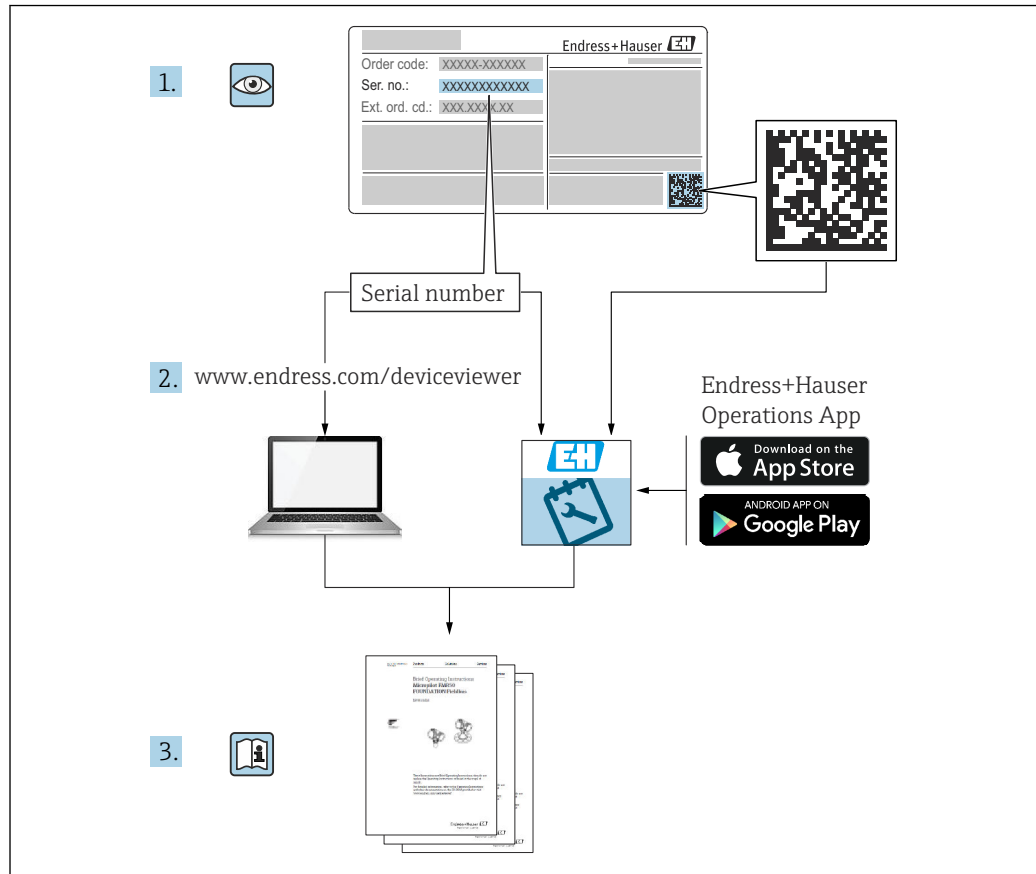# Operating Instructions
Prosonic S FMU95 PROFIBUS DP

Ultrasonic measuring technology
Level measurement
5 or 10 sensors

PROFI®
BUS

Endress+Hauser [EH]

People for Process Automation

A0023555

Table of contents

1   Important document information

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   Electrical symbols

∿

Alternating current

⎓

Direct current and alternating current

⎓

Direct current

⏚

Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

⏚ Protective earth (PE)

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

The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.2.3   Tool symbols

 Phillips head screwdriver

 Flat blade screwdriver

 Torx screwdriver

 Allen key

 Open-ended wrench

1.2.4   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

 Tip
Indicates additional information

 Reference to documentation

 Reference to graphic

▶ Notice or individual step to be observed
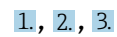
1. , 2. , 3.
Series of steps

↳ Result of a step

 Visual inspection

 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

 Temperature resistance of the connection cables
Specifies the minimum value of the temperature resistance of the connection cables

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   Registered trademarks

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

2   Basic safety instructions

2.1   Designated use

Prosonic S FMU95 is a transmitter for ultrasonic sensors FDU90, FDU91, FDU91F, FDU92, FDU93 and FDU95. To support existing installations, the following sensors can also be connected: FDU80, FDU80F, FDU81, FDU81F, FDU82, FDU83, FDU84, FDU85, FDU86, FDU96.

Typical measuring tasks
- Display of up to 10 measuring values
- Interference echo suppression (mapping) for each connected sensor
- Individually programmable linearization for each connected sensor
- Configurable calculation of totals and average values
- Measured value transmission via PROFIBUS DP

2.2   Installation, commissioning and operation

This device has been safely built with state-of-the-art technology and meets the applicable requirements and EU Directives. However, if it is used improperly or for applications for which it is not intended, application-related hazards may arise, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, commissioning, operation and maintenance of the measuring system must therefore be carried out exclusively by trained specialists authorized to perform such work by the system operator. Technical personnel must have read and understood these Operating Instructions and must adhere to them. Modifications and repairs to the device may only be carried out if they are expressly permitted in the Operating Instructions.

2.3   Operational safety and process safety

Alternative monitoring measures must be taken to ensure operational safety and process safety during configuration, testing and maintenance work on the device.

2.3.1   Hazardous area

When using the measuring system in hazardous areas, the applicable national standards must be observed. The device is accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. The installation specifications, connection data and safety instructions listed in this supplementary documentation must be observed.

- Ensure that the technical personnel is sufficiently trained.
- Comply with the metrological and safety-related requirements for the measuring point.

The transmitter may only be mounted in suitable areas. Sensors with an approval for hazardous areas may be connected to transmitters that do not have an Ex approval.

3   Product description

3.1   Product layout: polycarbonate field housing

ℹ️ Valid for:
Order code 030 (housing, material)
Option 1 (PC field mounting, IP66 NEMA4x)
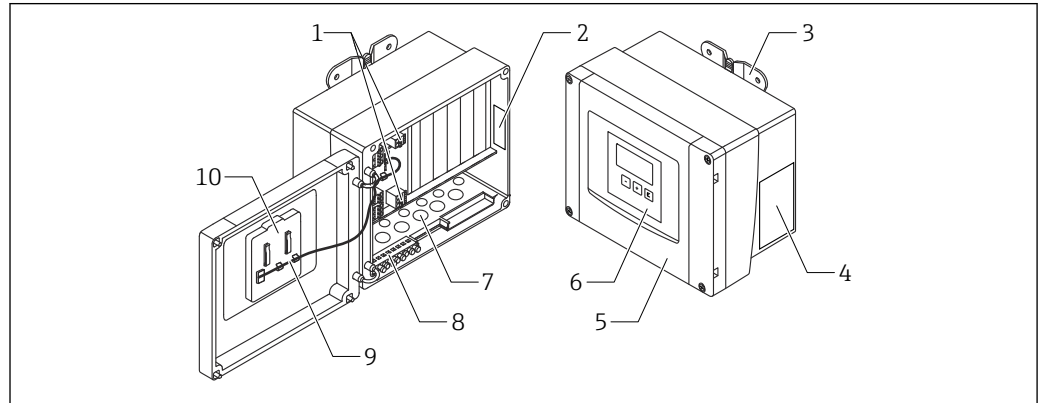
1   Parts of the Prosonic S in the polycarbonate field housing

1   Terminals
2   Device designation and identification
3   Housing bracket
4   Nameplate
5   Cover of terminal compartment
6   Display and operating module
7   Precut openings for cable entries
8   Grounding terminal block
9   Display cable
10   Brief Operating Instructions

3.2   Product layout: aluminum field housing

ℹ️ Valid for:
Order code 030 (housing, material)
Option 3 (aluminum field mounting, IP66 NEMA4x)
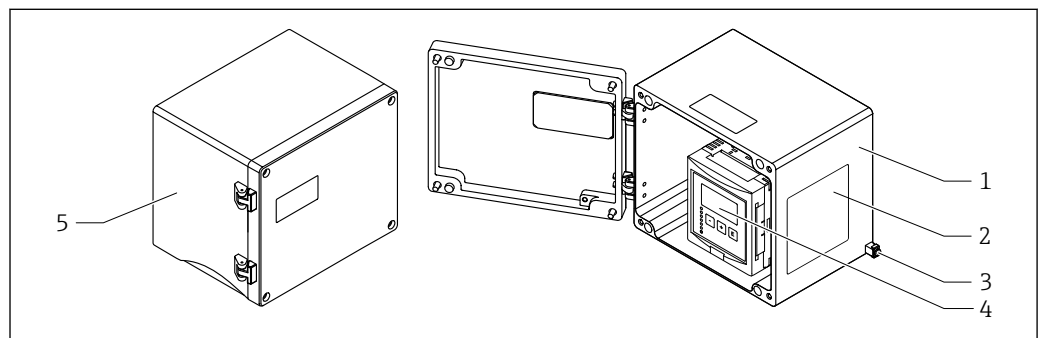
2   Parts of the Prosonic S in the aluminum field housing

1   Aluminum field housing, open
2   Nameplate
3   Terminal for potential equalization (protective ground)
4   Display and operating module
5   Aluminum field housing, closed

3.3   Product layout: DIN rail housing

ℹ️ **Valid for:**
Order code 030 (housing, material)
Option 2 (DIN rail mounting PBT, IP20)
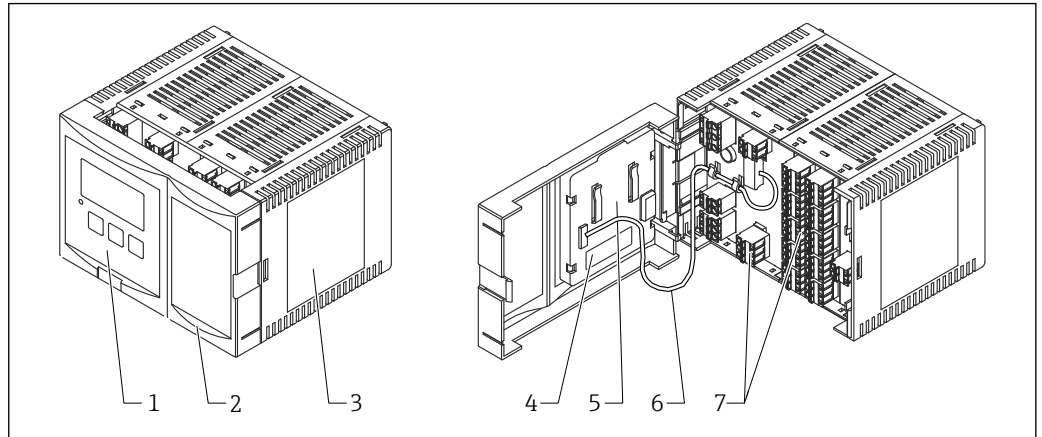
A0035268

🖼️ *3   Parts of the Prosonic S in the DIN rail housing*

1   Display and operating module
2   Cover of terminal compartment
3   Nameplate
4   Device designation and identification
5   Brief Operating Instructions
6   Display cable
7   Terminals

ℹ️ One possible version of the DIN rail housing is illustrated in the graphic above. The housing may be narrower or wider depending on the device version.

3.4   Product layout: remote display and operating module for cabinet door and panel mounting

ℹ️ **Valid for:**
Order code 040 (operation)
Option E (illuminated display + keypad, 96x96, panel mounting, IP65 at front)
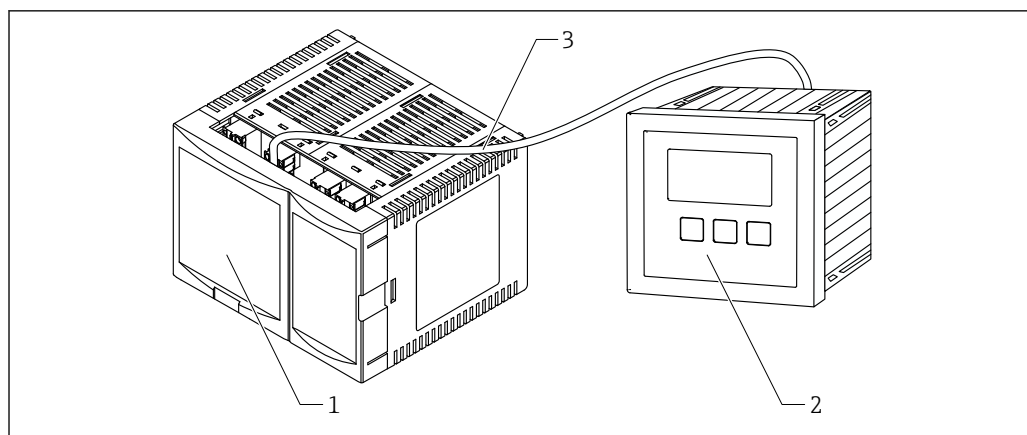
4   Parts of the Prosonic S with remote display and operating module

1   DIN rail housing without display and operating module
2   Remote display and operating module for mounting in a cabinet
3   The cable (3m [9.8 ft]) is supplied

One possible version of the DIN rail housing is illustrated in the graphic above. The housing may be narrower or wider depending on the device version.

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 label identical?
- Are the goods undamaged?
- Do the data on the nameplate 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 your Endress+Hauser sales office.

4.2 Product identification

The following options are available for the identification of the measuring device:
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial number on the nameplate into *W@M Device Viewer* (www.endress.com/deviceviewer): all the information about the measuring device is displayed.
- Enter the serial number on the nameplate into the *Endress+Hauser Operations App* or scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations App*: all the information about the measuring device is displayed.

4.2.1 Nameplate
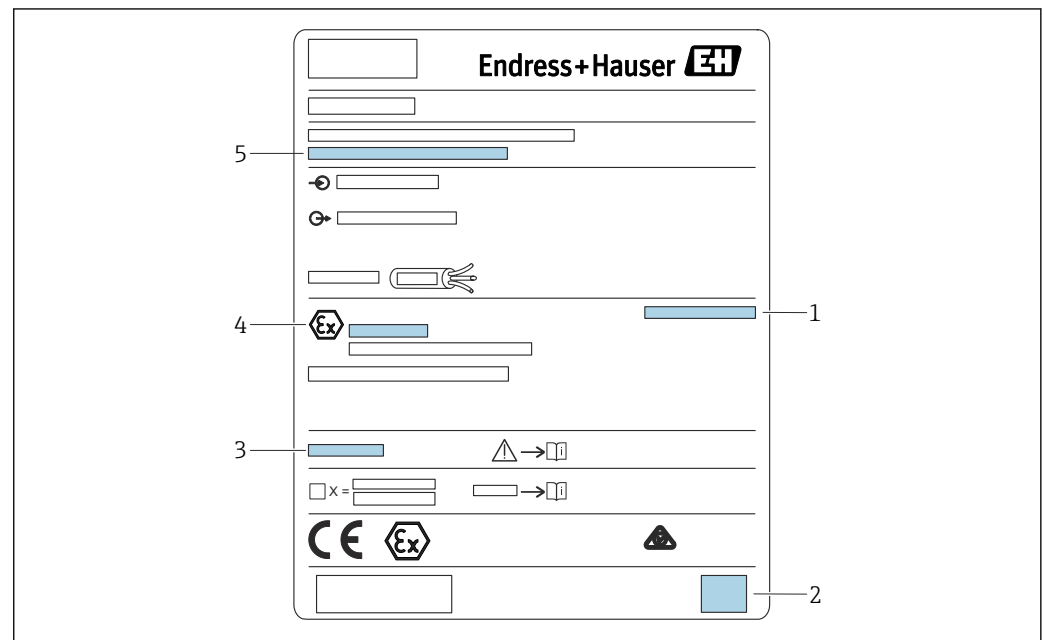
🖼 5   Nameplate

1   Degree of protection
2   2-D matrix code (QR code)
3   Reference to additional safety-related documentation
4   Identification marking according to ATEX Directive 2014/34/EC and type of protection
5   Serial number

4.3   Storage, transport

- Pack the device so that it is protected against impact for storage and transportation. The original packaging provides optimum protection.
- Permitted storage temperature: –40 to +60 ℃ (–40 to 140 ℉)

5   Installation

5.1   Mounting the polycarbonate field housing

Valid for:
Order code 030 (housing, material)
Option 1 (PC field mounting, IP66 NEMA4x)

5.1.1   Installation conditions

Dimensions of polycarbonate field housing
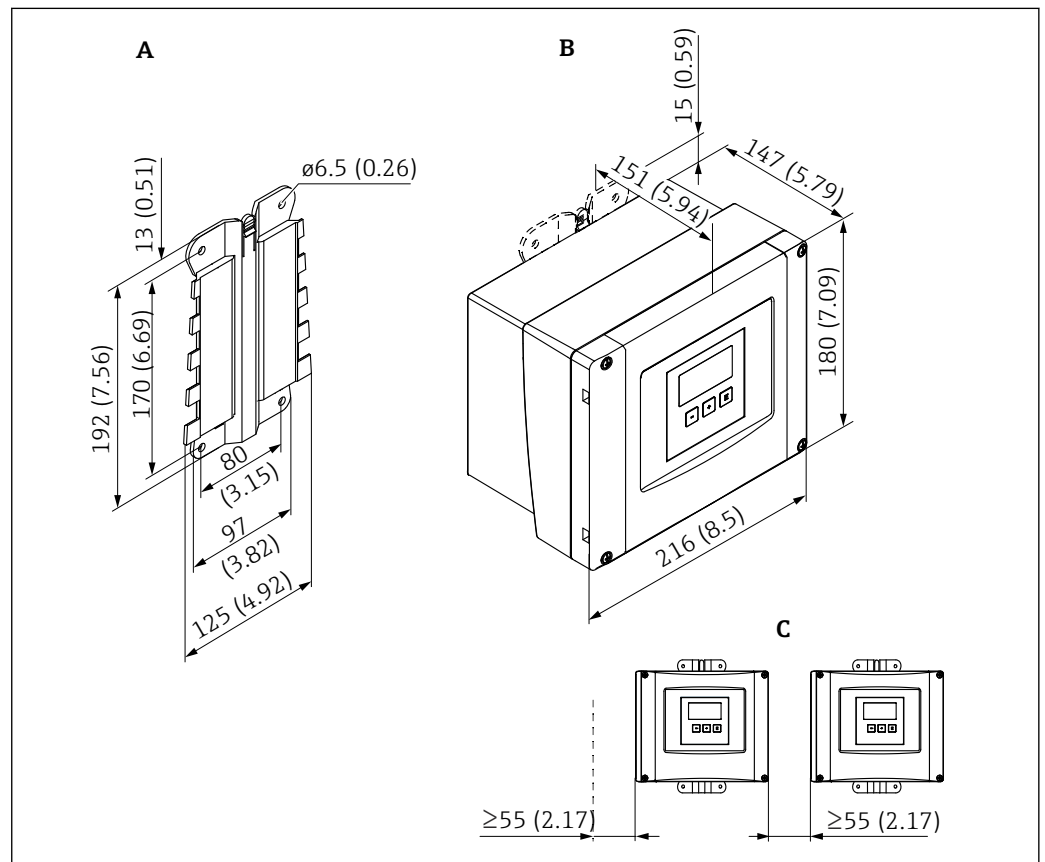
6   Dimensions of Prosonic S with polycarbonate field housing. Unit of measurement mm (in)

A   Housing bracket (supplied), can also be used as a drilling template
B   Polycarbonate field housing
C   Minimum mounting clearance

Mount the housing bracket on a level surface so that it cannot become warped or bent. Otherwise it may be difficult or impossible to mount the polycarbonate field housing.

Mounting location

- Shaded location, protected from direct sunlight. Use a weather protection cover if necessary.
- If mounting outdoors: use a surge arrester.
- Altitude: install at a maximum altitude of 2 000 m (6 560 ft) over MSL
- Minimum clearance to the left: 55 mm (2.17 in); the housing cover cannot be opened otherwise.

5.1.2   Mounting the device

Wall mounting

- The housing bracket supplied can also be used as a drilling template.
- Mount the housing bracket on a level surface so that it cannot become warped or bent.
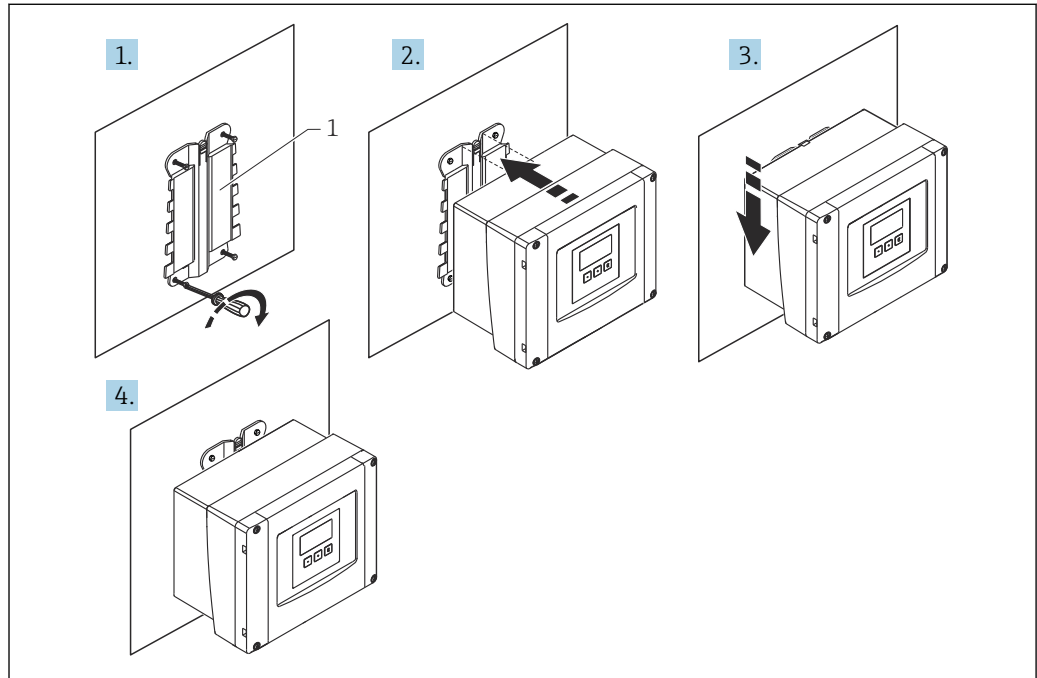
 7   Wall-mounted polycarbonate field housing

1   Housing bracket (supplied)

Post mounting
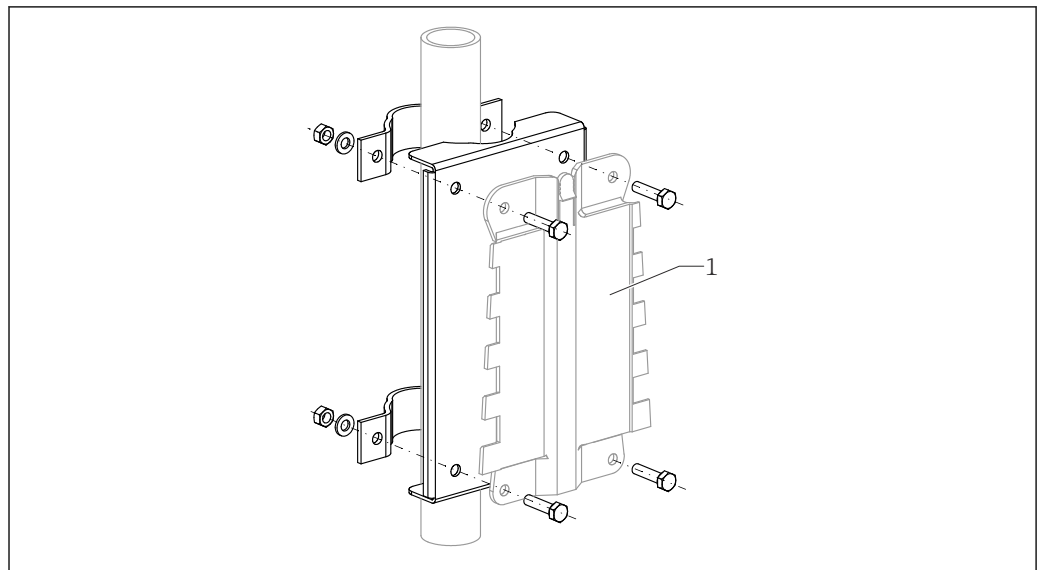
 8   Mounting plate for mounting the polycarbonate field housing on a post

1   Housing bracket (supplied)

5.2   Mounting the aluminum field housing

Valid for:
Order code 030 (housing, material)
Option 3 (aluminum field mounting, IP66 NEMA4x)

5.2.1   Installation conditions

Dimensions of the aluminum field housing
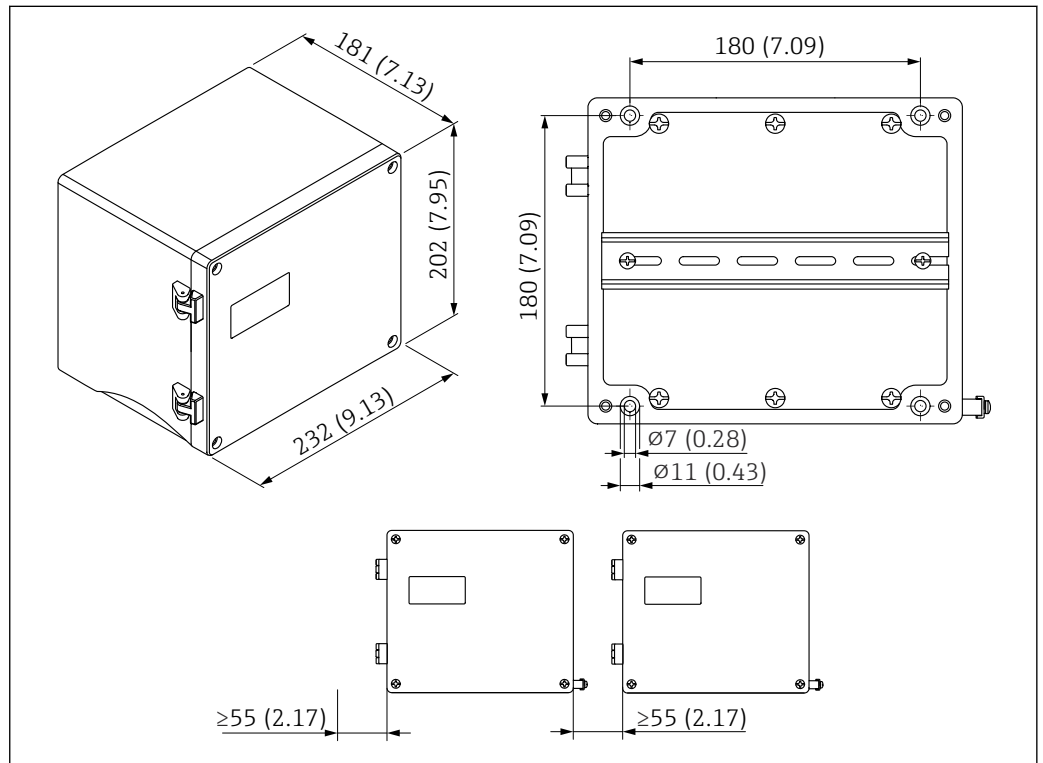
🖾 *9   Dimensions of Prosonic S with aluminum field housing. Unit of measurement mm (in)*

Mounting location

- Shaded location, protected from direct sunlight
- If mounting outdoors: use a surge arrester
- Altitude: install at a maximum altitude of 2 000 m (6 560 ft) over MSL
- Minimum clearance to the left: 55 mm (2.17 in); the housing cover cannot be opened otherwise

5.2.2   Mounting the device
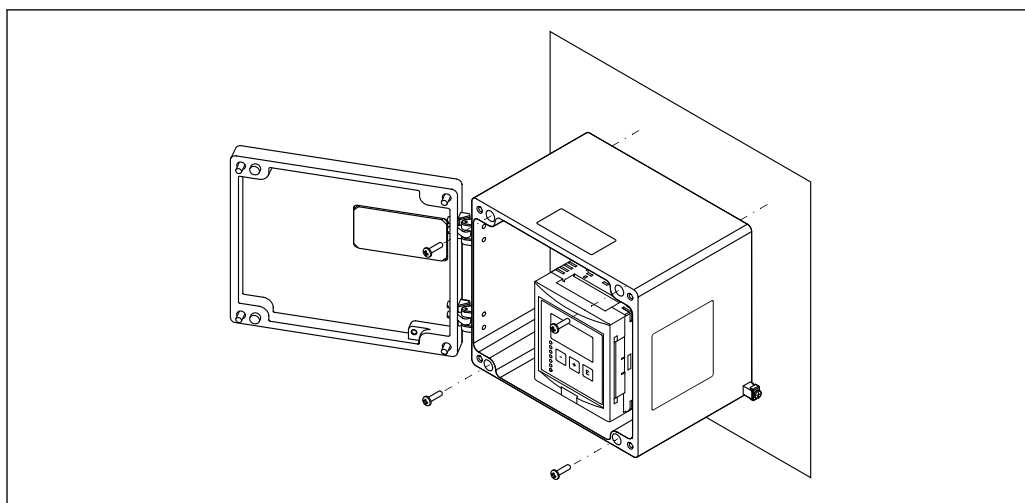
⊡ *10   Wall-mounted aluminum field housing*

5.3   Mounting the DIN rail housing

ℹ Valid for:
Order code 030 (housing, material)
Option 2 (DIN rail mounting PBT, IP20)

> **⚠ WARNING**
>
> **The DIN rail housing meets protection class IP06.**
> If the housing is damaged, there is a risk of electric shock at live parts.
> ▸ Install the device in a stable cabinet.

5.3.1   Installation conditions
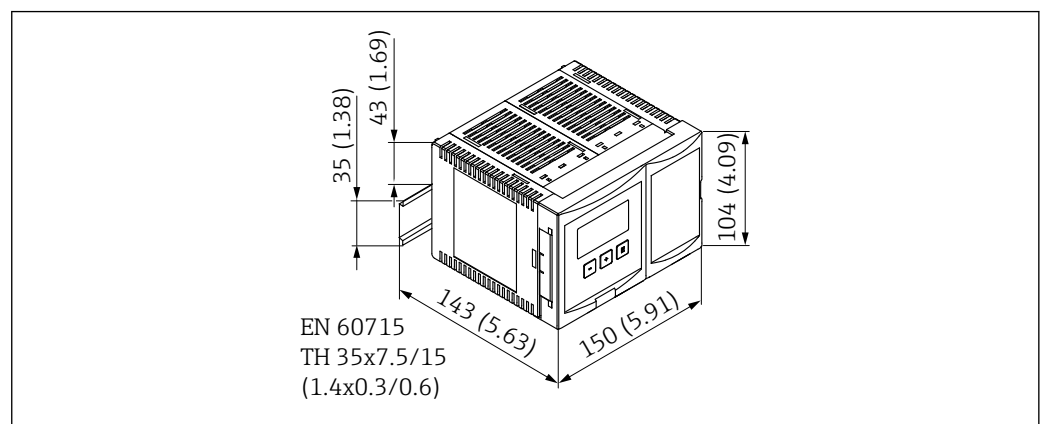
Dimensions

🖼 *11   Dimensions of Prosonic S with DIN rail housing. Unit of measurement mm (in)*

Mounting location

- In cabinet outside hazardous areas
- At a sufficient distance from high-voltage electric cables, motor cables, contactors or frequency converters
- Altitude: install at a maximum altitude of 2 000 m (6 560 ft) over MSL
- Minimum clearance to the left: 10 mm (0.4 in); the housing cover cannot be opened otherwise.

5.3.2   Mounting the device
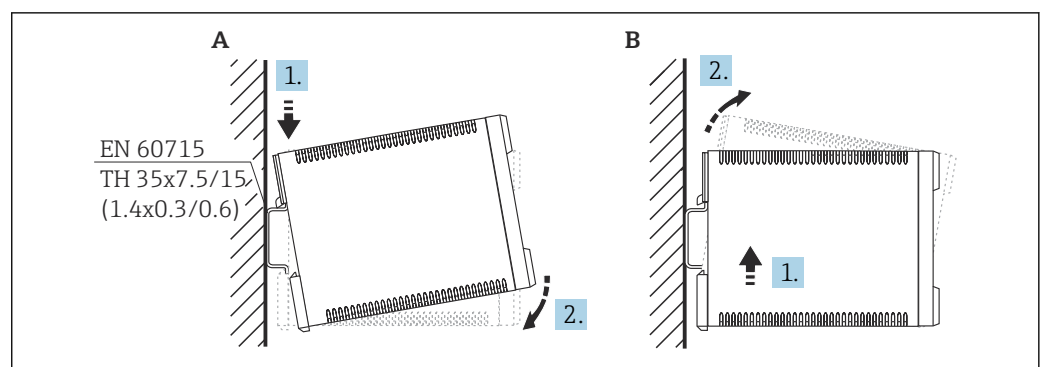
🖼 *12   Mounting/disassembling the DIN rail housing. Unit of measurement mm (in)*

A   Installation
B   Disassembly

5.4   Installing the remote display and operating module

Valid for:
Order code 040 (operation)
Option E (illuminated display + keypad, 96x96, panel mounting, IP65 at front)

5.4.1   Mounting methods

Mounting in appropriate installation opening
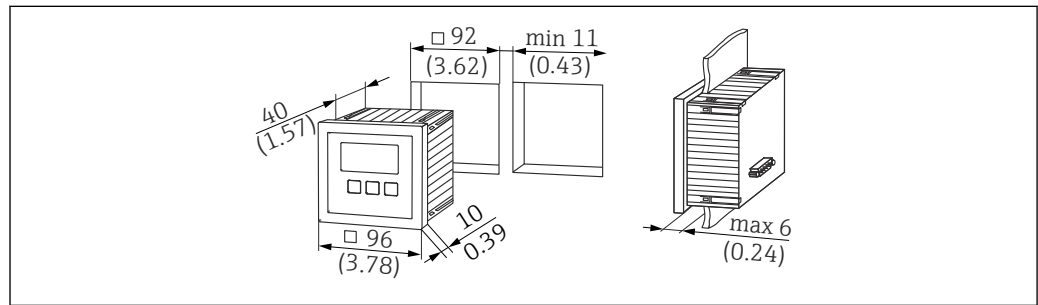
⊞ 13   Opening for remote display and operating module. Unit of measurement mm (in)

Mounting in remote display of Prosonic FMU860/861/862

- This mounting method is suitable if FMU9x replaces the FMU86x predecessor model (both with a remote display module).
- Order number for adapter plate: 52027441
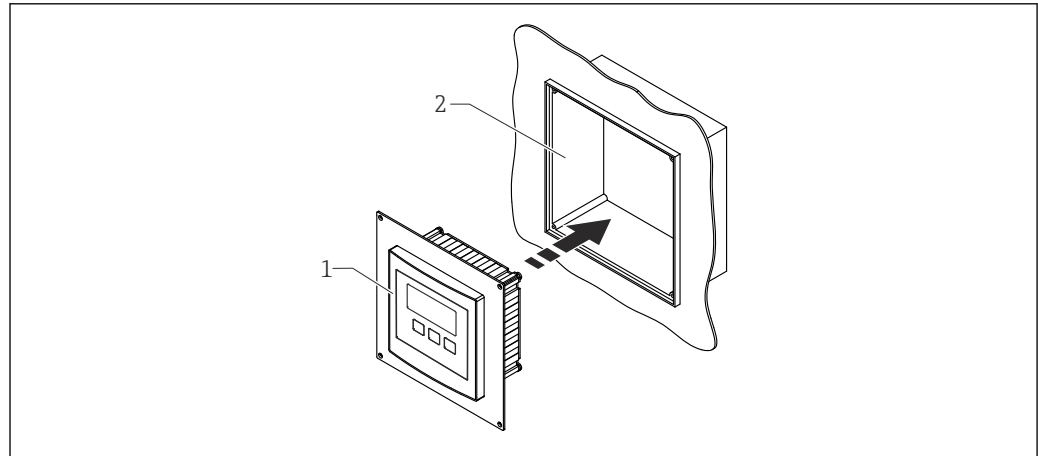
⊞ 14   Mounting in remote display of FMU860/861/862

1   Remote display of Prosonic S with adapter plate
2   Opening of remote display of the FMU860/861/862

5.4.2   Installing the device

Scope of delivery

- Display and operating module 96 x 96 mm (3.78 x 3.78 in)
- 4 retainers with nuts and screws
- Connecting cable (3 m (9.8 ft)) to connect to the transmitter (pre-terminated with suitable connectors)

Installation instructions
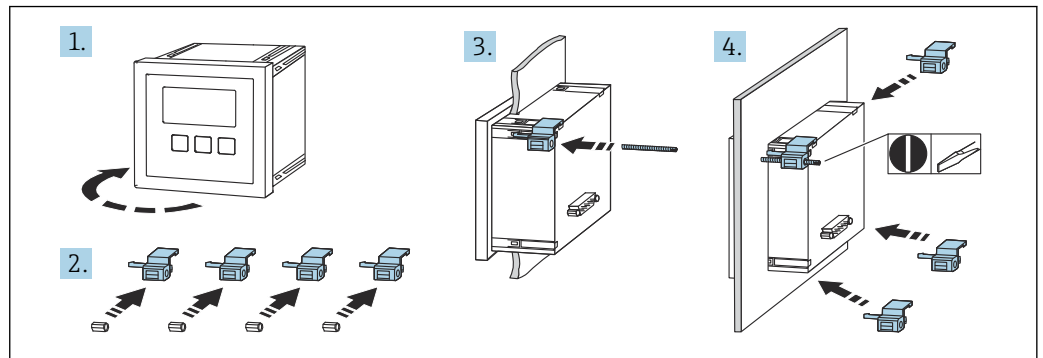
🖼 15   Installing the remote display and operating module

5.5   Mounting the sensors

📖 Further information and the documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.
Sensor documentation:
- TI01469F (FDU90)
- TI01470F (FDU91)
- TI01471F (FDU91F)
- TI01472F (FDU92)
- TI01473F (FDU93)
- TI01474F (FDU95)

Sensors FDU80/80F/81/81F/82/83/84/85/86/96 can no longer be ordered. The Prosonic S transmitter can still be connected if the sensors are already installed.

5.6   Post-installation check

Perform the following checks after mounting the device:

❑ Is the device undamaged (visual inspection)?

❑ Does the device match the measuring point specifications such as process temperature, process pressure, ambient temperature, measuring range etc.?

❑ If provided: are the measuring point number and labeling correct?

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

❑ In the case of the field housing: are the cable glands tightened correctly?

❑ Is the device firmly seated on the DIN rail/is the device correctly mounted on the field housing bracket (visual inspection)?

❑ Are the cover screws on the connection compartment cover of the field housing tightened securely (visual inspection)?

6   Electrical connection

6.1   Connection conditions

6.1.1   Cable specification

- **Conductor cross-section**: 0.2 to 2.5 mm² (26 to 14 AWG)
- **Wire sleeve cross-section**: 0.25 to 2.5 mm² (24 to 14 AWG)
- **Min. stripping length**: 10 mm (0.39 in)

6.2   Connecting the device

6.2.1   Terminal compartment of polycarbonate field housing

Valid for:
Order code 030 (housing, material)
Option 1 (PC field mounting, IP66 NEMA4x)

Access to terminal compartment
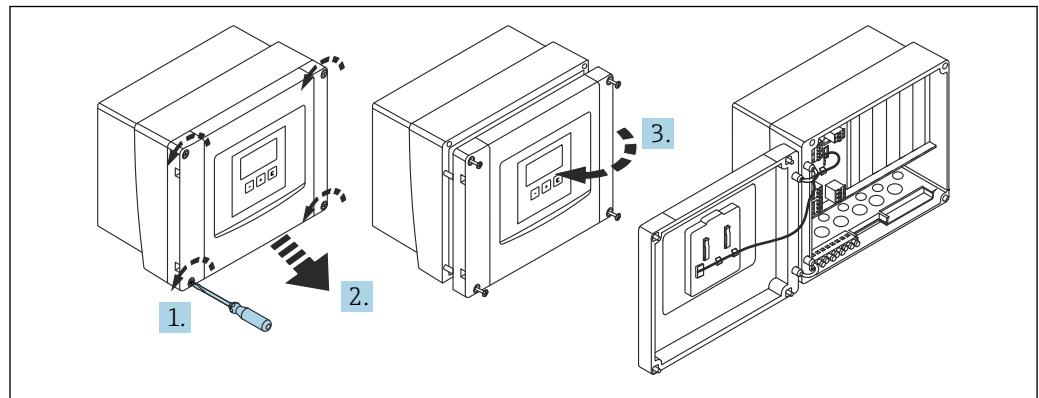
🖼 *16   Access to terminal compartment in polycarbonate field housing*
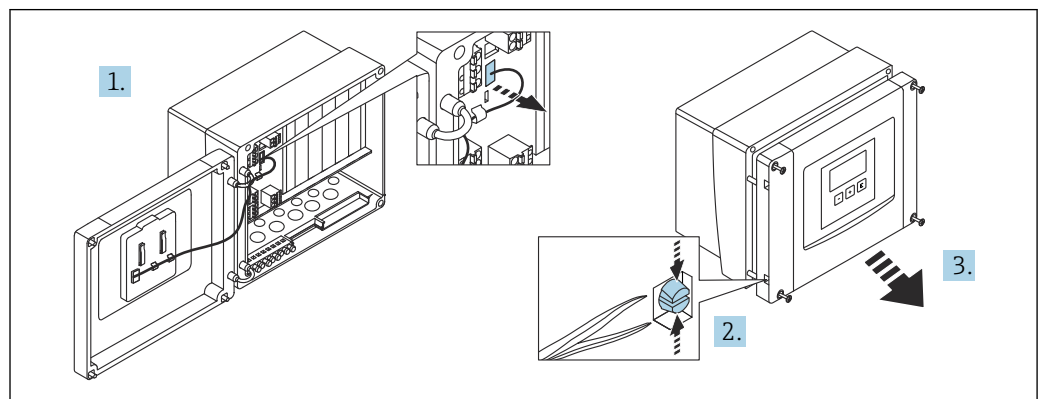
🖼 *17   For easier wiring, remove the cover from the field housing*

Cable entries

Precut openings on the bottom of the housing for the following cable entries:
- M20x1.5 (10 openings)
- M16x1.5 (5 openings)
- M25x1.5 (1 opening)

Use a suitable tool to cut out the openings.

6.2.2 Terminal compartment of aluminum field housing

ℹ **Valid for:**
Order code 030 (housing, material)
Option 3 (aluminum field mounting, IP66 NEMA4x)

> ⚠ **WARNING**
>
> **To ensure explosion protection:**
> ▸ Ensure that all the terminals are located in the field housing. (Exception: terminal for protective ground on the outside of the field housing).
> ▸ Connect the housing to the local ground potential (PML).
> ▸ To route the cables, only use cable glands that meet the explosion protection requirements at the place of operation.

Access to terminal compartment

A0033256
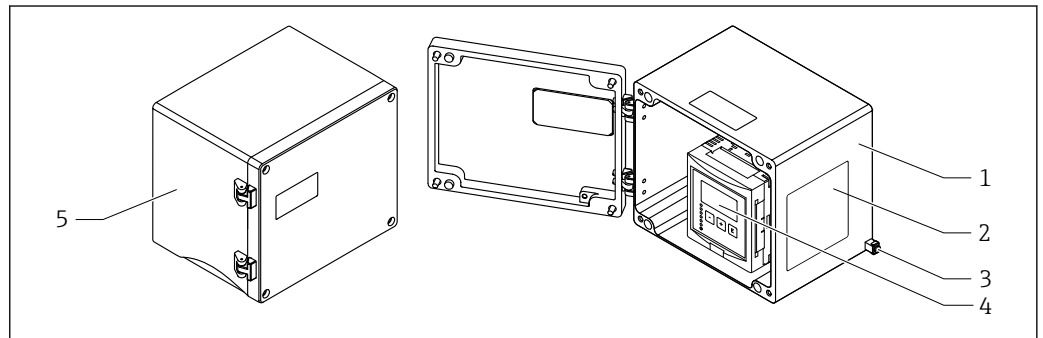
🖼 *18   Access to terminal compartment in aluminum field housing*

1   Aluminum field housing, open
2   Nameplate
3   Terminal for protective ground
4   Display and operating module
5   Aluminum field housing, closed

Cable entries

- 12 M20x1.5 openings for cable entries are located on the bottom of the field housing.
- To establish the electrical connection: guide the cables through the cable entries and into the housing. The electrical connection is then established in the same way as in the DIN rail housing.

6.2.3 Terminal compartment of DIN rail housing

ℹ **Valid for:**
Order code 030 (housing, material)
Option 2 (DIN rail mounting PBT, IP20)

Access to terminal compartment
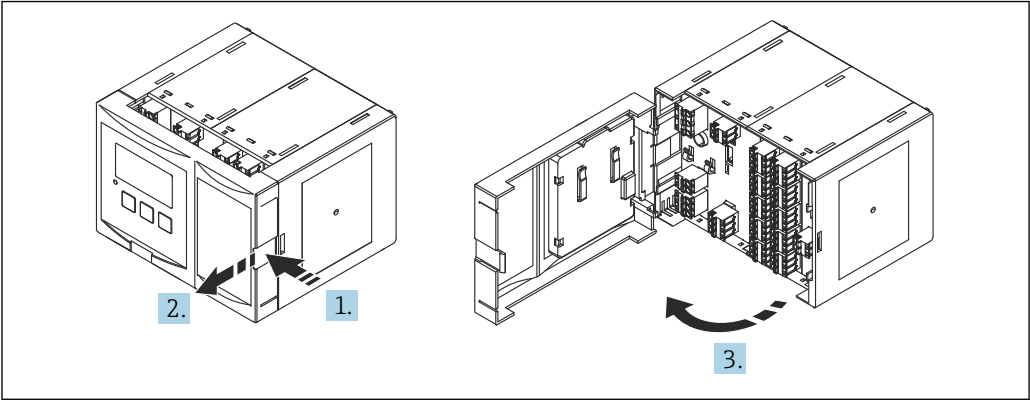
❖ *19   Access to terminal compartment: single DIN rail housing unit*
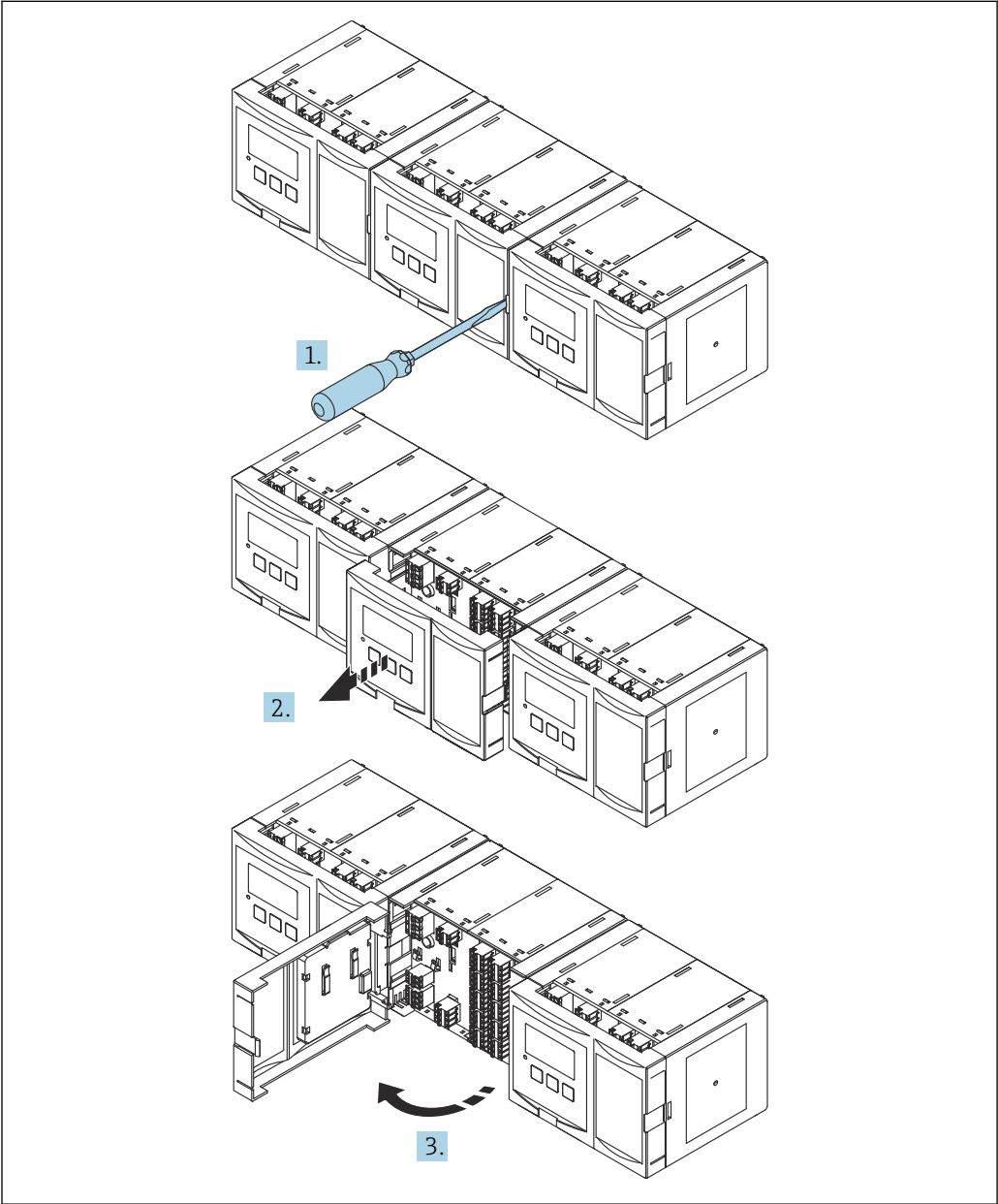
❖ *20   Access to terminal compartment: several DIN rail housing units mounted side by side*

6.2.4   Terminal assignment

Terminal type

Prosonic S has plug-in spring terminals. Rigid conductors or flexible conductors with ferrules can be inserted directly into the terminal without using the lever, and create a contact automatically.

Terminal areas
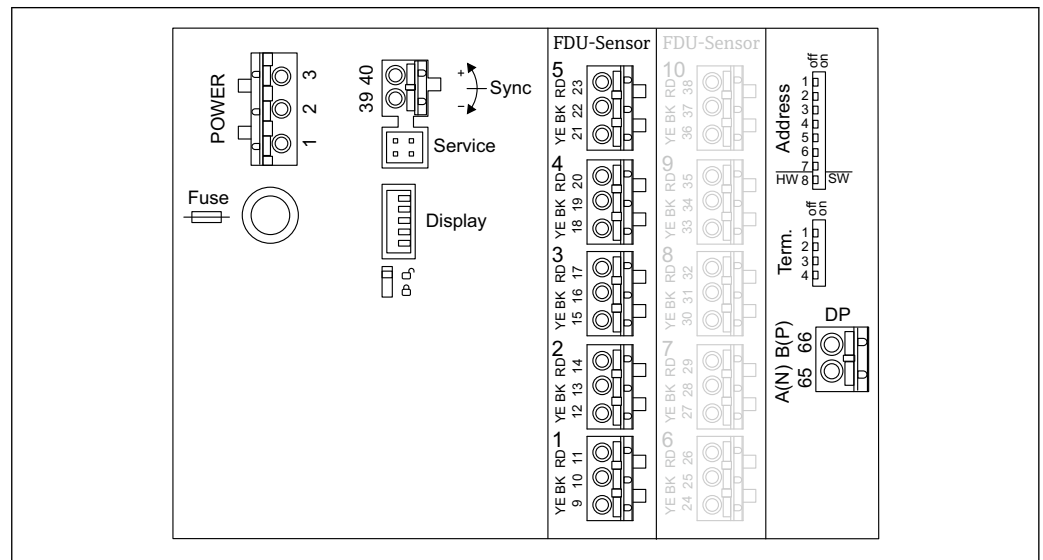
A0035251

🖾 *21   Terminal areas of Prosonic S FMU95*

Terminals for power supply (AC version)

- Terminal 1: L (90 to 253 V_{AC})
- Terminal 2: N
- Terminal 3: potential equalization
- Fuse: 400 mA T

Terminals for power supply (DC version)

- Terminal 1: L+ (10.5 to 32 V_{DC})
- Terminal 2: L-
- Terminal 3: potential equalization
- Fuse: 2AT

Terminals for level inputs

In all device versions
- Sensor 1: terminals 9 (yellow), 10 (black), 11 (red)
- Sensor 2: terminals 12 (yellow), 13 (black), 14 (red)
- Sensor 3: terminals 15 (yellow), 16 (black), 17 (red)
- Sensor 4: terminals 18 (yellow), 19 (black), 20 (red)
- Sensor 5: terminals 21 (yellow), 22 (black), 23 (red)

In device versions with 10 sensor inputs
- Sensor 6: terminals 24 (yellow), 25 (black), 26 (red)
- Sensor 7: terminals 27 (yellow), 28 (black), 29 (red)
- Sensor 8: terminals 30 (yellow), 31 (black), 32 (red)
- Sensor 9: terminals 33 (yellow), 34 (black), 35 (red)
- Sensor 10: terminals 36 (yellow), 37 (black), 38 (red)

Terminals for synchronization

Terminals 39, 40: synchronization of multiple Prosonic S transmitters

Terminals for PROFIBUS DP

- Terminal 65: PROFIBUS A (RxT/TxD - N)
- Terminal 66: PROFIBUS B (RxT/TxD - P)

Other elements on the terminal areas

- **Display**
  Connection of the display or the remote display and operating module
- **Service**
  Service interface; for connection of a PC/notebook via Commubox FXA291
- 🔒
  Write protection switch: locks the device to prevent modifications to the configuration.
- **Term.**
  Bus termination
- **Address**
  Device bus address

6.3 Special connection instructions

6.3.1 Connecting the power supply

⚠️ **CAUTION**

To guarantee electrical safety:
▶ Fix the power supply cables securely in place when installing so they are permanently connected to the electrical installations for the building.
▶ 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 power switch as a disconnector for the device (IEC/EN61010).
▶ For the 90-253VAC version: connect potential equalization
▶ Switch off the supply voltage before connecting.

Connection of the power supply in the polycarbonate field housing

ℹ️ Valid for:
Order code 030 (housing, material)
Option 1 (PC field mounting, IP66 NEMA4x)
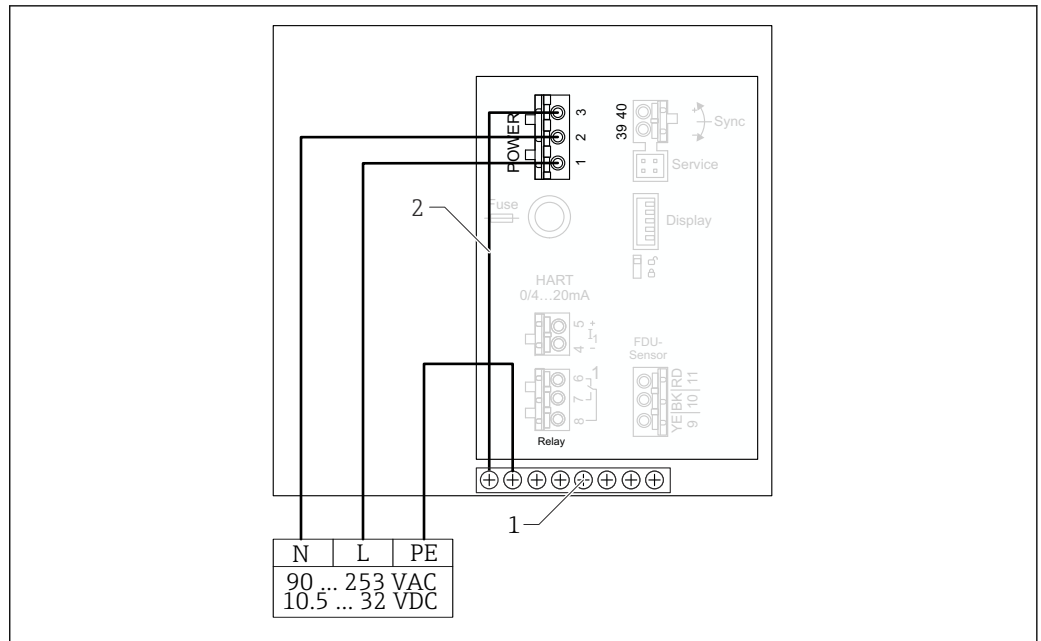
☒ 22   Connection of the power supply in the polycarbonate field housing

1   Terminal block in field housing for potential equalization
2   Potential equalization; wired on delivery

Connection of the power supply in the aluminum field housing

Valid for:
Order code 030 (housing, material)
Option 3 (aluminum field mounting, IP66 NEMA4x)

⚠ **WARNING**

Shock Hazard and Explosion Hazard
▶ Connect the aluminum field housing to the potential earth (PE) and/or the local ground potential (PML) via the protective ground terminal.
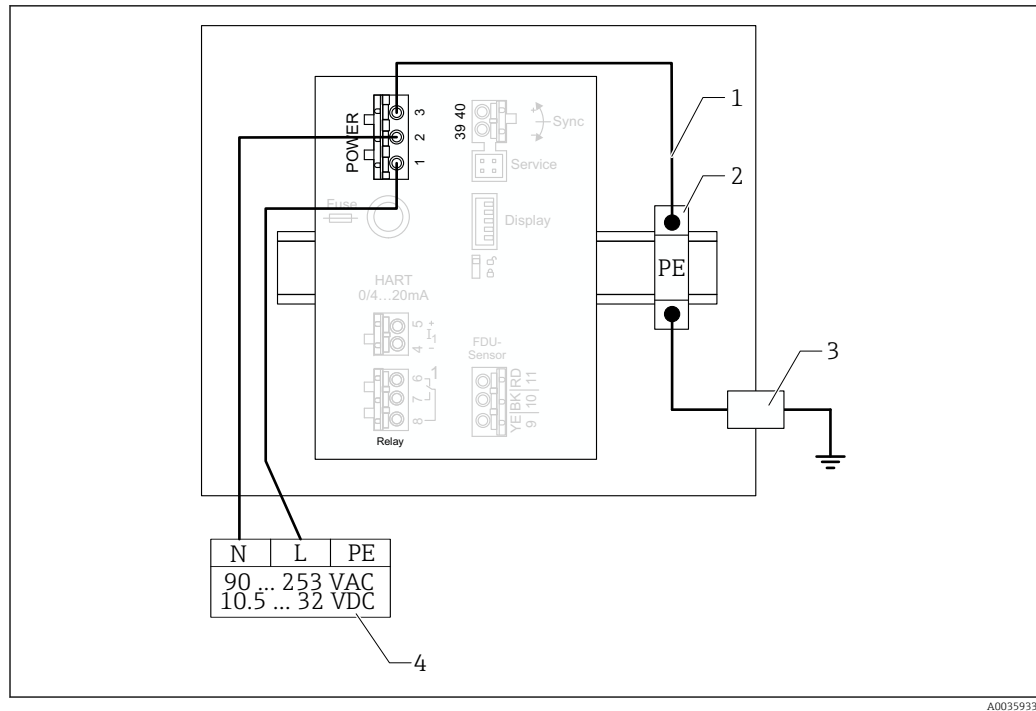
23 Connection of the power supply in the aluminum field housing

1   Potential equalization in aluminum field housing; wired on delivery
2   Protective ground terminal strip (with contact to DIN rail)
3   Protective ground terminal on outside of field housing
4   Power supply

Connection of the power supply in the DIN rail housing

ⓘ **Valid for:**
Order code 030 (housing, material)
Option 2 (DIN rail mounting PBT, IP20)
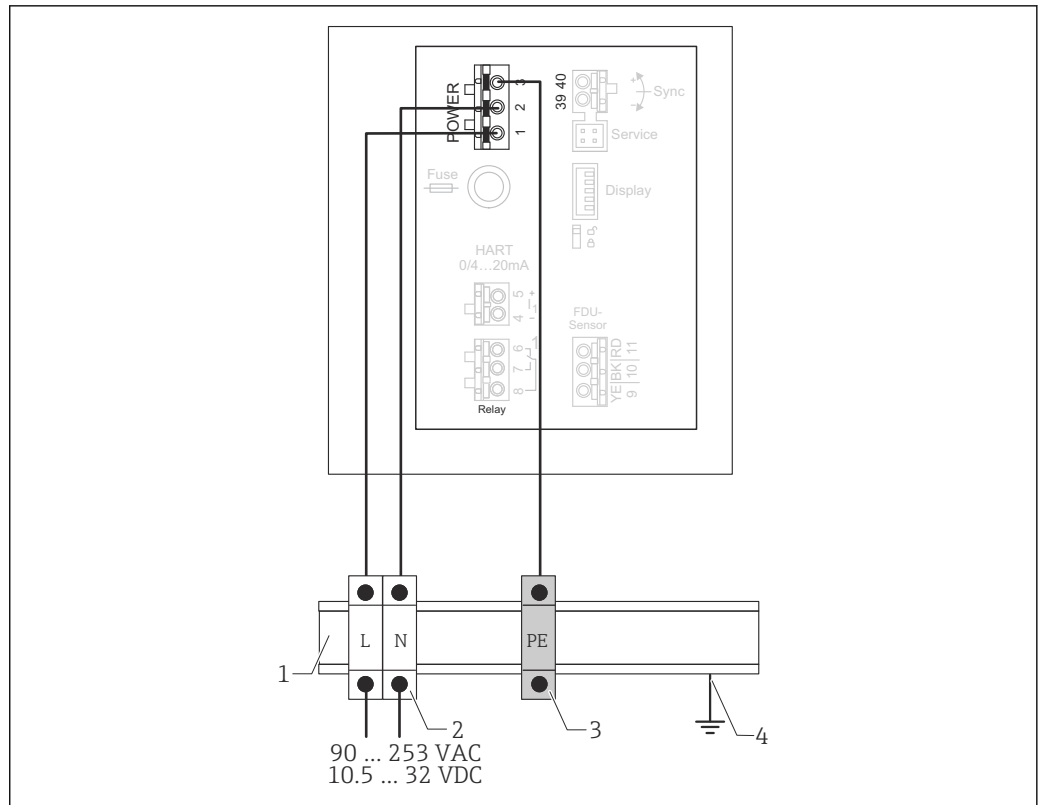
🖼 24   Connection of the power supply in the DIN rail housing

1   Metal DIN rail in cabinet
2   Terminal strip (no contact to DIN rail)
3   Protective ground terminal strip (with contact to DIN rail)
4   Grounding via DIN rail

6.3.2   Connection to a PROFIBUS DP network

ℹ️ For information on the layout of a PROFIBUS DP network, see Operating Instructions BA00034S, "PROFIBUS DP/PA - Guidelines for planning and commissioning"

Cable specification

ℹ️ For transmission rates up to 12 Mbit/s, use cable type A according to EN 50170.

- Characteristic impedance: 135 to 165 Ω at a measuring frequency of 3 to 20 MHz
- Cable capacitance: < 30 pF/m
- Wire cross-section: > 0.34 mm² (22 AWG)
- Wires: twisted pairs, 1x2, 2x2 or 1x4 conductors
- Loop-resistance: 110 Ω/km
- Signal attenuation: < 9 dB over the entire length of the cable segment
- Shielding: copper braided shielding or braided shielding and foil shield

ℹ️ Pre-terminated cables are available from Endress+Hauser.

T-junction boxes

It is recommended to connect the Prosonic S using T-junction boxes.

ℹ️ Suitable junction boxes are available from Endress+Hauser.

Spurs

Information regarding spurs
• The cable between the connector and the bus driver in the field device is known as a spur.
• Total length of all spurs < 6.6 m (22 ft) at max. 1.5 Mbit/s.
• Spurs may not have a bus terminator.
• Spurs should not be used for transmission rates > 1.5 Mbit/s.
• Practical experience in plants has shown that caution must be exercised when configuring spurs. It cannot be assumed that the sum of all spurs at transmission rates of 1.5 Mbit/s may be 6.6 m (22 ft). This is greatly influenced by the actual arrangement of the field devices.

6.3.3   Sensor connection

⚠ CAUTION

Inadequate potential equalization can compromise electrical safety
▶ Connect the yellow/green protective ground of the FDU91F, FDU93 and FDU95 sensors to local potential equalization after a **maximum distance of 30 m (98 ft)**. The can be done in a terminal box, at the transmitter or in the cabinet.

NOTICE

Interference signals may cause malfunctions
▶ Do not route the sensor cables parallel to high-voltage electric power lines or near frequency converters.

NOTICE

A damaged cable shield may cause malfunctions
▶ For pre-terminated cables: connect the black wire (shield) to the "BK" terminal.
▶ For extension cables: twist the shield and connect to the "BK" terminal.

⚠ WARNING

Explosion Hazard
▶ For the sensors FDU91F/93/95/96 and FDU83/84/85/86: connect the ground cable (GNYE) to local potential equalization after a maximum distance of 30 m (98 ft). This can be done in the terminal box or at the transmitter or in the cabinet if the distance to the sensor does not exceed 30 m (98 ft).

NOTICE

The evaluation electronics and their direct connections (display/service connector, service interface etc.) are galvanically isolated from the power supply and the communication signals, and are connected to the potential of the sensor electronics.
▶ Pay attention to the potential difference in the case of grounded sensors.
▶ If removing the jacket of the sensor cable, take the longest required cable length into consideration.

📖 Further information and the documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.
  Sensor documentation:
  • TI01469F (FDU90)
  • TI01470F (FDU91)
  • TI01471F (FDU91F)
  • TI01472F (FDU92)
  • TI01473F (FDU93)
  • TI01474F (FDU95)

  Sensors FDU80/80F/81/81F/82/83/84/85/86/96 can no longer be ordered. The Prosonic S transmitter can still be connected if the sensors are already installed.

Connection diagram for FDU9x → FMU95
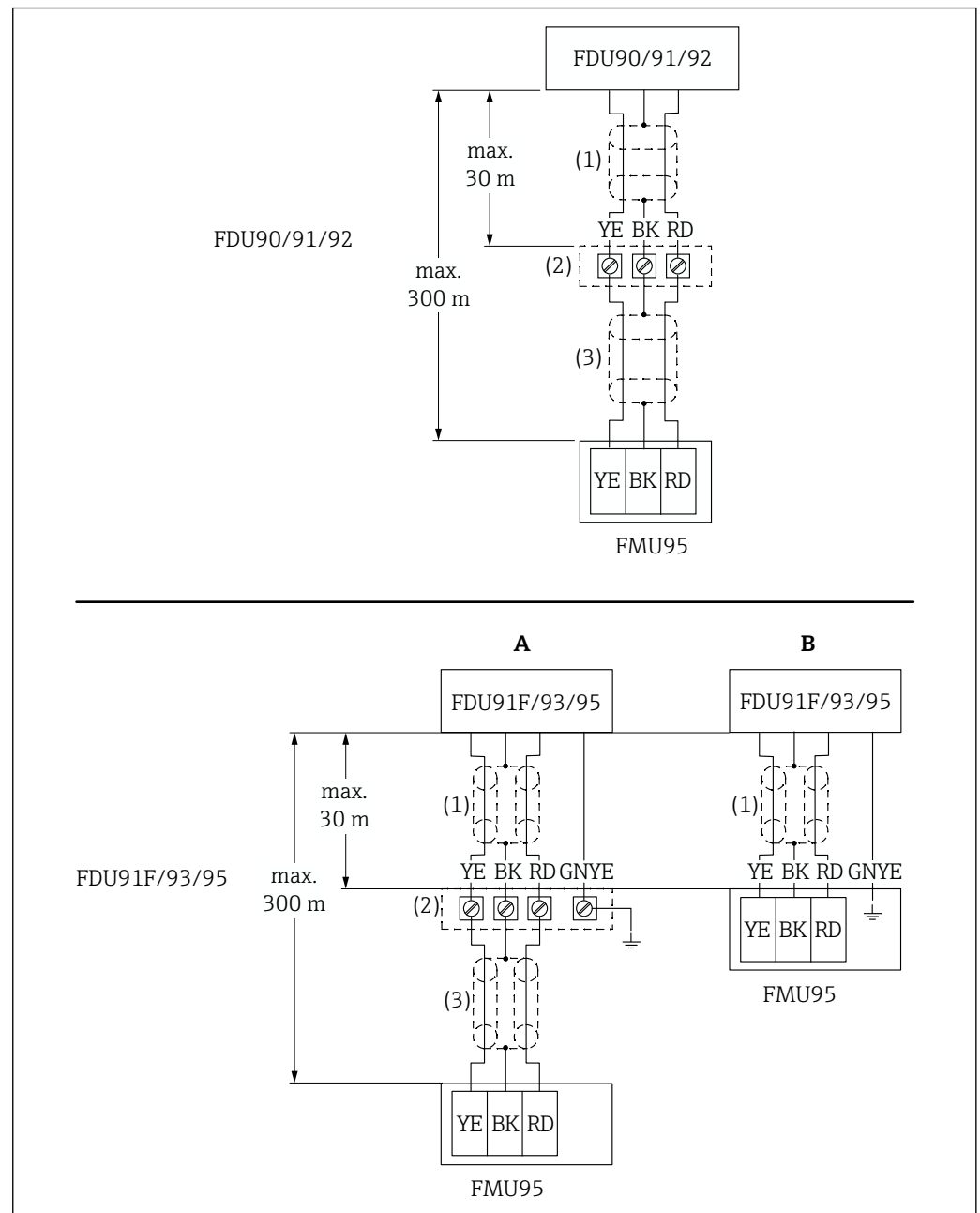
⊡ 25   *Connection diagram for sensors FDU9x; YE: yellow, BK: black; RD: red; BU: blue; BN: brown; GNYE: green/*
yellow

A   Grounding at terminal box
B   Grounding at transmitter FMU95
1   Shielding of sensor cable
2   Terminal box
3   Shielding of extension cable

Potential equalization of metallic sensors in polycarbonate field housing

ℹ **Valid for:**
Order code 030 (housing, material)
Option 1 (PC field mounting, IP66 NEMA4x)

Valid for the following sensors
- FDU91F
- FDU93
- FDU95

These sensors are no longer available but can be connected to the Prosonic S in existing installations.
- FDU96
- FDU83
- FDU84
- FDU85
- FDU86

⊠ *26   Potential equalization of metallic sensors in polycarbonate field housing*

1   FDU91F/93/95/96 (FDU83/84/85/86)
2   Terminal block in field housing for potential equalization
3   Potential equalization of supply voltage; wired on delivery

Potential equalization of metallic sensors in aluminum field housing

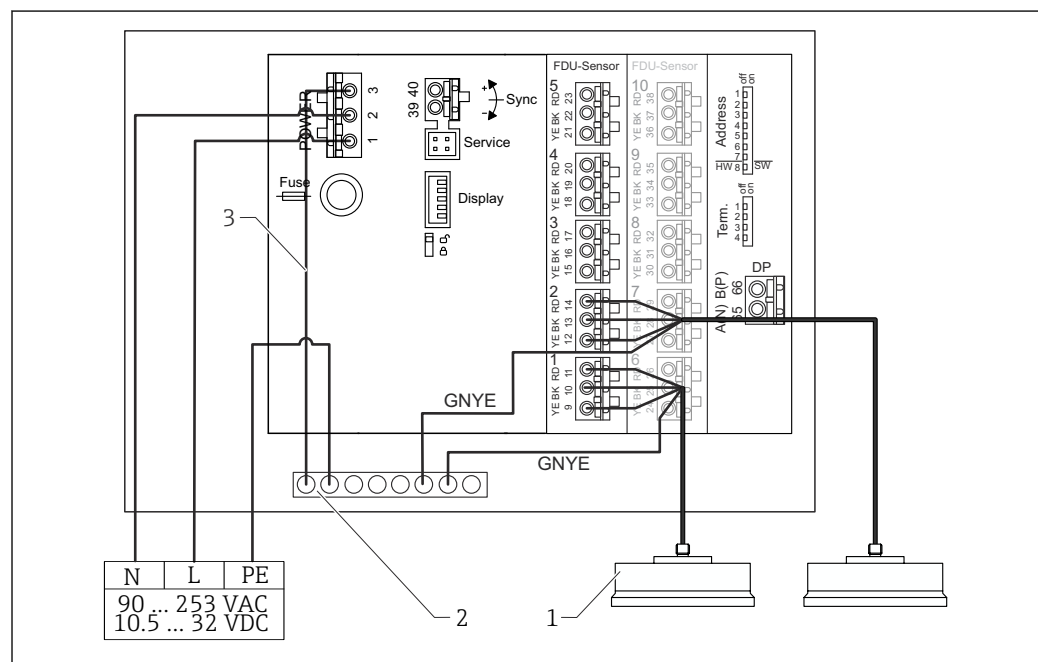ℹ **Valid for:**
Order code 030 (housing, material)
Option 3 (aluminum field mounting, IP66 NEMA4x)

Valid for the following sensors
- FDU91F
- FDU93
- FDU95

These sensors are no longer available but can be connected to the Prosonic S in existing installations.
- FDU96
- FDU83
- FDU84
- FDU85
- FDU86

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🖾 *27   Potential equalization of metallic sensors in aluminum field housing*

1   FDU91F/93/95/96 (FDU83/84/85/86)
2   Power supply
3   Potential equalization of supply voltage; wired on delivery
4   Protective ground terminal strip (with contact to DIN rail)
5   Protective ground terminal on outside of field housing

Potential equalization of metallic sensors in DIN rail housing

ℹ️ **Valid for:**
Order code 030 (housing, material)
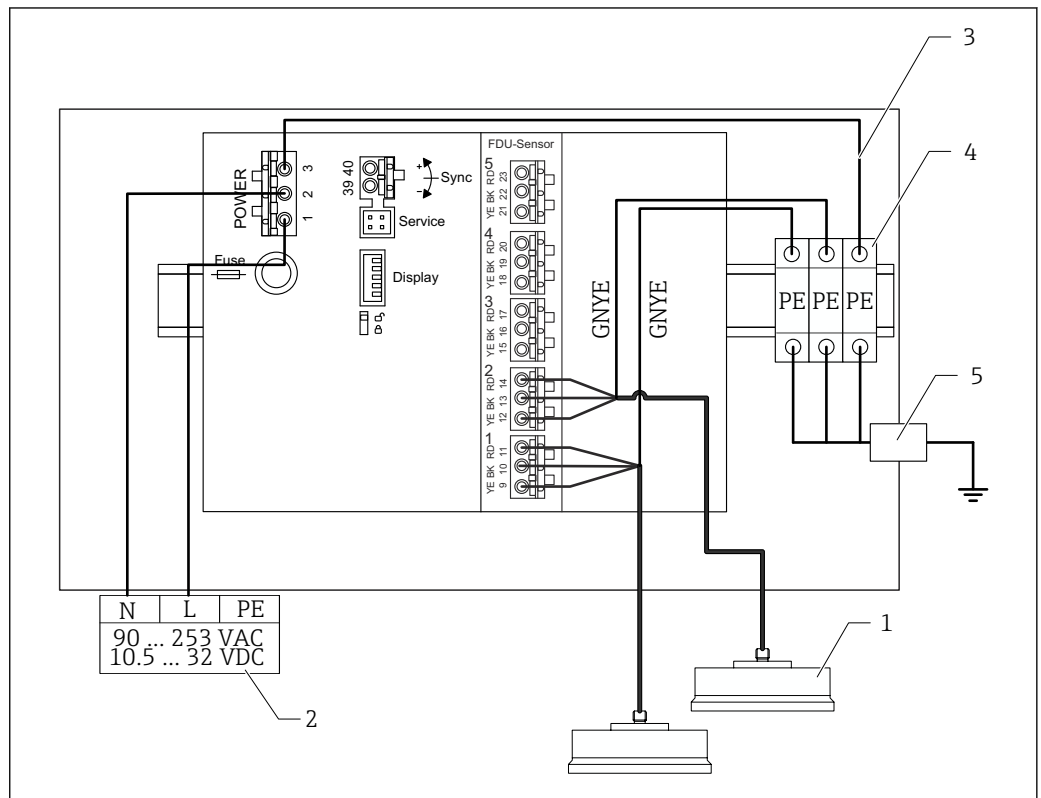Option 2 (DIN rail mounting PBT, IP20)

Valid for the following sensors
- FDU91F
- FDU93
- FDU95

These sensors are no longer available but can be connected to the Prosonic S in existing installations.
- FDU96
- FDU83
- FDU84
- FDU85
- FDU86
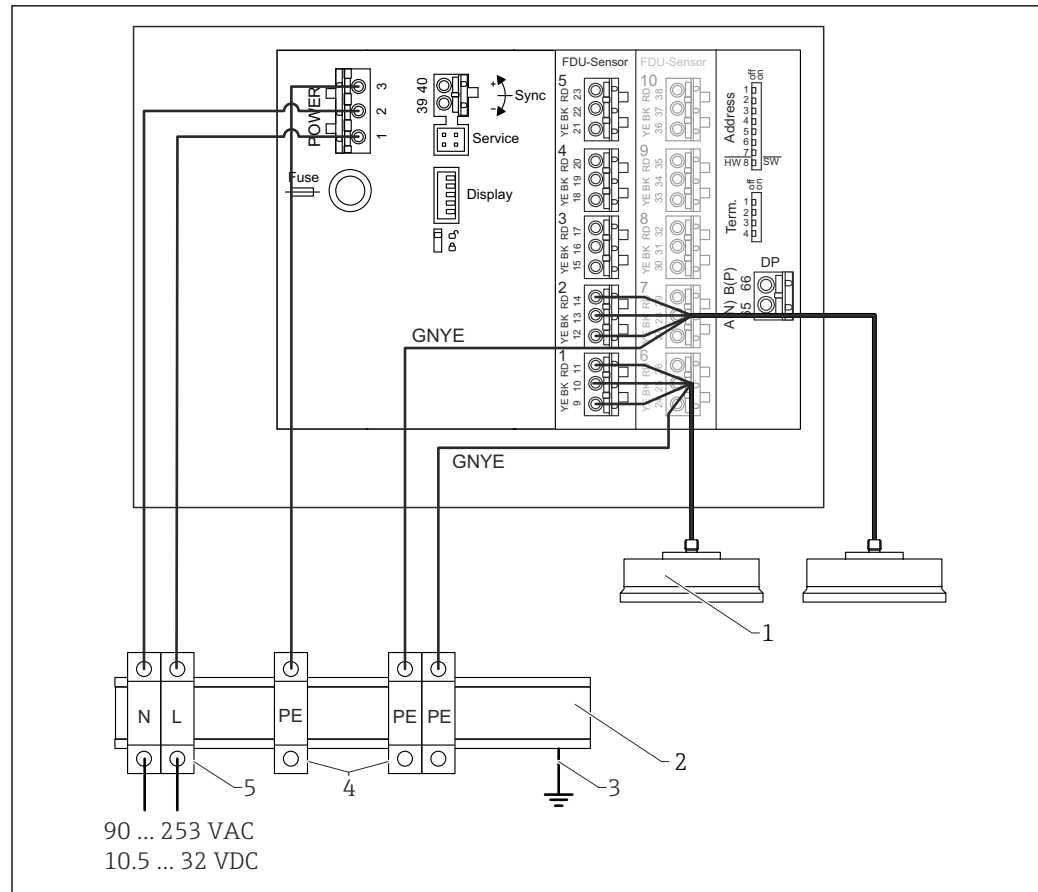
⊠ 28   Potential equalization of metallic sensors in DIN rail housing

1   *FDU91F/93/95/96 (FDU83/84/85/86)*
2   *Metal DIN rail in cabinet*
3   *Grounding via DIN rail*
4   *Protective ground terminal strip (with contact to DIN rail)*
5   *Terminal strip (no contact to DIN rail)*

6.3.4   Sensor extension cable

⚠ **WARNING**

Explosion Hazard
▶ Use a terminal box to connect the extension cable.
▶ If the terminal box is installed in hazardous areas, comply with applicable national requirements.

Extension cable specifications

- **Maximum total length (sensor cable + extension cable)**
  300 m (984 ft)
- **Number of wires**
  As per connection diagram
- **Shielding**
  One shielding braid for the YE wire and one for the RD wire (no foil shield)
- **Cross-section**
  0.75 to 2.5 mm² (18 to 14 AWG)

- **Resistance**
  Max. 8 Ω per wire
- **Capacitance, wire to shield**
  Max. 60 nF
- **Protective ground (for FDU91F/93/95)**
  May not be within the shielding.

ℹ️ Suitable connection cables are available from Endress+Hauser (→ 📖 73).

6.3.5 Shortening the sensor cable

NOTICE

Damaged wires or no return conductor may cause malfunctions

▸ Do not damage the wires when removing the insulation.
▸ After shortening the cable, twist the shielding metal braiding and connect it to the "BK" terminal.
▸ If the cable has a protective ground (GNYE), do **not** connect the protective ground to the cable shield.
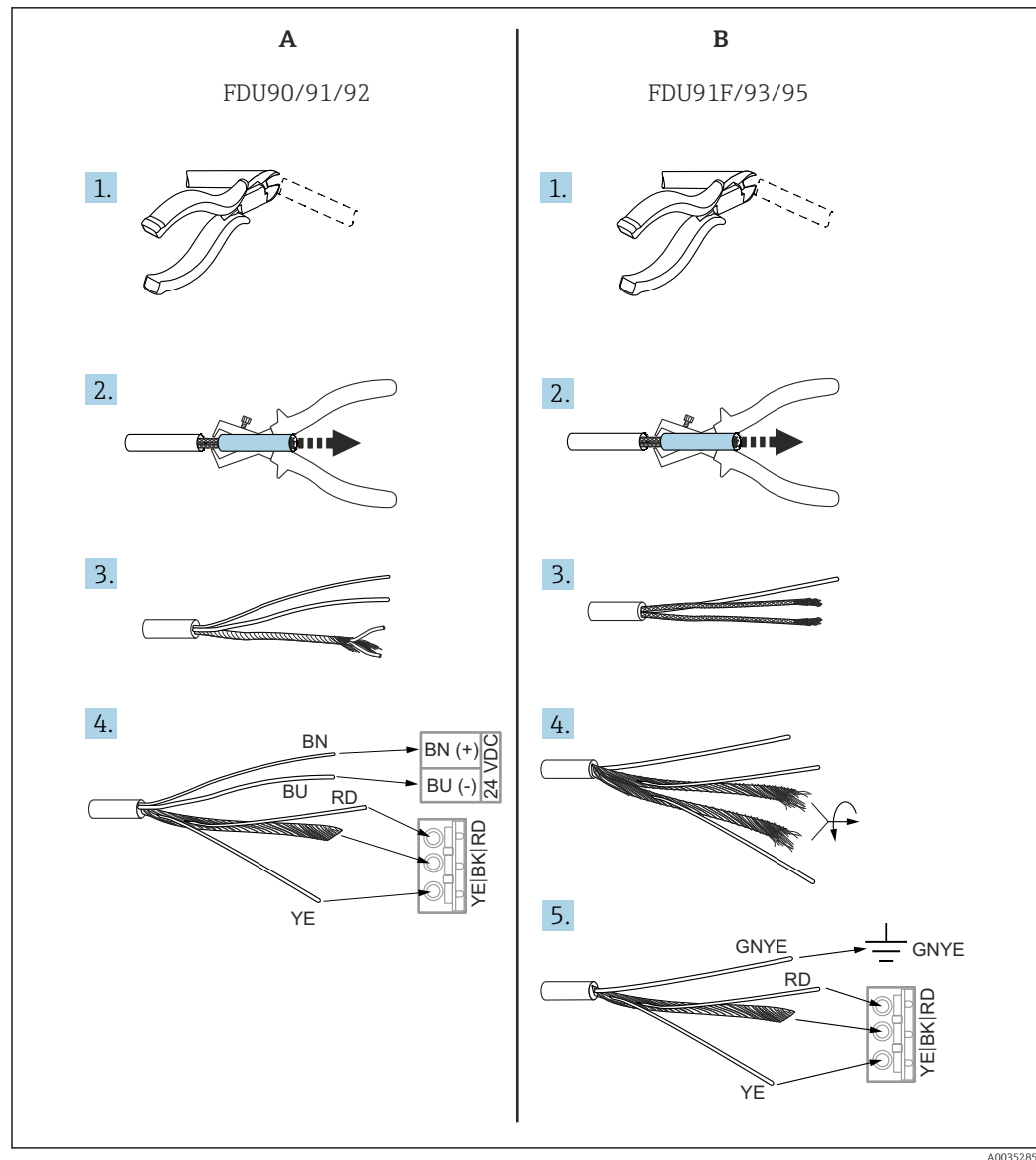
▣ 29   Shortening the sensor cable

A   FDU90/91/92 sensors
B   FDU91F/93/95 sensors

The "BU" (blue) and "BN" (brown) wires are only provided on sensors with a heater.

6.3.6   Synchronization terminal

Using the GSD files

The synchronization terminal must be used if the sensor cables of several transmitters are routed in parallel. As a result of synchronization, a transmitter cannot receive signals while another transmitter is transmitting signals. This prevents transmission and reception signals from mutually influencing one another.

Number of transmitters that can be synchronized

- 20 (in the case of FMU90/FMU95)
- 10 (if synchronizing FMU90/FMU95 with FMU86x)

Procedure if synchronizing more than 20 transmitters

• Form groups with a maximum of 20 transmitters.
• For transmitters within a group, the sensor cables can run in parallel.
• The sensor cables of different groups must be separated from one another.

Cable specification for synchronization

• **Max. length**
  10 m (33 ft) between the individual transmitters
• **Cross-section**
  2 x 0.75 to 2.5 mm² (18 to 14 AWG)
• **Cable shield**
  Required for cables > 1 m (3.3 ft); ground the shield.

Synchronization wiring diagram
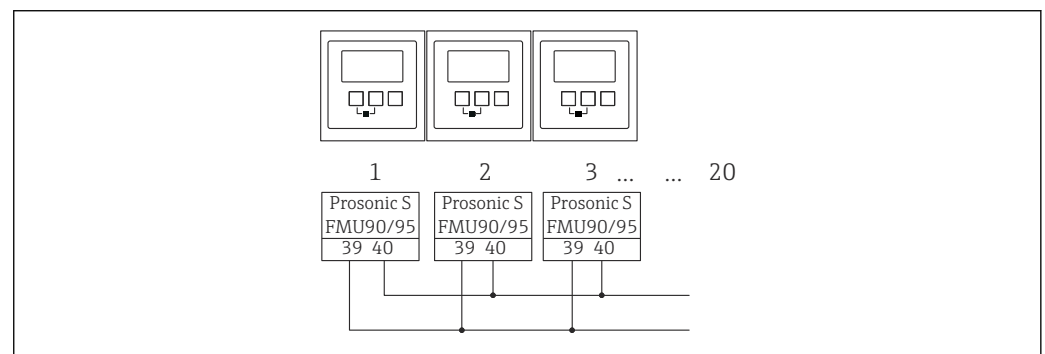
⊞ 30   Synchronization of multiple FMU90/FMU95 transmitters
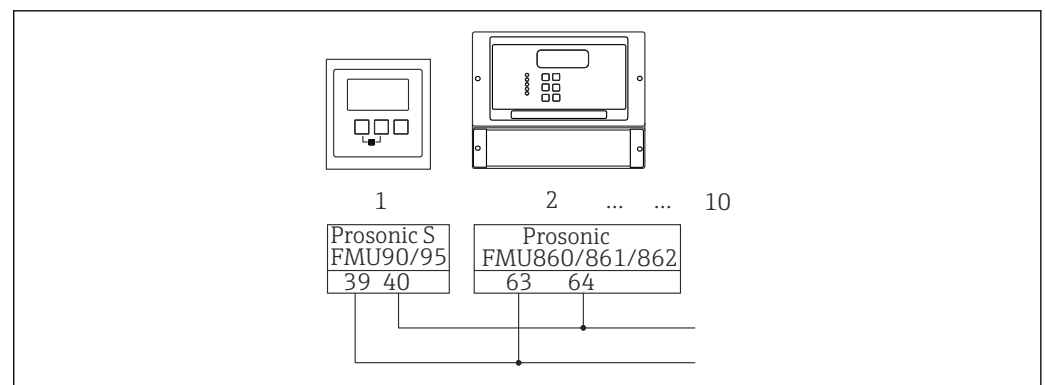
⊞ 31   Synchronization of FMU90/FMU95 with FMU86x

6.3.7   Connecting the remote display and operating module

Valid for:
Order code 040 (operation)
Option E (illuminated display + keypad, 96x96, panel mounting, IP65 at front)
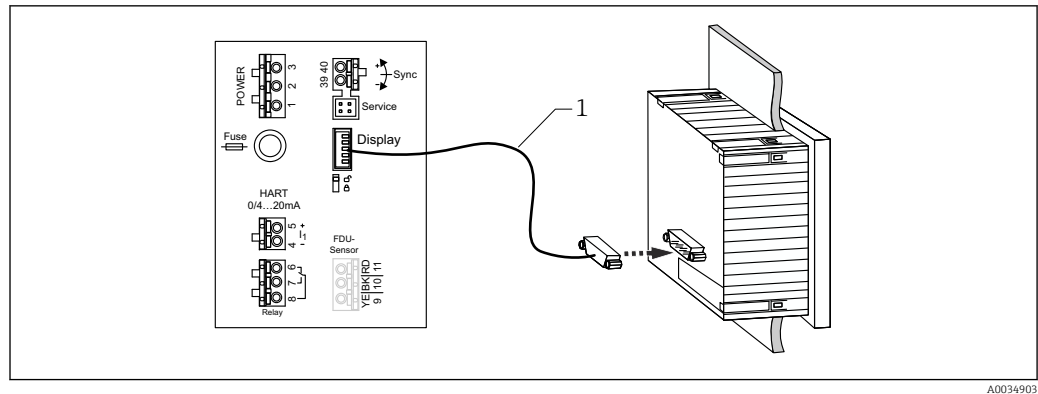
🖼 32   Connection of the remote display and operating module

1   Pre-terminated connecting cable 3 m (9.8 ft) with display plug (supplied)

Minimum diameter for cable entry

20 mm (0.79 in)

6.3.8   Post-connection check

❑ Is the terminal assignment correct?

For field housing (polycarbonate/aluminum):

❑ Are the cable glands tight?

❑ Is the housing cover securely closed?

For aluminum field housing:

❑ Is the housing connected to protective ground (PE) and/or the local ground potential (PML)?

If the power supply is switched on:

❑ Is the LED for the operating state lit green?

❑ If a display module is attached: does anything appear on the screen?

7 Operating options

7.1 Structure and function of the operating menu

7.1.1 Submenus and parameter sets

Parameters that belong together are grouped into one parameter set in the operating menu. Each parameter set is identified by a five-digit code.
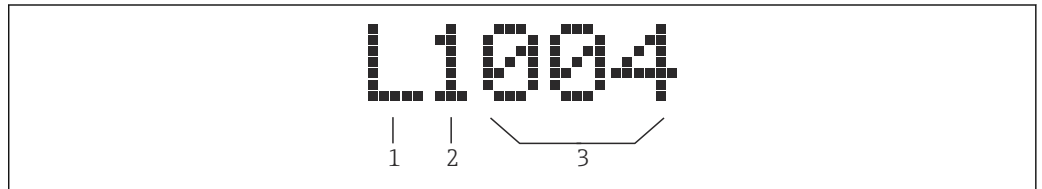
🖼 33   *Identification of the parameter sets:*

1   Submenu
2   Number of the associated input or output (for multi-channel devices)
3   Number of the parameter set within the submenu

7.1.2 Types of parameter

Read-only parameters

- Symbol: 🔲
- Cannot be edited.

Editable parameters

- Symbol: 🔲
- Can be opened for editing by pressing 🔲.

7.2 Access to the operating menu via the local display

7.2.1 Display and operating elements

Elements of the display and operating module
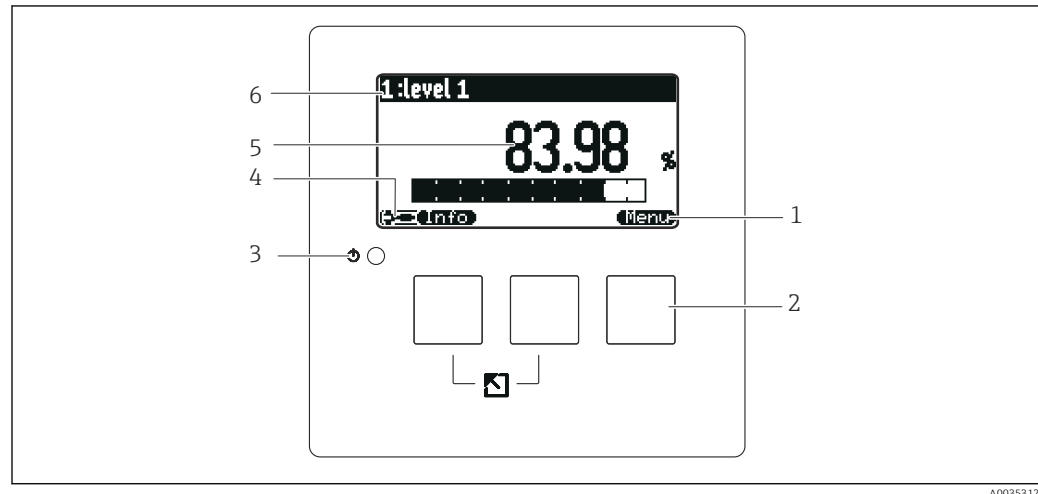
🖾 34 Display and operating module

1 Soft key symbols
2 Keys
3 LED to indicate the operational state
4 Display symbol
5 Parameter value with unit (here: primary value)
6 Name of displayed parameter

Symbols for operating state

-
  User operating state:
  User parameters can be edited. Service parameters cannot be edited.
-
  Diagnostics operating state:
  Service interface is connected.
-
  Service operating state:
  User parameters and service parameters can be edited.
-
  Locked operating state:
  All parameters are locked and cannot be edited.

Symbols indicating the editing state of the current parameter

-
  Read-only parameter
  The parameter **cannot** be edited in the current device operating state.
-
  Editable parameter
  The parameter can be edited.

Scroll symbols

⊡ ⊡
Scroll list available
Is displayed if the picklist contains more options than can be shown on the display. All the options in the list can be displayed by pressing ⬛⬛ or ⬛⬛ repeatedly.

Navigation in the envelope curve display (select the "Cyclic" display format)

- ◀◀
  Move left
- ▶▶
  Move right
- ◀▶
  Zoom in
- ▶◀
  Zoom out

LED for operating state

- **Lit green**
  Normal operation; no errors detected
- **Flashes red**
  Warning: an error has been detected, but measurement continues. The reliability of the measured value cannot be guaranteed.
- **Lit red**
  Alarm: an error has been detected. Measurement is interrupted. The measured value adopts the value specified by the user ("Output on alarm").
- **Off**
  No supply voltage.

Keys (soft key operation)

The current key function is indicated by soft key symbols above the key.

- ⬛⬛
  Moves the selection bar downwards in a picklist.
- ⬛⬛
  Moves the selection bar upwards in a picklist.
- ⬛⬛
  - Opens the selected submenu, parameter set or parameter.
  - Confirms the edited parameter value.
- ⬛⬛
  Goes to the previous parameter set within the submenu.
- ⬛⬛
  Goes to the next parameter set within the submenu.
- ⬛⬛
  Selects the option in a picklist which is currently marked by the selection bar.
- ⬛⬛
  Increases the selected digit of an alphanumeric parameter.
- ⬛⬛
  Decreases the selected digit of an alphanumeric parameter.
- ⬛⬛
  - Opens the list of errors which are currently detected.
  - If a warning is present, the symbol flashes.
  - If an alarm is present, the symbol is displayed permanently.

- ▪ ⬛▬◀▬⬛
  Displays the next page of measured values (only available if several pages of measured values have been defined; see the "Display" menu).
- ▪ **Info**
  Opens the "Shortcut" menu, which contains the most important read-only parameters.
- ▪ **Menu**
  Opens the main menu from where you can access **all** the device parameters.

General key combinations
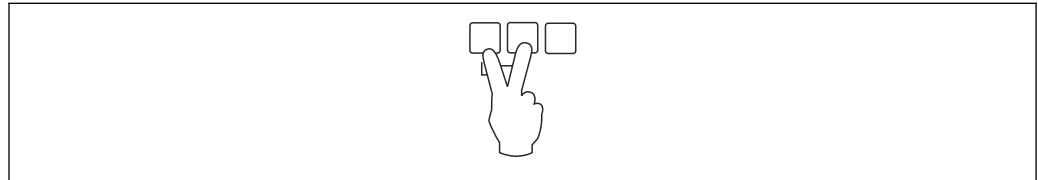
🔲 *35   Escape*
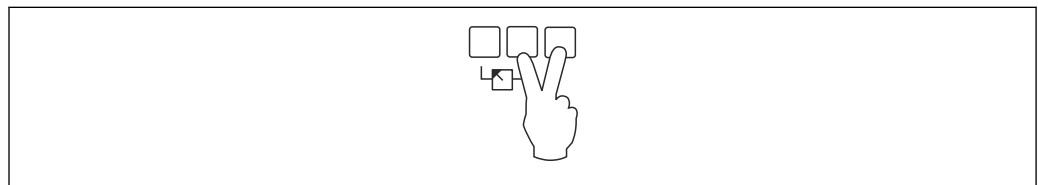
🔲 *36   Increase contrast*
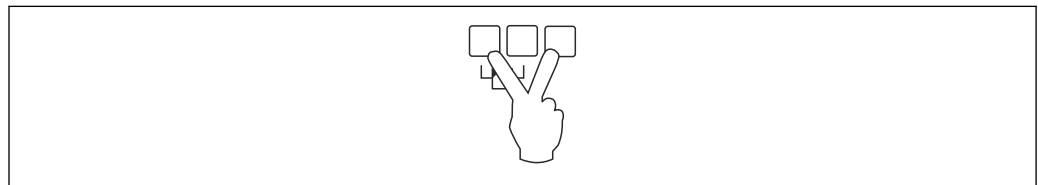
🔲 *37   Reduce contrast*
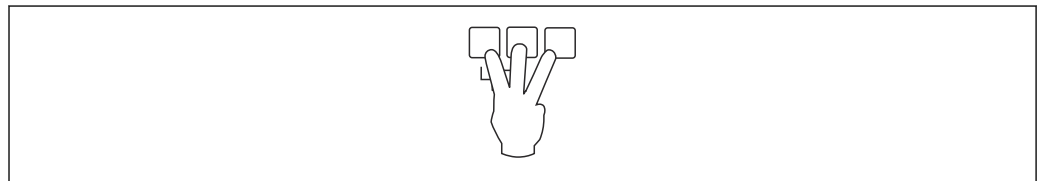
🔲 *38   Locking*

7.2.2 Calling the operating menu from a standard screen (measured value display)

- **Left button ("Info"): shortcut menu**
  Fast access to the most important parameters:
  - Tag marking
  - Envelope curve
  - Language
  - Device information
  - Password/reset
- **Middle key: current errors**
  If the self-monitoring system detects one or more errors, the soft key symbol appears above the middle key. When the button is pressed, a list of all the errors currently pending is displayed.
- **Right key ("Menu"): main menu**
  Contains all the parameters of the device, subdivided into submenus and parameter sets.

8   System integration

8.1   Overview of device description files

8.1.1   Device master file (GSD)

Meaning

The device master file contains a description of the properties of a PROFIBUS device, e.g. the supported data transmission rates or the type and format of the digital information sent to the PLC. The GSD files also include bitmap files. These files are required to represent the measuring points in the graphics. The device master file and the corresponding bitmaps are needed to configure a PROFIBUS-DP network.

File name

Every device is assigned an ID number by the PROFIBUS User Organization. The name of the GSD file and related files is derived from this number. The Prosonic S FMU95 has the ID number 154E (hex) = 5454 (dec).

The device master file is therefore: EH3x154E.gsd

Where to obtain the GSD files

- www.endress.de → use the search function under "Downloads".
- GSD library of the PROFIBUS User Organization (PNO): http://www.PROFIBUS.com
- CD-ROM with all the GSD files for Endress+Hauser devices; Order No.: 50097200

Using the GSD files

The GSD files must be loaded into a specific subdirectory of the PROFIBUS DP configuration software of the PLC.

Depending on the software used, the GSD files can be either copied to the program-specific directory or imported into the database using an import function in the configuration software.

For details, please refer to the documentation of the configuration software used.

8.2   Additional settings

8.2.1   Instrument address

Selecting the instrument address

- An address must be assigned to each PROFIBUS device. The control system can only recognize the device if the address is set correctly.
- Each address can only be assigned once in a PROFIBUS network.
- Valid device addresses are in the range from 0 to 126. All devices are delivered from the factory with the address 126. This is set via the software.
- The address "126" configured at the factory can be used to check the function of the device and connect it to an operating PROFIBUS system. This address must be changed subsequently to add additional devices.

Software addressing

- Software addressing takes effect when DIP switch 8 on the PROFIBUS DP terminal area is set to "SW (on)" (factory setting).
- The address can then be configured via an operating tool (e.g. "DeviceCare" or "FieldCare").
- The configured address is displayed in the parameter **Output/calculation → PROFIBUS DP → Instrument address**.

Hardware addressing
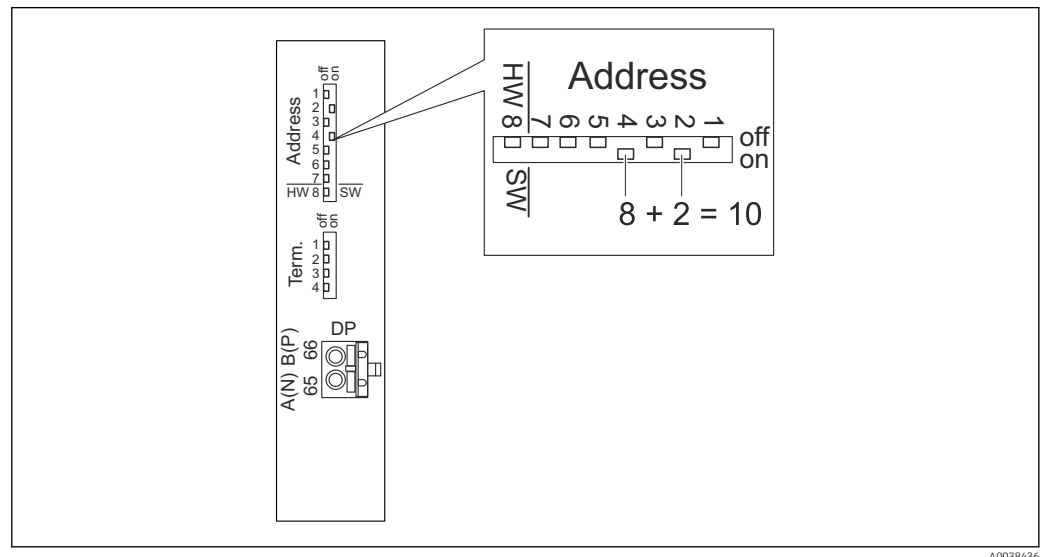
A0038436

Hardware addressing takes effect when DIP switch 8 is set to "HW (off)". When set to "on", the position of DIP switches 1 to 7 define the following values in the address:

- Switch 1: value = 1
- Switch 2: value = 2
- Switch 3: value = 4
- Switch 4: value = 8
- Switch 5: value = 16
- Switch 6: value = 32
- Switch 7: value = 64

8.2.2 Bus termination
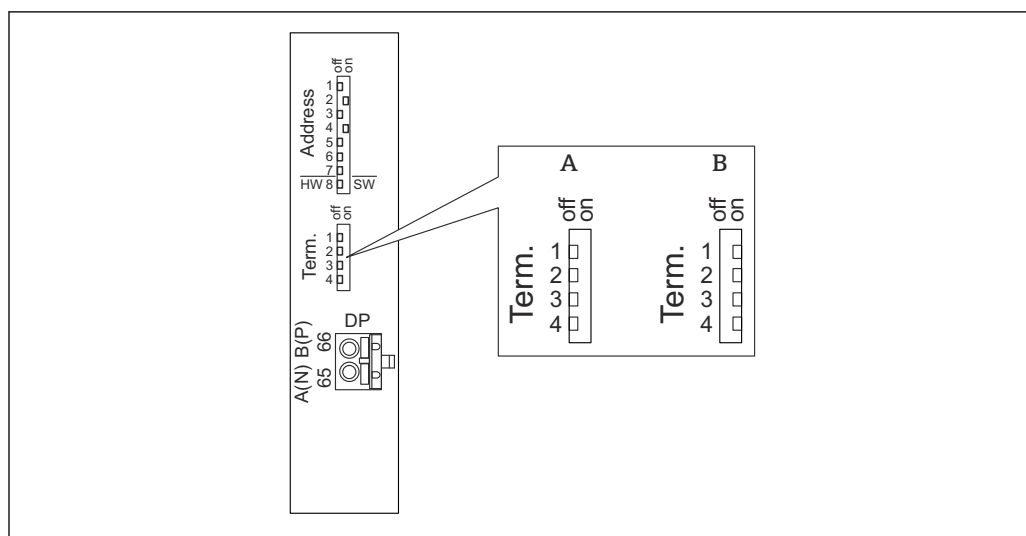
A0038437

🖼 *39   Bus termination on the device*

A   Termination not active
B   Termination active

▸ For the last device on the bus:
  Switch all four terminating switches to "on" to activate the bus terminating resistor.

9 Commissioning

9.1 Preparatory steps

9.1.1 Reset to factory settings

NOTICE

A reset may negatively impact the measurement.

▶ Perform a new basic setup after resetting the device.

Using the reset function

It is always advisable to reset the device if you want to use a device with an unknown history.

Effects of a reset

- All the parameters are reset to the factory setting.
- Linearization is disabled. If a linearization table is present it is not deleted, however, and can be reactivated if necessary.
- Interference echo suppression (mapping) is disabled. The mapping curve is not deleted, however, and can be reactivated if necessary.

Effect on a 5-point linearization protocol

With the creation of a 5-point linearity protocol, the measuring system (FDU9x sensor and FMU9x transmitter) is adjusted and the measuring accuracy is optimized for the specified range.

The **Zero distance** service parameter is fine-adjusted for this adjustment. Following a reset, this parameter must be re-configured in the Service menu according to the data indicated on the 5-point linearity protocol for the FDU9x sensor. Please contact Endress +Hauser customer service for this purpose.

Performing a reset

1. Navigate to **Device properties** → **Password/reset** → **Reset**.
2. Enter "33333".

9.2 Switching on the measuring device

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.
- **Temperature unit**
  Select the unit for the sensor temperature.

9.3 Configuring the measuring device

9.3.1 Parameter set "LVL N sensor sel."

Navigation
Level → Level (LVL) N → Basic setup → LVL N sensor sel.

Parameter
- **Input**
  Assign a sensor to the channel.
- **Sensor selection**
  Specify the sensor type.
  Select the **Automatic** option for FDU9x sensors.
  Select the **Manual** option for FDU8x sensors.
- **Detected**
  Only displayed if **Sensor selection** = **Automatic**
  Displays the sensor type detected automatically.

9.3.2   Parameter set "LVL N appl. para."

Navigation
Level → Level (LVL) N → Basic setup → LVL N app. para.

Parameter
- **Tank shape**
  Select the applicable option.
- **Medium property**
  If the medium cannot be clearly assigned to any of the categories, select the **Unknown** option.
- **Process conditions**
  For liquid applications that do not fall into any other category, select the **Standard liq.** option.
  For bulk solid applications that do not fall into any other category, select the **Standard solid** option.
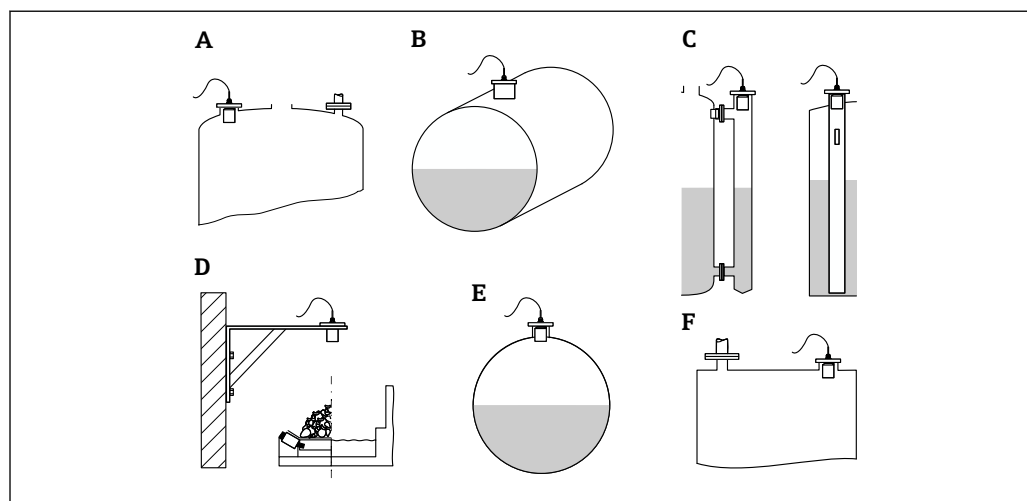
A0032713

🖻 *40   Tank shape*

A   Dome ceiling
B   Horizontal cylindrical
C   Bypass/stilling well
D   No ceiling
E   Sphere
F   Flat ceiling

9.3.3 Parameter set "LVL N empty cal."
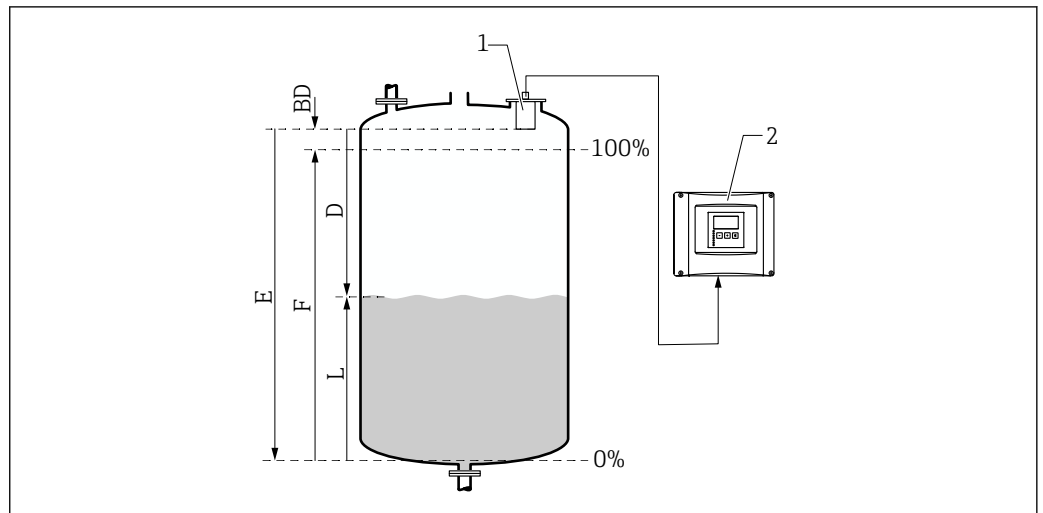
A0034882

🖾 *41   Empty and full calibration for level measurement*

1   FDU9x sensor
2   FMU90/FMU95 transmitter
BD   Blocking distance
D   Distance between sensor membrane and product surface
E   Empty E
F   Full F
L   Level

Navigation

Level → Level (LVL) N → Basic setup → LVL N empty cal.

Parameter "Empty E"

Specify the distance E from the reference point of the sensor to the minimum level (zero point). The zero point should not be lower than the point where the ultrasonic wave hits the bottom of the tank.

9.3.4 Parameter set "LVL N full cal."

Navigation

Level → Level (LVL) N → Basic setup → LVL N full cal.

Parameter

- **Full F**

  Specify the span F (the distance from the minimum level to the maximum level).
  F may not project into the blocking distance BD of the sensor.
- **Blocking distance**

  Indicates the blocking distance BD of the sensor.

9.3.5 Parameter set "LVL N unit"

Navigation

Level → Level (LVL) N → Basic setup → LVL N unit

Parameter
- **Unit level**
  Select the level unit.
  The level is output in this unit if linearization is not performed.
- **Level N**
  Displays the level F currently measured (from the zero point to the surface of the product) in the selected unit.
- **Sensor**
  Displays the distance D currently measured between the sensor membrane (reference point of the measurement) and the surface of the product.
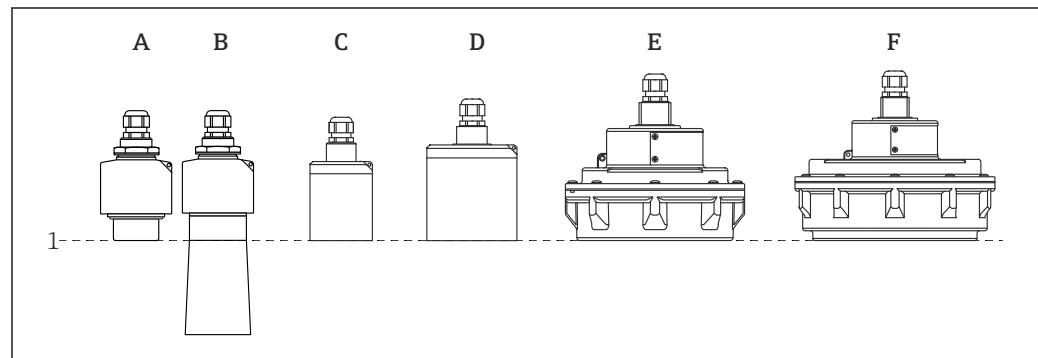
A0043335

1   Reference point of measurement
A   FDU90 without flooding protection tube
B   FDU90 with flooding protection tube
C   FDU91/FDU91F
D   FDU92
E   FDU93
F   FDU95

9.3.6   Parameter set "LVL N Linearisat."
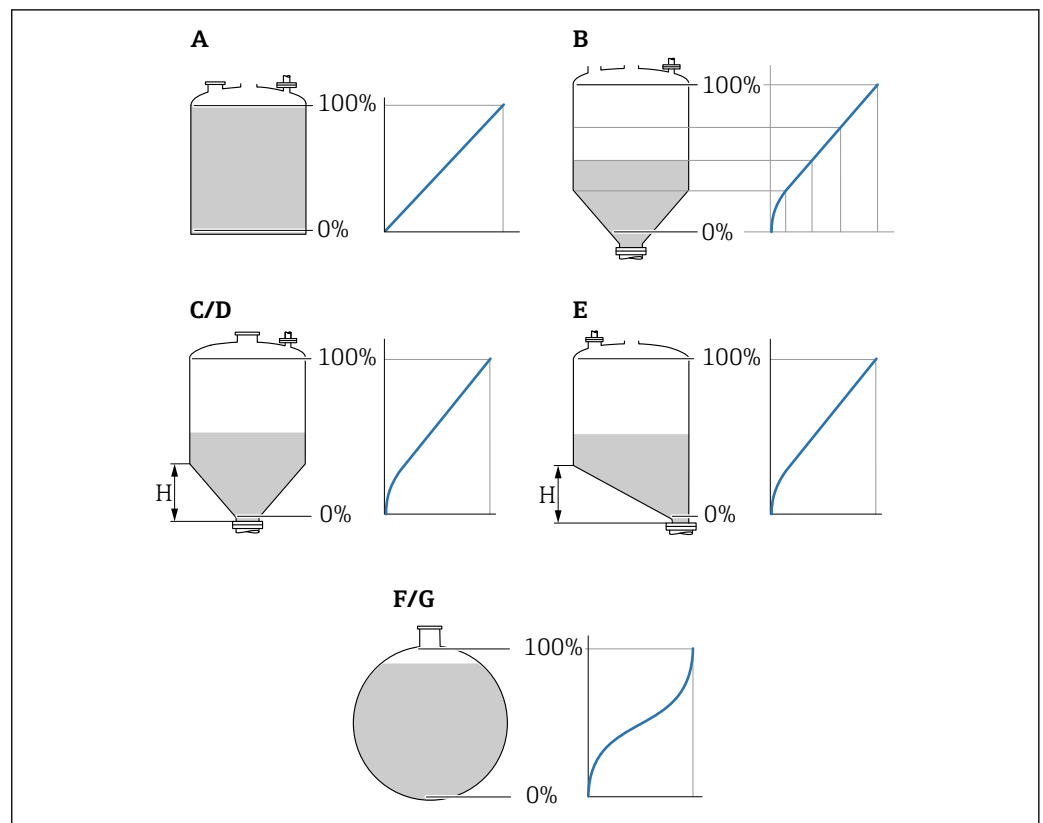
🖻 42   *Types of linearization*

A   None
B   Table
C   Pyramid bottom
D   Conical bottom
E   Angled bottom
F   Sphere
G   Horizontal cylindrical
H   Intermediate height

Navigation
Level → Level (LVL) N → Basic setup → LVL N Linearisat.

Parameter
- **Type**
  Select the type of linearization (see above)
- **Customer unit**
  Specify the unit for the linearized value.
- **Max. scale**
  Specify the maximum vessel content (100 %) in the selected customer unit.
  Not displayed if **Type** = **Table**.
  If **Type** = **Horizontal cyl.** or **Sphere**, the **Max. scale** must always refer to a completely full tank.
- **Diameter**
  Only displayed if **Type** = **Horizontal cyl.** or **Sphere**.
  Specify the diameter D of the tank.
- **Intermediate height (H)**
  Only displayed if **Type** = **Angled bottom**, **Pyramid bottom** or **Conical bottom**
  Specify the intermediate height H of the vessel (see above).

- **Edit**
  Only displayed if **Type** = **Table**.
  Opens the **Edit** parameter set to enter the linearization table.
- **Status table**
  Activates or deactivates the linearization table.
- **Mode**
  Specifies whether the linearization refers to the level or the ullage.

9.3.7 Table editor

Linearization table conditions:
  - Up to 32 "Level to volume" value pairs.
  - Monotonically increasing or decreasing. (The monotonicity is checked when the table is activated).
  - Once entered, must be activated by the **Status table** parameter.

A   Line number
B   Column for level
C   Column for values

1. Press [ ] to jump to the next line.
2. Press [ ] to jump to the previous line.
3. Press [ ] to open the selected line for editing.

A   Line number
B   Column for level
C   Column for values

1. Press [ ] or [ ] to navigate inside the table.
2. Press [ ] or [ ] to navigate inside the column with the line numbers.
3. Press [ ] to delete the entire line, insert or move a line.

Press **Escape** to return to the previous step.
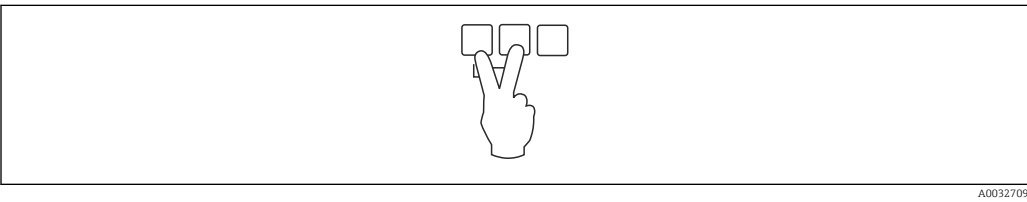
9.3.8   Parameter set "Check value"

ℹ️ • This parameter set starts inference echo suppression (mapping).
   • To record all the interference echoes, perform mapping at the minimum level possible (ideally with an empty vessel).
   • If it is not possible to empty the vessel during commissioning, record preliminary mapping when the vessel is partially filled. Repeat mapping when the level reaches approximately 0 % for the first time.
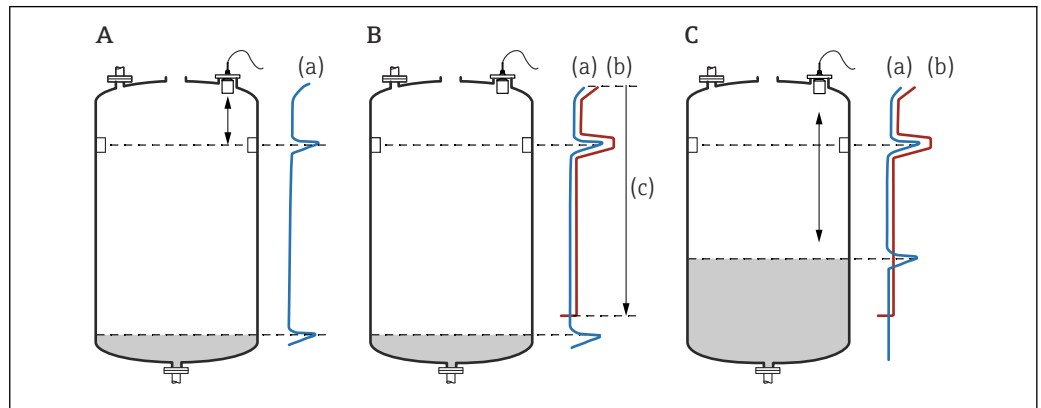
🖼 43   *Operating principle of the interference echo suppression (mapping) function*

A   The echo curve (a) contains an interference echo and the level echo. Without mapping, the interference echo would also be evaluated. This is not desired.
B   Mapping generates the mapping curve (b). This suppresses all the echoes that are inside the range of mapping (c).
C   Afterwards, only echoes that are higher than the mapping curve are evaluated. The interference echo is below the mapping curve and is therefore ignored (not evaluated).

Navigation
Level → Level (LVL) N → Basic setup → LVL N check value

Parameter
• **Actual distance**
  Displays the distance D currently measured between the sensor membrane and the surface of the product.
• **Check distance**
  Compare the distance displayed with the actual value and enter the result of the comparison. Based on the entry, the device automatically determines the range of mapping.
  • **Distance = ok**
    The displayed distance and actual distance match.
    → Continue with the parameter set **LVL N dist. map.**.
  • **Dist. too small**
    The displayed distance is smaller than the actual distance.
    → Continue with the parameter set **LVL N dist. map.**.
  • **Dist. too big**
    The displayed distance is larger than the actual distance.
    → Mapping is not possible.
    → Setup for sensor N ends.
  • **Dist. unknown**
    Actual distance is unknown.
    → Mapping is not possible.
    → Setup for sensor N ends.
  • **Manual**
    The range of mapping is to be defined manually.
    → Continue with the parameter set **LVL N dist. map.**.

9.3.9 Parameter set "LVL N dist. map."

Navigation
Level → Level (LVL) N → Basic setup → LVL N dist. map.

Parameter
- **Actual distance**
  Displays the distance D currently measured between the sensor membrane and the surface of the product.
- **Range of mapping**
  Specifies the range, starting from the sensor membrane, in which mapping is performed.
  - If **Check distance** = **Distance = Ok** or **Dist. too small**:
    Confirm the preset value.
  - If **Check distance** = **Manual**:
    Enter the desired mapping range.
- **Start mapping**
  Select **Yes** to start recording the mapping curve.
  → The **LVL N status** parameter set appears.
  → If the displayed distance is still too small: keep recording mapping curves until the displayed distance and the actual distance match.
- **Status**
  Specifies the mapping status:
  - **Enable map**
    The mapping curve is taken into consideration during signal evaluation.
  - **Disable map**
    The mapping curve is not taken into consideration during signal evaluation but remains stored in the device.
  - **Delete map**
    The mapping curve is deleted.

9.3.10 Parameter set "US sensor N"

For multi-channel devices: disable unused sensor inputs in the **US sensor N** parameter set.

Navigation
Sensor management → FDU sensor N → Sensor operation

Parameter "Sensor operation"
Switch sensor N on or off.

9.4 Advanced settings

9.4.1 Configuring the local display

Type of visualization
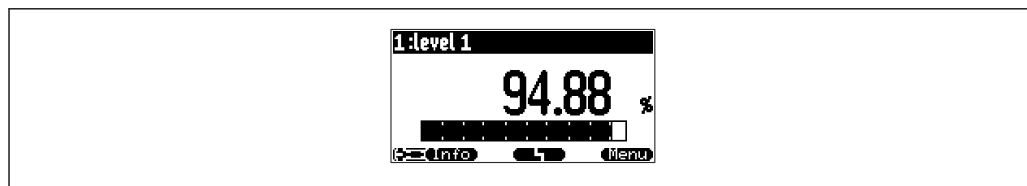
🖻 *44   "Type" = "1x value+bargr."*
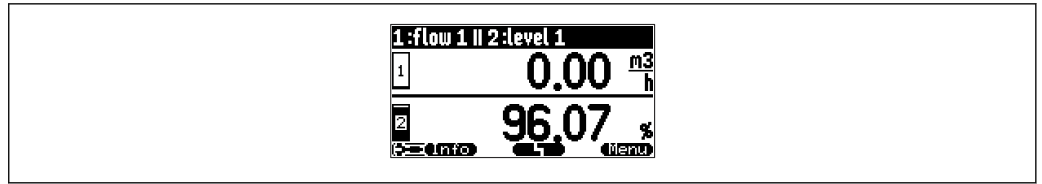
45   "Type" = "2x value+bargr."
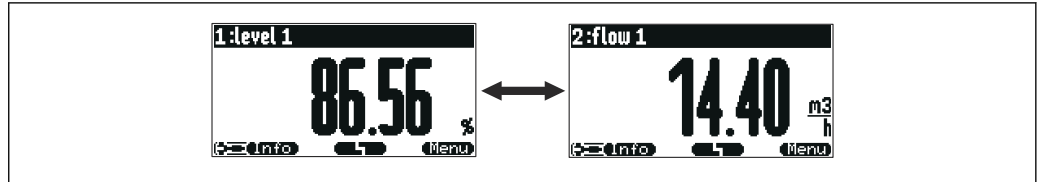
46   "Type" = "Value max. size"
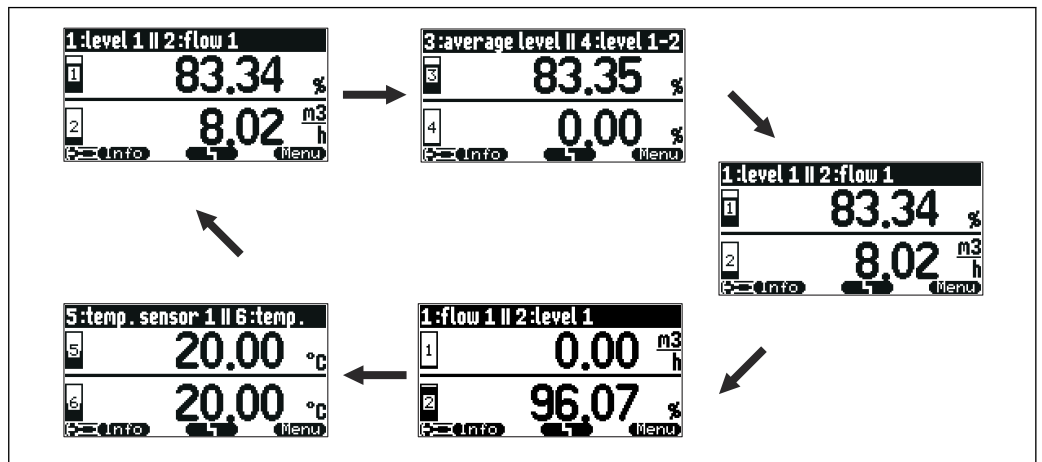
47   "Type" = "Alter. 5x2 val."
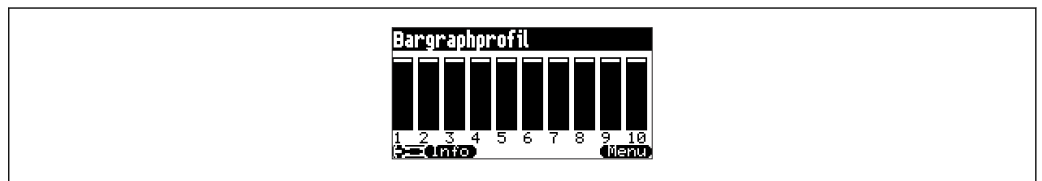
48   "Type" = "Bargr. profil"

Configuration of the type of visualization

1. Navigate to the parameter set **Display → Display**.

2. Select the type of visualization in the **Type** parameter (see above).

3. For **Type** = **Value max size** or **Alter. 5x2 val.**:
   In the **Time** parameter, specify the time after which the next screen is displayed.

4. In the **Value 1** to **Value N** parameters, select a measured value to be displayed.

5. In the **Customized text 1** to **Customized text N** parameters, enter a text string to be displayed with the values.
   ↳ The specified text string is displayed if **Customized text** = **Yes** (see below).

Configuration of the display format

1. Navigate to the parameter set: **Display → Display format**.

2. In the **Format** parameter, select the number format for length data.

3. In the **No. of decimals** parameter, specify the number of decimal places that are displayed.

4. In the **Sep. character** parameter, specify whether a comma or dot is used as the decimal separator.

5. In the **Customized text** parameter, specify whether **Customized text 1** to **Customized text N** (see above) is used and displayed on the screen.

Configuration of back to home time

1. Navigate to **Display → Back to home → Back to home**

2. Specify the time after which the onsite display returns to home (measured value display).

9.4.2   Configuration of the DI Blocks

Parameter set
Output/calculat. → Digital input → Digital input N

Parameter
- **Allocation**
  Select the switching state that is output as a binary signal via the DI Block.
  - **Relay**
    Connects the DI Block with one of the device relays.
    Once this option has been selected, the **Relay** function is displayed where you can select the relay.
  - **Pump control**
    Only displayed if pump control has been configured.
    Connects the DI Block with a pump control relay.
  - **Rake control**
    Only displayed if rake control has been configured.
    Connects the DI Block with a rake control relay.
  - **None**
- **Value**
  Indicates the current switching state of the relay.
- **Status**
  Displays the status that is transmitted together with the binary value.

9.4.3   Configuration of the AI Blocks

Parameter set
Output/calculat. → Analog input → Analog input N

Parameter
- **Measured value N**
  Select the measured variable which is output via the AI Block.
- **Value**
  Displays the current value of the selected measured variable.
- **Status**
  Displays the status that is transmitted with the value.

9.4.4 Configuration of the cyclic data telegram

- The general principles of cyclic data exchange between the measuring device and an automation system (e.g. PLC) are described in Operating Instructions BA00034S, "PROFIBUS DP/PA - Guidelines for planning and commissioning".
- As a prerequisite for cyclic data exchange, the correct GSD must have been loaded into the automation system.

Data format

- **Analog values**
  In PROFIBUS DP, analog values are cyclically transmitted to the PLC in data blocks that are 5 bytes long (modules). The measured value is represented in the first 4 bytes in the form of floating point numbers in accordance with the IEEE standard. The 5th byte contains standardized status information pertaining to the device. For details, see BA00034S.
- **Digital values**
  In PROFIBUS DP, digital values are cyclically transmitted in blocks that are 2 bytes long (modules). The first byte contains the digital value. The second byte contains the related status information. For details, see BA00034S.

Modules for analog values

Each AI Block in Prosonic S makes a 5-byte module available for the cyclic data telegram (from the device to the PLC). In line with the "Profile for Process Control Devices" PROFIBUS specification, there are two options for each module:

- **AI (OUT)**
  The module is transmitted in the cyclic data telegram.
- **Free Place**
  The module is not part of the cyclic data telegram.

The option is selected via the configuration tool of the PLC. For details, see the Operating Instructions of the manufacturer-specific configuration tool.

Modules for digital values (DI)

Each DI Block in Prosonic S makes a 2-byte module available for the cyclic data telegram (from the device to the PLC). In line with the "Profile for Process Control Devices" PROFIBUS specification, there are two options for each module:

- **AI (OUT)**
  The module is transmitted in the cyclic data telegram.
- **Free Place**
  The module is not part of the cyclic data telegram.

The option is selected via the configuration tool of the PLC. For details, see the Operating Instructions of the manufacturer-specific configuration tool.

Modules for digital values (DO)

Each DO Block in Prosonic S makes a 2-byte module available for the cyclic data telegram (from the PLC to the device). In line with the "Profile for Process Control Devices" PROFIBUS specification, the following options are available for each module:

- DO (SP_D)
- DO (SP_D/CB_D)
- DO (RCAS_IN_D/RCAS_OUT_D)
- DO (RCAS_IN-D/RCAS_OUT_D/CB_D)
- Free Place

The option is selected via the configuration tool of the PLC. For details, see the Operating Instructions of the manufacturer-specific configuration tool.

Default configuration of the cyclic data telegram (5-channel version)

ℹ️ Valid for FMU95 - *****A...

- AI 1
  - Bytes 0 - 3: Level 1 (IEEE754); unit: m
  - Byte 4: Status level 1
- AI 2
  - Bytes 5 - 8: Level 2 (IEEE754); unit: m
  - Byte 9: Status level 2
- AI 3
  - Bytes 10 - 13: Level 3 (IEEE754); unit: m
  - Byte 14: Status level 3
- AI 4
  - Bytes 15 - 18: Level 4 (IEEE754); unit: m
  - Byte 19: Status level 4
- AI 5
  - Bytes 20 - 23: Level 5 (IEEE754); unit: m
  - Byte 24: Status level 5

Default configuration of the cyclic data telegram (10-channel version)

ℹ️ Valid for FMU95 - *****B...

- AI 1
  - Bytes 0 - 3: Level 1 (IEEE754); unit: m
  - Byte 4: Status level 1
- AI 2
  - Bytes 5 - 8: Level 2 (IEEE754); unit: m
  - Byte 9: Status level 2
- AI 3
  - Bytes 10 - 13: Level 3 (IEEE754); unit: m
  - Byte 14: Status level 3
- AI 4
  - Bytes 15 - 18: Level 4 (IEEE754); unit: m
  - Byte 19: Status level 4
- AI 5
  - Bytes 20 - 23: Level 5 (IEEE754); unit: m
  - Byte 24: Status level 5
- AI 6
  - Bytes 25 - 28: Level 5 (IEEE754); unit: m
  - Byte 29: Status level 6
- AI 7
  - Bytes 30 - 33: Level 7 (IEEE754); unit: m
  - Byte 34: Status level 7
- AI 8
  - Bytes 35 - 38: Level 8 (IEEE754); unit: m
  - Byte 39: Status level 8
- AI 9
  - Bytes 40 - 43: Level 9 (IEEE754); unit: m
  - Byte 44: Status level 9
- AI 10
  - Bytes 45 - 48: Level 10 (IEEE754); unit: m
  - Byte 49: Status level 10

Changing the assigned measured variables

Parameter: Output/calculat. → Analog input → Analog input N → Measured value N

9.5   Simulation

9.5.1   Level or volume simulation

Navigation

Level → Level N → Simulation

Parameter

- **Simulation**

  Select the variable to be simulated (level or volume)
- **Sim. level value**

  Only displayed if **Simulation** = **Sim. level**

  Enter the level to be simulated. The linearization and the output signal follow this value.
- **Sim. volume value**

  Only displayed if **Simulation** = **Sim. volume**

  Enter the volume to be simulated. The output signal follows this value.

9.6   Protecting settings from unauthorized access

9.6.1   Software locking

Locking

1. Navigate to **Device properties** → **Password/reset** → **Code**.
2. Enter a number ≠ 2 457.
   ↳ The device is locked; no entries can be made.

Unlocking

▸ If an attempt is made to change a parameter, the device jumps to **Password/reset**.
  Enter "**2 457**".
  ↳ Entries can be made again.

9.6.2   Keypad lock

Locking

▸ Press all three keys simultaneously.
  ↳ The device is locked; no entries can be made. The [⬚] symbol appears on the
    display.

Unlocking

▸ If an attempt is made to change a parameter, the device jumps to **Password/reset**.
  Key-locked is displayed in the **Status** parameter.
  Press all three keys simultaneously.
  ↳ Entries can be made again.

9.6.3   Hardware locking
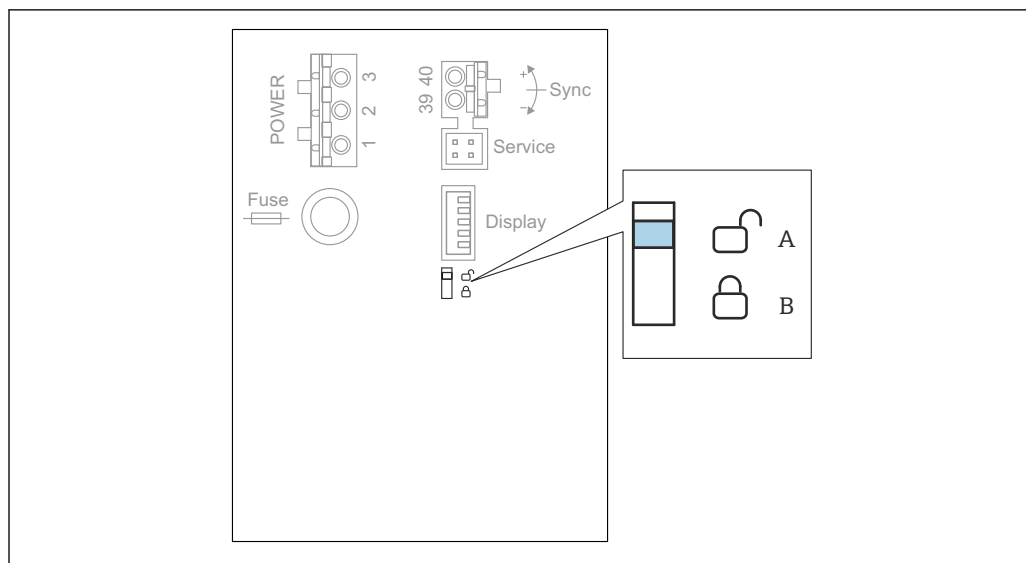
🔲 49   *Hardware locking*

A   Unlocked
B   Locked

A write protection switch, which can be used to lock the device against parameter changes, is located on the basic terminal area in the terminal compartment. When the device is locked the [⬚⬚⬚] symbol is shown on the display.

9.6.4   Displaying the locking status

Navigation
Device properties → Password/reset → Status

Display options
- **Unlocked**
  All parameters (apart from Service parameters) can be edited.
- **Code locked**
  The device has been locked via the operating menu. It can only be unlocked again by entering the access code in the **Device settings → Password/reset → Code** parameter.
- **Key-locked**
  The device has been locked via the operating keys. It can only be unlocked again by pressing all three keys simultaneously.
- **Switch-locked**
  The device has been locked via the write protection switch in the terminal compartment. It can only be unlocked again using this switch.

10 Diagnostics and troubleshooting

10.1 General troubleshooting

10.1.1 Calibration error

Measured value incorrect

Check the **Actual distance** parameter.
- The **Actual distance** is incorrect:
  - For measurements in a bypass or ultrasound guide pipe:
    Set the appropriate option in the **LVL N appl. param.** parameter set.
  - Perform interference echo suppression (mapping) (**LVL N check value** parameter set).
- The **Actual distance** is correct:
  - Check the **Empty E** and **Full F** parameters and correct them if necessary.
  - Check linearization and correct it if necessary.

No change of measured value on filling/emptying

- Perform interference echo suppression (mapping).
- Clean sensor.
- Select a better installation position for the sensor (to avoid interference echoes).

If the surface is turbulent, the measured value jumps sporadically to higher levels

- Perform interference echo suppression (mapping).
- Set the **Process cond.** parameter to **Turb. surface** or **Add. agitator**.
- Select another installation position and/or a larger sensor.

During filling/emptying, the measured value drops sporadically.

- Set the **Tank shape** parameter to **Dome ceiling** or **Horizontal cyl.**
- Avoid a central mounting position for the sensor.
- If possible, use a stilling well/ultrasound guide pipe.

Echo loss (error E xx 641)

- Check all the application parameters (**LVL N appl. param.** parameter set)
- Select another installation position and/or a larger sensor.
- Align the sensor so that it is parallel to the surface of the product (particularly for bulk solids applications).

10.1.2 Checking the signal in the envelope curve display

Aim of the envelope curve display

The measuring signal can be checked with the envelope curve display. From the envelope curve, it is possible to see if interference echoes are present and if these echoes are completely suppressed by the interference echo suppression (mapping) function.

Envelope curve on the display module

To call the envelope curve display:

1. Navigate to **System informat.** → **Envelope curve**.

2. For devices with several sensors:
   Select the sensor whose envelope curve is to be displayed.

3. Select which type of curve is to be displayed: envelope curve, floating average curve (FAC), mapping curve.

4. Select the display format: **single curve** or **cyclic**.
   ↳ The envelope curve display now appears:
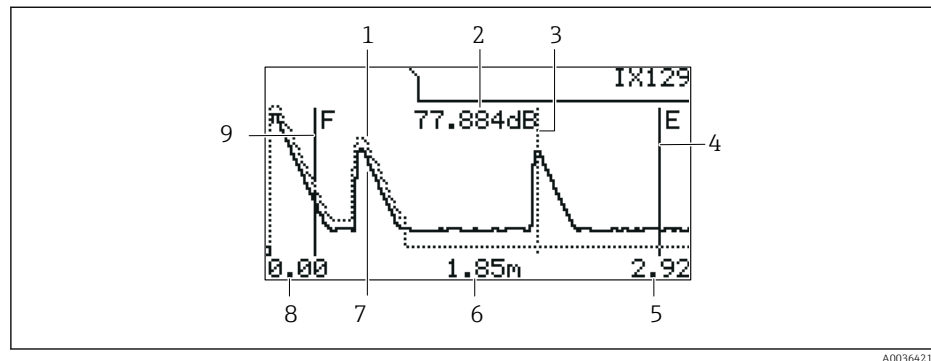
⊞ 50   Envelope curve on the local display

1   Mapping curve (dotted line)
2   Echo quality of the evaluated echo (i.e. distance of the peak of the echo from the floating average curve)
3   Marking for the evaluated echo
4   Marking for empty calibration E
5   Right limit of the display range
6   Distance of the evaluated echo (measured from the reference point of the sensor)
7   Envelope curve (solid line)
8   Left limit of the display range
9   Marking for full calibration F

Scaling the envelope curve display

1. Press the left or middle key.
   ↳ The ◀▶ or ▶◀ symbol appears in the top right-hand corner of the chart.

2. To zoom in: press the middle key.

3. To zoom out: press the left key.

Moving the envelope curve horizontally

1. Press the right key.
   ↳ The ◀◀ or ▶▶ symbol appears in the top right-hand corner of the chart.

2. To move the screen to the right, press the middle key.

3. To move the screen to the left, press the left key.

Quitting the envelope curve display

▶ Press all three keys simultaneously.

Envelope curve display in FieldCare/DeviceCare
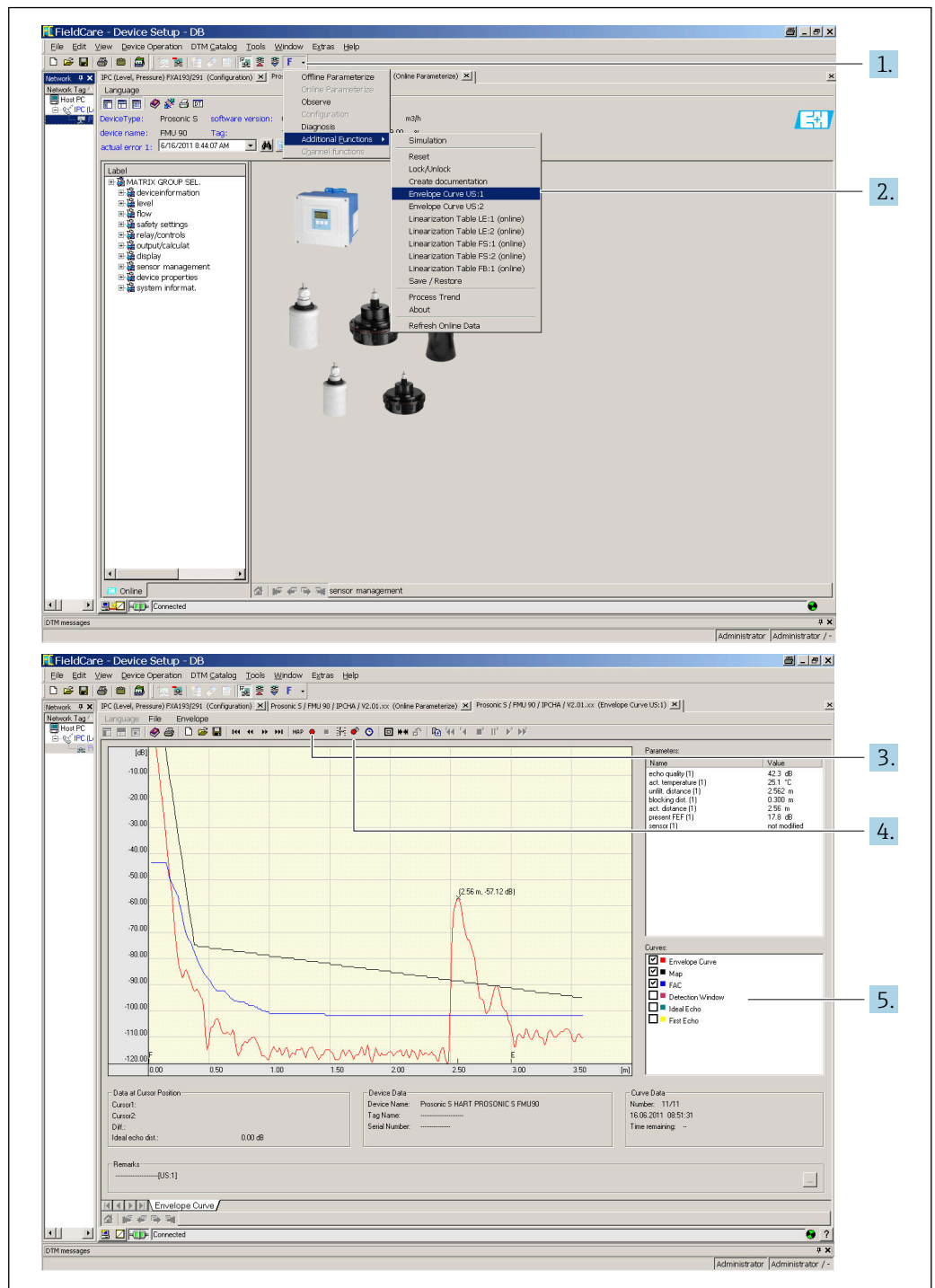
A0036420

1. Click **F** (functions) on the menu bar.

2. Select the sensor whose envelope curve is to be displayed.

3. To display a single curve, click the **Read curve** button.

4. To display the curves cyclically, press the **Cyclic read** button.

5. In the **Curves** window, select which type of curve is to be displayed: envelope curve, floating average curve (FAC), mapping curve.

10.2   Overview of diagnostic information

10.2.1   Error signal

Displaying errors that occur during commissioning or operation:
- **Local display**:
  - Error symbol
  - Error code
  - Error description
- **Cyclic data telegram**
  Status that is transmitted with the measured value.
- **Operating menu**:
  System informat. → Error list → Actual error

10.2.2   List of the last errors

Operating menu:
System informat. → Error list → Last error

10.2.3   Types of error

Alarm (A)

▐▬▬▬▐ lit permanently.

The value of the output signal is defined by the **Output on alarm → Output N** parameter:
- **Min**: −10 %
- **Max** : 110 %
- **Hold**: the last value is held.
- **User specific**: defined in the **Output value N** parameter.

The status of the output value of the affected AI blocks is BAD.

Warning (W)

▐▬▬▐ flashes.

- The device continues to measure.
- The operating status LED flashes red.
- An error message is displayed.
- The status of the output value of the affected AI blocks is UNCERTAIN.

10.2.4   Influence of errors on the status byte of the output signal

The following table indicates which status the block output values adopt when an error occurs. There are three possible status values: GOOD, UNCERTAIN and BAD. The status is passed on to the next block. If several status values coincide, the stronger value overwrites the weaker value according to the following order:

- BAD overwrites UNCERTAIN and GOOD.
- UNCERTAIN overwrites GOOD.
- GOOD does not overwrite any other status.

Therefore the strongest status value is supplied to the AI Block output. This status value is transmitted to the PLC along with the measured value.

Error in the Sensor Block (US N)

Each Sensor Block (US N) has two outputs: one for the measured distance D, and one for the sensor temperature T.

- **A 0x 231**
  Distance: BAD
  Temperature: GOOD
- **A 0x 281**
  Distance: BAD
  Temperature: BAD
- **W 0x 281**
  Distance: UNCERTAIN
  Temperature: UNCERTAIN
- **W 0x 501**
  Distance: BAD
  Temperature: BAD
- **A 0x 502**
  Distance: BAD
  Temperature: BAD
- **W 0x 521**
  Distance: UNCERTAIN
  Temperature: BAD
- **A 0x 641**
  Distance: BAD
  Temperature: GOOD
- **A 0x 651**
  Distance: BAD
  Temperature: GOOD
- **W 0x 651**
  Distance: UNCERTAIN
  Temperature: GOOD
- **A 0x 661**
  Distance: BAD
  Temperature: GOOD
- **W 0x 661**
  Distance: UNCERTAIN
  Temperature: GOOD
- **W 0x 691**
  Distance: UNCERTAIN
  Temperature: GOOD
- **W 0x 802**
  Distance: UNCERTAIN
  Temperature: GOOD

Error in the Level Block (LE)

- **W 0x 601**
  Level: BAD
- **A 0x 604**
  Level: BAD
- **W 0x 611**
  Level: BAD
- **A 0x 671**
  Level: BAD
- **W 0x 801**
  Level: UNCERTAIN

Error in the Calculation Blocks (SL, AL, DL, LD, SF, AF, DF, FD)

A 00 820-832
Total: BAD
Mean: BAD

10.2.5   Error codes

Meaning of the error codes

- **Digit 1:**
  Type of error
  - A: alarm
  - W: warning
  - E: error (the error behavior is defined by the user.)
- **Digits 2 and 3:**
  Input or output channel
  "**00**" means that the error does not refer to a specific channel.
- **Digits 4 to 6:**
  Error code according to the following table

List of error codes

- **A 00 100**
  Software version does not suit hardware version.
- **A 00 101**
  Checksum error
  → Total reset and recalibration
- **A 00 102**
  Checksum error
  → Total reset and recalibration
- **W 00 103**
  Initializing - please wait
  → If the message does not disappear after a few seconds, replace the electronics.
- **A 00 106**
  Downloading - please wait
  → Wait for the download to finish.
- **A 00 110**
  Checksum error
  → Total reset and recalibration
- **A 00 111/112/114/115**
  Electronics defect
  - → Switch off device and switch it on again.
  - → If the error persists: call Endress+Hauser Service.
- **A 00 116**
  Download error
  → Repeat download.
- **A 00 117**
  Hardware after change not identified
- **A 00 125**
  Electronics defect
  → Replace electronics.
- **A 00 152**
  Checksum error
  → Perform total reset and recalibration.
- **W 00 153**
  Initialization
  → If the message does not disappear after a few seconds, replace the electronics.
- **A 00 155**
  Electronics defect
  → Replace electronics.
- **A 00 164**
  Electronics defect
  Replace electronics.

- **A 00 171**
  Electronics defect
  Replace electronics.
- **A 00 180**
  Synchronization failure
  → Check synchronization connection.
- **A 00 183**
  Not supported hardware
  - → Check whether the printed circuit boards installed match the order code for the device.
  - → Call Endress+Hauser Service.
- **A xx 231**
  Sensor xx defective - check connection
  → Check that the sensor is connected correctly.
- **A xx 281**
  Temperature measurement of sensor xx defective - check connection
  → Check that the sensor is connected correctly.
- **W xx 501**
  No sensor selected for input xx
  → Select the sensor (**Level** menu).
- **A xx 502**
  Sensor xx is not recognized
  → Enter sensor type manually (**Level** menu, **Basic setup** submenu).
- **A 00 511**
  No factory calibration available
- **A xx 512**
  Recording mapping
  → Wait for the mapping to finish.
- **W xx 521**
  New sensor xx recognized
- **W xx 601**
  Linearization curve steps incorrect level xx
  → Enter linearization again (**Level** menu).
- **A xx 604**
  Calibration level xx failure
  → Correct calibration (**Level** menu).
- **W xx 611**
  Less than 2 linearization points for level xx
  → Enter additional linearization points (**Level** menu).
- **E xx 641**
  No usable echo sensor xx
  → Check basic setup for the sensor (**Level** menu).
- **A xx 651**
  Level in safety distance sensor xx - risk overspill
  The error disappears as soon as the level is no longer in the safety distance.
  → If necessary, activate the **Reset self holding** function (**Safety settings** menu).
- **E xx 661**
  Sensor xx temperature too high (max. temp. exceeded at sensor)
- **W xx 691**
  Noise filling detected sensor xx
- **W 00 801**
  Simulation level on
  → Switch off level simulation (**Level** menu).
- **W xx 802**
  Simulation sensor xx on
  → Switch off simulation.
- **A 00 820-832**
  Different units for the calculation of mean value/total
  → Check units in the corresponding basic setups (**Level** menu).

10.3   Firmware history

- **V01.00.00 (04.2007)**
  Original software
  BA00344F/00/en/05.06
- **V01.01.00 (06.2006)**
  Integration of the FDU90 sensor
  BA00344F/00/en/07.09
- **V01.01.03 (05.2011)**
  New option: binary inputs
  BA00344F/00/en/13.12

11   Maintenance

No special maintenance work is required.

11.1   Exterior 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 information

12.1.1 The Endress+Hauser repair concept

Under the Endress+Hauser repair concept, the measuring devices have a modular design and customers are able to undertake repairs themselves. For more information on service and spare parts, please contact your Endress+Hauser sales representative.

12.1.2 Repair of Ex-certified devices

- Only specialist personnel or Endress+Hauser-Service can carry out repairs to Ex certified devices.
- Comply with the prevailing standards, national Ex-area regulations, Safety Instructions (XA) and certificates.
- Use only original Endress+Hauser spare parts.
- When ordering spare parts, check the device designation on the nameplate. Only identical parts may be used as replacements.
- Carry out repairs according to the instructions. On completion of the repair, carry out the routine test specified for the device.
- A certified device may be converted to another certified device version by Endress +Hauser Service only.
- Document all repairs and modifications.

12.1.3 Replacing a 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 the "FieldCare" software. You can continue measuring without performing a new calibration. Only a linearization and interference echo suppression need to be performed again.

12.1.4 Replacing the sensor

Check the following parameters after replacing the sensor:
- **Empty E**
- **Full F**
- **Check distance** (mapping)

Afterwards, measurement can resume without further restrictions.

12.2 Spare parts

All the spare parts for the measuring device, along with the order code, are listed in the *W@M Device Viewer* (www.endress.com/deviceviewer) and can be ordered. If available, users can also download the associated Installation Instructions.

12.3 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.

12.4   Disposal

Observe the following notes during disposal:
- Observe valid federal/national regulations.
- Ensure proper separation and reuse of the device components.

13   Accessories

13.1   Communication-specific accessories

13.1.1   Commubox FXA291

- Connects the CDI interface (Common Data Interface) of Endress+Hauser devices with the USB port of a computer.
- Order number: 51516983
- Additional information: Technical Information TI00405C

13.2   Device-specific accessories

13.2.1   Weather protection cover for polycarbonate field housing
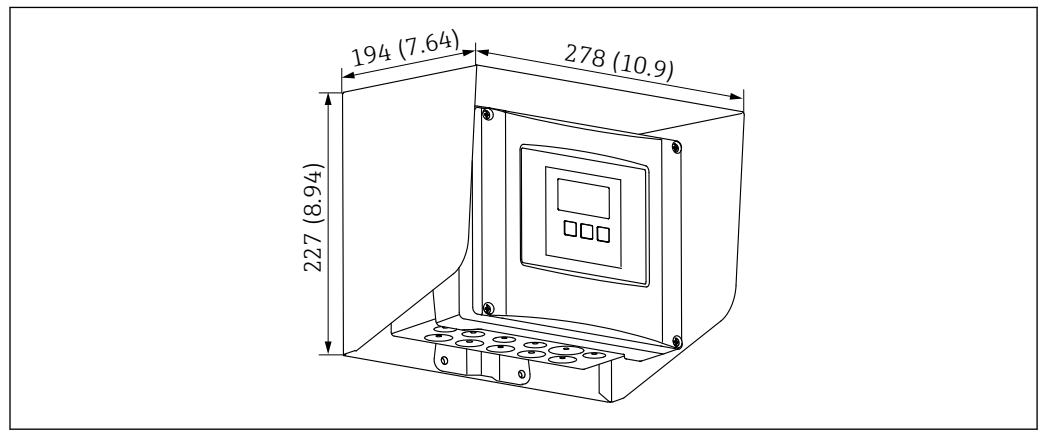
🖼 *51   Weather protection cover for polycarbonate field housing. Unit of measurement mm (in)*

- Material: 316Ti (1.4571)
- Mounting and fixing: using the Prosonic S housing bracket
- Order number: 52024477

13.2.2   Mounting plate for polycarbonate field housing
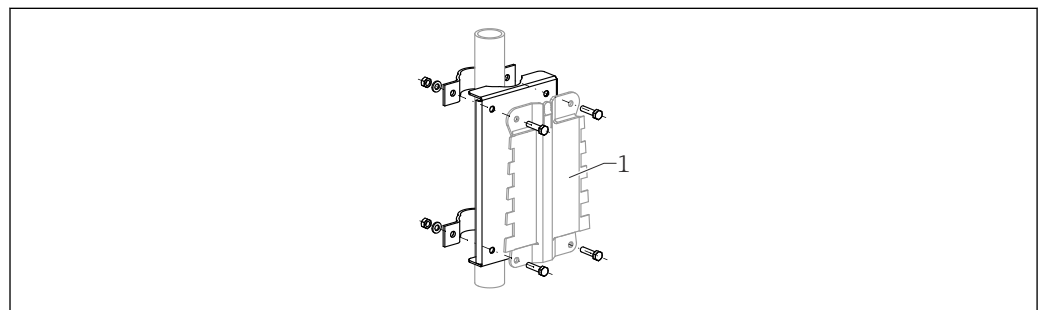
🖼 *52   Mounting plate for polycarbonate field housing*

- Compatible with the Prosonic S housing bracket
- Pipe diameter: 25 to 50 mm (1 to 2 in)
- Dimensions: 210 x 110 mm (8.27 x 4.33 in)

- Material: 316Ti (1.4571)
- Mounting accessories: Fastening clips, screws and nuts are supplied.
- Order number: 52024478

Mounting stand, 700 mm (27.6 in) for cantilever with pivot
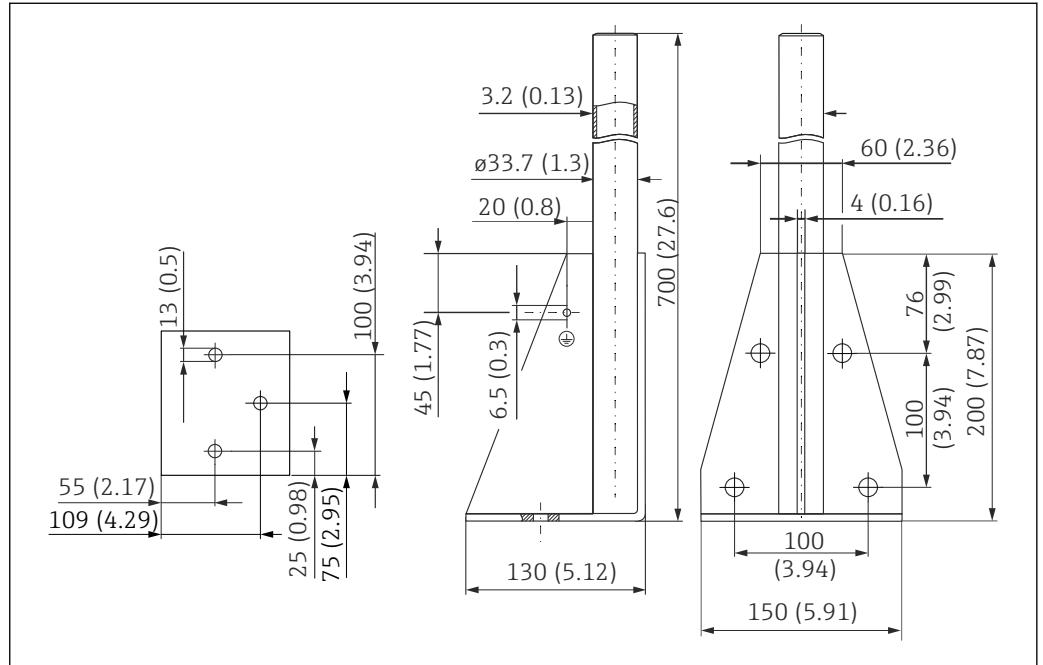
🖻 *53*   *Dimensions. Unit of measurement mm (in)*

Weight:
4.2 kg (9.26 lb)

Material
316L (1.4404)

Order number
71452327

Mounting stand, 1400 mm (55.1 in) for cantilever with pivot
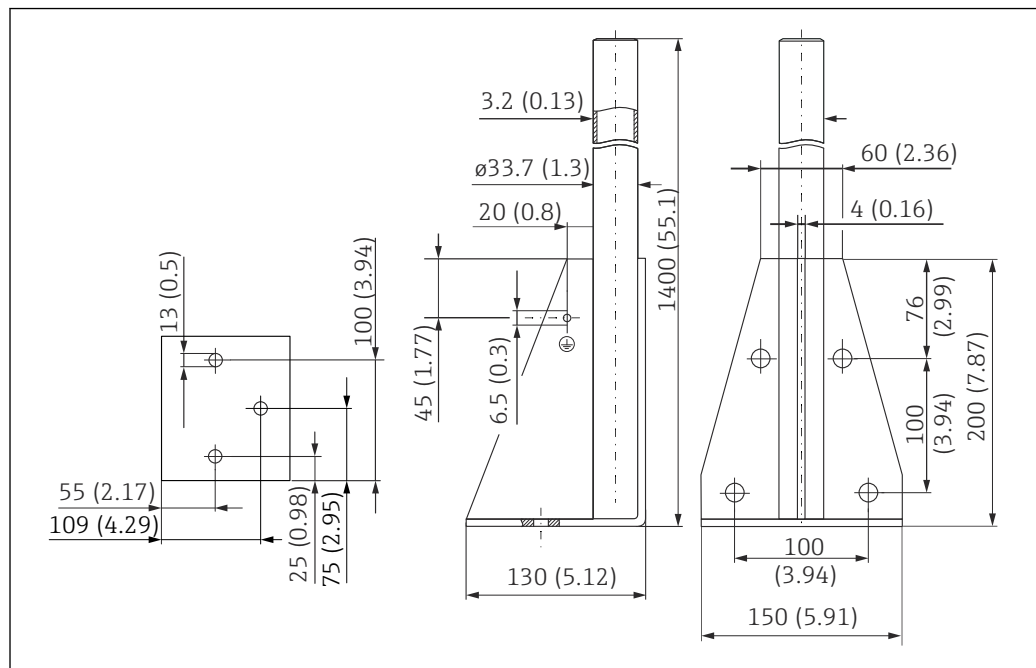
🖼 54   Dimensions. Unit of measurement mm (in)

Weight:
6 kg (13.23 lb)

Material
316L (1.4404)

Order number
71452326

13.2.3   Adapter plate for remote display
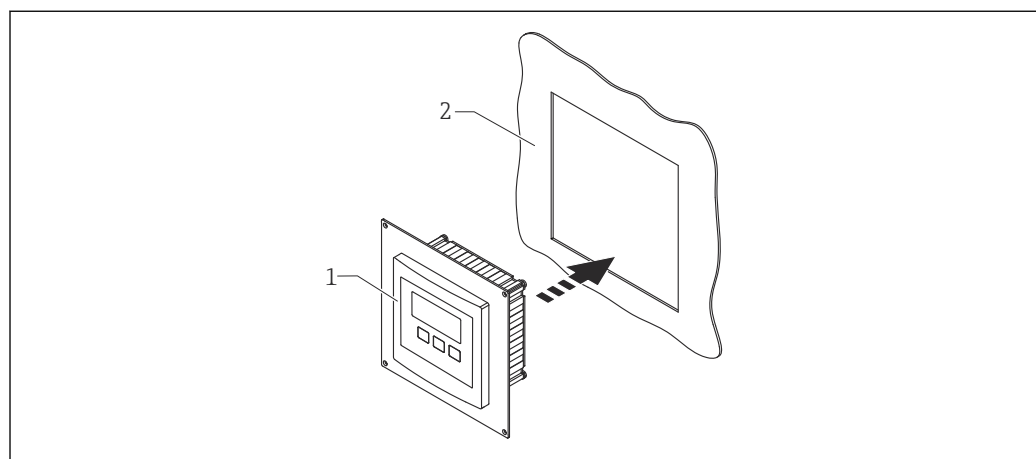
🖼 55   Use of adapter plate

1   Remote display of Prosonic S FMU9x with adapter plate
2   Installation opening of the remote display of the FMU86x predecessor transmitter

To mount the remote display of the Prosonic S FMU9x in the housing of the larger remote display of the FMU86x predecessor
- Dimensions: 144 x 144 mm (5.7 x 5.7 in)
- Material: 304 (1.4301)
- Order number: 52027441

13.2.4 HAW562 surge arrester

Reduces residual voltages from upstream lightning arresters; limits surges induced or generated in the system
Additional information: Technical Information TI01012K

13.2.5 Extension cables for sensors

- Maximum permissible total length (sensor cable + extension cable): 300 m (984 ft)
- The sensor cable and extension cable are the same type of cable.

FDU90/FDU91 without sensor heater
- Cable type: LiYCY 2x(0.75)
- Material: PVC
- Ambient temperature:
- Order number: 71027742

FDU90/FDU91 with sensor heater
- Cable type: LiYY 2x(0.75)D+2x0.75
- Material: PVC
- Ambient temperature:−40 to +105 ℃ (−40 to +221 ℉)
- Order number: 71027746

FDU92
- Cable type: LiYCY 2x(0.75)
- Material: PVC
- Ambient temperature:−40 to +105 ℃ (−40 to +221 ℉)
- Order number: 71027742

FDU91F/FDU93/FDU95
- Cable type: LiYY 2x(0.75)D+1x0.75
- Material: PVC
- Ambient temperature:−40 to +105 ℃ (−40 to +221 ℉)
- Order number: 71027743

FDU95
- Cable type: Li2G2G 2x(0.75)D+1x0.75
- Material: silicone
- Ambient temperature:−40 to +150 ℃ (−40 to +302 ℉)
- Order number: 71027745

14   Operating menu

14.1   Menu "Level → Level (LVL N)"

14.1.1   Submenu "Basic setup"

Parameter set L1003 "LVL N sensor sel."
- Input
- Sensor selection
- Detected

Parameter set L1004 "LVL N appl. param."
- Tank shape
- Medium property
- Process conditions

Parameter set L1005 "LVL N empty cal."
Empty E

Parameter set L 1006 "LVL N full cal."
- Full F
- Blocking distance

Parameter set L1007 "LVL N unit"
- Unit level
- Level N
- Distance

Parameter set L1008 "LVL N linearisat."
- Type
- Customer unit
- Customized text
- Max. scale
- Diameter
- Intermediate height (H)
- Mode
- Edit
- Status table

Parameter set L100B "LVL N check value"
- Act. distance N
- Check distance

Parameter set L100B "LVL N dist. map."
- Act. distance N
- Range of mapping
- Start mapping
- Status

Parameter set L100C "LVL N status"
- Level N
- Act. distance N
- Status

14.1.2   Submenu "Extended calibr."

Parameter set L1016 "LVL N dist. map."
- Act. distance N
- Range of mapping
- Start mapping
- Status

Parameter set L1017 "LVL N check value"
Correction

Parameter set L1018 "LVL N correction"
Offset

Parameter set L1020 "LVL N blocking distance"
Blocking distance

Parameter set L1019 "LVL N limitation"
- Limitation
- High limit
- Low limit

14.1.3   Submenu "Simulation"

Parameter set L1022 "LVL N simulation"
- Simulation
- Sim. level value
- Sim. volume value

14.2   Menu "Safety settings"

Parameter set AX102 "Outp. echo loss"
- Level N
- Ramp level N
- Value level N

Parameter set AX103 "Delay echo loss"
Delay Sensor N

Parameter set AX104 "Safety distance"
Saf. dist.sen N

Parameter set AX105 "In safety dist."
- In saf. dist.s N
- Reset sen N

Parameter set AX107 "React. high temp."
- Overtemp. sen. N
- Max. temp. sen. N

Parameter set A0000 "Defect temp. sen."
Def. temp. sen. N

14.3   Overview of the "Output/calculat." menu (PROFIBUS DP)

14.3.1   Submenu "Analog input"

Parameter set OXA01 "Analog input N"
- Measured value N
- Value
- Status

14.3.2   Submenu "PROFIBUS DP"

Parameter set O1C01 "PROFIBUS DP"
- Profile version
- Instrument address
- Ident number

14.4   Overview of the "Device properties" menu

14.4.1   Submenu "Operating param."

Parameter set D1101 "Distance unit"
Distance unit

Parameter set D110B "Temperature unit"
Temperature unit

14.4.2   Submenu "Tag marking"

Parameter set D1102 "Tag marking"
Device marking

14.4.3   Submenu "Language"

Parameter set D1103 "Language"
Language

14.4.4   Submenu "Password/reset"

Parameter set D1104 "Password/reset"
• Reset
• Code
• Status

14.5   Menu "System informat."

14.5.1   Submenu "Device information"

Parameter set IX101 "Device family"
Device family

Parameter set IX102 "Device name"
Device name

Parameter set IX103 "Device marking"
Device marking

Parameter set IX105 "Serial no."
Serial number

Parameter set IX106 "Software version"
Software version

Parameter set IX107 "Dev. rev."
Dev. rev.

Parameter set IX108 "DD version"
DD version

14.5.2   Submenu "In/output info"

Parameter set IX108 "Level N"
• Input
• Sensor selection
• Detected

Parameter set IX11A "Analog input N"
Measured value N

14.5.3 Submenu "Min/max values"

Parameter set IX302 "Level → Level (LVL) N"
- Max. value
- Min. Value
- Reset

Parameter set IX302 "Temperature → Temperature sen. N"
- Max. value
- Min. Value

14.5.4 Submenu "Envelope curve"

Parameter set IX126 "En. curve sen. N"
- Plot settings (choice of displayed curves)
- Plot settings (choice between an individual curve and cyclic presentation)

14.5.5 Submenu "Error list"

Parameter set E1002 "Actual error"
- 1:
- 2:
- ...

Parameter set E1003 "Last error"
- 1:
- 2:
- ...

14.5.6 Submenu "Diagnostics"

Parameter set E1403 "Operating hours"
Operating hours

Parameter set E1404 "Actual distance"
Act. distance N

Parameter set E1405 "Act. meas. value"
Level N

Parameter set E1405 "Application par."
Sensor N

Parameter set E1406 "Echo quality sen."
Echo quality N

14.6 Menu "Display"

Parameter set DX202 "Display"
- Type
- Value N
- Customized text N

Parameter set DX201 "Display format"
- Format
- No. of decimals
- Sep. character
- Customized text

Parameter set DX200 "Back to home"
Back to home

14.7   Menu "Sensor management"

14.7.1   Submenu "Sensor management → FDU sensor N"

Parameter set D1106 "US sensor N"
- Sensor operation
- Sensor priority
- Detected
- Detection window

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