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2022-04-04

Operating Instructions
Prosonic M FMU44 HART

Ultrasonic measuring technology

Endress+Hauser
People for Process Automation

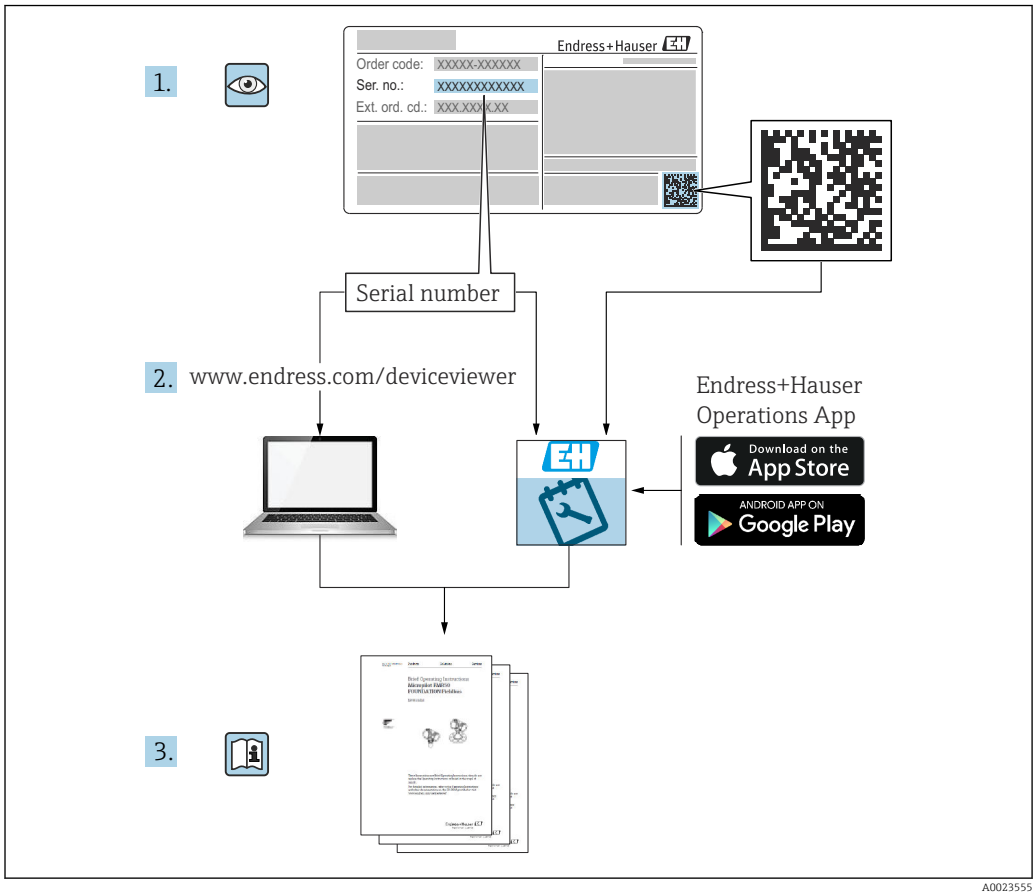
1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
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Table of contents

1 About this document

1.1 Document function

These Operating Instructions provide all of the information that is required in the various phases of the life cycle of the device.

1.2 Symbols

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 Electrical symbols

⏚ Ground connection
Grounded clamp, which is grounded via a grounding system.

⊜ Protective earth (PE)
Ground terminals, which must be grounded prior to establishing any other connections.
The ground terminals are located on the inside and outside of the device.


Temperature resistance of the connection cables
Minimum value for the temperature resistance of the connection cables

1.2.3 Symbols for certain types of information

✓ Permitted
Procedures, processes or actions that are permitted.

✗ Forbidden
Procedures, processes or actions that are forbidden.

Tip
Indicates additional information.

Reference to documentation

1., 2., 3. Series of steps

Result of an individual step

1.2.4 Symbols in graphics

1., 2., 3. Series of steps

1, 2, 3 ... Item numbers

1.3 Supplementary documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter serial number from nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate.

1.3.1 Standard documentation

Technical Information (TI)
Planning aid – contains technical data for planning and ordering information.

Operating Instructions (BA)
Installation and initial commissioning – contains all the functions in the operating menu that are needed for a normal measuring task. Functions beyond this scope are not included.

Brief Operating Instructions (KA)
Quick guide to obtaining the first measured value – includes all essential information from incoming acceptance to electrical connection. Another "Brief Operating Instructions" document is located under the housing cover of the device. The most important functions of the menu are summarized in this document.

Description of Device Parameters (BA)
Reference manual for parameters – contains a detailed explanation of each individual parameter in the operating menu. The description helps individuals who perform specific configurations throughout the entire operating life of the device.

1.3.2 Supplementary device-dependent documentation

Depending on the device version ordered, additional documentation or documents are provided. Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

Examples: ATEX, NEPSI, INMETRO, Control or Installation Drawings for FM-, CSA- and TIIS-certified device versions.

The relevant safety instructions are included with all certified device versions. If using the device in a hazardous area, all the specifications contained in the safety instructions must be complied with.

1.4 Registered trademarks

HART®
Registered trademark of the FieldComm Group, Austin, Texas, USA

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out their tasks, e. g. commissioning and maintenance:
- Trained specialists must have a qualification that is relevant to the specific function and task.
- Must be authorized by the plant owner/operator.
- Must be familiar with national regulations.
- Must have read and understood the instructions in the manual and supplementary documentation.
- Personnel must follow instructions and comply with general policies.

2.2 Intended use

Compact measuring device for continuous, non-contact level measurement. The measuring range is up to 20 m (66 ft) for liquids and up to 10 m (33 ft) for bulk solids. Flow measurements can be carried out in open flumes and weirs with the linearization function.

2.3 Workplace safety

For work on and with the device:
- Wear the required 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 ensuring failure-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
- If, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety and reliability:
- Only perform repair work on the device if this is expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.
- Use original spare parts and accessories from Endress+Hauser only.

2.5 Product safety

This device has been constructed and tested to state-of-the-art operational safety standards and in accordance with good engineering practice. The device left the factory in a safe operating condition.

2.5.1 CE mark

The device 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.

2.5.2 EAC conformity

The device meets the legal requirements of the applicable EAC Directives. These are listed in the corresponding EAC Declaration of Conformity along with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.

2.6 IT security

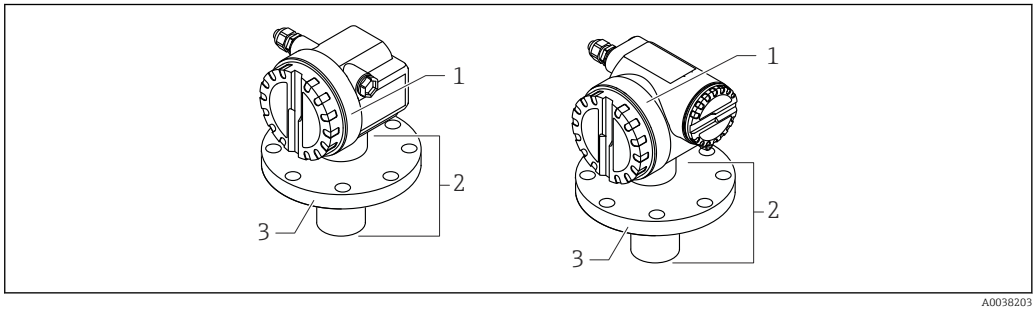
We only provide a warranty if the device is installed and used as described in the Operating Instructions.

Provide additional protection for the device and data transfer to/from the device

- IT security measures defined in the plant owner/operator's own security policy must be implemented by plant owners/operators themselves.

3 Product description

3.1 Product design



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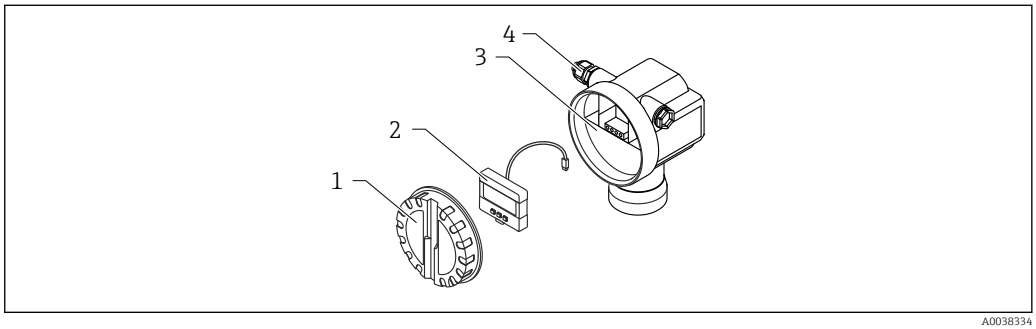
1 Product design

1 T12 or F12 housing with cover
2 Sensor part with process connection
3 Flange



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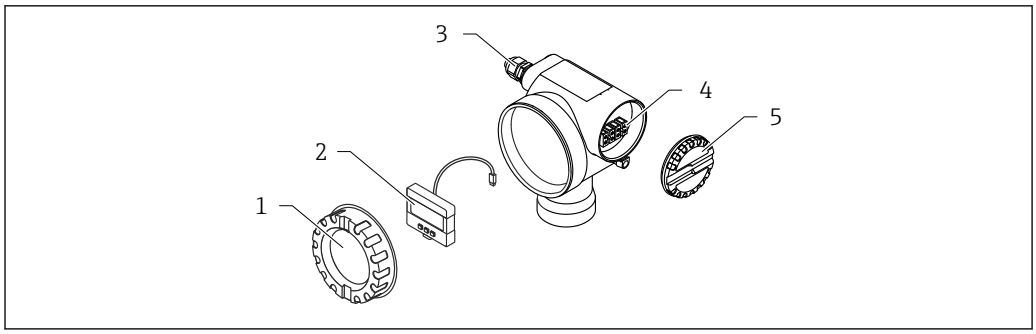
2 F12 housing, electronic insert and connection compartment

1 Housing cover
2 Local display
3 Connection compartment
4 Cable gland



3 T12 housing, electronic insert and connection compartment

1 Housing cover
2 Local display
3 Cable gland
4 Connection compartment
5 Cover for connection compartment

4 Incoming acceptance and product identification

4.1 Incoming 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 necessary (see nameplate), are the Safety Instructions, e. g. XA, provided?

If one of these conditions is not satisfied, contact your Sales Center.

4.2 Product identification

The device can be identified in the following ways:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

▶ Enter serial number from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer)
  ↳ All of the information on the measuring device and on the scope of the technical documentation pertaining to the device is displayed.

▶ Enter the serial number from the nameplate in the *Endress+Hauser Operations app* or scan the 2-D matrix code on the nameplate with the camera
  ↳ All of the information on the measuring device and on the scope of the technical documentation pertaining to the device is displayed.

4.3 Manufacturer address

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

Place of manufacture: See nameplate.

4.4 Storage and transport

- Pack the measuring device so that it is protected against impact.
  The original packaging offers the best protection
- Permitted storage temperature: −40 to +80 °C (−40 to 176 °F)

4.4.1 Transporting the product to the measuring point

⚠ CAUTION

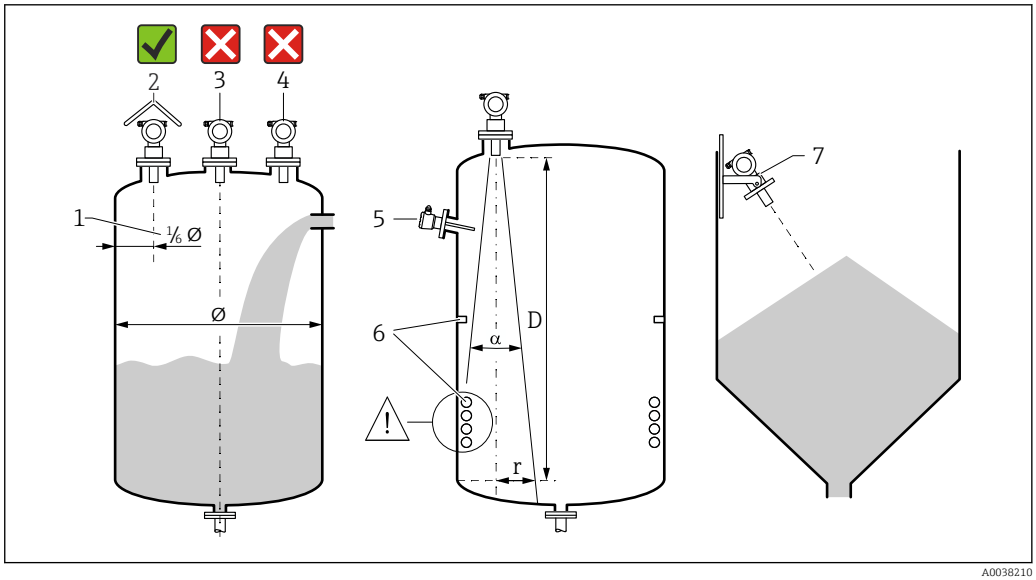
The housing or flange can be damaged.
Risk of injury!

- ▶ Transport the measuring device to the measuring point in its original packaging or by the process connection.
- ▶ Always secure lifting equipment (belts, lugs, etc.) at the process connection, while paying attention to the center of gravity of the device to ensure that the device does not tilt or slip.
- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.6 lb) (IEC 61010).

5 Mounting

5.1 Mounting requirements

5.1.1 Installation conditions for the sensor for level measurements

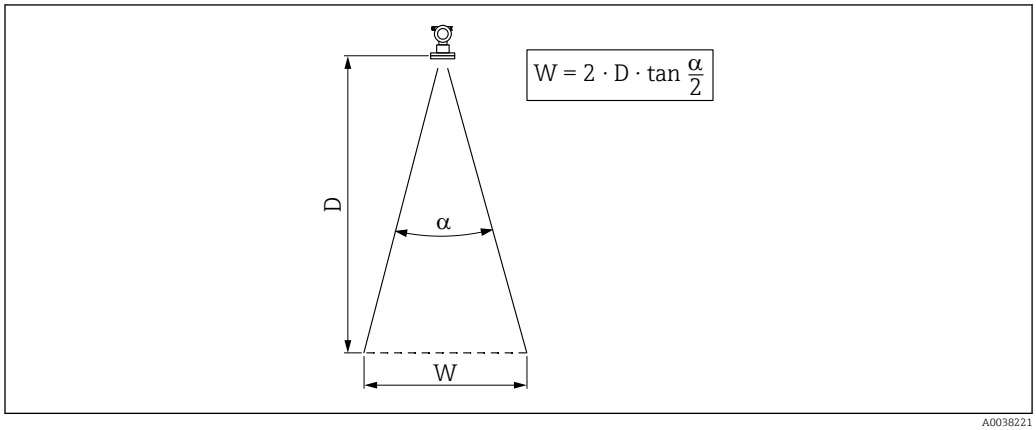


4 *Installation requirements*

1 *Distance to the vessel wall: ⅙ of the vessel diameter*
2 *Use of a weather protection cover; protection from direct sunlight or rain*
3 *Do not install the sensor in the middle of the vessel*
4 *Avoid measurements through the filling curtain*
5 *Do not install point level switches or temperature sensors within the beam angle*
6 *Symmetrical internal fixtures, e.g. heating coils and baffles, negatively impact the measurement*
7 *Align the sensor so that it is perpendicular to the product surface*

- Only mount one device per vessel: signals from multiple devices mutually affect one another
- Determine the detection range using the 3-dB beam angle α

5.1.2 Beam angle

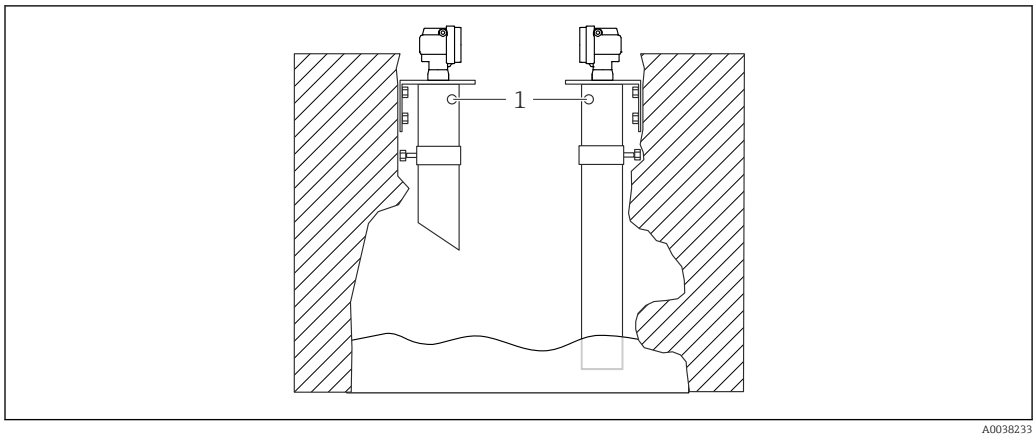


5 Relationship between beam angle α, distance D and beamwidth diameter W

Beamwidth diameter W as a function of beam angle α and distance D.
- α: 11 °
- D_{max}: 20 m (66 ft)
- r_{max}: 1.93 m (6.3 ft)

The angle α is defined as the beam angle. At α, the energy density of the ultrasonic wave reaches half the value of the maximum energy density. Ultrasonic waves are also emitted outside the signal beam and can be reflected off interfering installations.

5.1.3 Narrow shafts, uneven shaft walls



6 Installation in narrow shafts with very uneven shaft walls

1 Venting hole

Strong interference echoes can occur in narrow shafts and in uneven conditions.

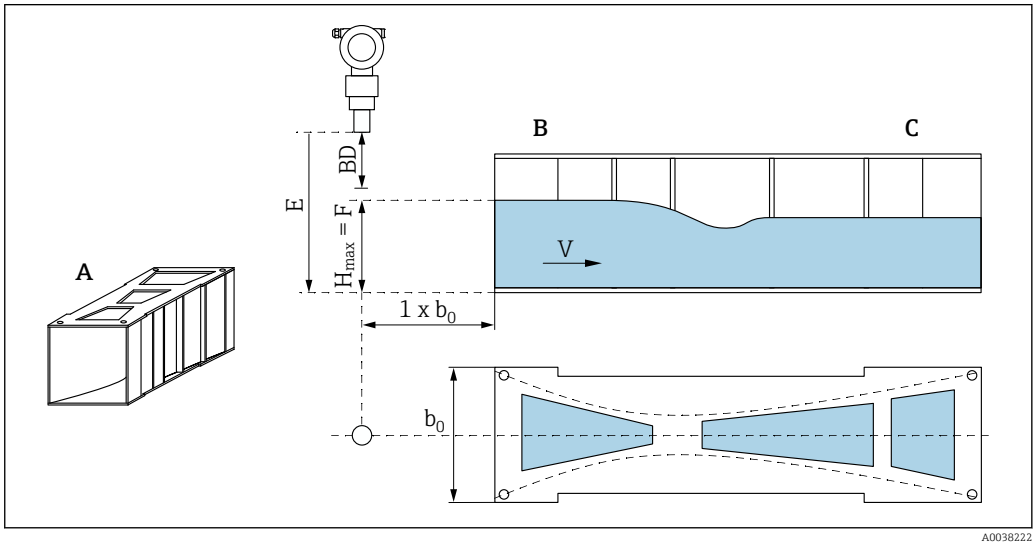
▶ Use an ultrasound guide pipe with a minimum diameter of 100 mm (3.94 in), e.g. PE or PVC wastewater pipe

Avoid the accumulation of dirt in the pipe.

▶ Clean the pipe regularly.

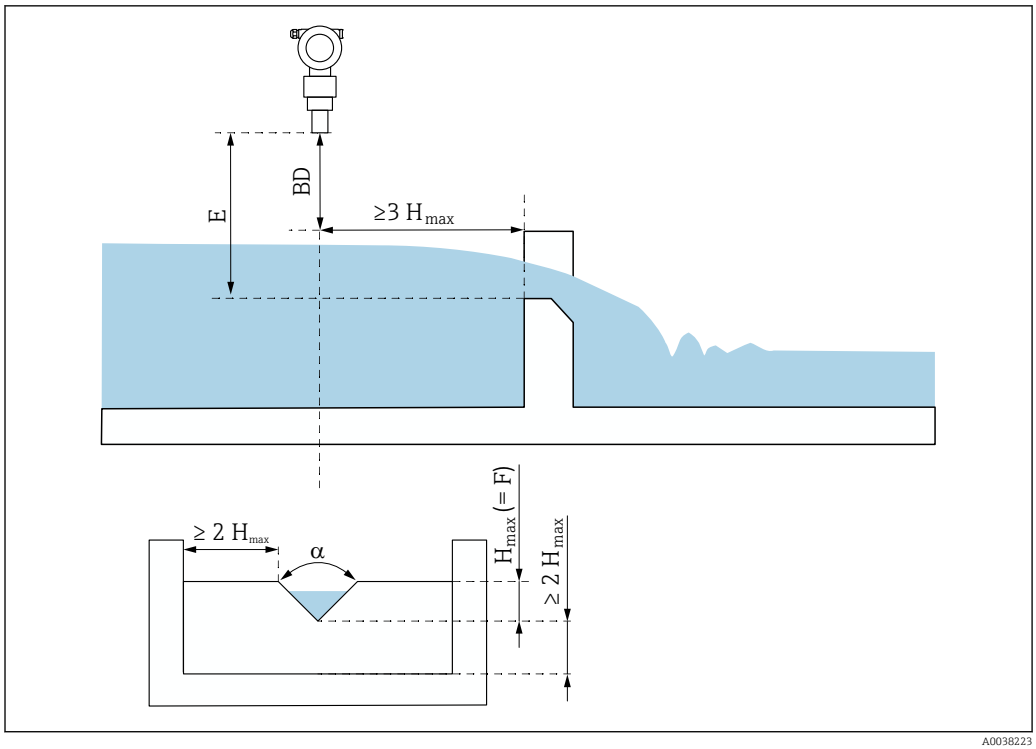
5.1.4 Installation conditions for the sensor for flow measurements

- Mount the measuring device on the upstream side immediately above the maximum upper water level H_{max}
- Take the blocking distance into account
- Position the measuring device in the center of the flume or weir
- Align the sensor membrane so that it is parallel to the surface of the water
- Observe the installation clearance of the flume or weir
- Enter the "flow - level" ("Q/h curve") linearization curve via the FieldCare operating program or manually via the local display



7 *Khafagi-Venturi flume (example)*

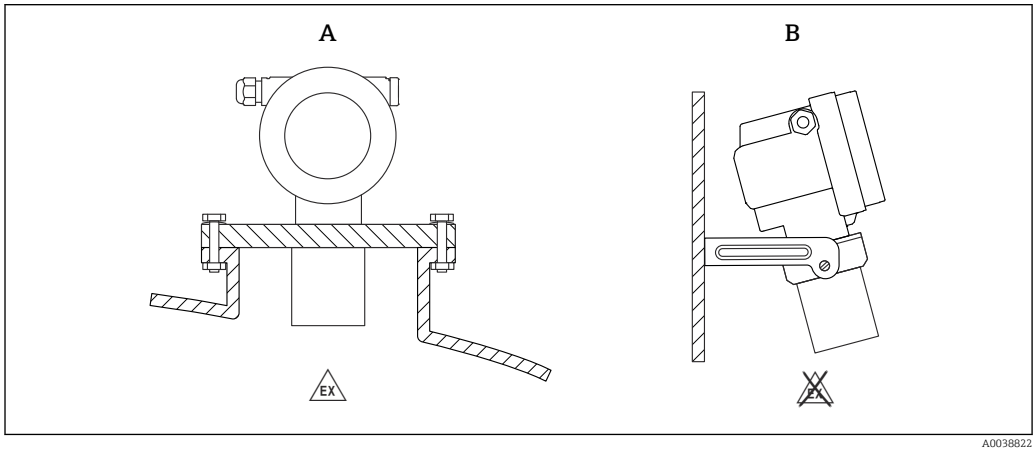
A Khafagi-Venturi flume
B Upstream side
C Downstream side
BD Blocking distance of the sensor
E Empty calibration (enter during commissioning)
H_{max} Maximum upstream level
V Flow
b_0 Width of Khafagi-Venturi flume



8 *Triangular weir (example)*

BD Blocking distance of the sensor
E Empty calibration (enter during commissioning)
F Full calibration
H_{max} Maximum upstream level

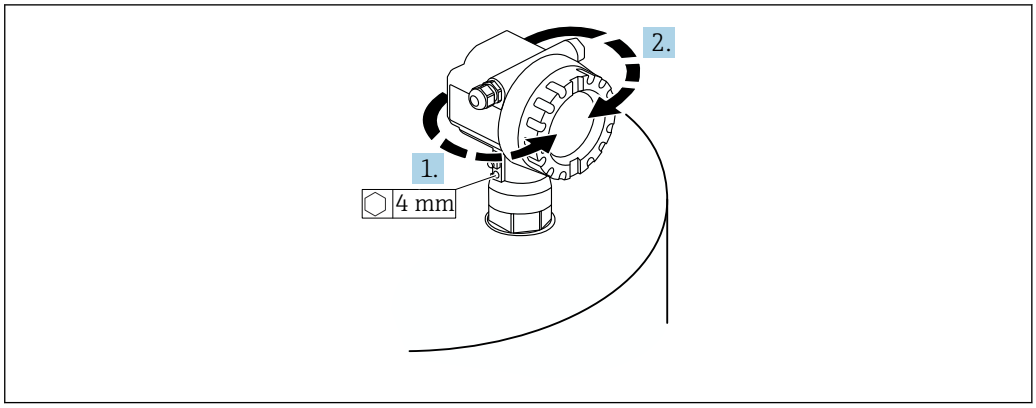
5.1.5 Mounting examples



9 *Mounting examples*

A Mounting with universal flange (e.g. hazardous area, Zone 20)
B Mounting with mounting bracket (non-hazardous area, Zone 20)

5.1.6 Turning the housing



10 Turning the F12 or T12 housing, (F12 housing in example)

1. Loosen the securing screw.
2. Rotate the housing in the desired direction, maximum 350 °.
3. Tighten the securing screw, maximum torque 0.5 Nm (0.36 lbf ft).
4. Lock the securing screw; use a glue specifically for metal.

5.2 Measuring range

5.2.1 Sensor features

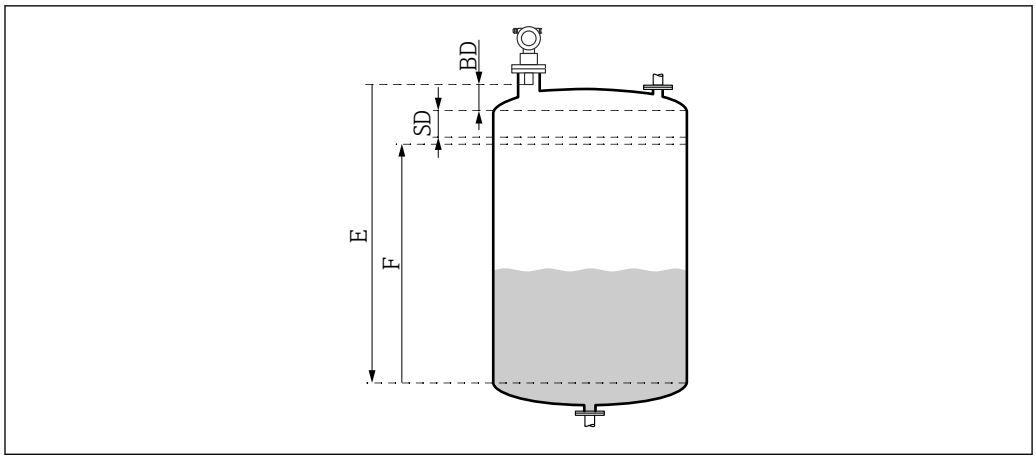
- Beam angle (α): 11 °
- Blocking distance (BD): 0.5 m (1.6 ft)
- Maximum range for liquids: 20 m (66 ft)
- Maximum range for bulk solids: 10 m (33 ft)

5.2.2 Blocking distance

NOTICE

If the blocking distance is undershot, this may cause a device malfunction.

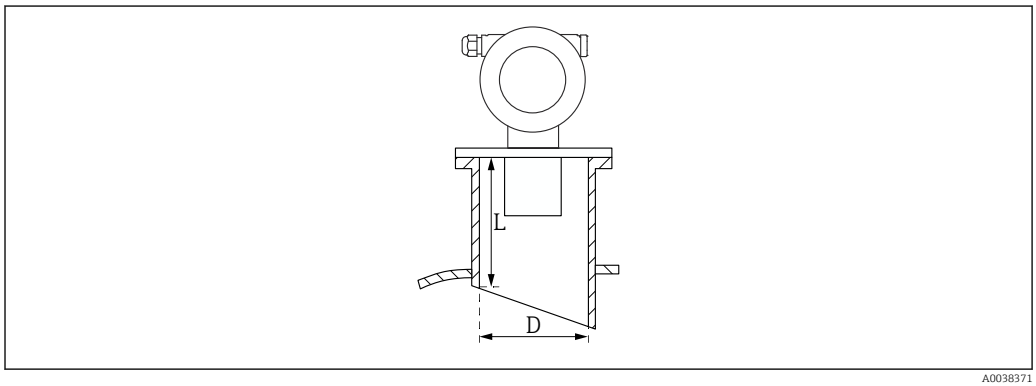
- ▶ Mount the measuring device high enough that the blocking distance is not reached at the maximum fill level.
- ▶ Define the safety distance (SD).
- ▶ If the level enters the safety distance SD, the device generates a warning or alarm.
- ▶ The measuring span F may not project into the blocking distance BD. Level echoes within the blocking distance cannot be evaluated due to the transient response of the sensor.



11 Parameter for the correct operation of the device

BD Blocking distance
SD Safety distance
E Empty calibration
F Measuring span

Mounting nozzle



12 Definition of nozzle length L and nozzle diameter D

D Nozzle diameter
L Nozzle length

Conditions
- Smooth interior surfaces in pipe nozzle
  Remove any edges or welded joints and burr on the inside of the tank side nozzle end
- To minimize disturbing factors: nozzle with an angled socket edge (ideally 45 °)
- Observe maximum nozzle length

Maximum nozzle length

400 mm (15.7 in) for the following nozzle diameters:
- DN150/6"
- DN200/8"
- DN250/10"
- DN300/12"

5.2.3 Safety distance

The device generates a warning or alarm if the level reaches the safety distance (SD). The SD size can be set as required by the user in the **Safety distance (015)** function.

In the **In safety dist. (016)** function define how the device should react if the safety distance is undershot.

Options and meaning
- **Warning**
  The measuring device displays an error message but keeps measuring.
- **Alarm**
  The measuring device displays an error message.
  The output signal in the **Output on alarm (011)** function displays the defined value.
  As soon as the level drops below the safety distance, the device resumes measuring.
- **Self holding**
  The measuring device responds in the same way as for an alarm.
  However, the alarm condition is maintained even if the level drops below the safety distance again.
  The device only starts measuring again when the user cancels the alarm using the **Acknowledge alarm (017)** function.

5.3 Post-mounting check

❑ Is the device free from damage (visual inspection)?

❑ Does the measuring device comply with the measuring point specifications?

❑ After aligning the housing: is the process seal on the nozzle or flange free from damage?

For example:
- Supply voltage
- Ambient temperature
- Process temperature
- Process pressure
- Ambient temperature range
- Measuring range

❑ Are the measuring point number and labeling correct (visual inspection)?

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

6 Electrical connection

6.1 Connecting requirements

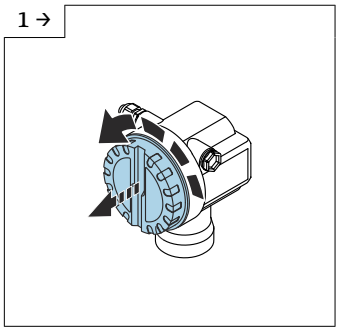
⚠ WARNING

Risk of explosion due to faulty connection.
- ▶ Observe applicable national standards.
- ▶ Comply with the specifications in the Safety Instructions (XA).
- ▶ Check to ensure that the supply voltage matches the information on the nameplate.
- ▶ The specified cable gland must be used.
- ▶ Switch off the supply voltage before connecting.
- ▶ Connect the potential equalization line to the outer ground terminal before applying the supply voltage.
- ▶ When connecting to the public mains, install a mains switch for the device such that it is within easy reach of the device. Mark the switch as a disconnector for the device (IEC/EN61010).

6.2 Connecting the measuring device

6.2.1 Connection in the F12 housing

1 →



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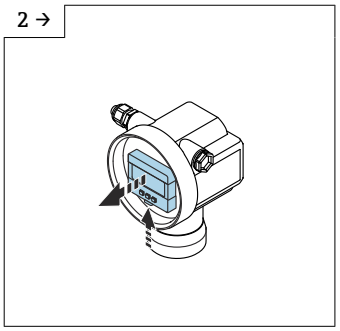
- Unscrew the cover

2 →



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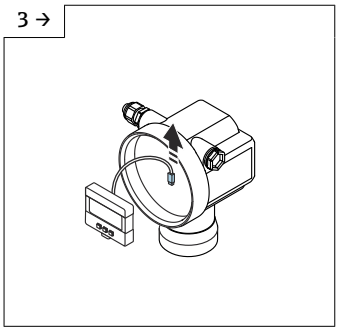
- Remove the display if one is fitted

3 →



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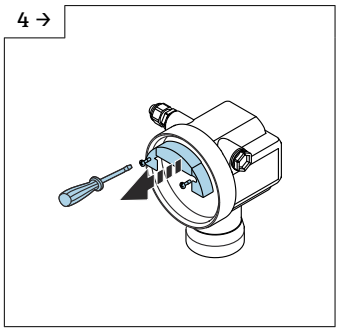
- Remove the cable from the display

4 →



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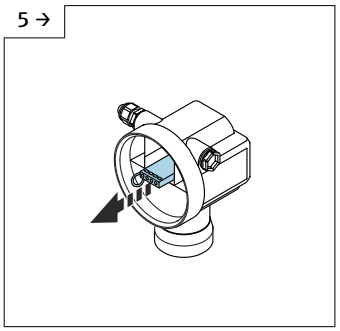
5 →



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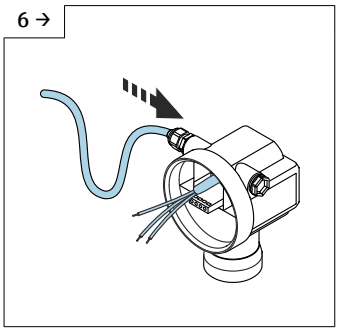
- Pull out the terminal module slightly using the pull loop

6 →



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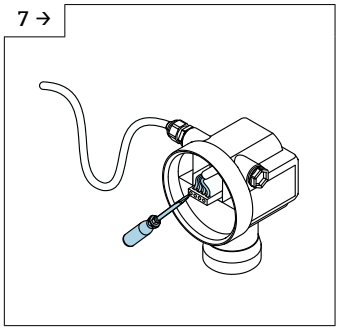
- Avoid moisture in the housing, provide a loop to allow moisture to drain off

7 →



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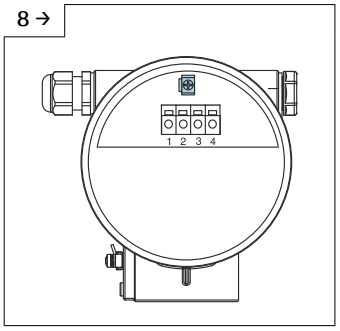
8 →



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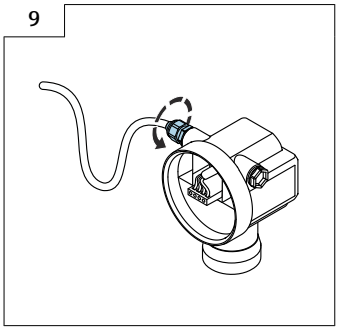
- Connect the cable shield to the ground terminal in the connection compartment

9



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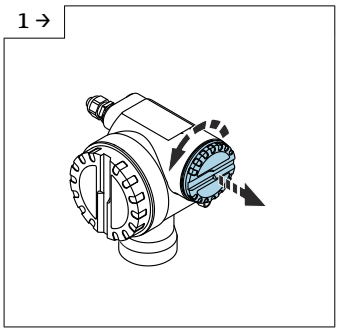
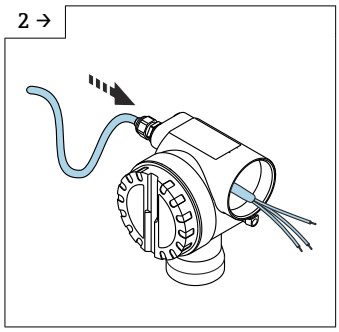
- Tighten the cable gland

10. Close the connection compartment.
11. Switch on the power supply.

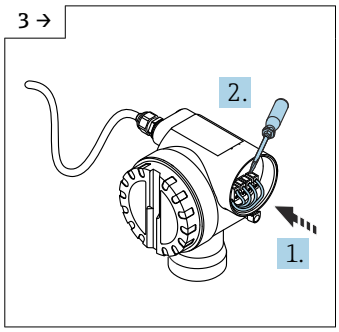
6.2.2 Connection in the T12 housing

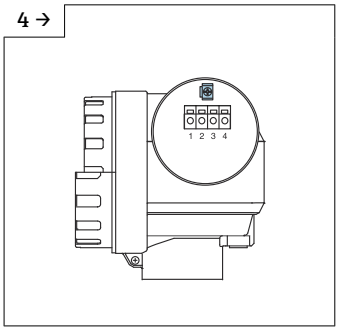


▶ Unscrew the cover

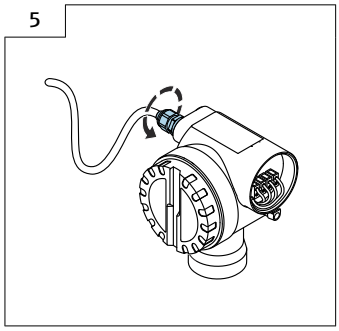


▶ Avoid moisture in the housing, provide a loop to allow moisture to drain off





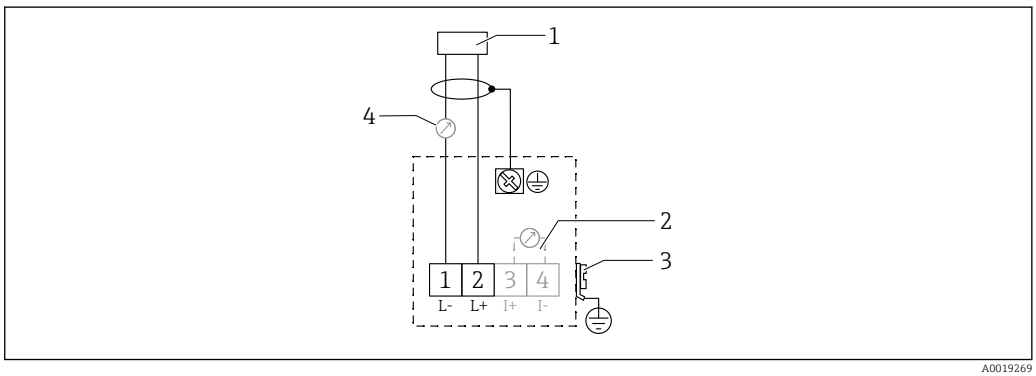
▶ Connect the cable shield to the ground terminal in the connection compartment



▶ Tighten the cable gland.

6. Close the housing.
7. Switch on the power supply.

6.3 Terminal assignment



13 Terminal assignment for two-wire version

1 Supply voltage
2 Test terminal to test the signal current
3 PAL (potential equalization)
4 4-20 mA HART

▶ Connect the connecting line to the screw terminals in the connection compartment (conductor cross-section 0.5 to 2.5 mm², 20 to 14 AWG)

- A standard device cable suffices if only the analog signal should be used. Use a shielded cable if working with a superimposed communication signal (HART).

Protective circuits against reverse polarity, RF influences and overvoltage peaks are integrated in the device.

Operation via handheld terminal or PC with operating program: take minimum communication resistance of 250 Ω and maximum load into consideration

- Superimposed communication signal (HART): use a shielded cable
- Analog signal: use a standard installation cable
- For other connections: use Commubox FXA291 or Field Xpert

6.4 Supply voltage

6.4.1 Two-wire version, HART

Terminal voltage directly at the device

Standard
- Current consumption 4 mA | terminal voltage 14 to 36 V
- Current consumption 20 mA | terminal voltage 8 to 36 V

Ex ia
- Current consumption 4 mA | terminal voltage 14 to 30 V
- Current consumption 20 mA | terminal voltage 8 to 30 V

Ex d
- Current consumption 4 mA | terminal voltage 14 to 30 V
- Current consumption 20 mA | terminal voltage 11 to 30 V

Fixed current, terminal voltage directly at the device

User-configurable, e.g. for solar powered operation (measured value via HART)

Standard
Current consumption 11 mA | terminal voltage 10 to 36 V

Ex ia
Current consumption 11 mA | terminal voltage 10 to 30 V

Fixed current for Multidrop mode

Standard
Current consumption 4 mA | (start-up current: 11 mA), terminal voltage 14 to 36 V

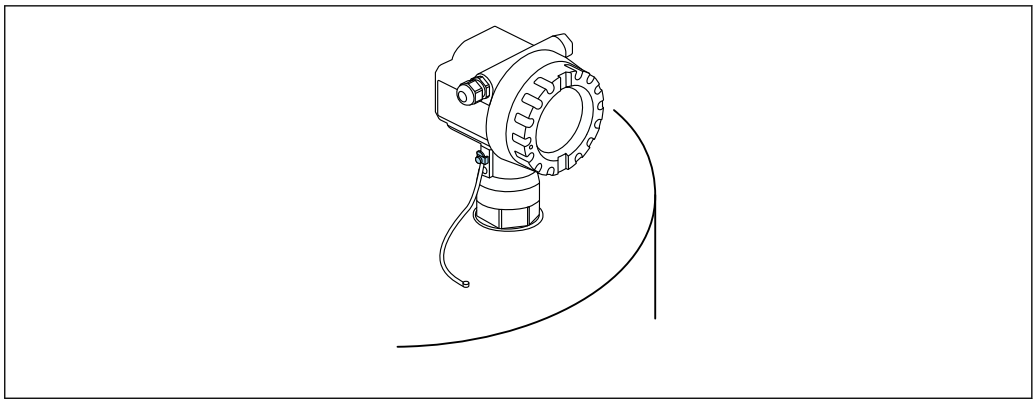
Ex ia
Current consumption 4 mA | (start-up current: 11 mA), terminal voltage 14 to 30 V

6.5 Potential equalization

NOTICE

The housing is isolated from the tank by the plastic sensor. Because of this, interference signals may occur if the potential equalization line is not properly connected.
- Use a short potential equalization line for optimum electromagnetic compatibility.
- Minimum line cross-section 2.5 mm^2 (14 AWG).

Use a ground strap if interference can be expected due to the installation conditions (existing interfering installations).



14 *Position of outer ground terminal, example of F12 housing*

- Connect the potential equalization line to the outer ground terminal of the transmitter
- In the case of hazardous area applications, only ground on the sensor side
- Comply with the specifications in the Safety Instructions

6.6 Post-connection check

❑ Are the device or cables undamaged (visual inspection)?

❑ Do the mounted cables have adequate strain relief?

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

❑ No reverse polarity, terminal assignment correct?

❑ Do the cables used comply with the requirements?

❑ Are the cable glands tightened correctly?

❑ Is the cable gland leak-tight?

❑ Is the housing cover screwed down?

❑ If required: Has the protective ground connection been established?

❑ If supply voltage is present, is the device operational and does a screen appear?

7 Operation options

7.1 Overview of operation options

- Local operation
- HART communication
  - FieldCare operating program
  - Handheld terminal

7.2 Structure and function of the operating menu

7.2.1 Function codes

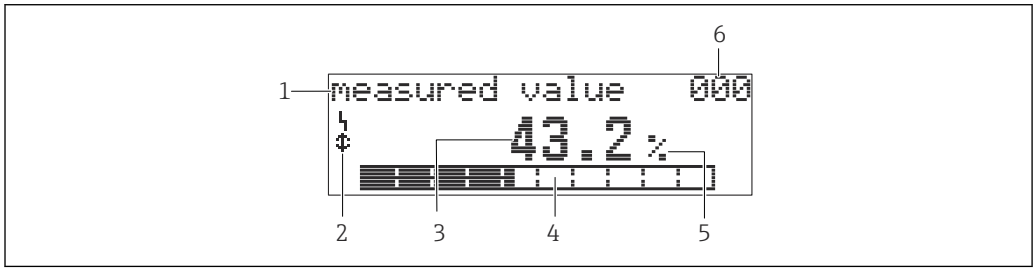
Within the function menus, a position is shown on the display for each function.

The first two digits identify the function group, examples:
- Basic setup: **00**
- Safety settings: **01**
- Linearization: **04**

The third digit refers to the individual functions within the function group, examples:
- Tank shape: 00**2**
- Medium property: 00**3**
- Process cond.: 00**4**

7.3 Access to the operating menu via the local display

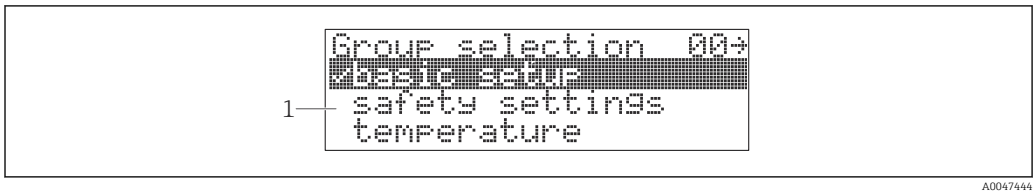
7.3.1 Display



15 *Measured value display*

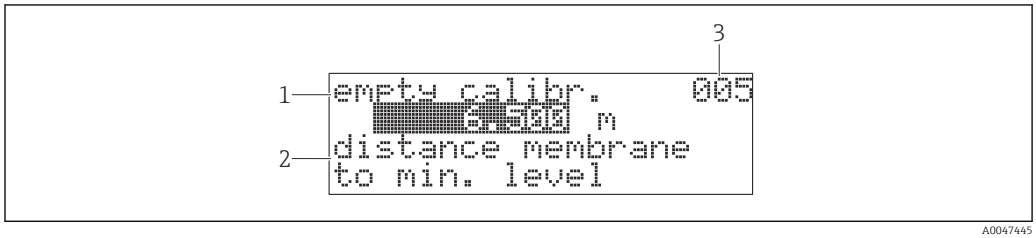
1 *Label, e.g. measured value*
2 *Symbol*
3 *Value and unit, e.g. 43.2 %*
4 *Position in menu, e.g. 000*
5 *Bar graph*
6 *Position in menu*

The bar graph corresponds to the measured value. The bar graph is divided into 10 bars. Each completely filled bar represents 10% of the set span.



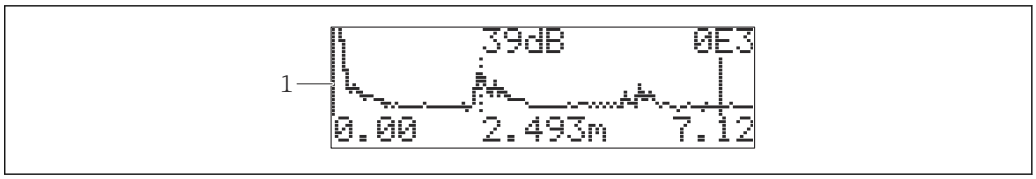
16 *Group selection*

1 *Picklist of function groups, e.g. basic setup, safety settings, temperature*



17 *Function with free parameter*

1 *Label, e.g. empty calibration*
2 *Help text*
3 *Position in menu, e.g. 005*



A0047446

18 Envelope curve display

1 Envelope curve, view

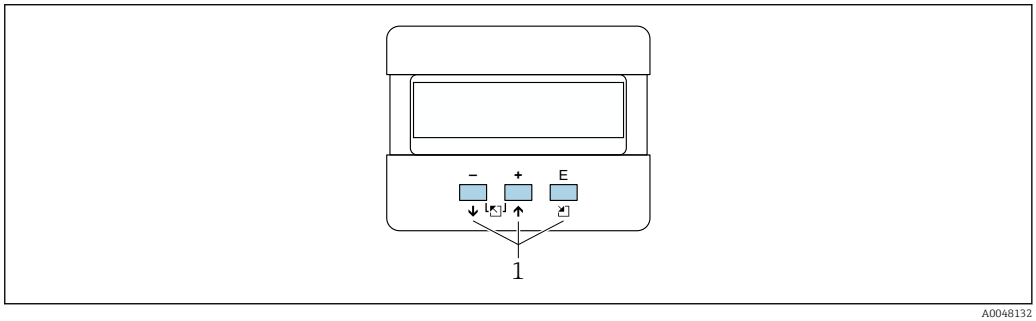
Symbols

ALARM_SYMBOL
The device is in an alarm state.
If the symbol flashes, this indicates a warning.

LOCK_SYMBOL
Device is locked. Additional entries are not possible.

COM_SYMBOL
Data are transmitted, e.g. via HART

Function of the keys



A0048132

19 Display module

1 Operating keys

⊞
- Navigate up in the picklist
- Edit the numerical values within a function

⊟
- Navigate down in the picklist
- Edit the numerical values within a function

Simultaneously ⊟ ⊞
Navigate to the left within a function group

Ⓔ
- Navigate to the right within a function group
- Confirm entry

Simultaneously ⊞ Ⓔ or ⊟ Ⓔ
Set the contrast of the liquid crystal display

Simultaneously ⊞ ⊟ Ⓔ
Lock or unlock the hardware. After a hardware lock, it is not possible to operate the device via the display or communication! The hardware can only be unlocked via the display. An access code must be entered to do so.

7.3.2 Operating the local display

Group selection

1. Press E
   ↳ Change from the **Measured value display** to the **Group selection**.
2. Press − or +: select the **Function group**.
3. Press E: confirm your choice.
   ↳ Symbol ✔ in front of the menu text indicates the active option.
4. Press − or +: activate the edit mode.
   ↳ *Continue editing in the selection menu.*

Selection menus

1. Press − or +: select the parameter.
2. Press E: confirm your choice.
   ↳ The ✔ symbol appears in front of the selected parameter
3. Press E: confirm the edited value.
   ↳ Editing mode inactive
   Continue entering numbers and text.

Entering numbers and text

1. Press − or +: edit the first character of a number or a text.
2. Press E: position the cursor at the next character and continue editing until you have entered the entire value.
3. If a ↵ symbol appears at the cursor, press E to accept the value entered.
   ↳ Editing mode inactive
4. If a ← symbol appears at the cursor, press E to return to the previous character.
5. Press − + simultaneously to quit entry mode.
   ↳ Editing mode inactive

Return to group selection

5. Press E: select the next **Function**.
6. Press − + once simultaneously: return to previous **Function**.
7. Press − + twice simultaneously: return to **Group selection**.
8. Press − + simultaneously: return to **Measured value display**.

7.4 Access to the operating menu via the operating tool

7.4.1 4 to 20 mA output with HART protocol

The device can be configured and measured values can be viewed using a HART protocol.
Two operation options are available:
- Field Xpert handheld terminal
- FieldCare operating program on PC

If operation is locked using the local display, parameter entry via communication is not possible.

7.5 Locking or enabling parameter configuration

7.5.1 Software locking

1. Navigate to: **"Diagnostics" (0A)** function group → **"Unlock parameter" (0A4) function**
2. Enter a number ≠100.
   ↳ The 🔒 symbol appears on the display. Additional entries are no longer possible.
3. If an attempt is made to change a parameter, the device jumps to **"Unlock parameter" (0A4)** function.
4. Enter the number "100".
   ↳ The parameters can be changed again.

7.5.2 Hardware locking

1. Press ⊟⊞Ⓔ simultaneously.
   ↳ Additional entries are no longer possible.
2. If you try to change a parameter, the following appears:
   ↳ **"Unlock parameter" (0A4)** function with the 🔒 symbol.
3. Press ⊟⊞Ⓔ simultaneously.
   ↳ The **"Unlock parameter" (0A4)** function appears.
4. Enter the number "100".
   ↳ Parameters can be changed again.

Hardware locking only possible via the display: press ⊟⊞Ⓔ again simultaneously.

Hardware unlocking via communication is not possible.

8 System integration

8.1 4 to 20 mA output with HART protocol

8.1.1 Operation via Field Xpert

Compact, flexible and robust industrial handheld terminal for remote configuration and for obtaining measured values via the HART current output or FOUNDATION Fieldbus. For details, see the Operating Instructions BA00060S/04.

8.1.2 Operation with FieldCare

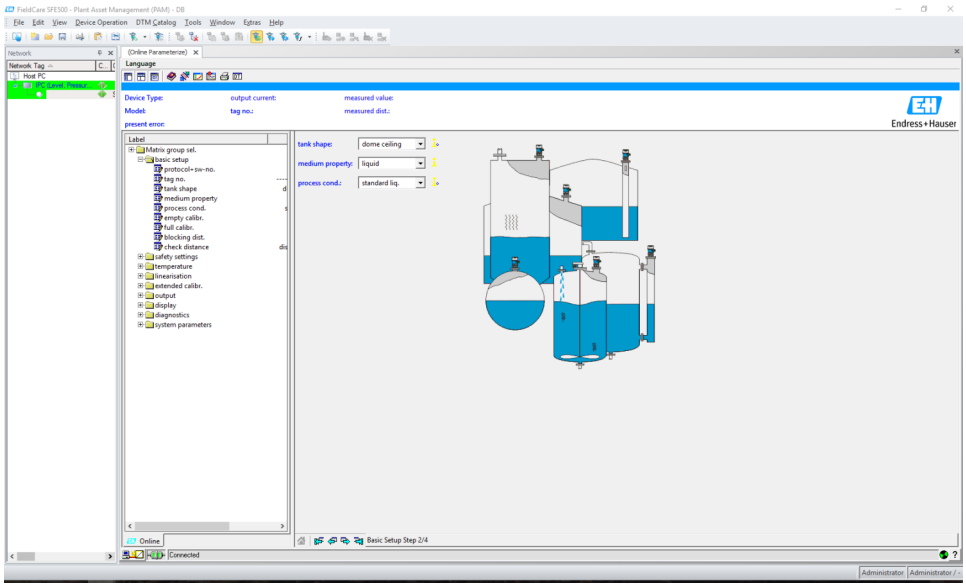
FieldCare is an Endress+Hauser asset management tool based on FDT technology. FieldCare configures all Endress+Hauser devices and devices from other manufacturers that support the FDT standard.

Hardware and software requirements: www.de.endress.com - Search: FieldCare

FieldCare supports the following functions:
- Configuration of transmitters in online mode
- Signal analysis with envelope curve
- Tank linearization
- Loading and saving of device data (upload/download)
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- Commubox FXA291 with ToF Adapter FXA291 via service interface

Menu-guided commissioning

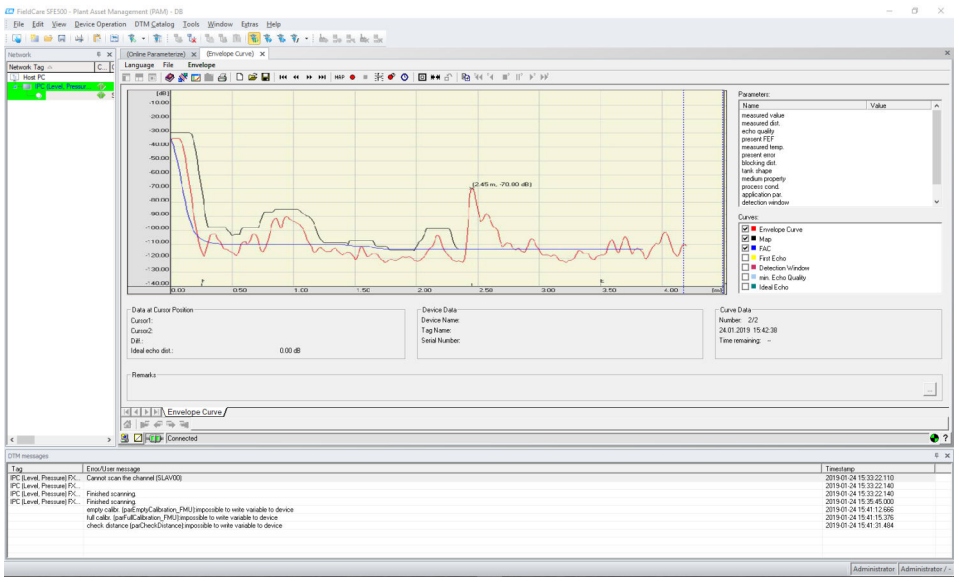


20 *View in the FieldCare operating program*

- Select the function groups and functions of the device via the navigation bar
- Enter parameters in the input window
- Click the parameter names and call up exact explanations via the help pages

Signal analysis with envelope curve

The "Envelope curve" view offers convenient ways to analyze the envelope curve:



21 *Signal analysis with envelope curve, view in the FieldCare operating program*

9 Commissioning

The Commissioning section contains the following steps:
- Function check
- Switching on the measuring device
- Establishing a connection via Fieldcare
- Configuring the measuring device
- Displaying the envelope curve

9.1 Function check

9.1.1 Post-mounting check

❑ Is the device free from damage (visual inspection)?

❑ Does the measuring device comply with the measuring point specifications?

❑ After aligning the housing: is the process seal on the nozzle or flange free from damage?

For example:
- Supply voltage
- Ambient temperature
- Process temperature
- Process pressure
- Ambient temperature range
- Measuring range

❑ Are the measuring point number and labeling correct (visual inspection)?

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

9.1.2 Post-connection check

❑ Are the device or cables undamaged (visual inspection)?

❑ Do the mounted cables have adequate strain relief?

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

❑ No reverse polarity, terminal assignment correct?

❑ Do the cables used comply with the requirements?

❑ Are the cable glands tightened correctly?

❑ Is the cable gland leak-tight?

❑ Is the housing cover screwed down?

❑ If required: Has the protective ground connection been established?

❑ If supply voltage is present, is the device operational and does a screen appear?

9.2 Switching on the measuring device

After the supply voltage has been switched on, the device is first initialized. Then the following information appears for approximately five seconds:
- Device type
- Software version

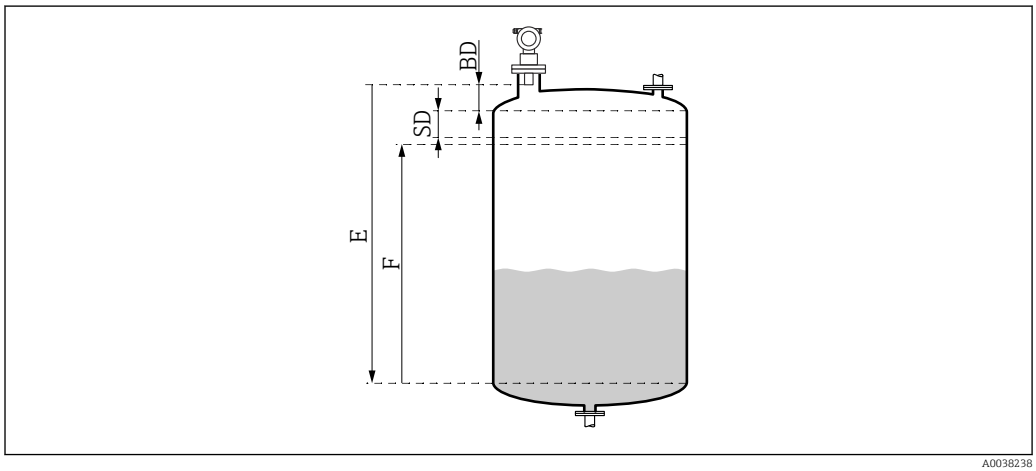
Parameters that need to be configured when the device is switched on for the first time:
- **Language**
  Select the language of the display.
- **Length unit**
  Select the unit of length in which the distance is measured.
- **Basic setup**
  A measured value is visible that does not yet display the level in the vessel
  Perform the basic setup

9.3 Connecting via FieldCare

Commissioning via FieldCare is the same as with the local display.

9.4 Configuring the measuring device

9.4.1 Basic setup



22 Parameters for the correct operation of the device

BD Blocking distance
SD Safety distance
E Empty calibration (= zero)
F Full calibration (= measuring span)

All the functions are grouped together in the **Basic setup (00)** function group. When you have completed your entries for a function, the next function appears automatically.

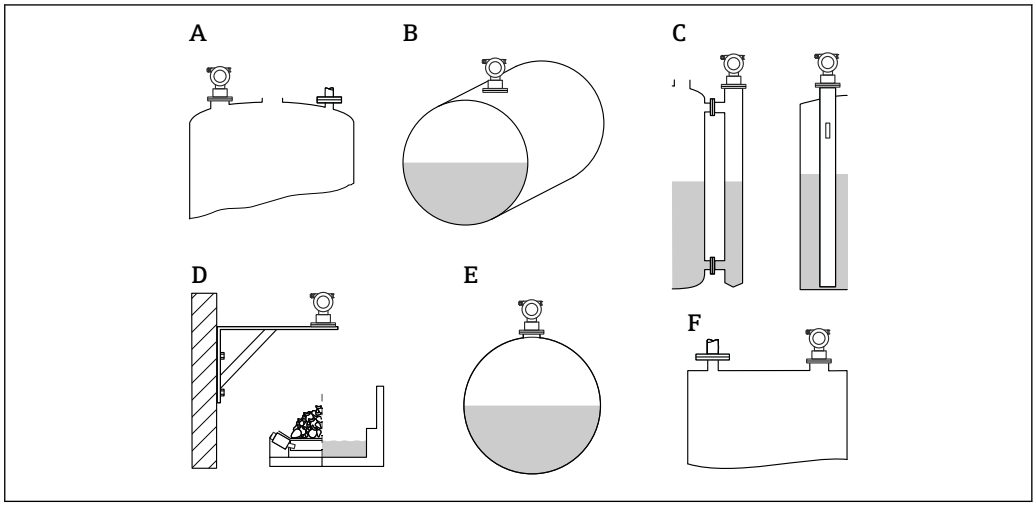
Basic setup procedure (example)
Function and selection
- **Tank shape** → Dome ceiling
- **Medium property**→ Unknown
- **Process cond.**→ Standard
- **Empty calibr.**
- **Full calibr.**
- **Mapping**

Optional functions
- **Safety settings**
- **Linearization**
- **Extended calibration**
- **...**

Configuration of the measuring point

Tank shape function (002)

Selection



23 Options in the "Tank shape" function

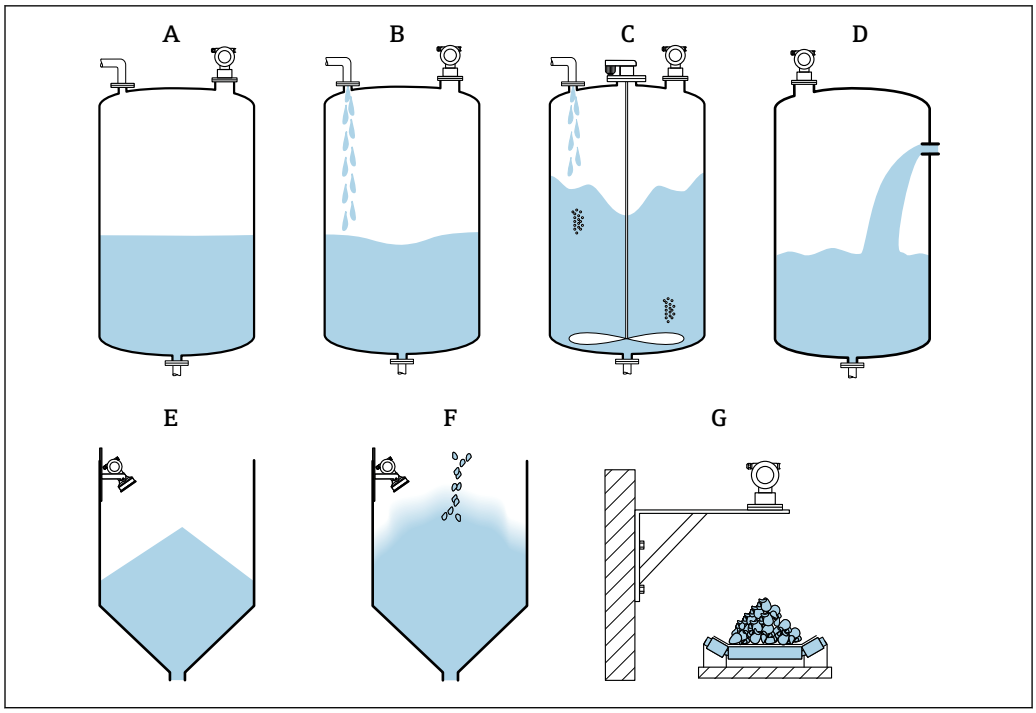
A Dome ceiling
B Horizontal cyl
C Bypass or stilling well/ultrasound guide pipe
D No ceiling, e.g. dumps, open levels, basins, flume
E Sphere
F Flat ceiling

Medium properties function (003)

Selection
- Unknown (e.g. pasty media such as greases, creams, gels etc.)
- Liquid
- Bulk solids, grain size < 4 mm, powder
- Bulk solids, grain size > 4 mm, coarse

Process cond. function (004)

Selection



24 *Some of the options in the "Process cond." function*

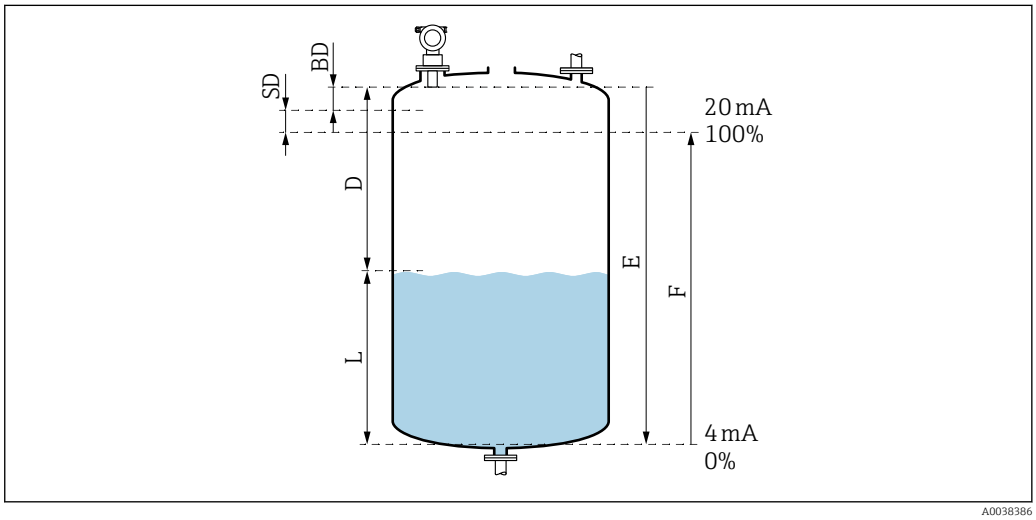
A Calm surface
B Turb. surface
C Add. agitator
D Fast change
E Standard solid
F Solid dusty
G Conveyor belt
- Not in graphic: Standard liq. and Test: no filter

Description of options

- **Standard liq.**
  - For liquid applications that do not suit any of the options
  - Average filter values and output damping
- **Calm surface**
  - For storage tanks with an immersion tube or bottom filling
  - Large filtering range and output damping
    → Stable measured value, accurate measurement, slow response time
- **Turb. surface**
  - For storage and buffer tanks with turbulent surfaces due to free filling, mixing nozzles or small bottom agitators
  - Emphasis on filters to stabilize the input signal
    → Steady measured value, medium response time
- **Add. agitator**
  - For agitated surfaces due to agitators, e.g. vortex formation
  - Large values are set for filters to stabilize the input signal
    → Steady measured value, medium response time
- **Fast change**
  - For fast changes in the level, particularly in small tanks
  - Small values are set for the filters
    → Fast response time
    → Possibly unstable measured value
- **Standard solid**
  - For bulk solids applications that do not suit any of the options
  - Average filter values and output damping

- **Solid dusty**
  - For dusty bulk solids
  - The filters are set in such a way that even relatively weak wanted signals are detected
- **Conveyor belt**
  - For bulk solids with rapid changes in the level, e.g. conveyor belts
  - Low values are set for the filters.
    → Fast response time, possibly unstable measured value
- **Test: no filter**
  For service and diagnostics only
  All the filters are switched off.

Empty calibration and full calibration



25 *Parameters for the correct operation of the device*

D *Distance (sensor membrane/product)*
E *Empty calibration = zero point*
F *Full calibration = measuring span*
L *Level*
BD *Blocking distance*
SD *Safety distance*

Empty calibration function (005)

Specify the distance E from the sensor membrane = reference point of the measurement to the minimum level (zero point).

Torispherical head or conical outlets: the zero point should not be lower than the point where the ultrasonic wave hits the bottom of the tank.

Blocking distance function (059)

The blocking distance (BD) of the sensor is displayed.
After the basic setup, enter the safety distance (SD) in the **Safety distance (015)** function

When entering the full distance, make sure that the maximum level does not enter the blocking distance.

NOTICE

If the blocking distance is undershot, this may cause a device malfunction.

- ▶ Mount the measuring device high enough that the blocking distance is not reached at the maximum fill level.
- ▶ Define the safety distance (SD).
- ▶ If the level enters the safety distance SD, the device generates a warning or alarm.
- ▶ The measuring span F may not project into the blocking distance BD. Level echoes within the blocking distance cannot be evaluated due to the transient response of the sensor.

Full calibration function (006)

Specify the measuring span F (distance from the minimum to the maximum level).

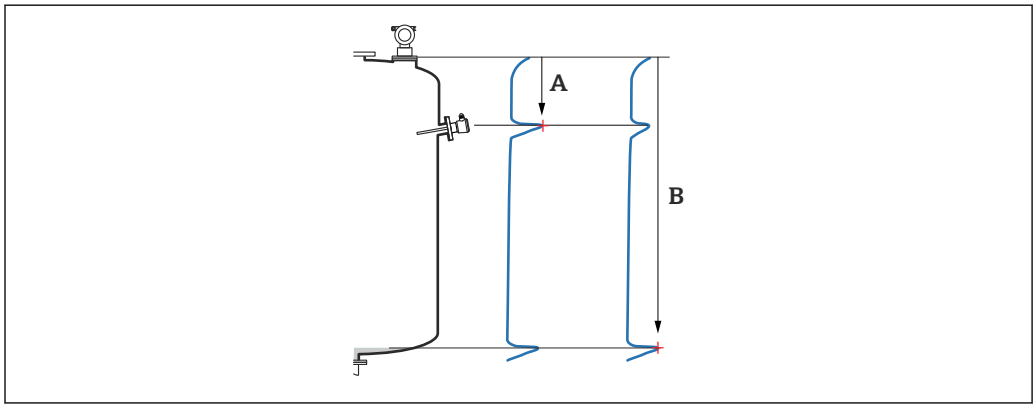
Interference echo suppression (mapping)

Dist./meas.value function (008)

This function displays the measured distance D from the sensor membrane to the surface of the product together with the level L. Check whether the values displayed match the actual distance/level.

"Check distance" function (051)

Start the mapping process.



26 *Example of mapping*

A Distance too small
B Distance = Ok

Selection and description

- **Distance = ok** → the correct distance is displayed
  Any echoes closer to the sensor will be suppressed by the subsequent interference echo suppression (mapping).
- **Dist. too small** → the displayed distance is too small
  In this case, the signal comes from an interference echo and will be suppressed by the subsequent interference echo suppression.
- **Dist. too big** → the displayed distance is too big
  - The error cannot be rectified by suppressing the interference echo. Two functions that follow are then skipped.
  - Check the application parameters: **Tank shape (002)**, **Medium properties (003)**, **Process cond. (004)**and in the function group **Basic setup (00)** → **Empty calibration (005)**
- **Dist. unknown** → the actual distance is not known
  Two functions that follow are then skipped.
- **Manual** → you can specify the mapping range yourself in the following function

Range of mapping (052) function

- The range of mapping is displayed, confirm the proposed value or enter your own value
- The sensor membrane is always the reference point
- The value can be edited by the user
- For manual suppression (mapping), the default value is 0 m

The mapping range must end 0.5 m (1.6 ft) before the echo of the actual level. If the tank is empty enter E – 0.5 m instead of E.

Start mapping (053) function

Selection
- Off: no mapping
- On: mapping starts

If a mapping already exists, it will be overwritten up to the distance specified. The existing mapping remains unchanged beyond this distance.

Dist./meas.value function (008)

Information displayed after mapping
Distance measured from the sensor membrane to the product surface

Check whether the values displayed match the actual distance or actual level.

The following situations can occur:
- Distance and level correct: **Basic setup** completed
- Distance and level incorrect: perform another mapping in the **Check distance (051)** function
- Distance is correct but the level is incorrect: check the value in the **Empty calibration (005)** function

Return to group selection

After the mapping has been recorded the basic setup is finished and the device automatically returns to the group selection.

9.5 Displaying the envelope curve

Check the measurement: after the basic setup, select the **Envelope curve (0E)** function group.

After the basic setup, it is advisable to evaluate the measurement using the envelope curve:
- Recognition of interference echoes
- Recognize whether interference echoes are completely suppressed by interference echo suppression (mapping)

9.5.1 Plot settings (0E1) function

Selection
- Envelope curve
- Envelope curve and FAC
- Envelope curve and mapping

For information on the FAC and mapping, see the documentation BA "Description of Device Functions".

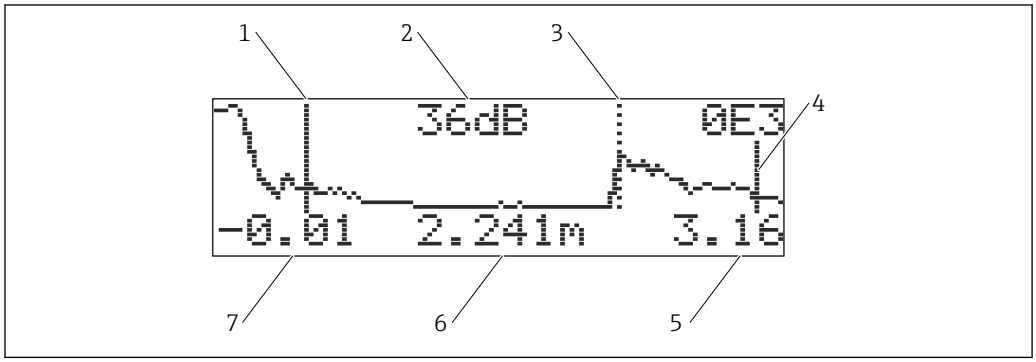
9.5.2 Recording curve (0E2) function

Selection
- Single curve
- Cyclic

9.5.3 Envelope curve display (0E3) function

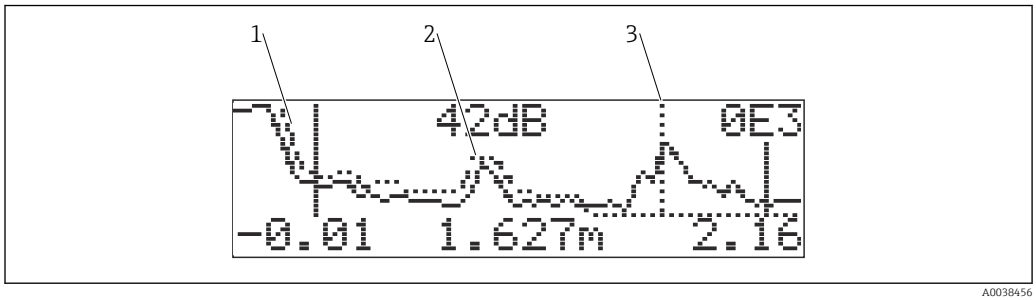
If cyclic envelope curve display is active on the display, the measured value is updated at a slower cycle time. Recommendation: exit the envelope curve display after optimizing the measuring point. Press E (the device does not leave the envelope curve display automatically.)

Conditions
- The echo quality at the end of measuring range is at least 10 dB
- There should be practically no interference echoes in front of the actual level signal
- Interference echoes must be below the mapping curve



27 *Envelope curve*

1 *Full calibration*
2 *Quality of the evaluated echo*
3 *Marking for the evaluated echo*
4 *Empty calibration*
5 *Display end value*
6 *Distance of the evaluated echo*
7 *Display start value*



28 *Envelope curve and mapping*

1 *Mapping*
2 *Interference echo*
3 *Level echo*

9.5.4 Navigate in the envelope curve display

Active navigation mode: symbol in the top left-hand corner of the display

Horizontal zoom mode
- Zoom in
- Zoom out

Move mode
- Move left
- Move right

Vertical zoom mode
Zoom in or out in 4 steps 0 to 3

Activating the horizontal zoom mode

1. Press ⊞ or ⊟.
   ↳ ◂▸ or ◂▸ is displayed.
2. ⊞ increases the horizontal scale.
3. ⊟ reduces the horizontal scale.

Activating the move mode

1. Then press Ⓔ.
   ↳ ◂◂ or ▸▸ is displayed.
2. ⊞ moves the curve to the right.
3. ⊟ moves the curve to the left.

Activating vertical zoom mode

1. Press Ⓔ again
   ↳ ↕1 is displayed.
2. ⊞ increases the vertical scale.
3. ⊟ reduces the vertical scale.
   ↳ The display symbol shows the current zoom factor ↕0 to ↕3

Exiting the navigation

1. Press Ⓔ repeatedly.
   ↳ Cyclically run through the various modes of the envelope curve navigation.
2. Press ⊞⊟ simultaneously.
   ↳ The set increases and shifts are retained.
3. Activate the **Recording curve (0E2)** function again.
   ↳ Standard display is shown.

10 Diagnostics and troubleshooting

10.1 Present error

Display
- Error symbol in **Measured value display (000)**
- **Diagnostics (0A)** function group, **Present error (0A0)** function
  - The error with the highest priority is displayed.
  - Several errors currently pending: scroll through the error messages with ⊞ or ⊟.

10.2 Previous error

Display
Diagnostics (0A) function group, **Previous error (0A1)** function
Clear the display in the **Clear last error (0A2)** function

10.3 Types of error

Alarm (A), ↯ symbol is lit continuously
The output signal adopts a value that can be specified by the **Output on alarm (010)** function.
- MAX: 110 %, 22 mA
- MIN: -10 %, 3.8 mA
- Hold: the last value is held
- User-specific value

Warning (W), ↯ symbol flashes
Device continues measuring, error message is displayed

Alarm/warning (E)
Define the error message as an alarm or warning

10.4 Diagnostics list

10.4.1 Error codes

A102, A110, A152, A160 = checksum error
Perform a reset
Alarm persists after a reset, replace the electronics

A106 = Downloading
Wait; the message disappears after the downloading sequence

A116 = Download error
- Check the connection
- Start downloading again

A111, A113, A114, A115, A121, A125, A155, A164, A171 = Electronics defective
- Perform a reset
- Check system for EMC
- If the alarm persists after a reset, replace the electronics

A231 = Sensor defect
- Check connection
- Change sensor

A502 = Sensor not recognized
Replace the sensor and/or electronics

A512 = Recording of mapping
Alarm ends after a few seconds

A521 = New sensor type identified
Perform a reset

A671 = Linearization not complete, not usable
Perform the basic setup

E281 = Wire breakage at temperature sensor
Replace the sensor and/or electronics

E641 = No usable echo
Check the basic setup

E651 = Level in safety distance, risk of overspill
- The error disappears as soon as the level is no longer in the safety distance
- Acknowledge alarm
  Safety settings (01) function group → **Acknowledge alarm (017)** function

E661 = Sensor temperature too high

W103 = Initializing
If the message does not disappear, replace the electronics

W153 = Initializing
- Wait a few seconds
- If the error remains active, switch the voltage off/on

W601 = Linearization curve not monotone
Correct the table, enter a table that increases monotonically

W611 = Less than 2 linearization points
Enter more value pairs

W621 = Simulation on
Switch off the simulation mode, **Output (06)** function group → **Simulation (065)** function

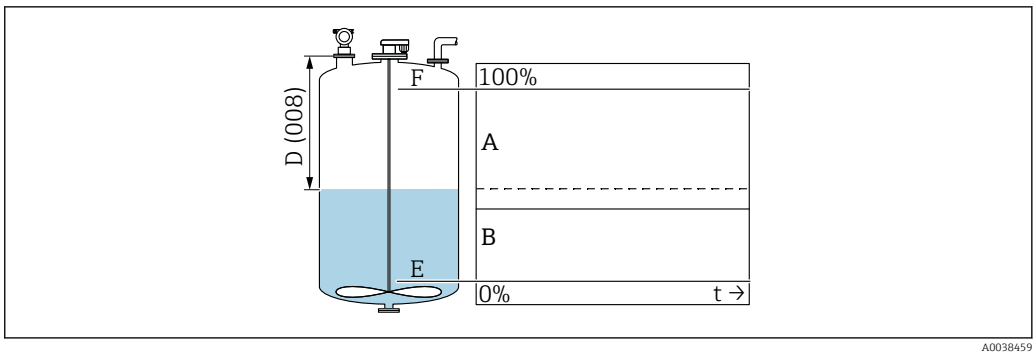
W681 = Current out of range
- Perform the basic setup
- Check linearization

W691 = Noise filling

10.5 Application errors

Error: **Measured value (000)** incorrect, measured **distance (008)** correct.

Example:

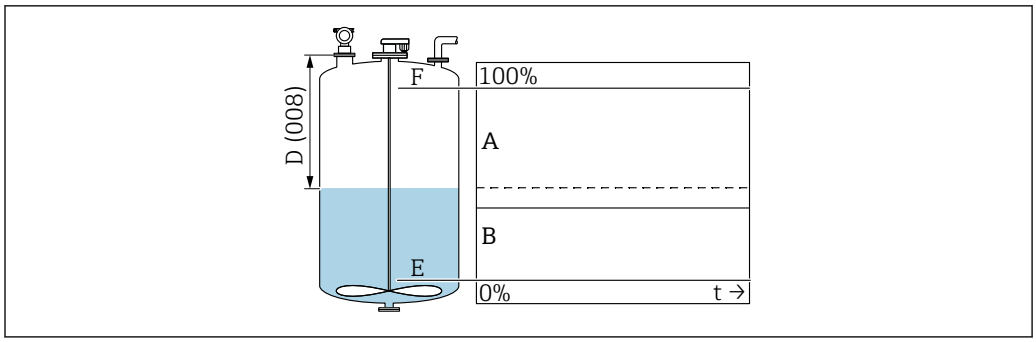


A Expected result
B Error occurred

1. Check **Empty calibration (005)** and **Full calibration (006)** and correct.
2. Check the linearization and correct it: **Level/ullage (040)**, **Max. scale (046)**, **Diameter vessel (047)**, Linearization table.

Error: **Measured value (000)** and measured distance in **Distance (008)** incorrect.

Example:

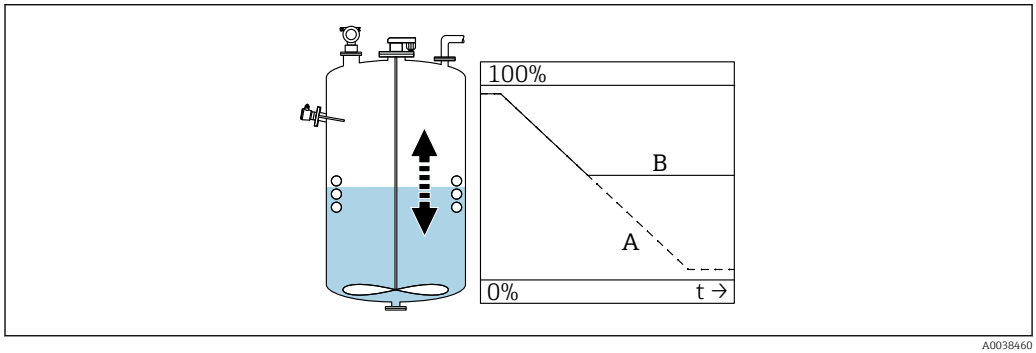


A Expected result
B Error occurred

1. In the **Tank shape (002)** function, select the corresponding option for measurements in a bypass or ultrasound guide pipe.
2. Perform mapping.

Error: No change of measured value when filling or emptying.

Example:

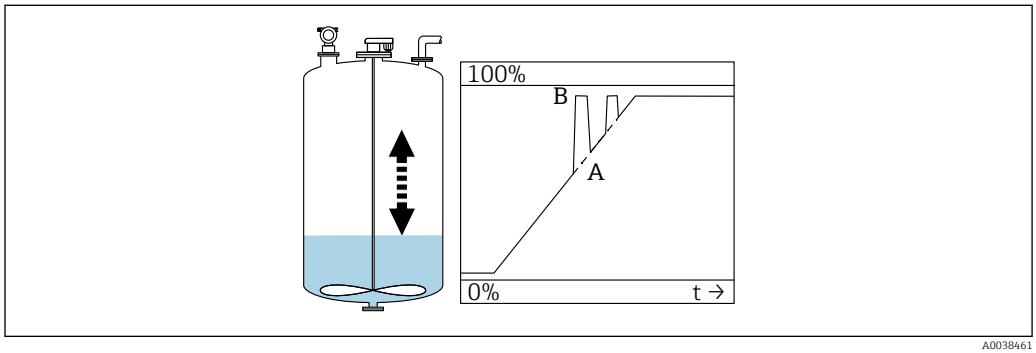


A Expected result
B Error occurred

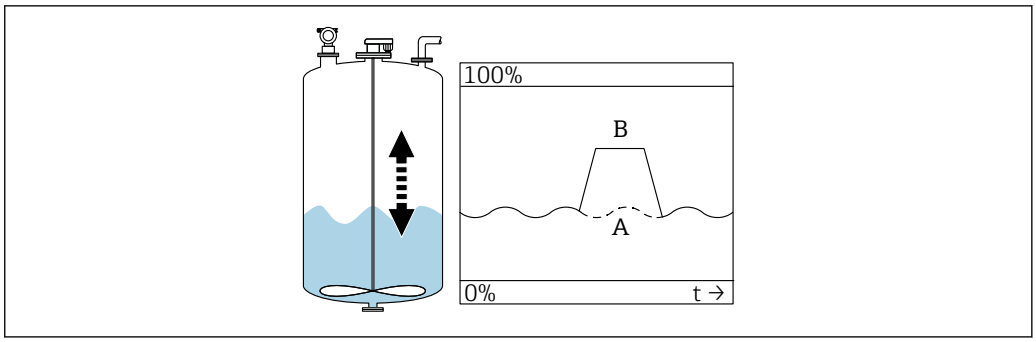
1. Perform mapping.
2. Clean sensor.
3. Select a better installation position.
4. If very large interference echoes occur simultaneously, select "Off" in the **Detection window (0A7)** function.

Error: If the surface is turbulent, the measured value jumps sporadically to higher levels.
Turbulent: e.g. when filling, emptying, or with running agitator

Examples:



A Expected result
B Error occurred

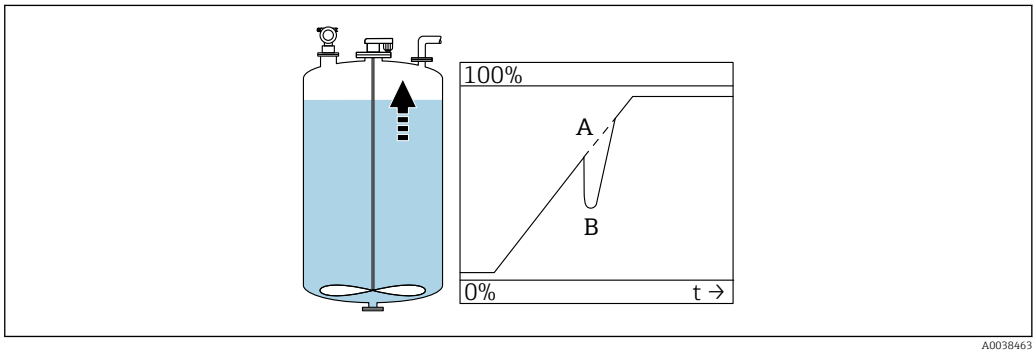


A Expected result
B Error occurred

1. Perform interference echo suppression (mapping).
2. In the **Process cond. (004)** function, select "Turb. surface" or "Add. agitator".
3. Increase the **output damping (058)**.
4. Select another installation position and/or a larger sensor.

Error: During filling or emptying, the measured value drops.

Example:

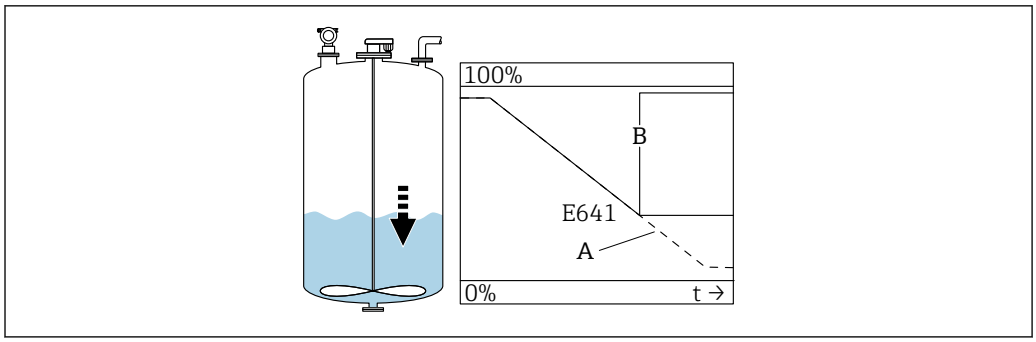


A Expected result
B Error occurred

1. Check the tank shape and correct it → "Dome ceiling" or "Horizontal cyl.".
2. If possible, do not select an installation position in the middle
3. If necessary, use a stilling well/ultrasound guide pipe

Error: **Echo loss (E641)**

Example:



A Expected result
B Error occurred

1. Check **application parameters (002)**, **(003)** and **(004)**.
2. Select another installation position.
3. Select a larger sensor.
4. Align the sensor so that it is parallel to the surface of the product, particularly for bulk solids applications.

10.6 Resetting the measuring device

10.6.1 Resetting customized parameters

NOTICE

A reset affects the measurement.

▶ Perform a new basic setup after resetting the device.

Use the **Reset (0A3)** function if you are using a device with an unknown history.

Effects
- Customized parameters are reset to default values
- Mapping performed by the customer onsite is not deleted
- Linearization switches to "linear", table values are retained;
  Switch the table in the **Linearization (04)** function group, **Linearization (041)** function back on

Navigation → **Diagnostics (0A)** function group → **Reset (0A3)** function → Enter the number "333"

5-point linearity protocol
- The parts of the measuring unit (sensor and electronics) are harmonized with one another.
- Accuracy is optimized for the specified range
- The **Zero distance** service parameter is fine-adjusted.
  Following a reset, the **Zero distance** parameter must be reconfigured in the Service menu. Follow the information on the 5-point linearity protocol and contact the sales organization.

10.6.2 Resetting interference echo suppression (mapping)

Reset interference echo suppression:
- If you want to use a device with an unknown history
- If an incorrect mapping has been recorded

Navigation → **Extended calibration (05)** function group → **Selection (050)** function → "Extended map." function → **Cust. tank map (055)**

Selection
- Delete: delete (reset) an existing interference echo suppression
- Inactive: switch off interference echo suppression, mapping is saved
- Active: switch interference echo suppression back on

10.7 Firmware history

V01.02.00 (01.2002) / V01.02.02 (03.2003)
- Valid from documentation version: BA237F/00/en/03.03
- Software changes:
  Original software
- Compatible with:
  - ToF tool
  - Commuwin II (from version 2.05.03)
  - HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1

V01.04.00 (07.2006)
- Valid from documentation version: BA237F/00/en/07.06
  "Detection window" added. Version :07.06
- Software changes:
  "Detection window" function added
- Compatible with:
  - ToF tool from version 4.50
  - HART Communicator DXR375 with Rev. 1, DD 1

11 Maintenance

11.1 Maintenance schedule

As a general rule, no specific maintenance work is required.

11.2 Maintenance tasks

11.2.1 Cleaning

When cleaning the exterior, always use cleaning agents that do not corrode the surface of the housing and the seals.

12 Repair

12.1 General notes

Endress+Hauser repair concept
- Measuring devices have a modular design
- Customers can carry out repairs

For more information on service and spare parts, please contact your Endress+Hauser sales representative.

12.2 Endress+Hauser services

12.2.1 Repair of Ex-certified devices

⚠ WARNING

Incorrect repair can compromise electrical safety!

Explosion Hazard!

- Only specialist personnel or the Endress+Hauser service team may carry out repairs on Ex-certified devices.
- Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- Use only original Endress+Hauser spare parts.
- Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- Carry out repairs according to the instructions.
- Only the Endress+Hauser service team is permitted to modify a certified device and convert it to another certified version.
- All repairs and modifications must be documented.

12.2.2 Replacing the device or electronics module

After an entire device or an electronics module has been replaced, the parameters can be downloaded to the device again via the communication interface.

For this, the data must have been uploaded to the PC beforehand using FieldCare . You can continue measuring without performing a new calibration.

Only a linearization and the interference echo suppression need to be performed again.

12.2.3 Return

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

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

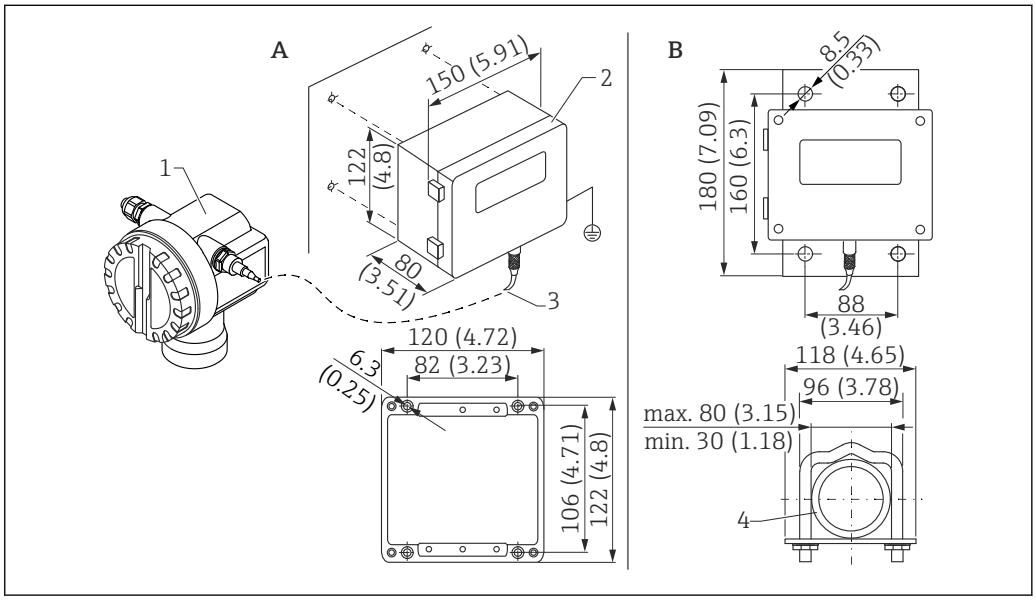
12.3 Disposal

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 the manufacturer for disposal under the applicable conditions.

13 Accessories

13.1 Device-specific accessories

13.1.1 Remote display and operating unit FHX40



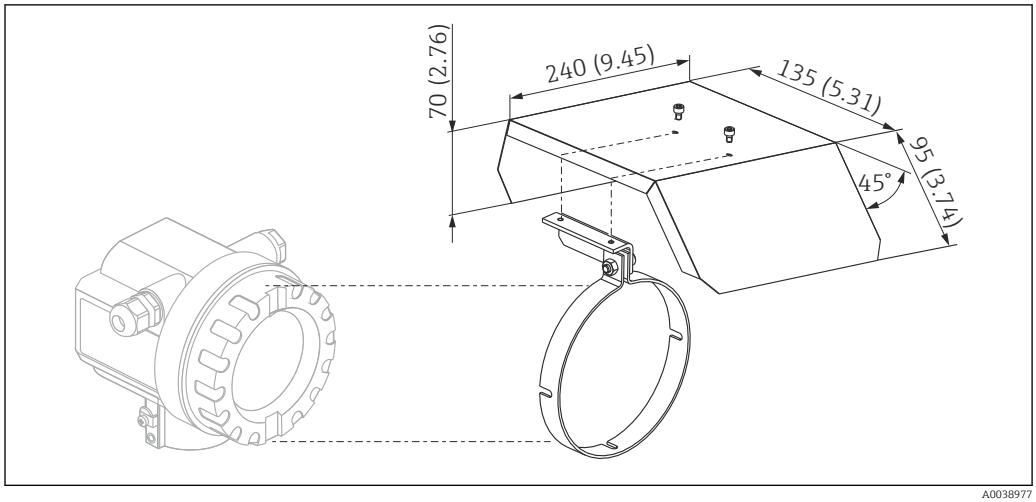
29 *Remote display. Unit of measurement mm (in)*

A Wall mounting without mounting bracket
B Pipe mounting, mounting bracket and mounting plate are optional
1 Device, e.g. Prosonic
2 Separate housing FHX40, IP 65
3 Cable
4 Pipe

Technical data
- Cable length: 20 m (66 ft), fixed length with cast-on connectors
- Temperature range T6: −40 to +60 °C (−40 to +140 °F)
  Temperature range T5: −40 to +75 °C (−40 to +167 °F)
- Degree of protection: IP65/67 (housing); IP68 (cable) according to IEC 60529
- Dimensions [mm (in)]: 122 x 150 x 80 (4.8 x 5.91 x 3.15)

Materials
- Housing, cover: AlSi12,
  Screw: V2A
- Ground terminal: CuZn nickel-plated
  Screw: V2A
- Display: glass
- Cable gland: CuZn nickel-plated
- Cable: PVC
- Mounting bracket: 316 Ti (1.4571) or 316 L (1.4435) or 316 (1.4401)
- Nut: V4A
- Plate: 316 Ti (1.4571)
- Screw set (M5)
  Spring washer: 301 (1.431) or V2A
  Screw: V4A
  Nut: V4A
- Additional information: Brief Operating Instructions KA00202F

13.1.2 Weather protection cover



30 Weather protection cover for F12 or T12 housing . Unit of measurement mm (in)

Materials
- Protection cap, tension clamp: stainless steel 304 (1.4301)
- Screw, nut, washer: A2

Order number: 543199-0001

13.2 Communication-specific accessories

13.2.1 Commubox FXA195 HART

- Function: Intrinsically safe HART communication with FieldCare or DeviceCare via the USB port
- Order number: 52027505
- Additional information: Technical Information TI00404F

13.2.2 Commubox FXA291

- Function: Connects the CDI interface (Common Data Interface) of Endress+Hauser devices to the USB port of a computer
- Order number: 51516983
- Accessory: ToF Adapter FXA291
- Additional information: Technical Information TI00405C

13.2.3 ToF Adapter FXA291

- Function: Connects the Commubox FXA291 via the USB port of a computer or laptop
- Order number: 71007843
- Additional information: Brief Operating Instructions KA00271F

13.2.4 SupplyCare Hosting SCH30

Inventory management software that visualizes levels, volumes, masses, temperatures, pressures, densities or other tank parameters. The parameters are recorded and transmitted using Fieldgate FXA42, FXA30 and FXA30B gateway types. SupplyCare Hosting is offered as a hosting service (Software as a Service, SaaS). In the Endress+Hauser portal, the user is provided with the data over the Internet.

Order number: 71214483

For details, see "Technical Information" TI01229S and Operating Instructions BA00050S.

13.2.5 SupplyCare Enterprise SCE30B

Inventory management software that visualizes levels, volumes, masses, temperatures, pressures, densities or other tank parameters. The parameters are recorded and transmitted using the Fieldgate FXA42 gateway type.

This Web-based software is installed on a local server and can also be visualized and operated with mobile terminals such as a smartphone or tablet.

Order number : 71214488

For details, see "Technical Information" TI01228S and Operating Instructions BA00055S

13.2.6 Connect Sensor FXA30/FXA30B

Fully integrated, battery-powered gateway for simple applications with SupplyCare Hosting. It is possible to connect up to 4 field devices with 4 to 20 mA communication (FXA30 / FXA30B), serial Modbus (FXA30B) or HART (FXA30B). With its robust design and ability to run for years on the battery, it is ideal for remote monitoring in isolated locations. Version with LTE (USA, Canada and Mexico only) or 3G mobile transmission for worldwide communication.

Order number: 71367395

For details, see "Technical Information" TI01356S and Operating Instructions BA01710S.

13.2.7 Fieldgate FXA42

Fieldgates enable communication between connected 4 to 20 mA, Modbus RS485 and Modbus TCP devices and SupplyCare Hosting or SupplyCare Enterprise. The signals are transmitted either via Ethernet TCP/IP, WLAN or mobile communications (UMTS). Advanced automation capabilities are available, such as an integrated Web-PLC, OpenVPN and other functions.

Order number: 71274336

For details, see "Technical Information" TI01297S and Operating Instructions BA01778S.

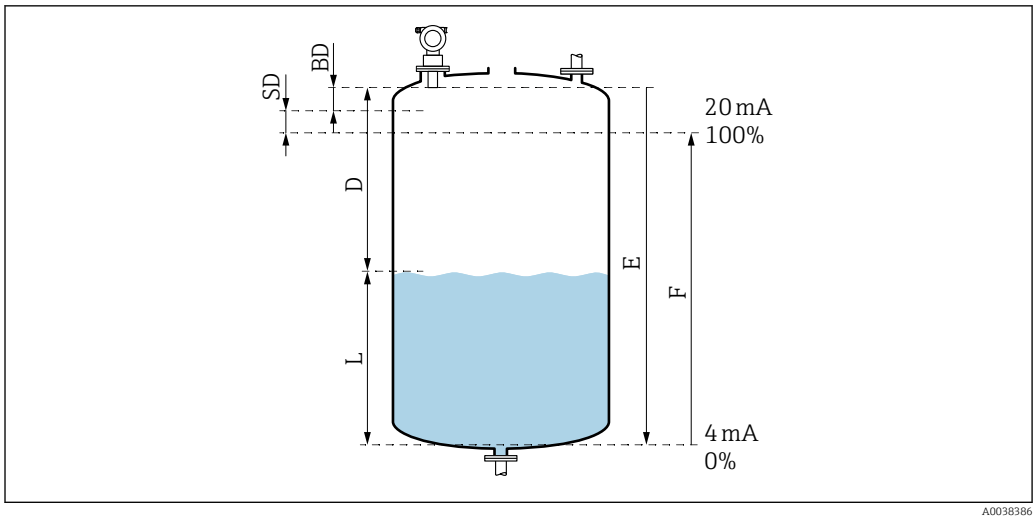
14 Technical data

14.1 Input

14.1.1 Measured variable

Distance D between sensor membrane and product surface

Using the linearization function, the device uses D to calculate the following in any unit:
- Level L
- Volume V
- Flow Q over measuring weirs or open flumes



31 Parameters for the correct operation of the device

BD Blocking distance
SD Safety distance
E Empty distance
L Level
D Distance from the sensor membrane to the surface of the product
F Measuring span (full distance)

14.1.2 Range

The range of the sensor depends on the measuring conditions.
- Blocking distance BD: 0.5 m (1.6 ft)
- Maximum range for liquids: 20 m (66 ft)
- Maximum range for bulk solids: 10 m (33 ft)

14.1.3 Operating frequency, sound pressure level

- Operating frequency: approx. 30 kHz
- Maximum sound pressure level, directly in front of the sensor: 143 dB
- Distance of threshold value 110 dB: 2.7 m (8.9 ft)

14.2 Output signal

4 to 20 mA with HART

14.2.1 Signal on alarm

Call up failure information:
- Local display (error symbol, error code and plain text description)
- Current output, failure mode can be selected, e.g. according to NAMUR Recommendation NE43
- Digital interface

14.3 Power supply

14.3.1 Supply voltage

Two-wire version, HART

Terminal voltage directly at the device

Standard
- Current consumption 4 mA | terminal voltage 14 to 36 V
- Current consumption 20 mA | terminal voltage 8 to 36 V

Ex ia
- Current consumption 4 mA | terminal voltage 14 to 30 V
- Current consumption 20 mA | terminal voltage 8 to 30 V

Ex d
- Current consumption 4 mA | terminal voltage 14 to 30 V
- Current consumption 20 mA | terminal voltage 11 to 30 V

Fixed current, terminal voltage directly at the device

User-configurable, e.g. for solar powered operation (measured value via HART)

Standard
Current consumption 11 mA | terminal voltage 10 to 36 V

Ex ia
Current consumption 11 mA | terminal voltage 10 to 30 V

Fixed current for Multidrop mode

Standard
Current consumption 4 mA | (start-up current: 11 mA), terminal voltage 14 to 36 V

Ex ia
Current consumption 4 mA | (start-up current: 11 mA), terminal voltage 14 to 30 V

14.3.2 Power consumption

Two-wire version: 51 to 800 mW

14.3.3 Load

Min. load for HART communication: 250 Ω

14.3.4 HART ripple

47 to 125 Hz: U_{ss} = 200 mV (at 500 Ω)

14.3.5 HART noise

500 Hz to 10 kHz: U_{eff} = 2.2 mV (at 500 Ω)

14.4 Performance characteristics

14.4.1 Reference operating conditions

- Temperature: +20 °C (+68 °F)
- Pressure: 1013 mbar abs. (15 psi abs.)
- Humidity: 50 %
- Ideally reflecting surface, e.g. calm, even liquid surface
- No interference reflections inside the signal beam
- Configured parameters for applications:
  - Tank shape = Dome ceiling
  - Medium property = Liquid
  - Process cond. = Standard liquid

14.4.2 Response time

The response time depends on the configured application parameters.

Minimum values:
Two-wire version: ≥ 3 s

14.4.3 Measured value resolution

2 mm (0.08 in)

14.4.4 Measuring error

Better than ±4 mm (±0.16 in)or 0.2 % of the measuring distance, the larger value applies

Observe typical measured error under reference operating conditions
- Linearity
- Reproducibility
- Hysteresis

14.4.5 Maximum measured error

According to EN 61298-2; under reference operating conditions

±0.2 % in relation to the maximum sensor span

14.4.6 Influence of gas phase

The vapor pressure of the medium at 20 °C (68 °F) is an indicator of the accuracy of the ultrasonic level measurement.

Accuracy
Very good accuracy: vapor pressure at 20 °C (68 °F) less than 50 mbar (1 psi). This applies for:
- Water
- Aqueous solutions
- Water/solid solutions
- Diluted acids, e.g. hydrochloric acid, sulfuric acid
- Diluted bases, e.g. sodium hydroxide solution
- Oils, greases, lime water, sludges or pastes

Accuracy impacted: high vapor pressures or outgassing from media, e.g.:
- Ethanol
- Acetone
- Ammonia

Please contact the sales organization if the accuracy is affected.

14.5 Environment

14.5.1 Ambient temperature range

–40 to +80 °C (–40 to +176 °F)

The functionality of the LCD display is limited at Tu < –20 °C (–4 °F) and Tu > 60 °C (140 °F)

If operating outdoors in strong sunlight, use a weather protection cover. Can be ordered as an accessory.

14.5.2 Storage temperature

−40 to +80 °C (−40 to +176 °F)

14.5.3 Climate class

- DIN EN 60068-2-38 (Test Z/AD)
- DIN/IEC 68 T2-30Db

14.5.4 Degree of protection

When housing is closed, tested according to
- IP68, NEMA 6P (24 h at 1.83 m (6 ft) under water)
- IP66, NEMA 4X

When housing is open, tested according to
IP20, NEMA 1 (also degree of protection of the display)

14.5.5 Vibration resistance

DIN EN 60068-2-64/IEC 68-2-64: 20 to 2 000 Hz, 1 $(m/s^2)^2$/Hz; 3 x 100 min

14.5.6 Electromagnetic compatibility

Electromagnetic compatibility in accordance with all of the relevant requirements outlined in EN 61326 series and NAMUR Recommendation EMC (NE 21)

More information is provided in the Declaration of Conformity.

- Superimposed communication signal (HART): use a shielded cable
- Analog signal: use a standard installation cable

14.6 Process

14.6.1 Process temperature range

−40 to +80 °C (−40 to +176 °F)

The temperature sensor integrated in the sensor corrects the temperature-dependent sound time-of-flight.

14.6.2 Process pressure range

0.7 to 2.5 bar abs. (10.15 to 36.25 psi)

15 Appendix

15.1 Overview of the operating menu

Function groups and functions

Basic setup 00
- Tank shape: 002
- Medium property: 003
- Process cond. 004

- Empty calibration 005
- Full calibration 006
- Distance/measured value 008

Safety settings 01
- Outp. on alarm 010
- Outp. on alarm 011
- Outp. echo loss 012
- Ramp %span/min 013
- Delay time 014
- Safety distance 015
- In safety dist. 016
- Acknowledge alarm 017

Temperature 03
- Measured temp. 030
- Max. temp. limit 031
- Max. temperature 032
- React. high temp. 033
- Defect temp. sens. 034

Linearization 04
- Level/ullage 040
- Linearization 041
- Customer unit 042
- Table no. 043
- Input level 044
- Input volume 045
- Max. scale 046
- Diameter vessel 047

Extended calibration 05
- Selection 050
- Check distance 051
- Range of mapping 052
- Start mapping 053
- Pres. map dist. 054
- Mapping 055
- Echo quality 056
- Offset 057
- Output damping 058
- Blocking distance 059

Output 06
- Commun. address 060
- No. of preambles 061
- Low output limit 062
- Current output mode 063
- Fixed current 064
- Simulation 065
- Simulation value 066
- Output current 067
- 4 mA value 068
- 20 mA value 069

Envelope curve 0E
- Plot settings 0E1
- Recording curve 0E2
- Envelope curve display 0E3

Display 09
- Language 092
- Back to home 093
- Format display 094
- No. of decimals 095
- Sep. character 096
- Display test 097

Diagnostic 0A
- Present error 0A0
- Previous error 0A1
- Clear last error 0A2
- Reset 0A3
- Unlock parameter 0A4
- Measured dist. 0A5
- Measured level 0A6
- Detection window 0A7
- Application par. 0A8

System parameter 0C
- Measuring point 0C0
- Protocol+SW no. 0C2
- Serial number 0C4
- Distance unit 0C5
- Temperature unitOC6
- Download mode 0C8

Index

R

S

T

U

W

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