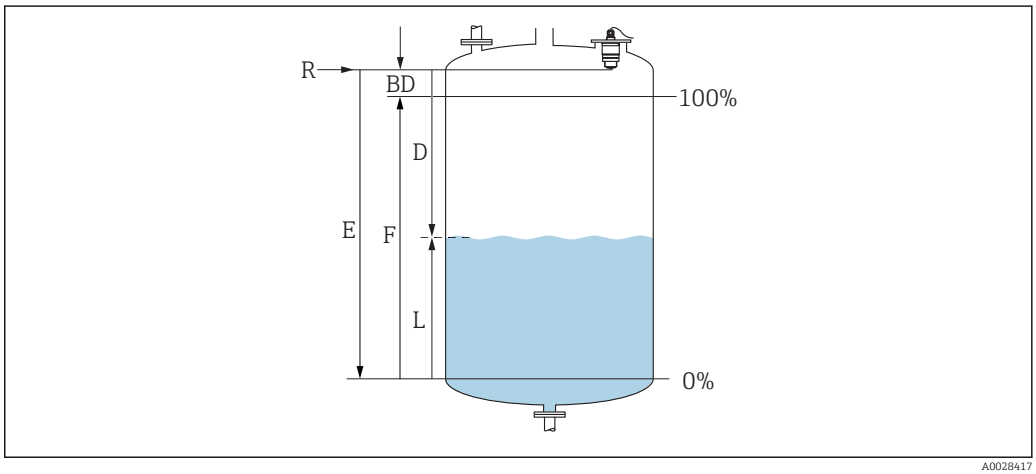
1 *Record video*
2 *Create screenshot*
3 *Display mapping menu*
4 *Start/stop video recording*
5 *Move time on time axis*



23 Envelope curve display (sample) in SmartBlue for iOS

1 Record video
2 Create screenshot
3 Display mapping menu
4 Start/stop video recording
5 Move time on time axis

9.3 Configuring level measurement via operating software



24 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)
BD Blocking distance

9.3.1 Via SmartBlue

1. Navigate to: Setup → Distance unit
   ↳ Select unit of length for distance calculation
2. Navigate to: Setup → Empty calibration
   ↳ Specify empty distance E (distance from reference point R to minimum level)
3. Navigate to: Setup → Full calibration
   ↳ Specify full distance F (span: max. level - min. level)

4. Navigate to: Setup → Distance
   ↳ Shows the distance D that is currently measured from the reference point (lower edge of flange / last sensor thread) to the level
5. Navigate to: Setup → Confirm distance
   ↳ Compare the distance displayed with the actual value in order to start the recording of an interference echo map
6. Navigate to: Setup → Mapping end point
   ↳ This parameter determines the distance up to which the new mapping is to be recorded
7. Navigate to: Setup → Present mapping
   ↳ Displays the distance up to which a mapping has already been recorded
8. Setup → Confirm distance
9. Navigate to: Setup → Level
   ↳ Shows the level L measured
10. Navigate to: Setup → Signal quality
    ↳ Displays the signal quality of the analyzed level echo

9.3.2 Via Modbus

1. Navigate to: Modbus Register 5262 (float32) (LE_EMPTY)
   ↳ Write empty distance E
2. Navigate to: Modbus Register 5264 (float32) (LE_FULL)
   ↳ Write full distance F (span: max. level - min. level)
3. Navigate to: Modbus Register 5105 (float32) (LCRS_DISTANCE_VALUE)
   ↳ Shows the distance D that is currently measured from the reference point (lower edge of flange / last sensor thread) to the level
4. If distance is o.k.:
   Navigate to: Distance ok → Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ↳ Write distance ok (value: 32859)
   ↳ MAP is recorded
5. If distance is not o.k.:
   Navigate to: Distance ok → Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ↳ Start manual recording of MAP (value: 179)
6. Navigate to: Modbus Register 5267 (float32) (LCRS_MAPPING_ENDPOINTCTRL)
   ↳ Write real distance - 0.1m
   ↳ MAP is recorded up to this distance
7. End mapping→ Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ↳ Write end mapping (value: 32862)
8. Or: do nothing
   ↳ No mapping recorded -> factory settings are used.

9.3.3 Displaying level value as %

A standardized signal which is in proportion to the level, e.g. 0 to 100 % level, can be calculated with Full calibration.

X	Level	Y	Output signal as %
X1	0.00 m (0.00 ft)	Y1	0 %
X2	Value F (=Full)	Y2	100 %

Configuration with Modbus

1. Navigate to: Modbus Register 5284 (float32)
   ↳ X1 = Specify level value in m / ft for 0 %
2. Navigate to: Modbus Register 5286 (float32)
   ↳ Enter Y1 = 0 %
3. Navigate to: Modbus Register 5288 (float32)
   ↳ X2 = Specify level value in m / ft for 100 %
4. Navigate to: Modbus Register 5290 (float32)
   ↳ Enter Y2 = 100 %
5. Navigate to: Modbus Register 5282 (uint16) (UIDHPM_LE_CSTLINTYPE_0)
   ↳ Write linearization type table (value: 33171)
6. Navigate to: Modbus Register 5283 (uint16)
   ↳ Select the length unit:

Selection/input
- 1095 = [short Ton]
- 1094 = [lb]
- 1088 = [kg]
- 1092 = [Ton]
- 1048 = [US Gal.]
- 1049 = [Imp. Gal.]
- 1043 = [ft^3]
- 1571 = [cm^3]
- 1035 = [dm^3]
- 1034 = [m^3]
- 1038 = [l]
- 1041 = [hl]
- 1342 = [%]
- 1010 = [m]
- 1012 = [mm]
- 1018 = [ft]
- 1019 = [inch]
- 1351 = [l/s]
- 1352 = [l/min]
- 1353 = [l/h]
- 1347 = [m^3/s]
- 1348 = [m^3/min]
- 1349 = [m^3/h]
- 1356 = [ft^3/s]
- 1357 = [ft^3/min]
- 1358 = [ft^3/h]
- 1362 = [US Gal./s]
- 1363 = [US Gal./min]
- 1364 = [US Gal./h]
- 1367 = [Imp. Gal./s]

- 1358 = [Imp. Gal./min]
- 1359 = [Imp. Gal./h]
- 32815 = [Ml/s]
- 32816 = [Ml/min]
- 32817 = [Ml/h]
- 1355 = [Ml/d]

7. Navigate to: Activate linearization table -> Modbus Register 5415 (uint16) (UIDHPM_LE_CT_ACTTABLE_0)
   ↳ Write activate linearization table (value: 32887)

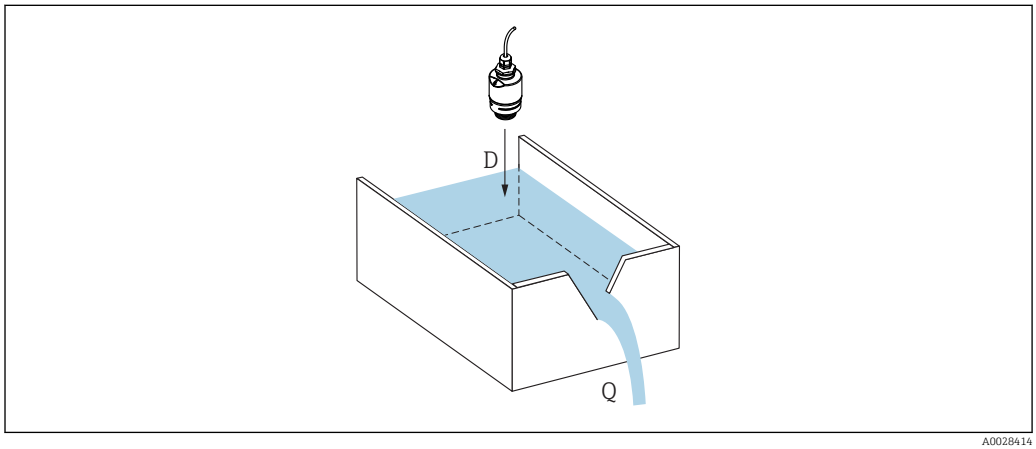
Configuration with SmartBlue

1. Navigate to: Main menu → Setup → Advanced setup → Linearization type
   ↳ Select table as the linearization type
2. Select linearization table
3. X1 = Specify level value in m / ft for 0 %
4. X2 = Specify level value in m / ft for 100 %
5. Activate linearization table

9.4 Configuring flow measurement via operating software

9.4.1 Installation conditions for flow measurement

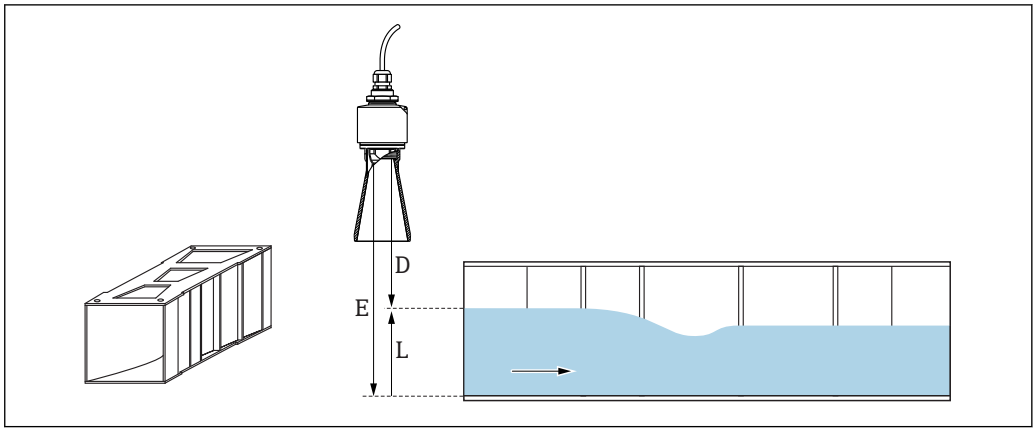
- A channel or a weir is required for flow measurement
- Position the sensor in the center of the channel or weir
- Align the sensor so that it is perpendicular to the surface of the water
- Use a weather protection cover to protect the device from sunshine and rain
- It is recommended to use the "flooding protection sleeve" accessory



25 Configuration parameters for the flow measurement of liquids

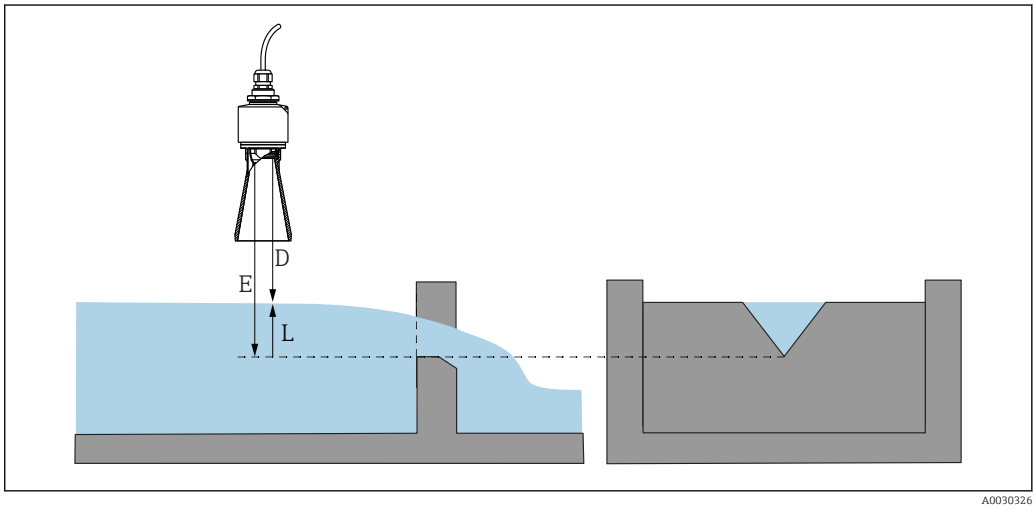
D Distance
Q Flow rate at measuring weirs or channels (calculated from the level using linearization)

9.4.2 Flow measurement configuration



26 *Example: Khafagi-Venturi flume*

E Empty calibration (= zero point)
D Distance
L Level



27 *Example: Triangular weir*

E Empty calibration (= zero point)
D Distance
L Level

Via SmartBlue app

1. Navigate to: Setup → Distance unit
   ↳ Select unit of length for distance calculation.
2. Navigate to: Setup → Empty calibration
   ↳ Specify empty distance E (distance from reference point R to the zero point of the weir or channel)
   In the case of channels, the zero point is at the narrowest point of the floor.
3. Navigate to: Setup → Full calibration
   ↳ Specify the maximum level (span: max. level - min. level)
4. Navigate to: Setup → Distance
   ↳ Shows the distance D that is currently measured from the reference point (lower edge of sensor) to the level.

5. Navigate to: Setup → Confirm distance
   ↳ Compare the distance displayed with the actual value to start recording an interference echo map.
6. Navigate to: Setup → Mapping end point
   ↳ This parameter determines the distance up to which the new mapping is to be recorded.
7. Navigate to: Setup → Present mapping
   ↳ Displays the distance up to which a mapping has already been recorded.

Configuring the blocking distance when using the flooding protection tube

▶ Navigate to: Main menu → Setup → Advanced setup → Blocking distance
↳ Enter 100 mm (4 in).

Linearization via Modbus

1. Navigate to: Modbus Register 5284 (float32)
   ↳ Write lower 16 X/Y points
   Example of lower 16 points:
   5284 → X1 = … m
   5286 → Y1 = … m³
   ……
   5344 → X16 = … m
   5346 → Y16 = … m³
2. Navigate to: Modbus Register 5348 (float32)
   ↳ Write upper 16 X/Y points
   5348 → X17 = … m
   5350 → Y17 = … m³
   ……
   5408 → X32 = … m
   5410 → Y32 = … m³
3. Navigate to: Modbus Register 5282 (uint16) (UIDHPM_LE_CSTLINTYPE_0)
   ↳ Write linearization type table (value: 33171)
4. Navigate to: Modbus Register 5283 (uint16)
   ↳ Select the length unit:

Selection/input
- 1095 = [short Ton]
- 1094 = [lb]
- 1088 = [kg]
- 1092 = [Ton]
- 1048 = [US Gal.]
- 1049 = [Imp. Gal.]
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- 1342 = [%]
- 1010 = [m]
- 1012 = [mm]
- 1018 = [ft]
- 1019 = [inch]
- 1351 = [l/s]
- 1352 = [l/min]
- 1353 = [l/h]

- 1347 = [m^3/s]
- 1348 = [m^3/min]
- 1349 = [m^3/h]
- 1356 = [ft^3/s]
- 1357 = [ft^3/min]
- 1358 = [ft^3/h]
- 1362 = [US Gal./s]
- 1363 = [US Gal./min]
- 1364 = [US Gal./h]
- 1367 = [Imp. Gal./s]
- 1358 = [Imp. Gal./min]
- 1359 = [Imp. Gal./h]
- 32815 = [Ml/s]
- 32816 = [Ml/min]
- 32817 = [Ml/h]
- 1355 = [Ml/d]

7. Navigate to: Activate linearization table -> Modbus Register 5415 (uint16) (UIDHPM_LE_CT_ACTTABLE_0)
   ↳ Write activate linearization table (value: 32887)

Linearization via SmartBlue

1. Navigate to: Setup → Advanced setup
   ↳ Linearization table
2. Select the length unit
3. Select the unit after linearization
4. Select the Linearization type table
5. Select the "Manual" table mode
6. Enter the value pairs (maximum 32) manually in the table. The table must be in the "disabled" mode in this context
7. Activate table

9.5 Measuring mode

The following measuring modes are possible:
- The continuous mode (standard mode)
  The device measures continuously once per second.
- The single-shot mode
  The device only performs one measurement and afterwards goes to a mode with reduced power consumption. This can reduce the power consumption of the device.

The measuring mode can be configured as follows:
- Via Modbus
  Modbus Register 5426 (uint16) (MODB_RUNMODE) → write 3494 (single-shot mode) or 1380 (continuous mode)
- Via app
  Navigate to: Setup → Communication → Advanced setup → Measurement mode

A measurement can be triggered by the following criteria in the single-shot mode:
- Start-up
  When the device is started, a measurement is taken in the single-shot mode
- By writing the value 32965 to the Modbus Register 5427 (uint16) (MODB_MEASUREMENT_ TRIGGER)

9.6 Data access - Security

9.6.1 Software locking via access code in Modbus

The configuration data can be write-protected using an access code (software locking).

▶ Navigate to: Modbus Register 5272 (uint16) (LCRS_ENTERPRIVATECODE) → Define access code → Modbus Register 5273 (uint16) (LCRS_CONFIRMPRIVATECODE) → Confirm access code

The new access code must differ from the last access code used and may not be "0000".

- The access code is only active if a different (wrong) code is entered or the device is deenergized.
- Once the access code has been defined, write-protected devices can only be switched to maintenance mode if the access code is entered in the **Enter access code** parameter. If the factory setting is not changed or if "0000" is entered, the device is in maintenance mode and its configuration data are therefore **not** write-protected and can be changed at any time.

9.6.2 Unlocking via Modbus

▶ Navigate to: Modbus Register 5271 (uint16) (STD_ACCESSCODE) → Enter access code

9.6.3 Software locking via access code in SmartBlue

The configuration data can be write-protected using an access code (software locking).

▶ Navigate to: Setup → Advanced setup → Administration → Administration1 → Define access code → Confirm access code

The new access code must differ from the last access code used and may not be "0000".

- The access code is only active if a different (wrong) code is entered or the device is deenergized.
- Once the access code has been defined, write-protected devices can only be switched to maintenance mode if the access code is entered in the **Enter access code** parameter. If the factory setting is not changed or if "0000" is entered, the device is in maintenance mode and its configuration data are therefore **not** write-protected and can be changed at any time.

9.6.4 Unlocking via SmartBlue

▶ Navigate to: Setup → Advanced setup → Access status tooling → Enter access code

9.6.5 Bluetooth® wireless technology

Signal transmission via Bluetooth® wireless technology uses a cryptographic technique tested by the Fraunhofer Institute

- The device is not visible via *Bluetooth*® wireless technology without the SmartBlue app
- Only one point-to-point connection between **one** sensor and **one** smartphone or tablet is established
- The *Bluetooth*® wireless technology has a configurable switch-on delay
- The *Bluetooth*® wireless technology interface can be disabled via SmartBlue and Modbus

Bluetooth® wireless technology start-up delay

It is possible to delay the activation of the Bluetooth interface when the power supply is switched on. If the sensor is only switched on briefly for one measurement and then

switched off again, the Bluetooth interface does not necessarily also have to be enabled. This setting also helps save energy.

The value entered corresponds to the delay in seconds (maximum 600 s) from the time the device is switched on.

Via app
Navigate to:
Setup → Communication → Bluetooth configuration → Switch-on delay
↳ Entry in seconds

Via Modbus
Navigate to:
Modbus Register 5436 (uint16) (MODB_BLUETOOTH_STARTUP_DELAY)
↳ Entry in seconds

Disabling the Bluetooth® wireless technology interface

- ▶ Navigate to: Setup → Communication → Bluetooth configuration → Bluetooth mode
  - ↳ Switch off the *Bluetooth*® wireless technology interface. "Off" position disables remote access via app

Re-enabling the Bluetooth® wireless technology interface

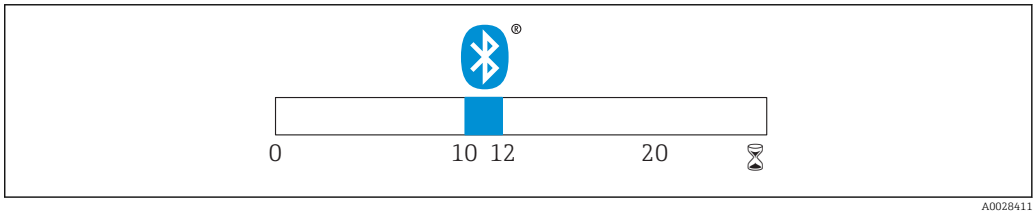
If the *Bluetooth*® wireless technology interface has been disabled, it can be re-enabled via Modbus at any time.
The *Bluetooth*® wireless technology interface is restarted 10 minutes after the device is switched on.

- ▶ Navigate to: Modbus Register 5435 (uint8) (LCRS_BLESWITCH)
  - ↳ Switch on the *Bluetooth*® wireless technology interface. Writing the value '0x01' enables remote access via the app

Bluetooth recovery sequence

The *Bluetooth*® wireless technology interface can be re-enabled after performing the following recovery sequence:

1. Connect device to voltage supply
   - ↳ After a waiting time of 10 minutes, a time window of 2 minutes opens
2. You can re-enable the *Bluetooth*® wireless technology interface of the device using the SmartBlue (app) during this time window
3. Navigate to: Setup → Communication → Bluetooth configuration → Bluetooth mode
   - ↳ Switch on the *Bluetooth*® wireless technology interface. "On" position enables remote access via app



28 *Timeline for Bluetooth wireless technology recovery sequence, time in minutes*

10 Diagnostics and troubleshooting

10.1 General errors

Error	Possible cause	Remedy
Device does not respond	Supply voltage does not match the specification on the nameplate	Apply correct voltage
	The polarity of the supply voltage is wrong	Correct the polarity
	The cables do not contact the terminals properly	Ensure electrical contact between the cable and the terminal
Modbus communication not working	Modbus signals connected incorrectly	Connect the Modbus signals correctly
	Access code is activated	Enter access code
Device measures incorrectly	Configuration error	▪ Check and correct the parameter configuration ▪ Carry out mapping
Display values not plausible (linearization)	SmartBlue and Modbus active simultaneously	Log off Modbus and disconnect or Log off SmartBlue and disconnect (connection via SmartBlue has priority)
Linearized output value not plausible	Linearization error	Check the linearization table Check the vessel selection in the linearization module

10.2 Error - SmartBlue operation

Error	Possible cause	Remedy
Device is not visible in the live list	No Bluetooth connection	Enable Bluetooth function on smartphone or tablet
		Bluetooth function of sensor disabled, perform recovery sequence
Device is not visible in the live list	The device is already connected with another smartphone/tablet	Only **one** point-to-point connection is established between a sensor and a smartphone or tablet
Device is visible in the live list but cannot be accessed via SmartBlue	Android end device	Is the location function permitted for the app, was it approved the first time?
		GPS or positioning function must be activated for certain Android versions in conjunction with Bluetooth
		Activate GPS - close the app fully and restart - enable the positioning function for the app
Device is visible in the live list but cannot be accessed via SmartBlue	Apple end device	Log in as standard Enter user name "admin" Enter initial password (device serial number) paying attention to lower/upper case
Login via SmartBlue not possible	Device is being put into operation for the first time	Enter initial password (device serial number) and change. Pay attention to lower/upper case when entering the serial number.
Device cannot be operated via SmartBlue	Incorrect password entered	Enter correct password

Error	Possible cause	Remedy
Device cannot be operated via SmartBlue	Password forgotten	Contact the manufacturer's Service Department
Device cannot be operated via SmartBlue	The sensor temperature is too high	If the ambient temperature results in an elevated sensor temperature of >60 °C (140 °F), Bluetooth communication may be disabled. Shield the device, isolate it and cool it down if necessary.

10.3 Diagnostic event

10.3.1 Diagnostic event in the operating tool

If a diagnostic event is present in the device, the status signal appears in the top left status area of the operating tool along with the corresponding symbol for the event level in accordance with NAMUR NE 107:

- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)

Calling up remedial measures

- ▶ Navigate to the **Diagnostics** menu
  - ↳ In the **Actual diagnostics** parameter the diagnostic event is shown with event text

10.3.2 List of diagnostic events in the operating tool

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of electronic				
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	1. Restart device 2. If failure remains, exchange device.	F	Alarm
272	Main electronic failure	1. Restart device 2. Check enviroment for strong EMC fields 3. If failure remains, exchange device.	F	Alarm
283	Memory content	1. Transfer data or reset device 2. Contact service	F	Alarm
Diagnostic of configuration				
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
435	Linearization	Check linearization table	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
585	Simulation distance	Deactivate simulation	C	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
586	Record map	Recording of mapping please wait	C	Warning
Diagnostic of process				
801	Energy too low	Increase supply voltage	S	Warning
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
941	Echo lost	Check parameter 'DC value'	S	Warning
941	Echo lost		F	Alarm

10.3.3 List of Modbus diagnostic codes

Diagnostic code	Short text	Remedy	Status signal [ex-factory]	Diagnostic behavior [ex-factory]
Diagnostics for the electronics				
0x010002B4 (16777908)	Main electronics error	1. Restart device 2. Error persists, replace the device	F	Alarm
0x010002B7 (16777911)				
0x010002B5 (16777909)	Main electronics error	1. Restart device 2. Check the environment for sources of strong EMC interference. 3. Error persists, replace the device	F	Alarm
0x010002B6 (16777910)				
0x0100009E (16777374)	Memory content	1. Transfer data or reset device 2. Contact Service Department	F	Alarm
Diagnostics for the configuration				
0x01000075 (16777333)	Linearization	Check linearization table	F	Alarm
0x020000E0 (33554656)	Simulation distance	Switch off simulation	C	Warning
0x02000160 (33554784)	Recording mapping	Recording mapping, please wait	C	Warning
Diagnostics for the process				
0x08000061 (134217825)	Energy too low	Increase supply voltage	S	Warning
0x08000087 (134217863)	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
0x08000072 (134217842)	Lost echo	Check DC value setting	S	Warning
0x01000076 (16777334)	Lost echo	Check DC value setting	F	Alarm

11 Maintenance

No special maintenance work is required.

11.1 Cleaning the antenna

The antenna may become contaminated depending on the application. Emission and reception of microwaves can thus be potentially hindered. The level of contamination leading to an error depends on the medium and on the reflectivity, mainly determined by the dielectric constant ε_r.

If the medium tends to cause contamination and buildup, cleaning on a regular basis is recommended.

- Care must be taken to ensure the device is not damaged in the process of mechanical or hose-down cleaning.
- Material compatibility must be taken into account if cleaning agents are used!
- Do not exceed maximum permitted temperatures.

11.2 Process seals

The process seals of the sensor (at the process connection) should be replaced periodically. The interval between changes depends on the frequency of the cleaning cycles, the cleaning temperature and the medium temperature.

12 Repair

12.1 General information

12.1.1 Repair concept

The Endress+Hauser repair concept is devised in such a way that repairs can only be carried out through device replacement.

12.1.2 Replacing a device

Once the device has been replaced, parameters must be reconfigured and interference echo suppression or linearization may need to be carried out once again.

12.1.3 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the website for more information:
   http://www.endress.com/support/return-material
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

12.1.4 Disposal

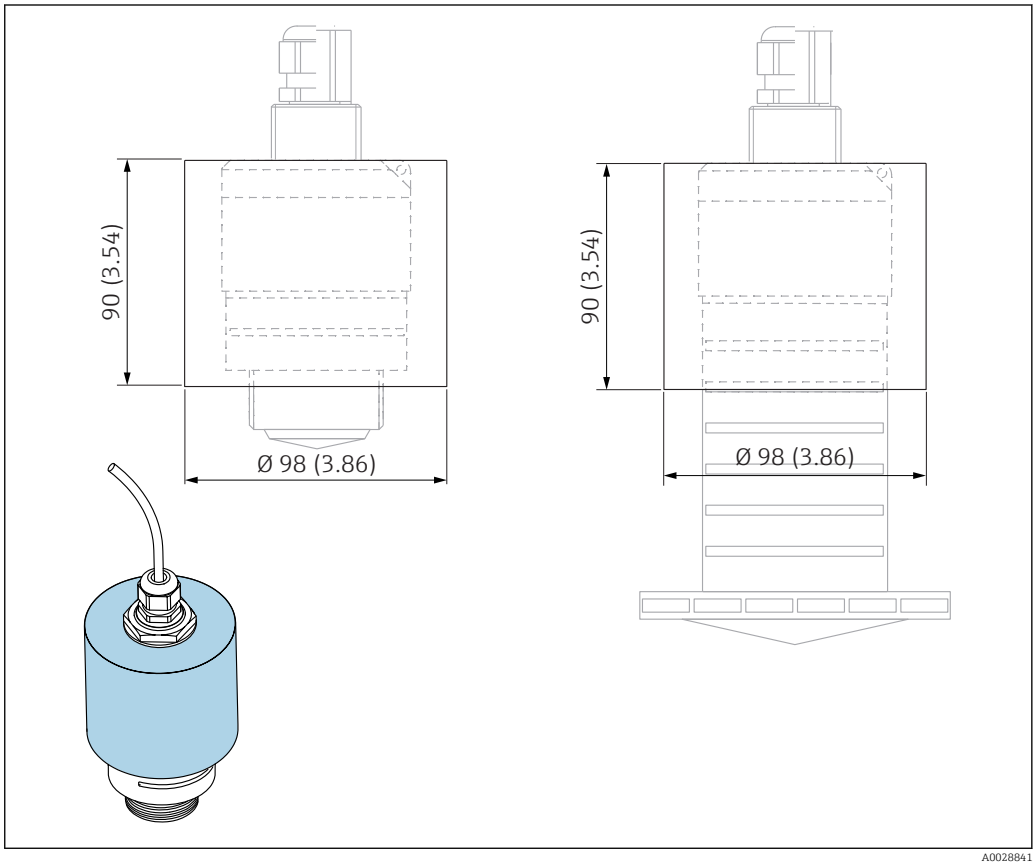
If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to Endress+Hauser for disposal under the applicable conditions.

13 Accessories

13.1 Device-specific accessories

13.1.1 Protective cover

The protective cover can be ordered together with the device via the product structure "Accessory enclosed".



29 *Dimensions of protective cover, engineering unit: mm (in)*

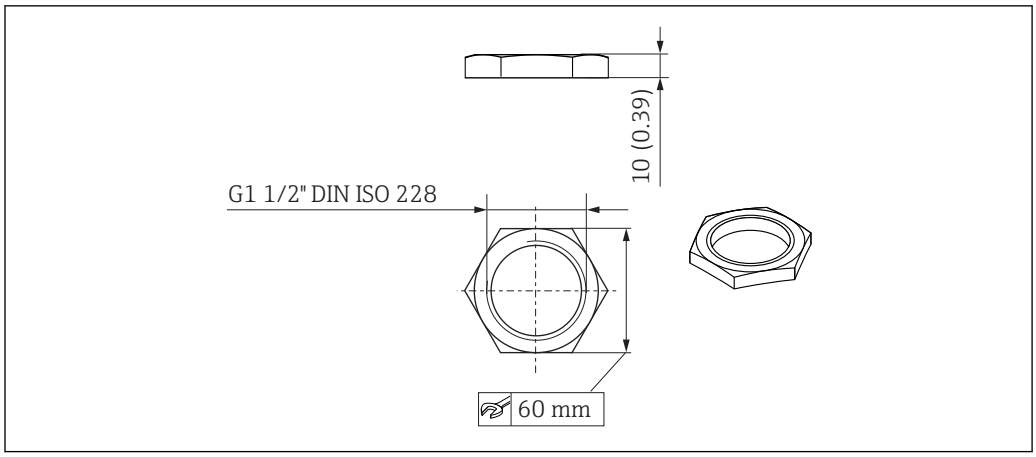
Material
PVDF

Order number
52025686

The sensor is not completely covered in the case of the 40 mm (1.5 in) antenna or the 80 mm (3 in) antenna.

13.1.2 Securing nut G 1-1/2"

Suitable for devices with G 1-1/2" and MNPT 1-1/2" process connection.



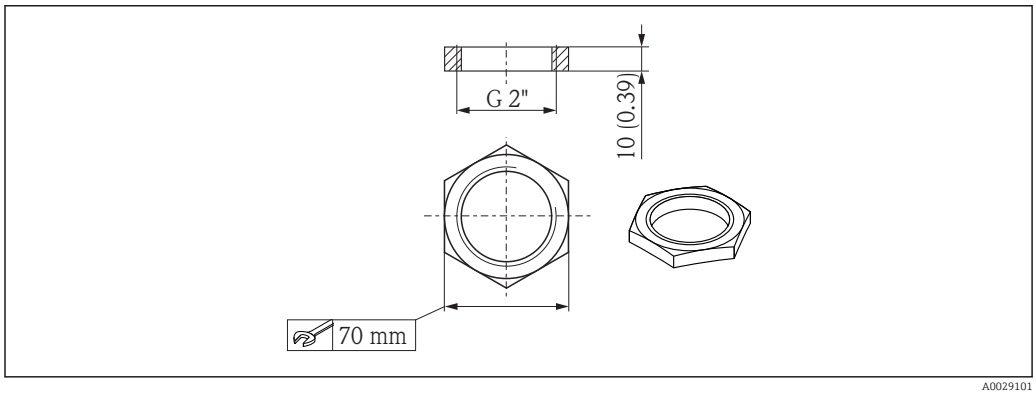
30 Dimensions of securing nut, engineering unit: mm (in)

Material
PC

Order number
52014146

13.1.3 Securing nut G 2"

Suitable for devices with G 2" and MNPT 2" process connection on front.



31 Dimensions of securing nut, engineering unit: mm (in)

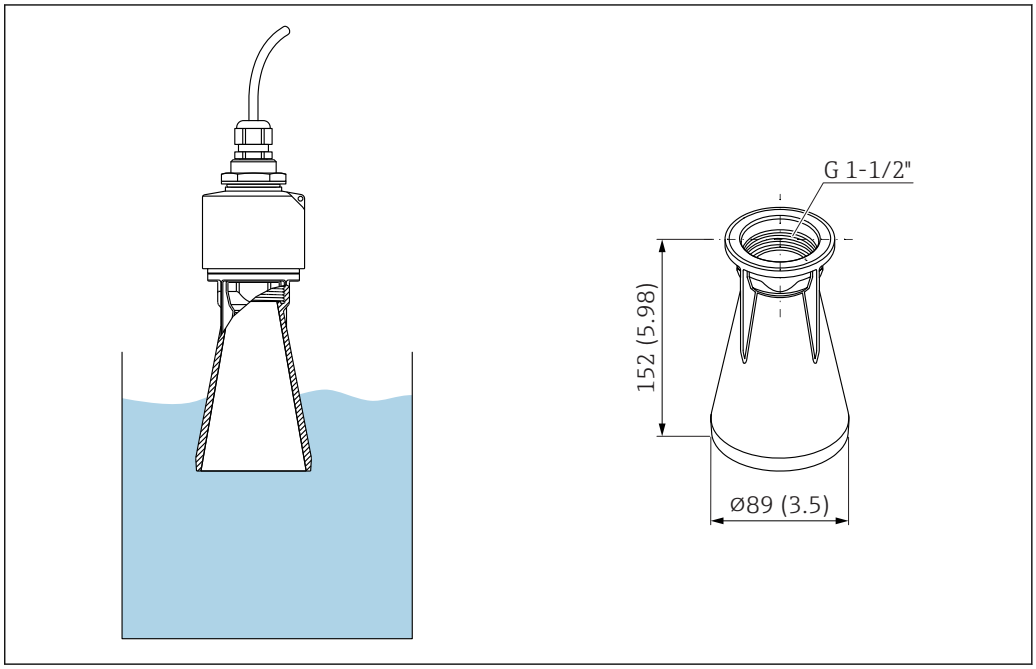
Material
PC

Order number
52000598

13.1.4 Flooding protection tube 40 mm (1.5 in)

Suitable for use with devices with a 40 mm (1.5 in) antenna and G 1-1/2" process connection on front.

The flooding protection tube can be ordered together with the device via the product structure "Accessory enclosed".



32 *Dimensions of 40 mm (1.5 in) flooding protection tube, engineering unit: mm (in)*

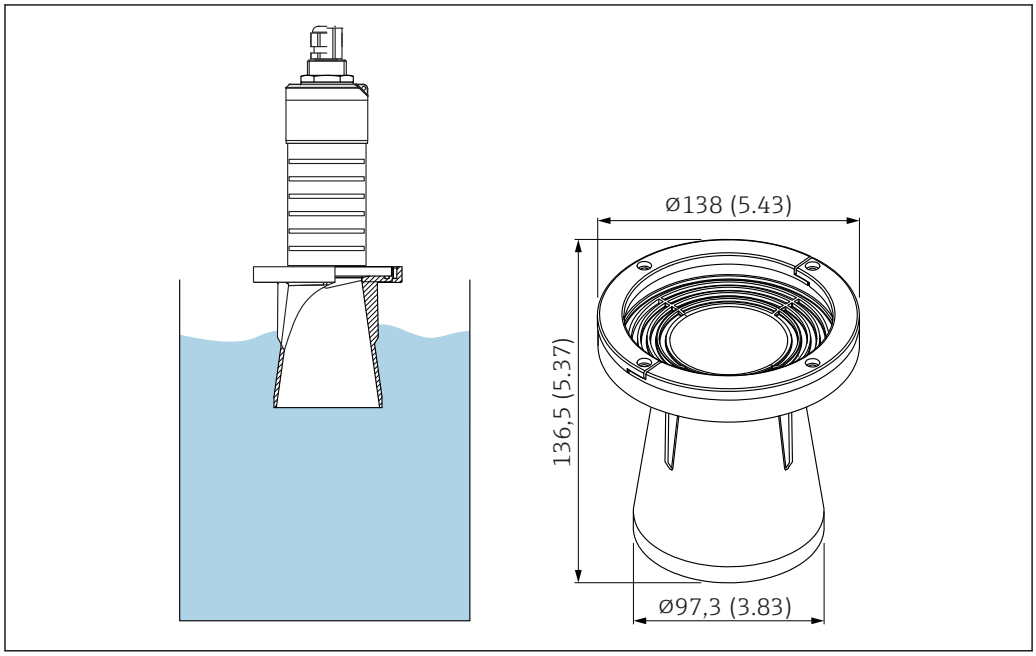
Material
PBT-PC, metalized

Order number
71325090

13.1.5 Flooding protection tube 80 mm (3 in)

Suitable for use with devices with a 80 mm (3 in) antenna and "Mounting customer side w/o flange" process connection.

The flooding protection tube can be ordered together with the device via the product structure "Accessory enclosed".



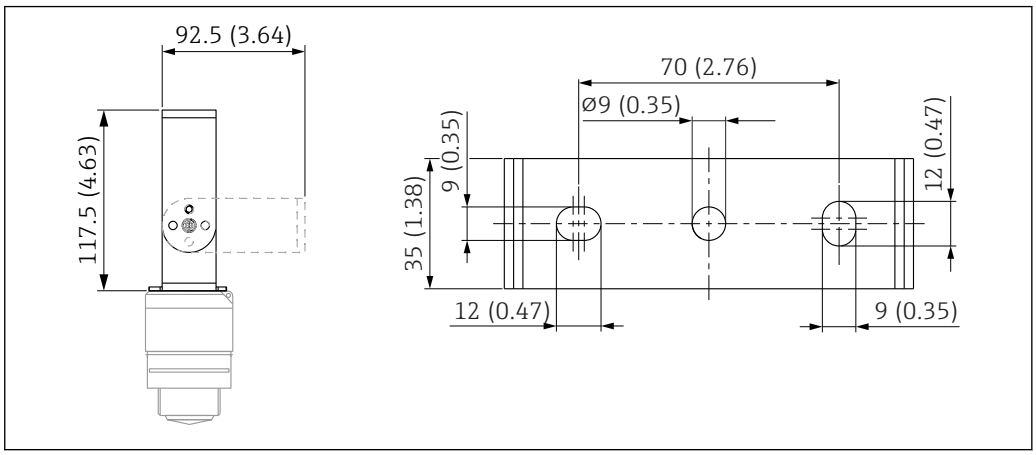
33 *Dimensions of 80 mm (3 in) flooding protection tube, engineering unit: mm (in)*

Material
PBT-PC, metalized

Order number
71327051

13.1.6 Mounting bracket, adjustable

The mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".



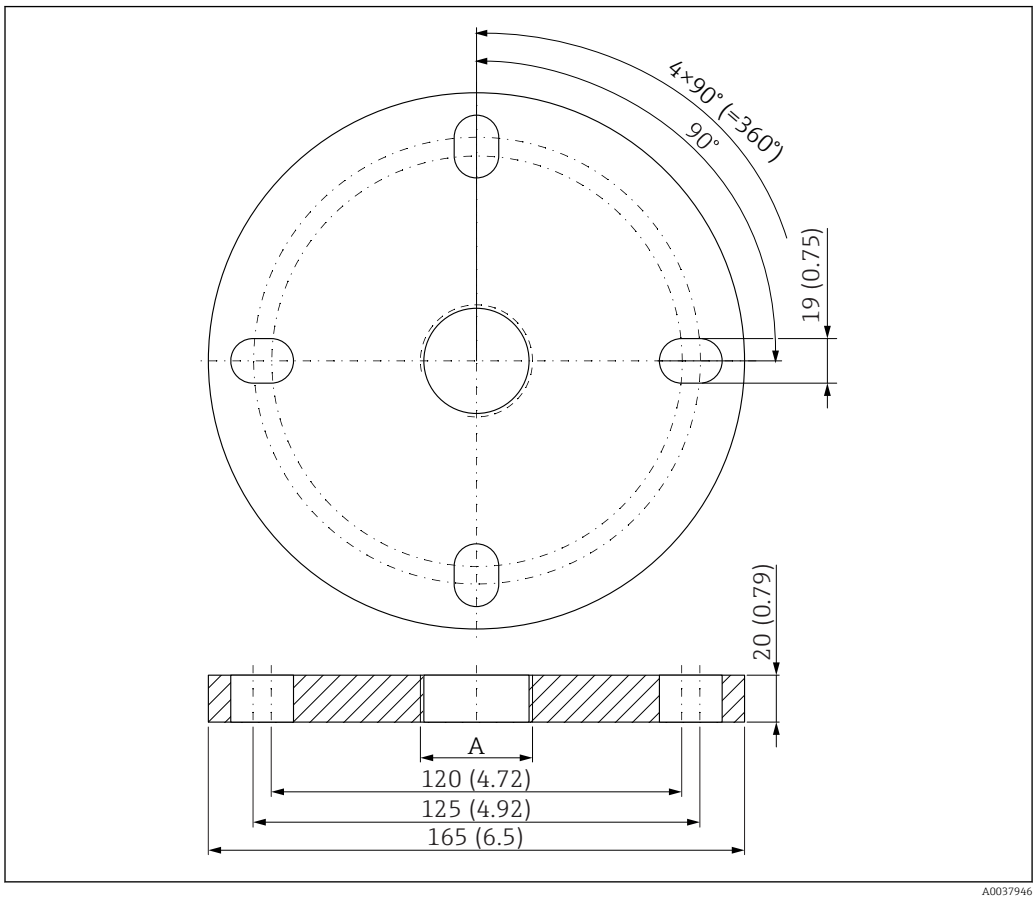
34 *Dimensions of mounting bracket, engineering unit: mm (in)*

Consists of:
- 1 × mounting bracket, 316L (1.4404)
- 1 × mounting bracket, 316L (1.4404)
- 3 × screws, A4
- 3 × securing disks, A4

Order number
71325079

13.1.7 UNI flange 2"/DN50/50, PP

The UNI flange 2"/DN50/50 can be ordered together with the device via the product structure "Accessory enclosed".



35 *Dimensions of UNI flange 2"/DN50/50, engineering unit: mm (in)*

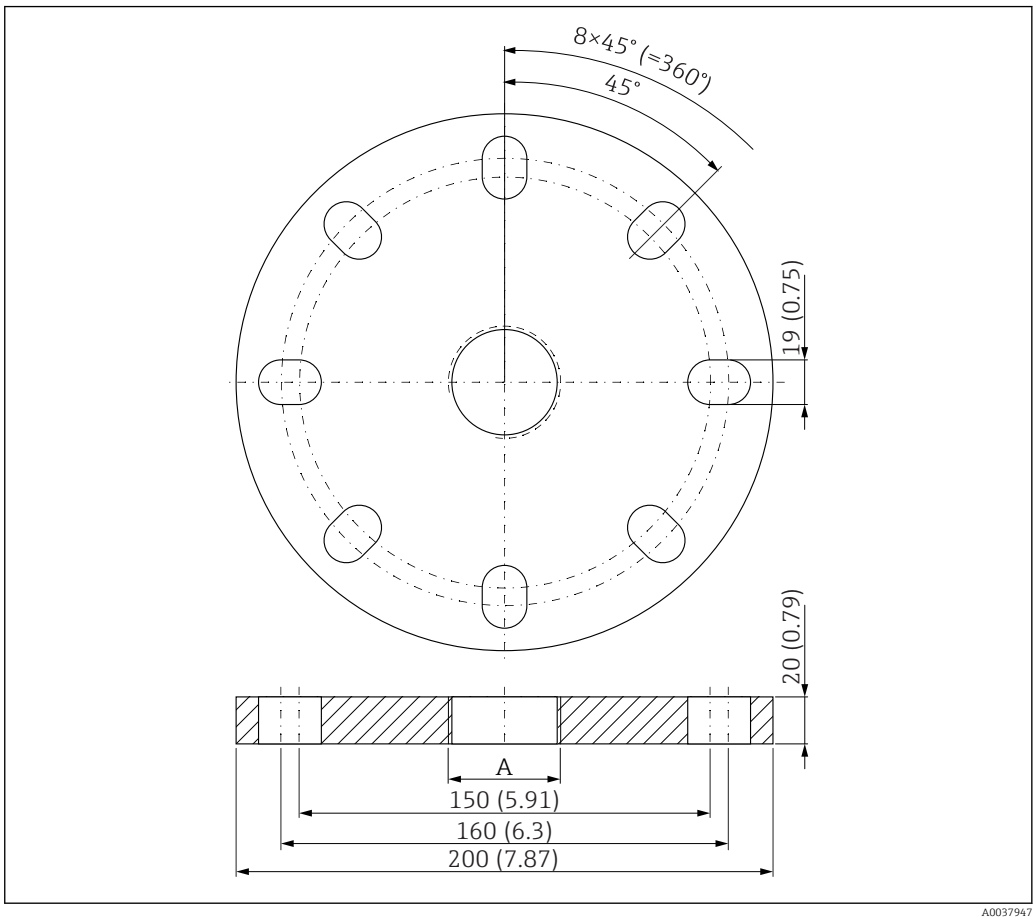
A Sensor connection in accordance with product structure "Process connection on front" or "Process connection on rear"

Material
PP

Order number
FAX50-####

13.1.8 UNI flange 3"/DN80/80, PP

The UNI flange 3"/DN80/80 can be ordered together with the device via the product structure "Accessory enclosed".



36 *Dimensions of UNI flange 3"/DN80/80, engineering unit: mm (in)*

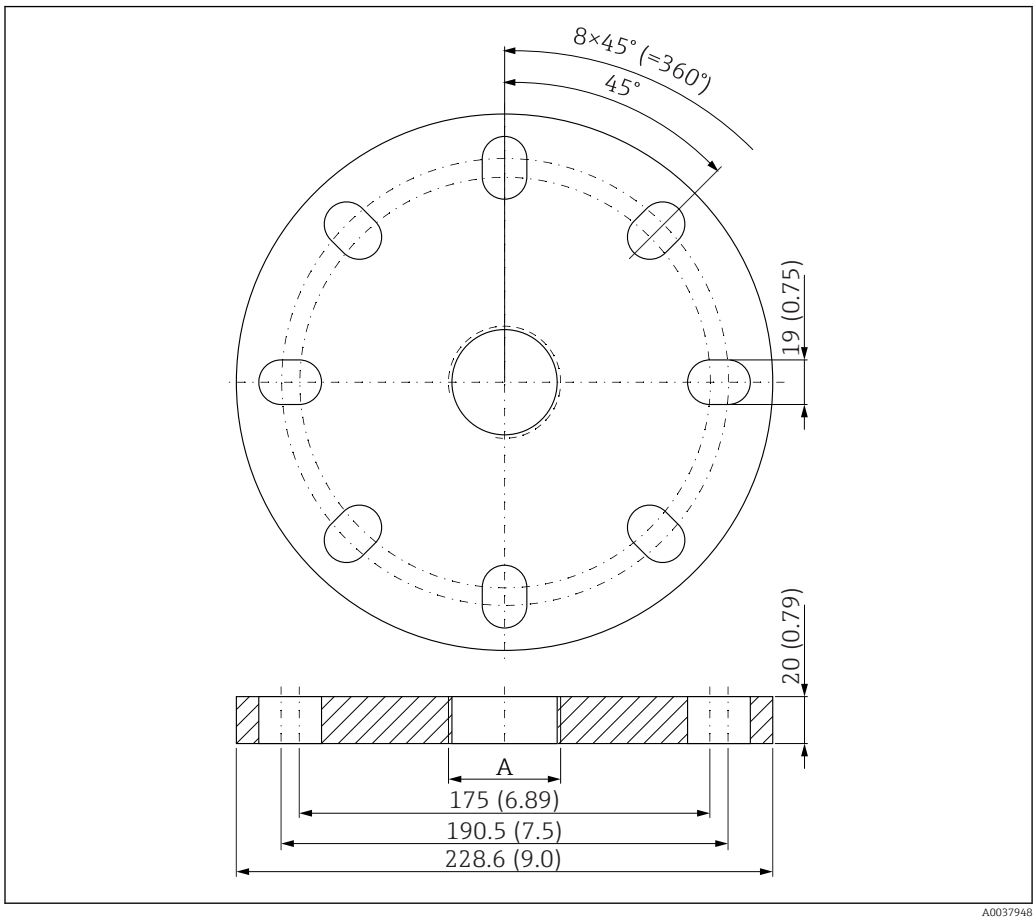
A Sensor connection in accordance with product structure "Process connection on front" or "Process connection on rear"

Material
PP

Order number
FAX50-####

13.1.9 UNI flange 4"/DN100/100, PP

The UNI flange 4"/DN100/100 can be ordered together with the device via the product structure "Accessory enclosed".



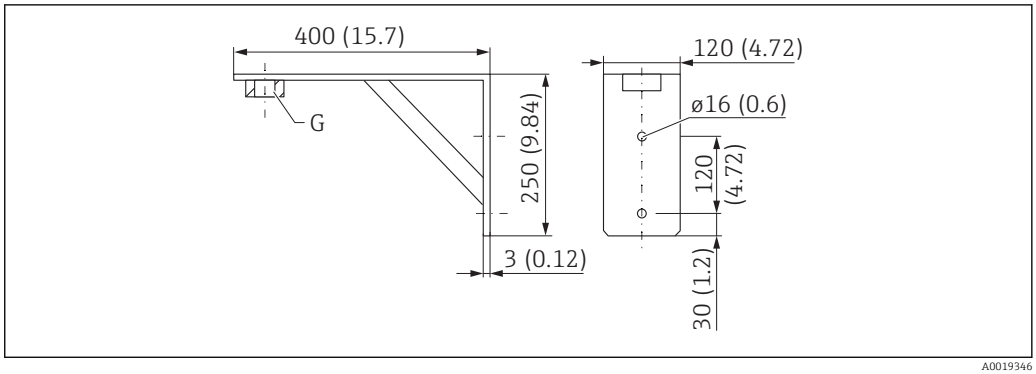
37 *Dimensions of UNI flange 4"/DN100/100, engineering unit: mm (in)*

A Sensor connection in accordance with product structure "Process connection on front" or "Process connection on rear"

Material
PP

Order number
FAX50-####

13.1.10 Angle bracket for wall mounting



38 Dimensions of angle bracket. Unit of measurement mm (in)

G Sensor connection in accordance with product structure "Process connection on front"

Weight
3.4 kg (7.5 lb)

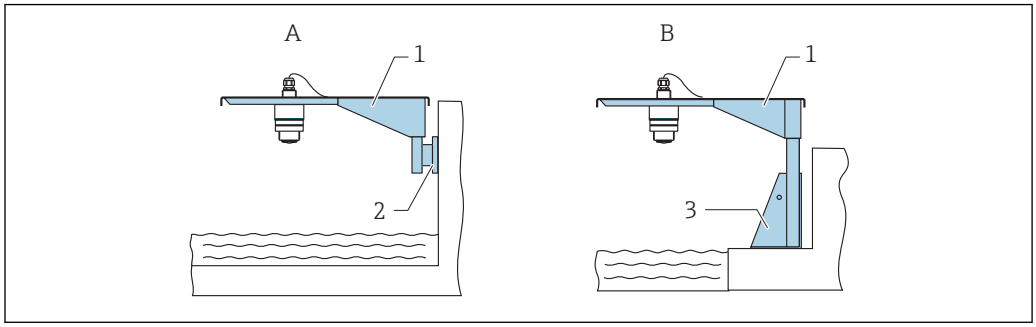
Material
316L (1.4404)

Order number for G 1-1/2" process connection
71452324
Also suitable for MNPT 1-1/2"

Order number for G 2" process connection
71452325
Also suitable for MNPT 2"

13.1.11 Cantilever with pivot

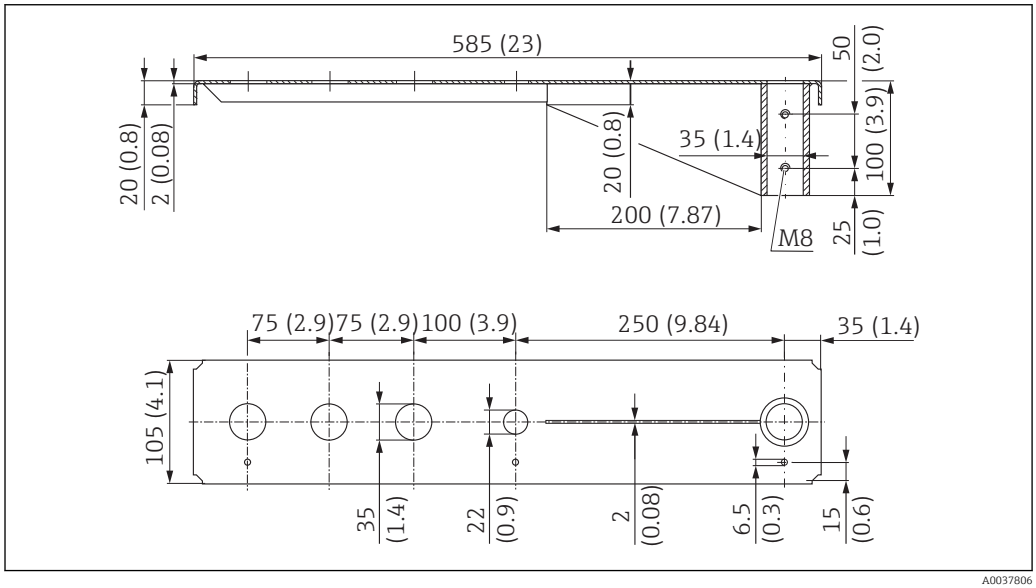
Installation type sensor process connection rear side



39 *Installation type sensor process connection rear side*

A Installation with cantilever and wall bracket
B Installation with cantilever and mounting frame
1 Cantilever
2 Wall bracket
3 Mounting frame

Cantilever (short) with pivot, sensor process connection on rear



40 *Dimensions of cantilever (short) with pivot for sensor process connection on rear. Unit of measurement mm (in)*

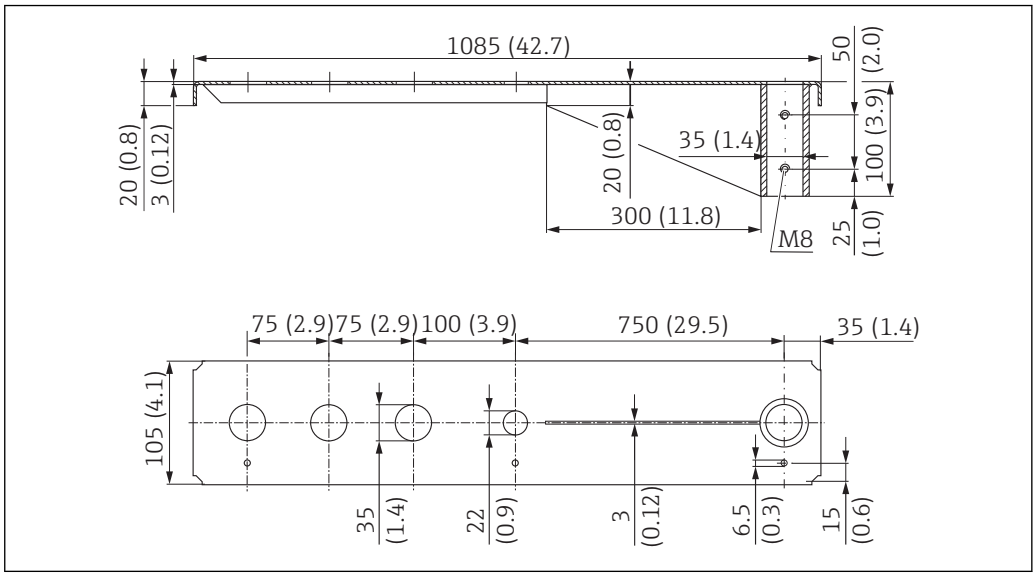
Weight:
2.1 kg (4.63 lb)

Material
316L (1.4404)

Order number
71452315

- 35 mm (1.38 in) openings for all G 1" or MNPT 1" connections on rear
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Cantilever (long) with pivot, sensor process connection on rear



41 *Dimensions of cantilever (long) with pivot for sensor process connection on rear. Unit of measurement mm (in)*

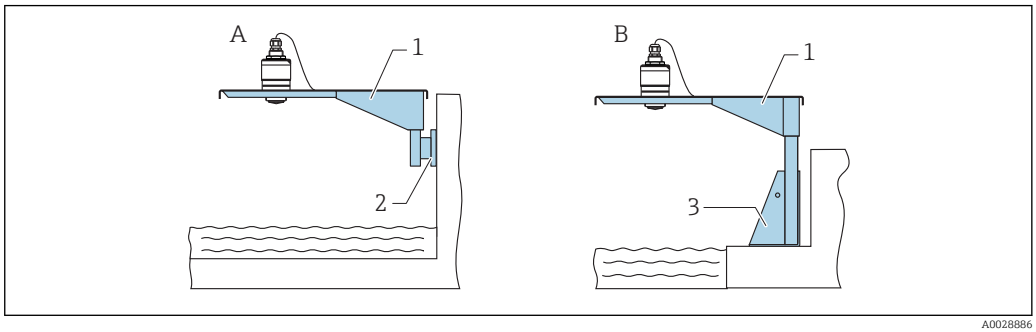
Weight:
4.5 kg (9.92 lb)

Material
316L (1.4404)

Order number
71452316

- 35 mm (1.38 in) openings for all G 1" or MNPT 1" connections on rear
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

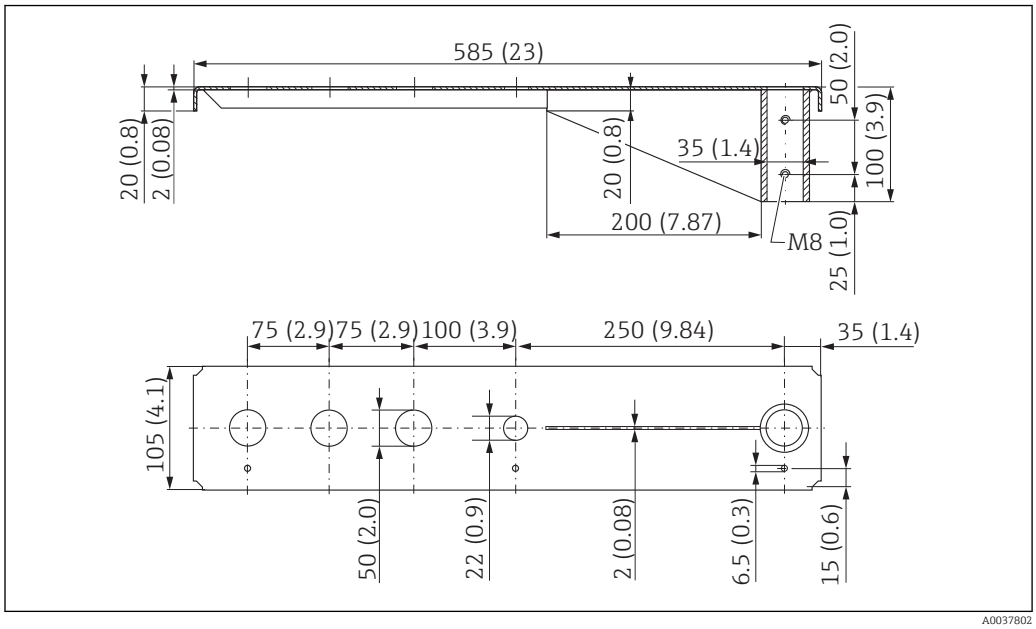
Installation type sensor process connection front side



42 *Installation type sensor process connection front side*

A Installation with cantilever and wall bracket
B Installation with cantilever and mounting frame
1 Cantilever
2 Wall bracket
3 Mounting frame

Cantilever (short) with pivot, G 1-½" sensor process connection on front



43 *Dimensions of cantilever (short) with pivot for G 1-½" sensor process connection on front. Unit of measurement mm (in)*

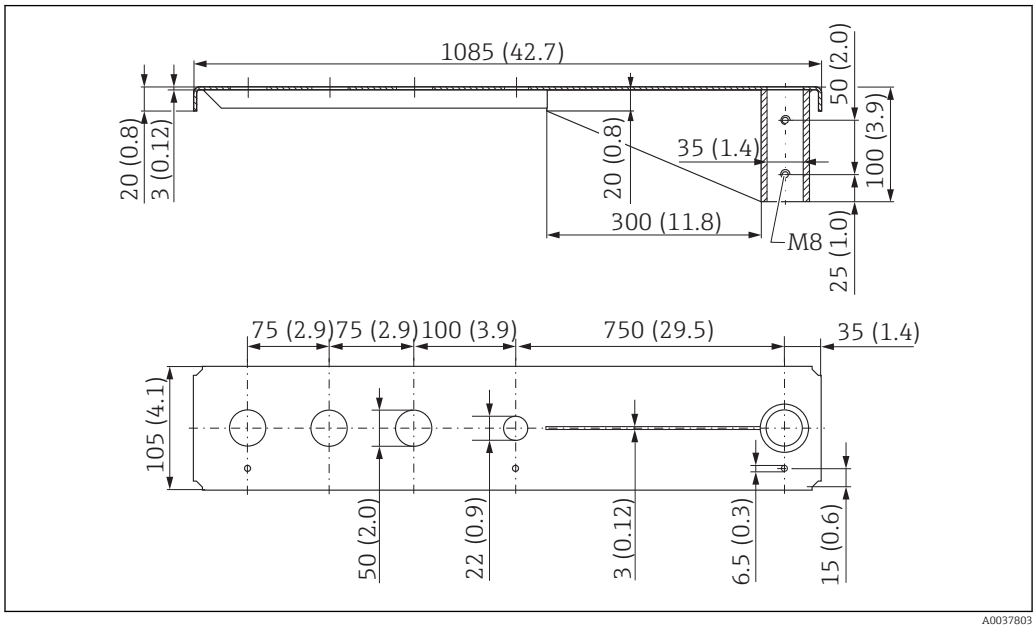
Weight:
1.9 kg (4.19 lb)

Material
316L (1.4404)

Order number
71452318

- 50 mm (2.17 in) openings for all G 1-½" (MNPT 1-½") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Cantilever (long) with pivot, G 1-½" sensor process connection on front



44 *Dimensions of cantilever (long) with pivot for G 1-½" sensor process connection on front. Unit of measurement mm (in)*

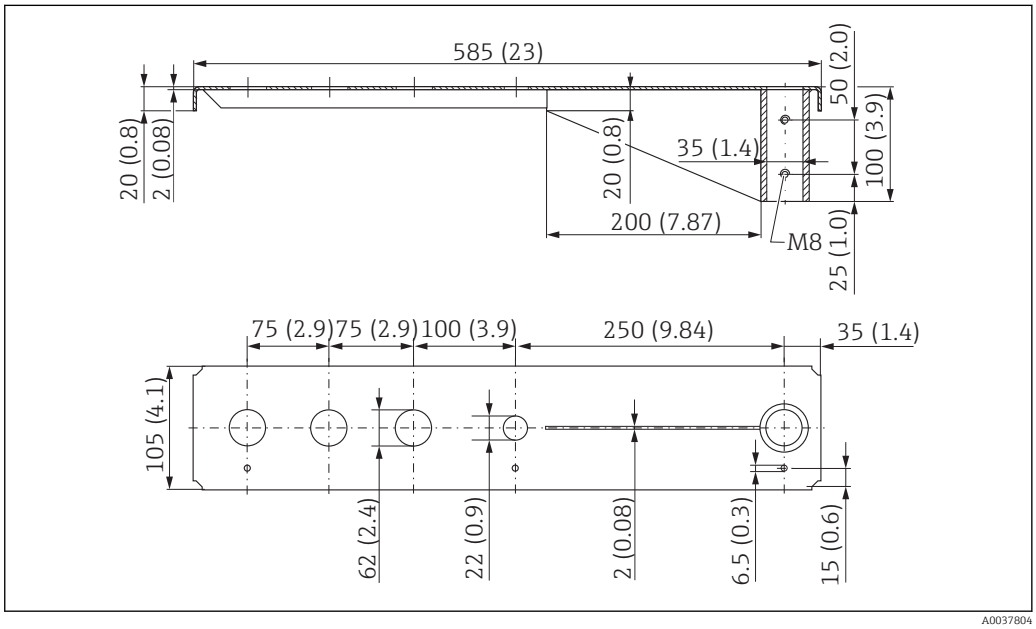
Weight:
4.4 kg (9.7 lb)

Material
316L (1.4404)

Order number
571452319

- 50 mm (2.17 in) openings for all G 1-½" (MNPT 1-½") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Cantilever (short) with pivot, G 2" sensor process connection on front



45 *Dimensions of cantilever (short) with pivot for G 2" sensor process connection on front. Unit of measurement mm (in)*

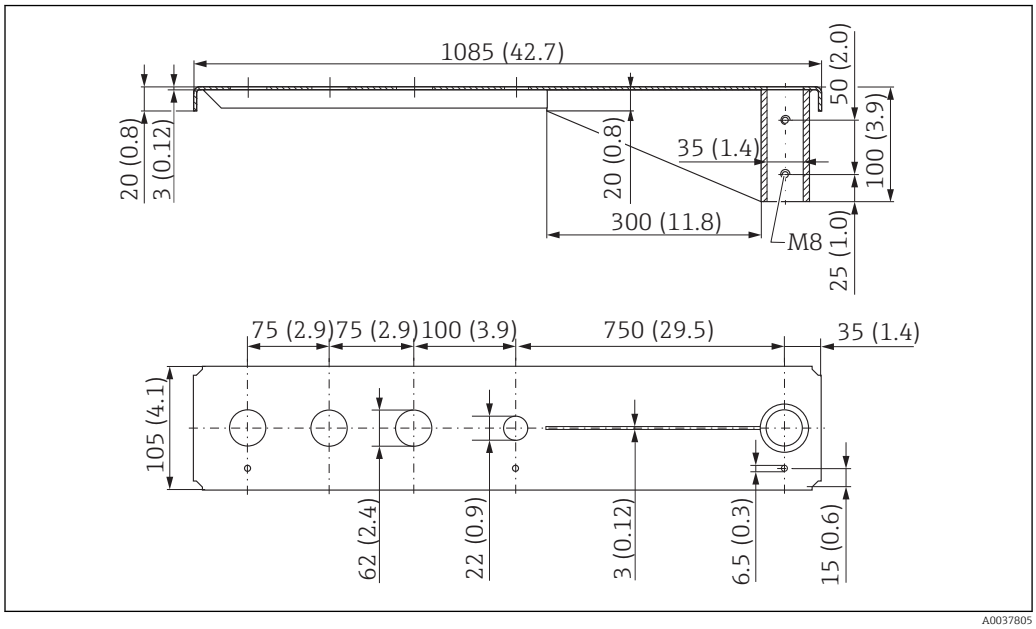
Weight:
1.9 kg (4.19 lb)

Material
316L (1.4404)

Order number
71452321

- 62 mm (2.44 in) openings for all G 2" (MNPT 2") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Cantilever (long) with pivot, G 2" sensor process connection on front



46 *Dimensions of cantilever (long) with pivot for G 2" sensor process connection on front. Unit of measurement mm (in)*

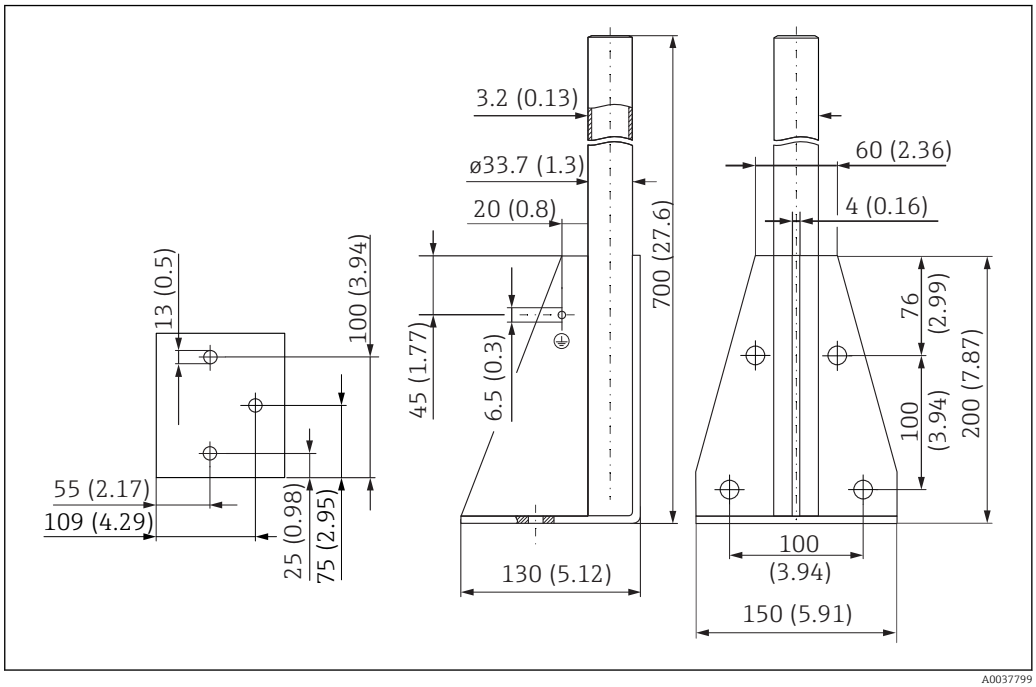
Weight:
4.4 kg (9.7 lb)

Material
316L (1.4404)

Order number
71452322

- 62 mm (2.44 in) openings for all G 2" (MNPT 2") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Mounting frame (short) for cantilever with pivot



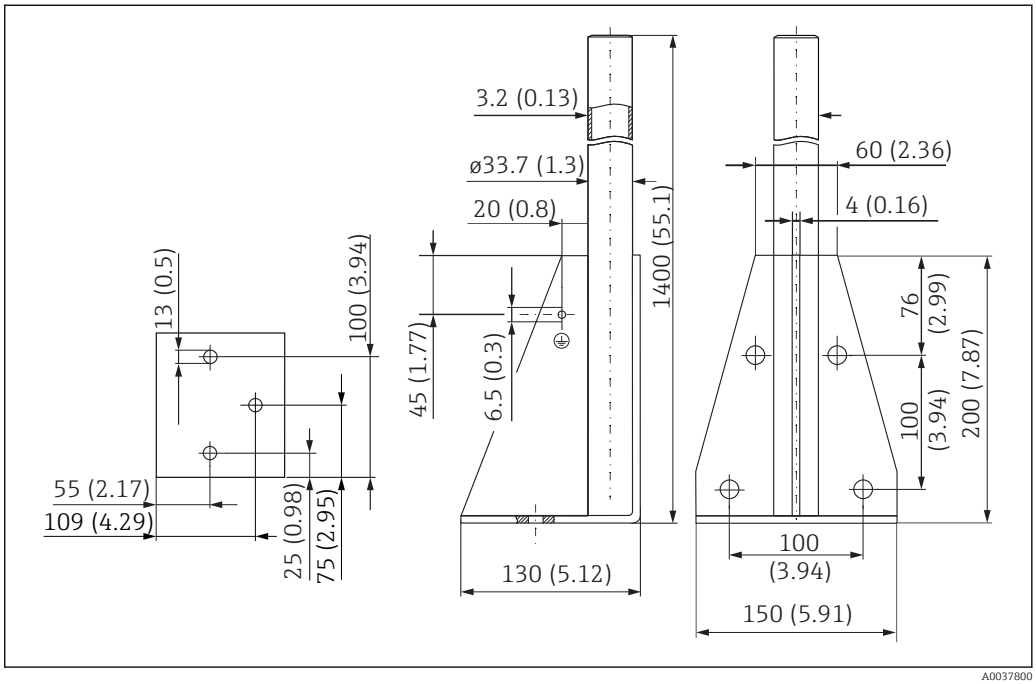
47 *Dimensions of mounting frame (short). Unit of measurement mm (in)*

Weight:
3.2 kg (7.06 lb)

Material
316L (1.4404)

Order number
71452327

Mounting frame (long) for cantilever with pivot



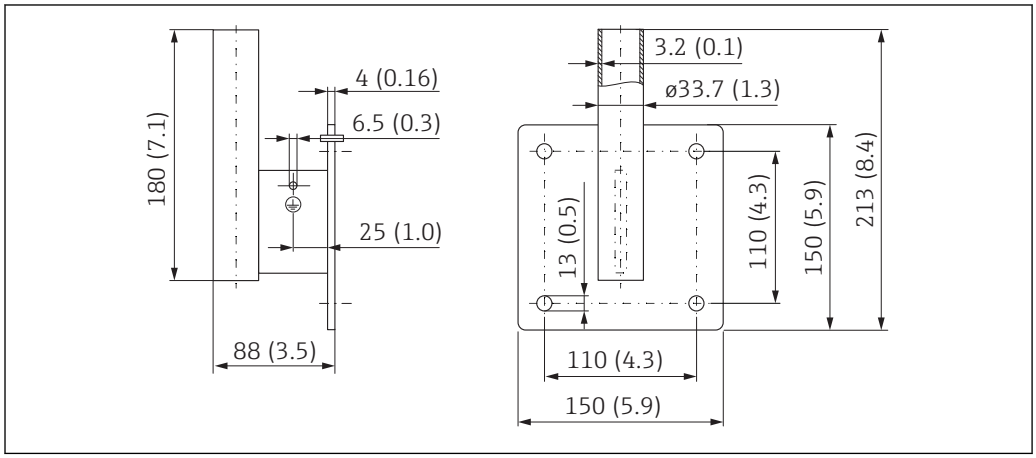
48 *Dimensions of mounting frame (long). Unit of measurement mm (in)*

Weight:
4.9 kg (10.08 lb)

Material
316L (1.4404)

Order number
71452326

Wall bracket for cantilever with pivot



49 Dimensions of the wall bracket. Unit of measurement mm (in)

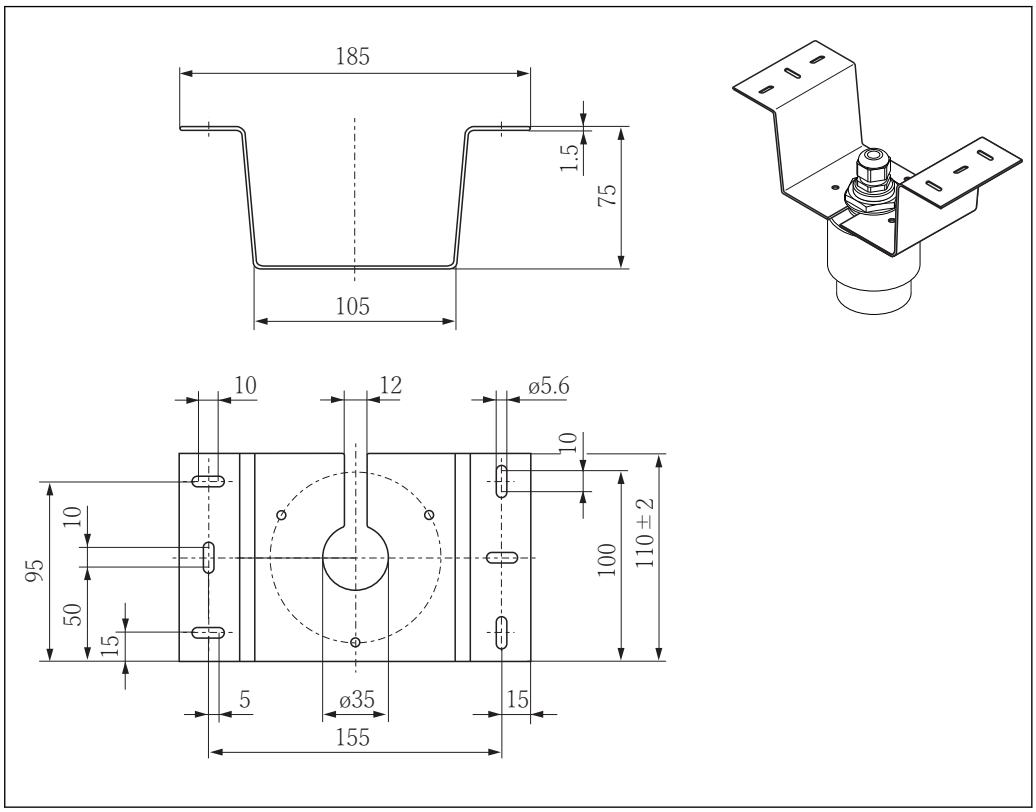
Weight
1.4 kg (3.09 lb)

Material
316L (1.4404)

Order number
71452323

13.1.12 Ceiling mounting bracket

The ceiling mounting bracket can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



50 Dimensions of ceiling mounting bracket. Unit of measurement mm (in)

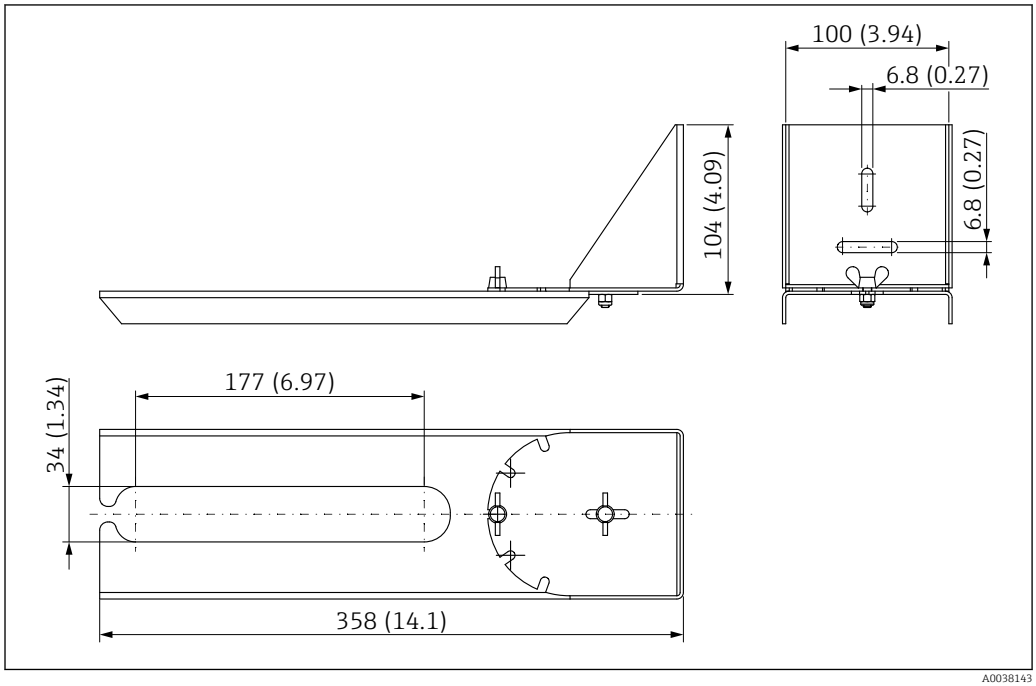
Material
316L (1.4404)

Order number
71093130

13.1.13 Pivoted mounting bracket for sewer channel

The pivotable mounting bracket is used to install the device in a manhole over a sewer channel.

The mounting bracket can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



51 Dimensions of pivotable mounting bracket. Unit of measurement mm (in)

Material
316L (1.4404)

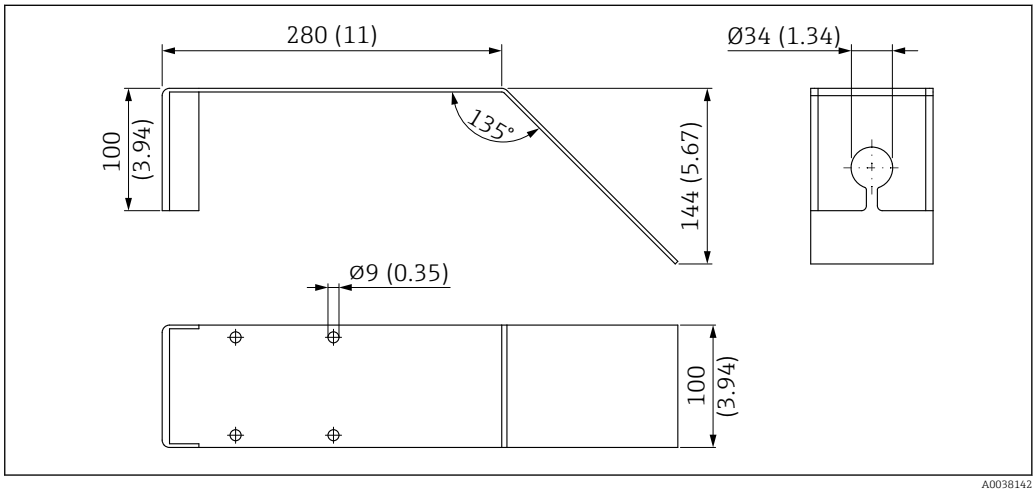
Order number
71429910

13.1.14 Horizontal mounting bracket for sewer shafts

#

The horizontal mounting bracket for sewer shafts is used to install the device in confined spaces.

The mounting bracket can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



52 *Dimensions of horizontal mounting bracket for sewer shafts. Unit of measurement mm (in)*

Material
316L (1.4404)

Order number
71429905

13.2 Service-specific accessories

Applicator
Software for selecting and sizing Endress+Hauser measuring devices:
- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:
https://portal.endress.com/webapp/applicator

Configurator
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

W@M
Life cycle management for your plant
W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.
The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.

W@M is available:
www.endress.com/lifecyclemanagement

14 Technical data

14.1 Input

Measured variable

The measured variable is the distance between the reference point and the product surface.

The level is calculated based on **E**, the empty distance entered.

Measuring range

Maximum measuring range

- Device with 40 mm (1.5 in) antenna: 15 m (49 ft)
- Device with 80 mm (3 in) antenna: 20 m (66 ft)

Installation requirements

- Recommended tank height > 1.5 m (5 ft) for media with low ε_r value
- Open channel minimum width 0.5 m (1.6 ft)
- Calm surfaces
- No agitators
- No buildup
- Relative dielectric constant $\varepsilon_r > 4$
  Contact Endress+Hauser for lower ε_r values

Usable measuring range

The usable measuring range depends on the antenna size, the medium's reflective properties, the installation position and any possible interference reflections.

Media groups

- $\varepsilon_r = 4$ to 10
  e.g. concentrated acid, organic solvents, ester, aniline, alcohol, acetone.
- $\varepsilon_r > 10$
  e.g. conductive liquids, aqueous solutions, diluted acids and bases

Reduction of the maximum possible measuring range by:

- Media with bad reflective properties (= low ε_r value)
- Formation of buildup, particularly of moist products
- Strong condensation
- Foam generation
- Freezing of sensor

Operating frequency

K-band (~ 26 GHz)

Transmission power

Mean power density in the direction of the beam

- At a distance of 1 m (3.3 ft): < 12 nW/cm^2
- At a distance of 5 m (16 ft): < 0.4 nW/cm^2

14.2 Output

Digital output

Modbus®

Dedicated differential Modbus interface via separate wire pair

Bluetooth® wireless technology

The device has a *Bluetooth*® wireless technology interface and can be operated and configured via this interface using the SmartBlue app.

- The range under reference conditions is 25 m (82 ft)
- Incorrect operation by unauthorized persons is prevented by means of encrypted communication and password encryption
- The *Bluetooth*® wireless technology interface can be deactivated

Signal on alarm

Depending on the interface, failure information is displayed as follows:
- Digital communication (Modbus)
  - Status signal (as per NAMUR Recommendation NE 107)
  - Diagnostic code
- Operating tool via SmartBlue (app)
  - Status signal (as per NAMUR Recommendation NE 107)
  - Plain text display with remedial action

Linearization

The linearization function of the device allows the conversion of the measured value into any unit of length, weight, flow or volume. When operating via Modbus, linearization tables are pre-programmed for the calculation of the volume in vessels (see the following list).

Pre-programmed linearization curves
- Cylindrical tank
- Spherical tank
- Tank with pyramid bottom
- Tank with conical bottom
- Tank with flat bottom

Other linearization tables of up to 32 value pairs can be entered manually.

14.3 Performance characteristics

Reference operating conditions

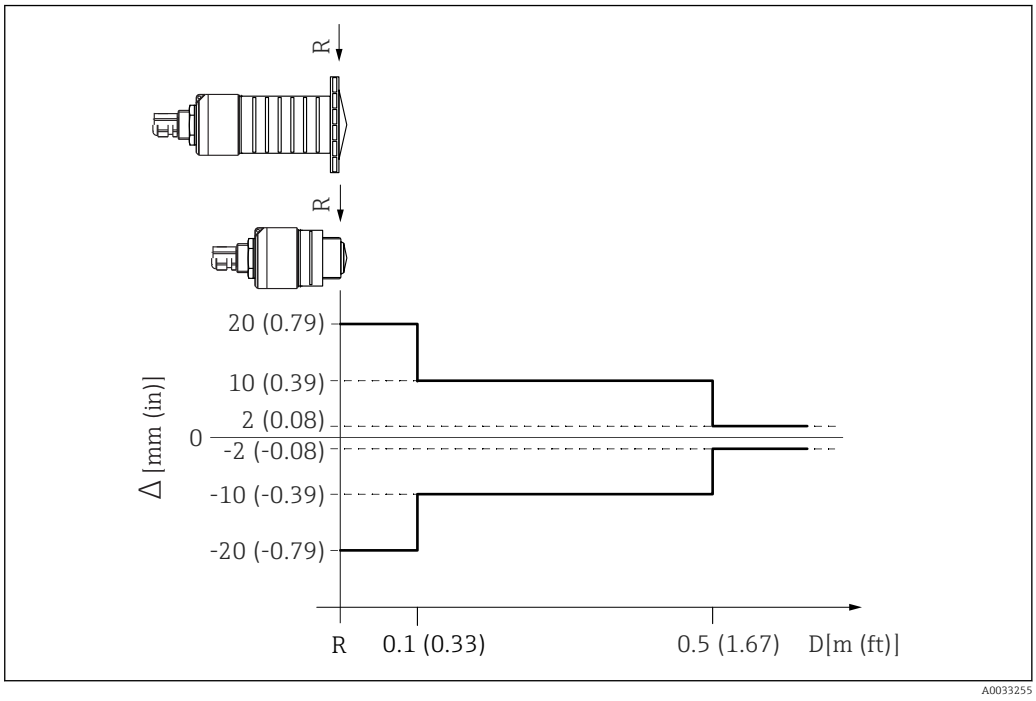
- Temperature = +24 °C (+75 °F) ±5 °C (±9 °F)
- Pressure = 960 mbar abs. (14 psia) ±100 mbar (±1.45 psi)
- Humidity = 60 % ±15 %
- Reflector: metal plate with diameter ≥ 1 m (40 in)
- No major interference reflections inside the signal beam

Maximum measured error

Typical data under reference operating conditions: DIN EN 61298-2, percentage values in relation to the span.

Digital output; Modbus, SmartBlue (app)
- Sum of non-linearity, non-repeatability and hysteresis: ±2 mm (±0.08 in)
- Offset/zero point: ±4 mm (±0.16 in)

Differing values in near-range applications



53 Maximum measured error in near-range applications; values for standard version

Δ Maximum measured error
R Reference point of the distance measurement
D Distance from reference point of antenna

Measured value resolution

Dead band as per EN61298-2:
Digital: 1 mm (0.04 in)

Response time

The response time can be configured. The following step response times apply (in accordance with DIN EN 61298-2) when damping is switched off:

Tank height
<20 m (66 ft)

Sampling rate
1 s^{-1}

Response time
<3 s

In accordance with DIN EN 61298-2, the step response time is the time following an abrupt change in the input signal up until the changed output signal has adopted 90% of the steady-state value for the first time.

Influence of ambient temperature

The measurements are carried out in accordance with EN 61298-3.
Digital (Modbus, *Bluetooth*® wireless technology):
Standard version: average T_C = ±3 mm (±0.12 in)/10 K

14.4 Environment

Ambient temperature range

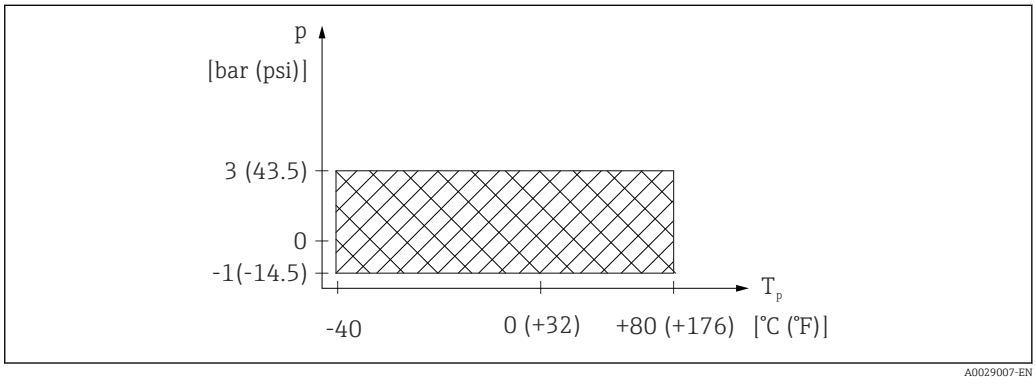
Measuring device: −40 to +80 °C (−40 to +176 °F)

It may not be possible to use the Bluetooth connection at ambient temperatures > 60 °C (140 °F).

	Outdoor operation in strong sunlight: ▪ Mount the device in the shade. ▪ Avoid direct sunlight, particularly in warm climatic regions. ▪ Use a weather protection cover.
Storage temperature	−40 to +80 °C (−40 to +176 °F)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Operating altitude as per IEC 61010-1 Ed.3	Generally up to 2 000 m (6 600 ft) above sea level.
Degree of protection	Tested acc. to: ▪ IP66, NEMA 4X ▪ IP68, NEMA 6P (24 h at 1.83 m (6.00 ft)1.83 m under water)
Vibration resistance	DIN EN 60068-2-64/IEC 60068-2-64: 20 to 2 000 Hz, 1 $(m/s^2)^2/Hz$
Electromagnetic compatibility (EMC)	Electromagnetic compatibility in accordance with all of the relevant requirements outlined in the EN 61000 series and NAMUR Recommendation EMC (NE 21). Details are provided in the Declaration of Conformity (www.endress.com/downloads).

14.5 Process

Process temperature, process pressure



54 *FMR20: Permitted range for process temperature and process pressure*

Process temperature range
−40 to +80 °C (−40 to +176 °F)

Process pressure range, threaded process connection
- p_{rel} = −1 to 3 bar (−14.5 to 43.5 psi)
- p_{abs} < 4 bar (58 psi)

Process pressure range, UNI flange process connection
- p_{rel} = −1 to 1 bar (−14.5 to 14.5 psi)
- p_{abs} < 2 bar (29 psi)

The pressure range may be further restricted in the event of a CRN approval.

Dielectric constant

For liquids
- $\varepsilon_r \geq 4$
- Contact Endress+Hauser for lower ε_r values

For dielectric constants (DC values) of many media commonly used in various industries refer to:
- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

15 Operating menu

15.1 Overview of Modbus parameters

The following tables provide a complete list of the parameters that can be accessed via Modbus.

The register address must be incremented by one (register address +1) when using the Memograph M RSG45 or Fieldgate FXA30b Modbus master. This can also apply for other masters.

15.1.1 Section: Burst read

The most important parameters to be read-out during a measurement in the float32 format (only used if Burst read is necessary)

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5000	MODB_ PV_ VALUE	2	▪ read only ▪ read only	-inf to inf	float32	according to LE_ PVUNIT_ 0	Primary value of measurement (Level linearized)
5002	MODB_ SV_ VALUE	2	▪ read only ▪ read only	-inf to inf	float32	m	Secondary value of measurement (Distance)
5004	MODB_ TV_ VALUE	2	▪ read only ▪ read only	-inf to inf	float32	dB	Tertiary value of measurement (Relative echo amplitude)
5006	MODB_ QV_ VALUE	2	▪ read only ▪ read only	-273.14 to inf	float32	°C	Quaternary value of measurement (Temperature)
5008	MODB_ SIGNALQUALITY	2	▪ read only ▪ read only	strong: 0 medium: 1 weak: 2 no signal: 3	float32	-	Signal Quality
5010	MODB_ ACTUALDIAGNOSTICS	2	▪ read only ▪ read only	see "List of diagnostic events in the operating tool"	float32	-	Current diagnostic number
5012	MODB_ LOCATION_ LONGITUDE	2	▪ read only ▪ read only	−180 to 180	float32	°	Configurable GPS longitude coordinate
5014	MODB_ LOCATION_ LATITUDE	2	▪ read only ▪ read only	−90 to 90	float32	°	Configurable GPS latitude coordinate

15.1.2 Section: Measured values

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5105	LCRS_ DISTANCE_ VALUE	2	▪ read only ▪ read only	-inf to inf	float32	m	Secondary value of measurement (Distance)
5117	HO_ QVVALUE	2	▪ read only ▪ read only	-273.14 to inf	float32	°C	Quaternary value of measurement (Temperature)
5104	LCRS_ SIGNALQUALITY	1	▪ read only ▪ read only	strong: 0 medium: 1 weak: 2 no signal: 3	enum8	-	Signal Quality

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5102	LCRS_ PRIMLEVOUT_ VALUE	2	▪ read only ▪ read only	-inf to inf	float32	according to LE_ DISTANCEUNIT_ 0	Primary value of measurement (Level)
5109	LCRS_ ABSECHO AMPLITUDE	2	▪ read only ▪ read only	-inf to inf	float32	dB	Tertiary value of measurement (absolute echo amplitude)
5111	LCRS_ SNAPPEDLEVEL	2	▪ read only ▪ read only	-inf to inf	float32	m	Snapped level
5115	LCRS_ SNAPPED ABSOLUTE ECHOAMPLITUDE	2	▪ read only ▪ read only	-inf to inf	float32	dB	Snapped absolute echo amplitude
5113	LCRS_ SNAPPED DISTANCE	2	▪ read only ▪ read only	0 to 21.8	float32	m	Snapped distance
5100	HO_ PVVALUE	2	▪ read only ▪ read only	-inf to inf	float32	according to LE_ PVUNIT_ 0	Primary value of measurement (Level linearized)
5107	HO_ TVVALUE	2	▪ read only ▪ read only	−60 to 60	float32	dB	Tertiary value of measurement (relative echo amplitude)

15.1.3 Section: Device status

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5124	LCRS_ CURRENTEVENTCATEGORY	1	▪ read only ▪ read only	ok: 0 failure: 1 check: 2 maintenance: 4 out of spec: 8 offline: 16	enum8	-	Device status
5119	LCRS_ ACTUALDIAGNOSTICS	2	▪ read only ▪ read only	see "List of Modbus diagnostic codes"	uint32	-	Current diagnostic code
5121	LCRS_ PREVIOUSDIAGNOSTICS	2	▪ read only ▪ read only	see "List of Modbus diagnostic codes"	uint32	-	Last diagnostic code
5123	LCRS_ DELETEPREVIOUSDIAGNOSTIC	1	▪ read/write ▪ read only	no: 0 yes: 1	enum8	-	Delete previous diagnostic code
5125	STD_ LOCKINGSTATE	1	▪ read only ▪ read only	0 to 65535	uint16	-	Locking state

15.1.4 Section: Device information

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5126	STD_ ENPDEVICESERIALNUMBER	6	▪ read/write ▪ read only	-	string	-	Device serial number
5132	STD_ ENPDEVICEORDERIDENT	10	▪ read/write ▪ read only	-	string	-	Order code
5142	STD_ ENPDEVICEFIRMWAREREVISION	4	▪ read only ▪ read only	-	string	-	Firmware version
5146	STD_ ENPDEVICENAME	8	▪ read/write ▪ read only	-	string	-	Device name

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5154	STD_ ENPVERSION	8	▪ read only ▪ read only	-	string	-	ENP version
5162	STD_ ENPDEVICEORDERCODEAPS	30	▪ read/write ▪ read only	-	string	-	Extended order code
5192	STD_ ENPDEVICEORDERCODEAPS1	10	▪ read/write ▪ read only	-	string	-	Extended order code part1
5202	STD_ ENPDEVICEORDERCODEAPS2	10	▪ read/write ▪ read only	-	string	-	Extended order code part2
5212	STD_ ENPDEVICEORDERCODEAPS3	10	▪ read/write ▪ read only	-	string	-	Extended order code part3
5222	STD_ MAINBOARDSERIALNUMBER	10	▪ read/write ▪ read only	-	string	-	Mainboard (electronics) serial number
5232	LCRS_ MODULESERIALNUMBER	10	▪ read/write ▪ read only	-	string	-	Module (electronics) serial number
5242	MODB_ LOCATION_ LONGITUDE	2	▪ read/write ▪ read only	−180 to 180	float32	°	Configurable GPS longitude coordinate
5244	MODB_ LOCATION_ LATITUDE	2	▪ read/write ▪ read only	−90 to 90	float32	°	Configurable GPS latitude coordinate
5246	UIDHPM_ HO_ LONGTAG_ 0	16	▪ read/write ▪ read only	-	string	-	Bluetooth tag (device name shown in SmartBlue app)

15.1.5 Section: Installation

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5264	LE_ FULL	2	▪ read/write ▪ read only	0 to 20	float32	m	Full calibration
5262	LE_ EMPTY	2	▪ read/write ▪ read only	0 to 20	float32	m	Empty calibration
5266	LCRS_ DISTANCESELECTIONCONTROL	1	▪ read/write ▪ read only	distance ok: 32859 manual map: 179 delete map: 32847	enum16	-	Customer map selection
5267	LCRS_ MAPPING_ ENDPOINTCTRL	2	▪ read/write ▪ read only	0 to 20	float32	m	Customer map distance

15.1.6 Section: Maintenance

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5269	STD_ RESETLEVEL	1	▪ read/write ▪ read only	to factory defaults: 33053	enum16	-	Device parameter reset
5270	STD_ USERLEVEL	1	▪ read only ▪ read only	maintenance: 32959 user: 33014	enum16	-	Access level
5271	STD_ ACCESSCODE	1	▪ read/write ▪ read/write	0 to 9 999	uint16	-	Register to enter the access code
5272	LCRS_ ENTERPRIVATECODE	1	▪ read/write ▪ read only	0 to 9 999	uint16	-	Register to change the Maintenance access code

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5273	LCRS_ CONFIRMPRIVATECODE	1	▪ read/write ▪ read only	0 to 9 999	uint16	-	Register to confirm the Maintenance access code
5274	LCRS_ SIMULATIONMODE	1	▪ read/write ▪ read only	no simulation: 0 distance simulation: 2	enum8	-	Simulation mode
5275	LE_ SIMULATVALUE	2	▪ read/write ▪ read only	0 to 22	float32	m	Simulation value, if LCRS_ SIMULATIONMODE is set to 2

15.1.7 Section: Measurement configuration

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5278	LE_ DISTANCEUNIT	1	▪ read/write ▪ read only	m: 1010 ft: 1018	enum16	-	Distance unit for LCRS_ PRIMLEVOUT_ VALUE_ 0
5277	LCRS_ FIRSTECHOSENSITIVITYCTRL	1	▪ read/write ▪ read only	low: 0 medium: 1 high: 2	enum8	-	First echo sensitivity
5279	LCRS_ ECHOLOSTDELAY	1	▪ read/write ▪ read only	0 to 600	uint16	s	Echo lost delay (time between alarm and echo lost)
5280	LCRS_ ADJUSTEVENTECHOLOST	1	▪ read/write ▪ read only	warning: 0 alarm: 1	enum8	-	Defines the lost echo status
5281	LCRS_ CHANGINGVELOCITY	1	▪ read/write ▪ read only	>1m/min: 0 <1m/min: 1 <10cm/min: 2 no Filter/Test:3	enum8	-	Defines maximum change velocity of an echo change
5282	LE_ CSTLINTYPE	1	▪ read/write ▪ read only	not active: 32989 active: 33171	enum16	-	Is linearization table is used
5283	LE_ CUSTOMUNIT	1	▪ read/write ▪ read only	see **Unit after linearization** parameter	enum16	-	Customer level unit
5412	LCRS_ EVALUATIONSENSITIVITY	1	▪ read/write ▪ read only	low: 0 medium: 1 high: 2	enum8	-	Sensitivity of the echo detection
5413	LE_ LEVCORROFFS	2	▪ read/write ▪ read only	−25 to 25	float32	-	Level correction
5415	LE_ CT_ ACTTABLE	1	▪ read/write ▪ read only	disable: 32852 enable: 32887	enum16	-	States if linearization table is active
5416	LE_ OUTPUTMODE	1	▪ read/write ▪ read only	level: 32949 empty: 33197	enum16	-	States the output mode
5417	LE_ CT_ EDITMODE	1	▪ read/write ▪ read only	edit manual: 32890 delete table: 32889	enum16	-	Edit mode of the linearization table
5418	LCRS_ EVALUATIONDISTANCE	2	▪ read/write ▪ read only	0 to 21.8	float32	m	Max distance which will be evaluated

Address	Name	Number of registers	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5420	LCRS_ FREEFIELDMODE	1	▪ read/write ▪ read only	off: 33004 on: 33006	enum16	-	Switch to free field parameters
5421	LCRS_ HIGHBLOCKDISTANCE	2	▪ read/write ▪ read only	0 to 20	float32	m	Blocking distance (distance from sensor which is not evaluated)
5423	LCRS_ MAP_ ENDX	2	▪ read/write ▪ read only	0 to 21.8	float32	m	End-point of overlay map (factory map + custom map)
5425	LE_ PVUNIT	1	▪ read/write ▪ read only	see **Unit after linearization** parameter	enum16	-	Level unit
5426	MODB_ RUNMODE	1	▪ read/write ▪ read only	stopped: 3493 continuous: 1380 single-shot: 3494	enum8	-	Run-Mode
5427	MODB_ MEASUREMENT_ TRIGGER	1	▪ read/write ▪ read/write	idle: 33296 measure: 32965	enum8	-	Measurement-Trigger (only used if MODB_ RUNMODE is either stopped or single-shot)
5284	FMR_ LIN_ TABLE	64	▪ read/write ▪ read only	-inf to inf	float32Point	m → m³	Lower half of linearization table (X1, Y1, X2, Y2, ...)
5348	FMR_ LIN_ TABLE_ 2	64	▪ read/write ▪ read only	-inf to inf	float32Point	m → m³	Upper half of linearization table (X17, Y17, X18, Y18, ...)

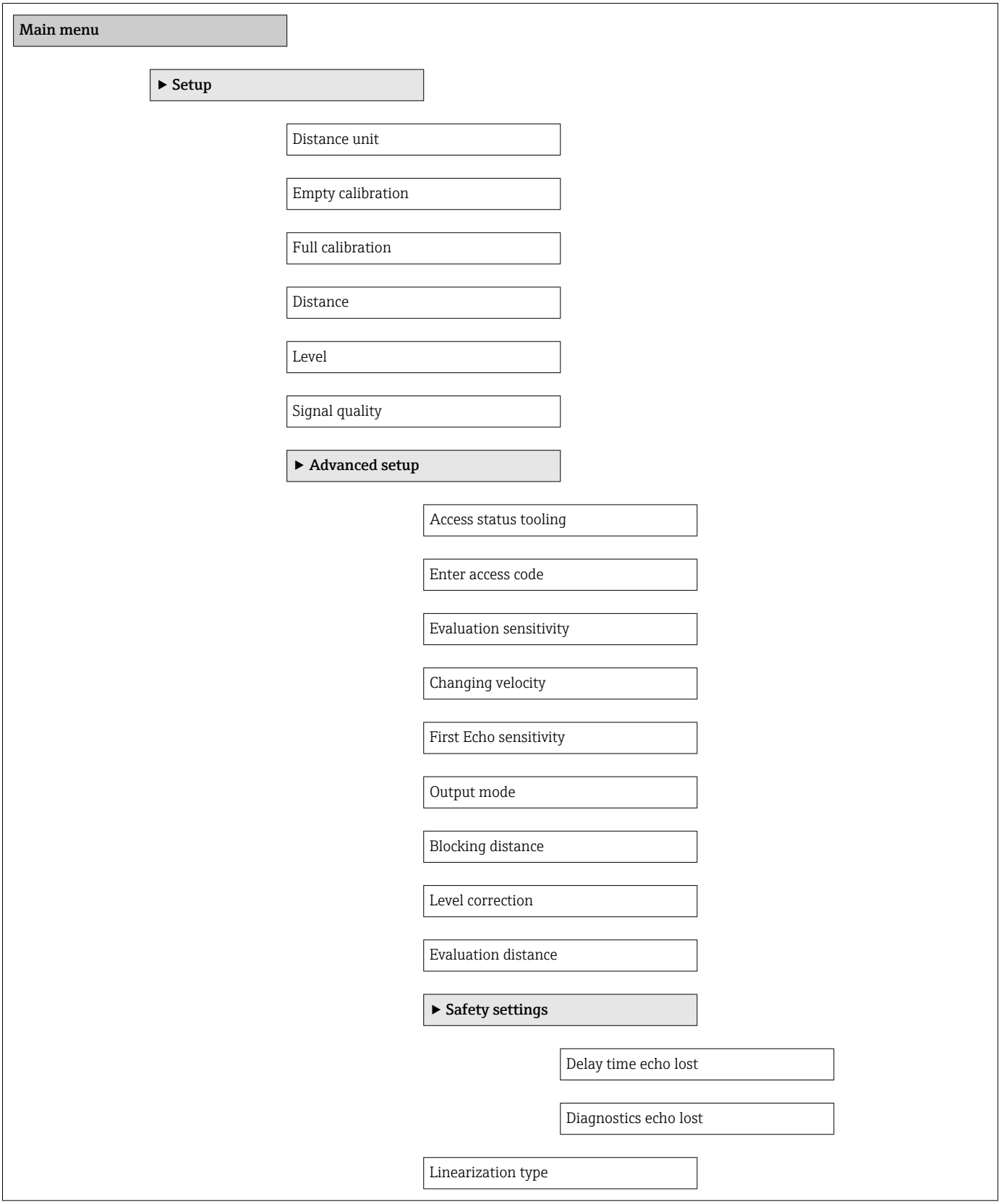
15.1.8 Section: Communication

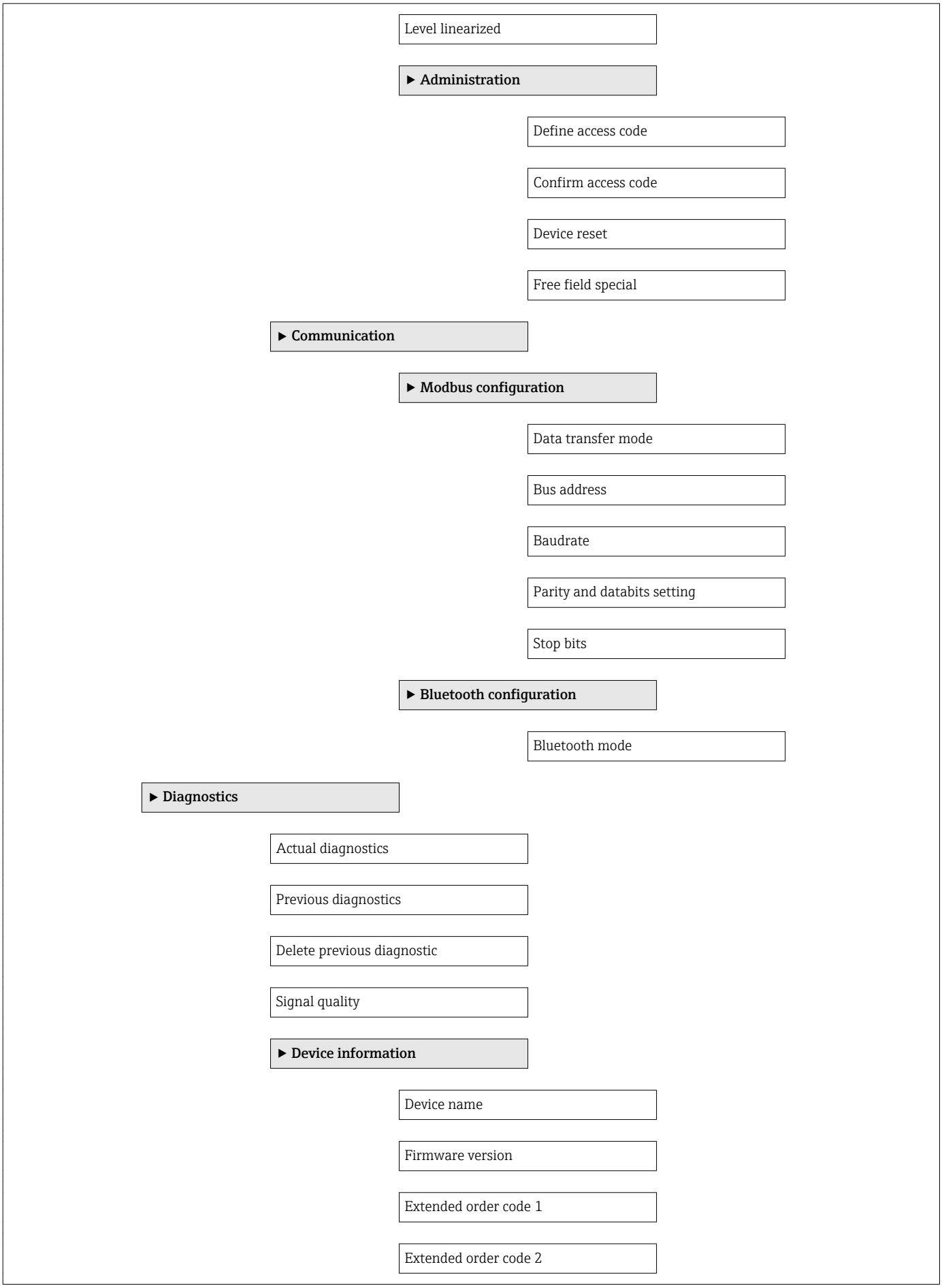
Address	Name	Register	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5428	MODB_ PROTOCOL	1	▪ read/write ▪ read only	RTU: 974 ASCII: 973	enum8	-	Modbus protocol
5429	MODB_ PARITY_ AND_ DATABITS	1	▪ read/write ▪ read only	8N: 3498 8O: 3499 8E: 3500 7O: 3501 7E: 3502	enum8	-	Modbus transmission
5430	MODB_ STOPBIT	1	▪ read/write ▪ read only	1 Stop Bit: 3503 2 Stop Bit: 3504	enum8	-	Modbus transmission
5431	MODB_ BAUDRATE	1	▪ read/write ▪ read only	1200: 975 2400: 976 4800: 977 9600: 978 19200: 979	enum16	-	Modbus baud rate
5432	MODB_ ADDRESS	1	▪ read/write ▪ read only	1 to 200	uint8	-	Modbus slave address

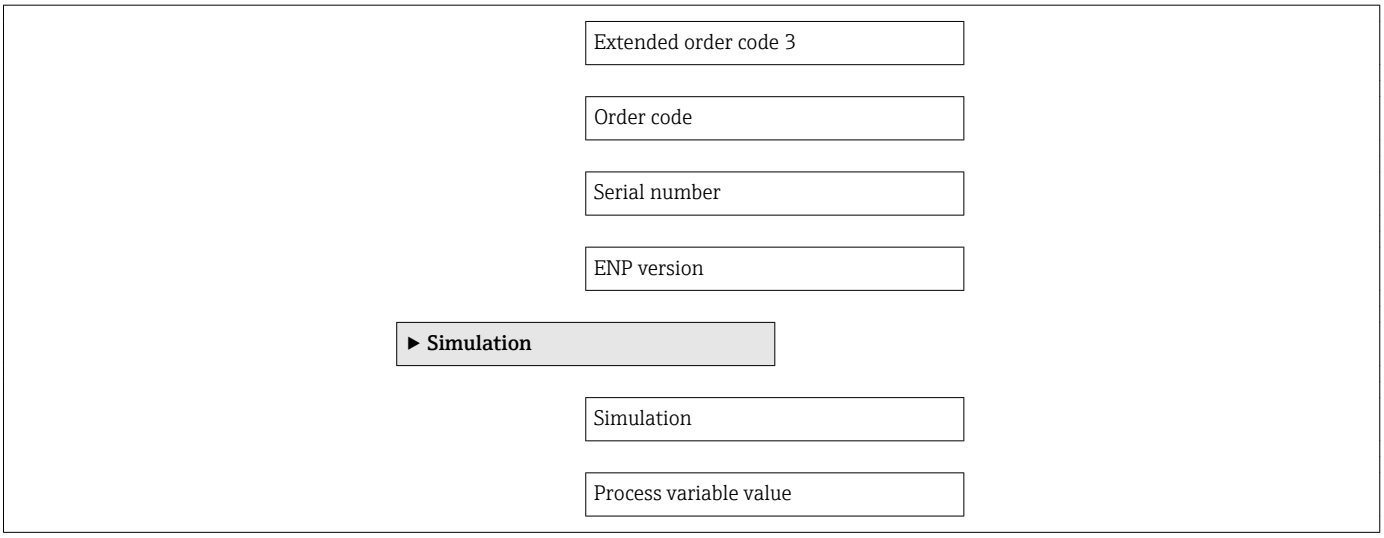
Address	Name	Register	Access ▪ Service ▪ Operator	Range	Data type	SI unit	Description
5433	MODB_ FLOAT32_ SWAP_ ORDER	1	▪ read/write ▪ read only	ABCD: 991 BADC: 993 CDAB: 994 DCBA: 992	enum8	-	Swap order for float32 data type parameters
5434	MODB_ INT32_ SWAP_ ORDER	1	▪ read/write ▪ read only	ABCD: 991 BADC: 993 CDAB: 994 DCBA: 992	enum8	-	Swap order for int32 data type parameters
5435	LCRS_ BLESWITCH	1	▪ read/write ▪ read only	enable: 1 disable: 0	enum8	-	Bluetooth interface switch
5436	MODB_ BLUETOOTH_ STARTUP_ DELAY	1	▪ read/write ▪ read only	0 to 600	uint16	s	Bluetooth startup delay compared to device startup
5437	MODB_ BLE_ CONNECTION_ STATE	1	▪ read only ▪ read only	connection active: 2333 no connection active: 3495	enum8	-	Indicates if a Bluetooth connection is active

15.2 Overview of the operating tool (SmartBlue)

Navigation Operating menu




Level linearized
▶ Administration
Define access code
Confirm access code
Device reset
Free field special
▶ Communication
▶ Modbus configuration
Data transfer mode
Bus address
Baudrate
Parity and databits setting
Stop bits
▶ Bluetooth configuration
Bluetooth mode
▶ Diagnostics
Actual diagnostics
Previous diagnostics
Delete previous diagnostic
Signal quality
▶ Device information
Device name
Firmware version
Extended order code 1
Extended order code 2


Extended order code 3
Order code
Serial number
ENP version
▶ Simulation
Simulation
Process variable value

15.3 "Setup" menu

- : Indicates navigation to the parameter via operating tools
- : Indicates parameters that can be locked via the access code

Navigation Setup

Distance unit

Navigation Setup → Distance unit

Description Used for the basic calibration (Empty / Full).

Selection

SI units	*US units*
m	ft

Factory setting m

Empty calibration

Navigation Setup → Empty calibration

Description Distance between process connection and minimum level (0%).

User entry 0.0 to 20 m

Factory setting Depends on the antenna version

Full calibration

Navigation Setup → Full calibration

Description Distance between minimum level (0%) and maximum level (100%).

User entry 0.0 to 20 m

Factory setting Depends on the antenna version

Distance

Navigation Setup → Distance

Description Shows the distance D that is currently measured from the reference point (lower edge of flange / last thread of sensor) to the level.

User interface 0.0 to 20 m

Level

Navigation Setup → Level

Description Displays the measured level L (before linearization). The unit is defined in the Distance unit parameter (factory setting = m).

User interface −99 999.9 to 200 000.0 m

Factory setting 0.0 m

Signal quality

Navigation Setup → Signal quality

Description Displays the signal quality of the level echo. Meaning of the display options - Strong: The evaluated echo exceeds the threshold by at least 10 dB. - Medium: The evaluated echo exceeds the threshold by at least 5 dB. - Weak: The evaluated echo exceeds the threshold by less than 5 dB. - No signal: The device does not find a usable echo. The signal quality indicated in this parameter always refers to the currently evaluated echo, either the level echo or the tank bottom echo. In case of a lost echo (Signal quality = No signal) the device generates the following error message: Diagnostic echo lost = Warning (factory setting) or Alarm, if the other option has been selected in Diagnostic echo lost.

User interface
- Strong
- Medium
- Weak
- No signal

15.3.1 "Advanced setup" submenu

Navigation Setup → Advanced setup

Access status tooling

Navigation Setup → Advanced setup → Access status tooling

Description Shows the access authorization to the parameters via the operating tool.

Enter access code

Navigation Setup → Advanced setup → Enter access code

Description The customer-specific access code, which has been defined in the **Define access code** parameter, must be entered to change from the Operator to the Maintenance mode. The device remains in the Operator mode if an incorrect access code is entered. If you lose the access code, please contact your Endress+Hauser sales center.

User entry 0 to 9 999

Factory setting 0

Evaluation sensitivity

Navigation Setup → Advanced setup → Evaluation sensitivity

Description Selection of the evaluation sensitivity Options to select from: - Low Interferers but also small level signals are not recognized. The weighting curve is located high. - Medium The weighting curve is in a medium region. - High Small level signals but also interferers can be reliably detected. The weighting curve is located low.

Selection
- Low
- Medium
- High

Factory setting Medium

Changing velocity

Navigation Setup → Advanced setup → Changing velocity

Description Selection of the expected draining or filling speed of the measured level.

Selection
- Slow <10 cm (0,4 in)/min
- Standard <1 m (40 in)/min
- Fast >1 m (40 in)/min
- No filter / test

Factory setting Standard <1 m (40 in)/min

First Echo sensitivity

Navigation Setup → Advanced setup → First Echo sensitivity

Description This parameter describes the band for First Echo evaluation. Is measured / calculated down from the peak of the current level echo. Options to select from: - Low The band for the first echo evaluation is very narrow. The evaluation stays longer at the found echo respectively does not jump to the next Echo or distortion signal. - Medium The band for the first echo evaluation has an average width. - High The band for the first echo evaluation is broad. The evaluation jumps earlier to the next echo or distortion signal.

Selection
- Low
- Medium
- High

Factory setting Medium

Output mode

Navigation Setup → Advanced setup → Output mode

Description Select output mode between: Ullage = The remaining space in the tank or silo is indicated. or Level linearized = The level is indicated (more precisely: the linearized value if a linearization has been activated).

Selection
- Ullage
- Level linearized

Factory setting Level linearized

Blocking distance

Navigation Setup → Advanced setup → Blocking distance

Description Specify blocking distance (BD). No signals are evaluated within the blocking distance. Therefore, BD can be used to suppress interference signals in the vicinity of the antenna. Note: The measuring range should not overlap with the blocking distance.

User entry 0.0 to 20 m

Factory setting

An automatic Blocking distance (→ 80) of at least 0.1 m (0.33 ft) is configured as standard. However, this can be overwritten manually (0 m (0 ft) is also permitted).
Automatic calculation of the Blocking distance = Empty calibration - Full calibration - 0.2 m (0.656 ft).
Each time a new entry is made in the **Empty calibration** parameter or **Full calibration** parameter, the **Blocking distance** parameter is recalculated automatically using this formula.
If the result of the calculation is a value <0.1 m (0.33 ft), the Blocking distance of 0.1 m (0.33 ft) continues to be used.

Level correction

Navigation

Setup → Advanced setup → Level correction

Description

The measured level is corrected by this value to compensate for a constant level error. Level correction > 0: The level is increased by this value. Level correction < 0: The level is decreased by this value.

User entry

−25 to 25 m

Factory setting

0.0 m

Evaluation distance

Navigation

Setup → Advanced setup → Evaluation distance

Description

Extended signal search area. Is generally greater than the empty distance. If the signal is found below the empty distance, '0' (empty) is indicated as measured value. Only for signals, detected below the 'Evaluation distance', the error 'Echo Lost' is issued. e.g. flow measurement in overflow weirs.

User entry

0.0 to 21.8 m

Factory setting

21.8 m

Linearization type

Navigation

Setup → Advanced setup → Linearization type

Description

Linearization types
Meaning of the options:
- None:
  The level is output in the level unit without being converted (linearized) beforehand.
- Table:
  The relationship between the measured level L and the output value (volume/flow/weight) is defined by a linearization table. This table consists of up to 32 value pairs, i.e. "level - volume" or "level - flow" or "level - weight".

Selection
- None
- Table

Factory setting None

Level linearized

Navigation Setup → Advanced setup → Level linearized

Description Currently measured level.

User interface Signed floating-point number

Distance unit

Navigation Setup → Advanced setup → Distance unit

Description Used for the basic calibration (Empty / Full).

Selection

SI units	*US units*
m	ft

Factory setting m

Unit after linearization

Navigation Setup → Advanced setup → Unit after linearization

Prerequisite **Linearization type (→ 81)** ≠ None

Description Select the unit for the linearized value.

Selection Selection/input (uint16)
- 1095 = [short Ton]
- 1094 = [lb]
- 1088 = [kg]
- 1092 = [Ton]
- 1048 = [US Gal.]
- 1049 = [Imp. Gal.]
- 1043 = [ft³]
- 1571 = [cm³]
- 1035 = [dm³]
- 1034 = [m³]
- 1038 = [l]
- 1041 = [hl]
- 1342 = [%]
- 1010 = [m]

- 1012 = [mm]
- 1018 = [ft]
- 1019 = [inch]
- 1351 = [l/s]
- 1352 = [l/min]
- 1353 = [l/h]
- 1347 = [m^3/s]
- 1348 = [m^3/min]
- 1349 = [m^3/h]
- 1356 = [ft^3/s]
- 1357 = [ft^3/min]
- 1358 = [ft^3/h]
- 1362 = [US Gal./s]
- 1363 = [US Gal./min]
- 1364 = [US Gal./h]
- 1367 = [Imp. Gal./s]
- 1358 = [Imp. Gal./min]
- 1359 = [Imp. Gal./h]
- 32815 = [Ml/s]
- 32816 = [Ml/min]
- 32817 = [Ml/h]
- 1355 = [Ml/d]

Factory setting

%

Additional information

The selected unit is only used for display purposes. The measured value is **not** converted on the basis of the selected unit.

Distance-to-distance linearization is also possible, i.e. a linearization from the level unit to another length unit. Select the **Linear** linearization mode for this purpose. To specify the new level unit, select the **Free text** option in the **Unit after linearization** parameter and enter the unit in the **Free text** parameter.

Activate table

Navigation

Setup → Advanced setup → Activate table

Prerequisite

Linearization type (→ 81) = **Table**

Description

Enable or disable the linearization table.

Selection

- Disable
- Enable

Factory setting

Disable

Additional information

Meaning of the options

- **Disable**
  No linearization is calculated.
  If, at the same time, **Linearization type (→ 81)** = **Table**, then the device displays the error message F435.
- **Enable**
  The measured value is linearized according to the table entered.

When the table is edited, the **Activate table** parameter is automatically reset to **Disable** and then has to be set to **Enable** again afterwards.

Table mode

Navigation Setup → Advanced setup → Table mode

Prerequisite **Linearization type (→ 81) = Table**

Description Select the entry mode for the linearization table.

Selection
- Manual
- Clear table

Factory setting Manual

Additional information

Meaning of the options
- **Manual**
  The level and the associated linearized value are manually entered for each point in the table.
- **Semiautomatic**
  The level is measured by the device for each point in the table. The associated linearized value is entered manually.
- **Clear table**
  The existing linearization table is cleared.
- **Sort table**
  The points in the table are sorted in ascending order.

Linearization table conditions
- The table can consist of up to 32 "level - linearized value" pairs.
- The table must be monotonic (decreasing or increasing).
- The first value in the table must correspond to the minimum level.
- The last value in the table must correspond to the maximum level.

Before you create a linearization table, first select the correct values for **Empty calibration (→ 77)** and **Full calibration (→ 77)**.

If the full/empty calibration is subsequently changed and should individual values then be changed in the linearization table, an existing table in the device first needs to be cleared and a new one created for the linearization to be performed correctly. For this purpose, first clear the table (**Table mode (→ 84)** = **Clear table**). Then enter the new table.

Entering the table
Via the local display
Call up the graphic table editor with the **Edit table** submenu. The table then appears on the display screen and can be edited line by line.

The factory setting for the level unit is "%". If the linearization table is to be entered in physical units, another suitable unit first needs to be selected in the **Level unit** parameter.

Level

Navigation Setup → Advanced setup → Level

User entry Signed floating-point number

Factory setting 0.0 m

Volume

Navigation Setup → Advanced setup → Volume

User entry Signed floating-point number

Factory setting 0.0 %

"Safety settings" submenu

Navigation Setup → Advanced setup → Safety settings

Delay time echo lost

Navigation Setup → Advanced setup → Safety settings → Delay time echo lost

Description Define the delay time in the case of an echo loss. After an echo loss, the device waits for the time specified in this parameter before reacting as specified in the Diagnostic echo lost parameter. This helps to avoid interruptions of the measurement by short-term interferences.

User entry 0 to 600 s

Factory setting 300 s

Diagnostics echo lost

Navigation Setup → Advanced setup → Safety settings → Diagnostics echo lost

Description At this parameter it can be set if in case of a lost echo a warning or an alarm is issued.

Selection
- Warning
- Alarm

Factory setting Warning

"Administration" submenu

Navigation Setup → Advanced setup → Administration

Define access code

Navigation Setup → Advanced setup → Administration → Define access code

Description Define release code for changing device operation mode. If the factory setting is not changed or 0000 is defined as the access code, the device works in maintenance mode without write-protection and the configuration data of the device can then always be modified. Once the access code has been defined, write-protected devices can only be changed to maintenance mode if the access code is entered in the Enter access code parameter. The new access code is only valid after it has been confirmed in the Confirm access code parameter. Please contact your Endress+Hauser Sales Center if you lose your access code.

User entry 0 to 9 999

Factory setting 0

Confirm access code

Navigation Setup → Advanced setup → Administration → Confirm access code

Description Re-enter the entered access code to confirm.

User entry 0 to 9 999

Factory setting 0

Device reset

Navigation Setup → Advanced setup → Administration → Device reset

Description Reset the device configuration - either entirely or in part - to a defined state.

Selection
- Cancel
- To factory defaults

Factory setting Cancel

Free field special

Navigation Setup → Advanced setup → Administration → Free field special

Description Switch the free field option on or off. This parameter can be switched on for free field applications (e.g. below bridges). Caution: The customer map (if one exists) is reset to the factory map!.

Selection
- Off
- On

Factory setting Off

15.3.2 "Communication" submenu

Navigation Setup → Communication

"Modbus configuration" submenu

Navigation Setup → Communication → Modbus configuration

Data transfer mode

Navigation Setup → Communication → Modbus configuration → Data transfer mode

Description Use this function to select the data transmission mode.

Selection
- ASCII
  Transmission of data in the form of readable ASCII characters. Error protection via LRC.
- RTU
  Transmission of data in binary form. Error protection via CRC16.

Factory setting RTU

Bus address

Navigation Setup → Communication → Modbus configuration → Bus address

Description For entering the device address.

User entry 1 to 200

Factory setting 200

Baudrate

Navigation Setup → Communication → Modbus configuration → Baudrate

Description Use this function to select a transmission rate.

Selection
- 1200 BAUD
- 2400 BAUD
- 4800 BAUD
- 9600 BAUD
- 19200 BAUD

Factory setting 9600 BAUD

Parity and databits setting

Navigation Setup → Communication → Modbus configuration → Parity and databits setting

Selection
- 8, None
- 8, Odd
- 8, Even
- 7, Odd
- 7, Even

Factory setting 8, Even

Stop bits

Navigation Setup → Communication → Modbus configuration → Stop bits

Selection
- 1 stop bits
- 2 stop bits

Factory setting 1 stop bits

"Bluetooth configuration" submenu

Navigation Setup → Communication → Bluetooth configuration

Bluetooth mode

Navigation Setup → Communication → Bluetooth configuration → Bluetooth mode

Description Enable or disable Bluetooth function.. Remark: Switching to position 'Off' will disable remote access via the app with immediate effect. To re-establish a Bluetooth connection via the app: Please follow the advices in the manual.

Selection
- Off
- On

Factory setting On

15.4 "Diagnostics" menu

Navigation Diagnostics

Actual diagnostics

Navigation Diagnostics → Actual diagnostics

Description Displays current diagnostic message. If several messages are active at the same time, the messages with the highest priority is displayed.

Previous diagnostics

Navigation Diagnostics → Previous diagnostics

Description Displays the last diagnostic message, with its diagnostic information, which has been active before the current message. The condition displayed may still apply.

Delete previous diagnostic

Navigation Diagnostics → Delete previous diagnostic

Description Delete previous diagnostic message? It is possible that the diagnostic message remains valid.

Selection
- No
- Yes

Factory setting No

Signal quality

Navigation Diagnostics → Signal quality

Description Displays the signal quality of the level echo. Meaning of the display options - Strong: The evaluated echo exceeds the threshold by at least 10 dB. - Medium: The evaluated echo exceeds the threshold by at least 5 dB. - Weak: The evaluated echo exceeds the threshold by less than 5 dB. - No signal: The device does not find a usable echo. The signal quality indicated in this parameter always refers to the currently evaluated echo, either the level echo or the tank bottom echo. In case of a lost echo (Signal quality = No signal) the device generates the following error message: Diagnostic echo lost = Warning (factory setting) or Alarm, if the other option has been selected in Diagnostic echo lost.

User interface

- Strong
- Medium
- Weak
- No signal

15.4.1 "Device information" submenu

Navigation Diagnostics → Device information

Device name

Navigation Diagnostics → Device information → Device name

Description Shows the name of the transmitter.

Factory setting Micropilot FMR20

Firmware version

Navigation Diagnostics → Device information → Firmware version

Description Shows the device firmware version installed.

Extended order code 1

Navigation Diagnostics → Device information → Extended order code 1

Description Shows the 1st part of the extended order code.

Extended order code 2

Navigation Diagnostics → Device information → Extended order code 2

Description Shows the 2nd part of the extended order code.

Extended order code 3

Navigation Diagnostics → Device information → Extended order code 3

Description Shows the 3rd part of the extended order code.

Order code

Navigation Diagnostics → Device information → Order code

Description Shows the device order code.

Serial number

Navigation Diagnostics → Device information → Serial number

Description Shows the serial number of the measuring device.

ENP version

Navigation Diagnostics → Device information → ENP version

Description Shows the version of the electronic nameplate (ENP).

15.4.2 "Device information" submenu

Navigation Diagnostics → Device information

Device name

Navigation Diagnostics → Device information → Device name

Description Shows the name of the transmitter.

Factory setting Micropilot FMR20

Firmware version

Navigation Diagnostics → Device information → Firmware version

Description Shows the device firmware version installed.

Extended order code 1

Navigation Diagnostics → Device information → Extended order code 1

Description Shows the 1st part of the extended order code.

Extended order code 2

Navigation Diagnostics → Device information → Extended order code 2

Description Shows the 2nd part of the extended order code.

Extended order code 3

Navigation Diagnostics → Device information → Extended order code 3

Description Shows the 3rd part of the extended order code.

Order code

Navigation Diagnostics → Device information → Order code

Description Shows the device order code.

Serial number

Navigation Diagnostics → Device information → Serial number

Description Shows the serial number of the measuring device.

ENP version

Navigation Diagnostics → Device information → ENP version

Description Shows the version of the electronic nameplate (ENP).

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