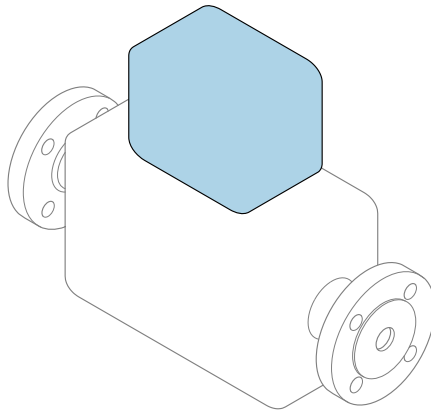


Brief Operating Instructions

Flowmeter

Proline 500 – digital

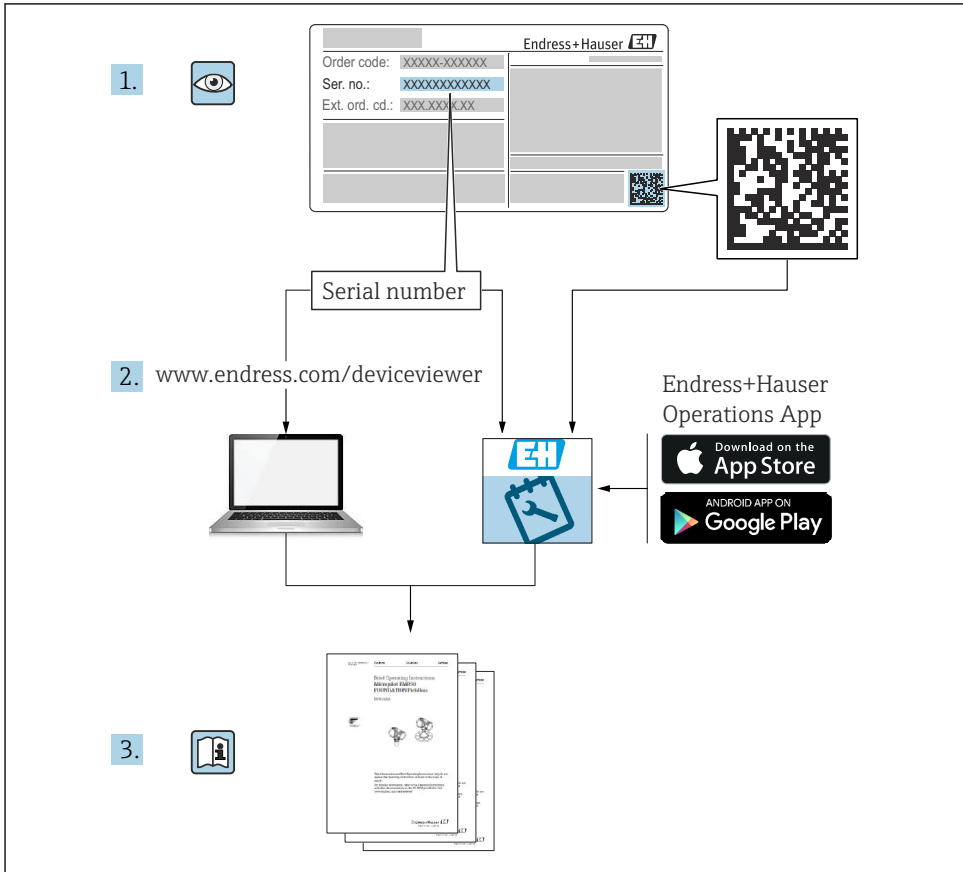
Transmitter with electromagnetic sensor
Modbus TCP



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

Brief Operating Instructions part 2 of 2: Transmitter
Contain information about the transmitter.

Brief Operating Instructions part 1 of 2: Sensor →  3



A0023555

Brief operating instructions Flowmeter

The device consists of a transmitter and a sensor.

The process of commissioning these two components is described in two separate manuals which together form the Brief Operating Instructions for the flowmeter:

- Brief Operating Instructions Part 1: Sensor
- Brief Operating Instructions Part 2: Transmitter

Please refer to both parts of the Brief Operating Instructions when commissioning the device, as the contents of the manuals complement one another:

Brief Operating Instructions Part 1: Sensor

The Sensor Brief Operating Instructions are aimed at specialists with responsibility for installing the measuring device.

- Incoming acceptance and product identification
- Storage and transport
- Mounting procedure

Brief Operating Instructions Part 2: Transmitter

The Transmitter Brief Operating Instructions are aimed at specialists with responsibility for commissioning, configuring and parameterizing the measuring device (until the first measured value).

- Product description
- Mounting procedure
- Electrical connection
- Operation options
- System integration
- Commissioning
- Diagnostic information

Additional device documentation



These Brief Operating Instructions are **Brief Operating Instructions Part 2: Transmitter**.

The "Brief Operating Instructions Part 1: Sensor" are available via:

- Internet: www.endress.com/deviceviewer
- Smartphone/tablet: *Endress+Hauser Operations app*

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

- Internet: www.endress.com/deviceviewer
- Smartphone/tablet: *Endress+Hauser Operations app*

Special documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Radio approvals for WLAN interface for A309/A310 display module	SD01793D
Remote display and operating module DKX001	SD01763D
Modbus TCP system integration	SD03383D

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1 About this document

1.1 Symbols

1.1.1 Safety symbols

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.1.2 Symbols for certain types of information

Symbol	Meaning	Symbol	Meaning
	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 page
	Reference to graphic		Series of steps
	Result of a step		Visual inspection

1.1.3 Electrical symbols

Symbol	Meaning	Symbol	Meaning
	Direct current		Alternating current
	Direct current and alternating current		Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Symbol	Meaning
	Potential equalization connection (PE: Protective earth) 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: potential equalization connection is connected to the supply network. ■ Exterior ground terminal: device is connected to the plant grounding system.

1.1.4 Communication-specific symbols

Symbol	Meaning	Symbol	Meaning
	LED LED is on.		LED LED is off.
	LED LED flashing.		Wireless Local Area Network (WLAN) Communication via a wireless, local area network

1.1.5 Tool symbols

Symbol	Meaning	Symbol	Meaning
	Torx screwdriver		Flat-blade screwdriver
	Phillips screwdriver		Allen key
	Open-end wrench		

1.1.6 Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers		Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
	Hazardous area		Safe area (non-hazardous area)
	Flow direction		

2 Safety requirements

2.1 Requirements for the personnel

The personnel must fulfill the following requirements for its tasks:

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

2.2 Intended use

Depending on the version ordered, the measuring instrument can also measure potentially explosive, flammable, poisonous and oxidizing media.

Measuring instruments for use in hazardous areas, in hygienic applications, or where there is an increased risk due to pressure, are specially labeled on the nameplate.

To ensure that the measuring instrument remains in proper condition during the operating time:

- ▶ Only use the measuring instrument in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- ▶ Using the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area (e.g. explosion protection, pressure vessel safety).
- ▶ Use the measuring instrument only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Keep within the specified pressure and temperature range.
- ▶ Keep within the specified ambient temperature range.
- ▶ Protect the measuring instrument permanently against corrosion from environmental influences.

Incorrect use

Non-designated use can compromise safety. The manufacturer is not liable for damage caused by improper or non-designated use.

⚠ WARNING

Danger of breakage due to corrosive or abrasive fluids and ambient conditions!

- ▶ Verify the compatibility of the process fluid with the sensor material.
- ▶ Ensure the resistance of all wetted materials during the process.
- ▶ Keep within the specified pressure and temperature range.

NOTICE**Verification for borderline cases:**

- ▶ For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability as minute changes in the temperature, concentration or level of contamination in the process can alter the corrosion resistance properties.

Residual risks**⚠ CAUTION**

Risk of hot or cold burns! The use of media and electronics with high or low temperatures can produce hot or cold surfaces on the device.

- ▶ Mount suitable touch protection.

2.3 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Damage to the device!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

2.6 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

2.7 Device-specific IT security

The device offers a range of specific functions to support protective measures on the operator's side. These functions can be configured by the user and guarantee greater in-operation safety if used correctly.



For detailed information on device-specific IT security, see the Operating Instructions for the device.

2.7.1 Access via service interface (port 2): CDI-RJ45

The device can be connected to a network via the service interface. Device-specific functions guarantee the secure operation of the device in a network.

The use of relevant industrial standards and guidelines that have been defined by national and international safety committees, such as IEC/ISA62443 or the IEEE, is recommended. This includes organizational security measures such as the assignment of access authorization as well as technical measures such as network segmentation.



For detailed information on connecting transmitters with an Ex de approval, see separate document "Safety instructions" (XA) for the device.

2.7.2 Advanced safety requirements

If the specified requirements for measures cannot be met, alternative measures may need to be put in place. This may involve, for example, mechanical protection of the product against tampering, the cabling, or organizational measures. The Proline measuring instruments can be used in the open field for example. Measures to combat physical tampering of the Proline measuring instruments must be arranged by the customer.

Additional analysis is required if Proline measuring instruments are integrated into a different system. Please note the following:

- The fieldbus network (OT) and company network (IT) must be strictly separated.
- Endress+Hauser recommends the segmentation of the fieldbus networks according to DIN IEC 62443-3-3.

Network

Pay particular attention to the network components used, the router and switches for example. The operator must guarantee the integrity of the components. Access to the network must be restricted by the operator, if necessary.

FDI Packages

Signed FDI Packages can be obtained via www.endress.com for the configuration of the field device.

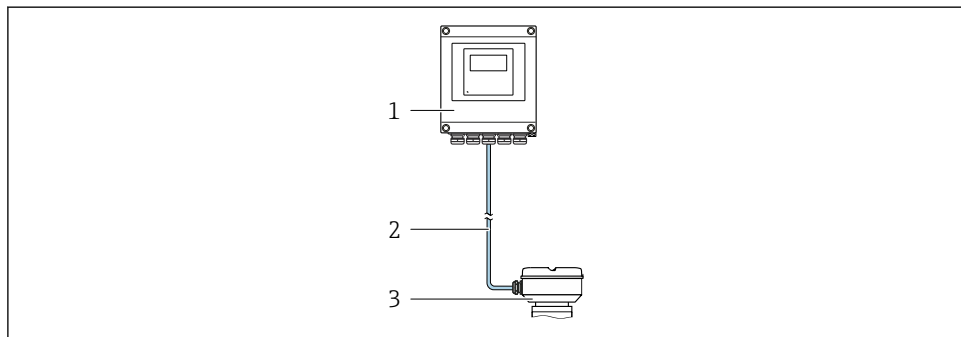
User training

Depending on the application scenario, users who are not specialized in this area may come in contact with the instrument. We recommend that these users be trained in the safe use of the relevant terminals, components and/or interfaces and be made aware of security issues.

3 Product description

The measuring system consists of a Proline 500 - digital transmitter and a Proline Promag electromagnetic sensor.

The transmitter and sensor are mounted in physically separate locations. They are interconnected by a connecting cable.



- 1 Transmitter
- 2 Connecting cable: cable, separate, standard
- 3 Sensor connection housing with integrated ISEM (intelligent sensor electronics module)



For detailed information on the product description, see the Operating Instructions for the device →  3

4 Installation

4.1 Mounting the sensor



For detailed information about mounting the sensor, see the Sensor Brief Operating Instructions →  3

4.2 Mounting the transmitter

NOTICE

Ambient temperature too high!

Danger of electronics overheating and housing deformation.

- ▶ Do not exceed the permitted maximum ambient temperature.
- ▶ If operating outdoors: Avoid direct sunlight and exposure to weathering, particularly in warm climatic regions.

NOTICE

Excessive force can damage the housing!

- ▶ Avoid excessive mechanical stress.

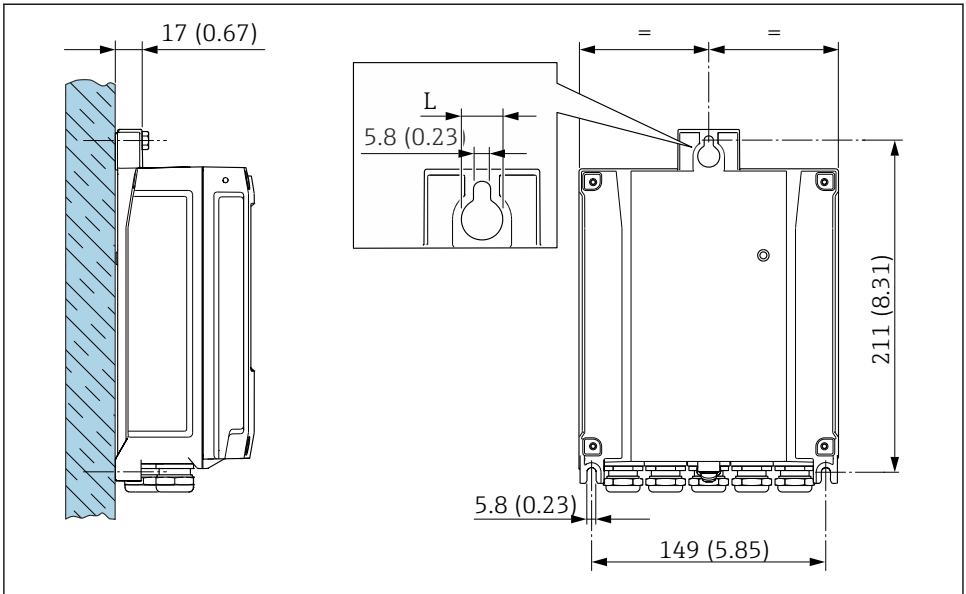
The transmitter can be mounted in the following ways:

- Wall mounting →  12
- Pipe mounting →  14

4.2.1 Wall mounting

Required tools:

Drill with drill bit Ø 6.0 mm



1 Unit mm (in)

L Depends on order code for "Transmitter housing"

Order code for "Transmitter housing"

Option **A**, aluminum, coated: L = 14 mm (0.55 in)

4.2.2 Pipe mounting

Required tools:

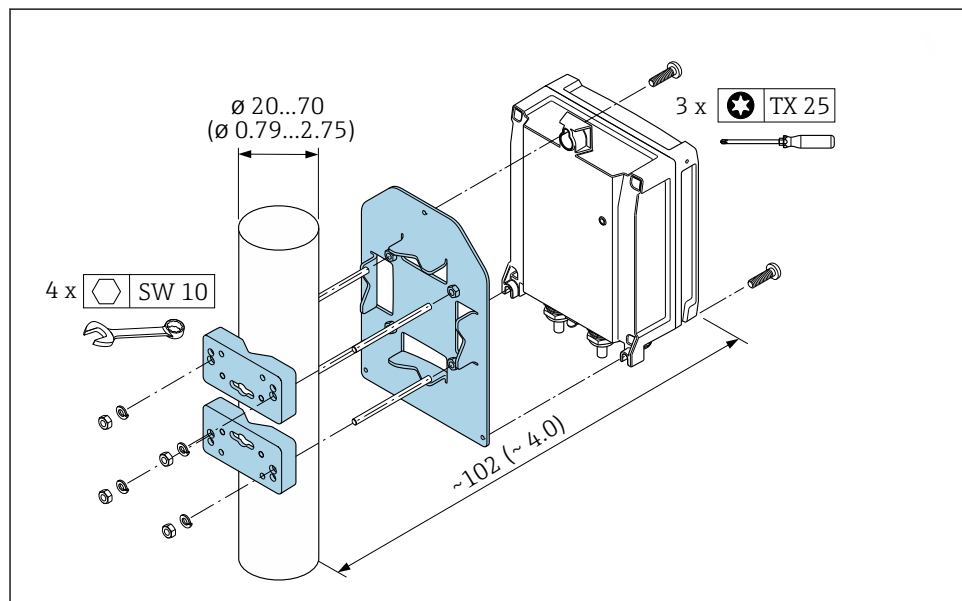
- Open-ended wrench AF 10
- Torx screwdriver TX 25

NOTICE

Excessive tightening torque applied to the fixing screws!

Risk of damaging the plastic transmitter.

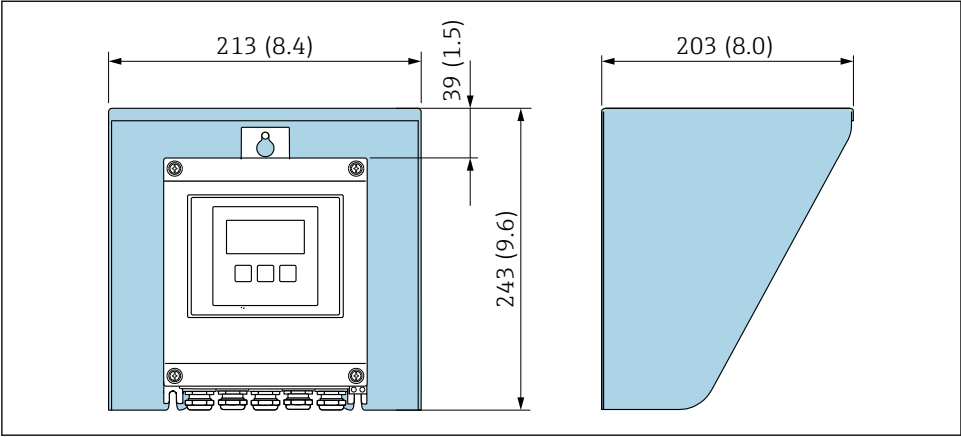
- Tighten the fixing screws as per the tightening torque: 2.5 Nm (1.8 lbf ft)



A0029051

2 Unit mm (in)

4.2.3 Protective cover



A0029552

3 Unit mm (in)

 A weather protection cover is available as an accessory.

4.3 Transmitter post-installation check

The post-installation check must always be performed after the following tasks:
Mounting the transmitter housing:

- Post mounting
- Wall mounting

Is the device undamaged (visual inspection)?	☐
Post and wall mounting: Are the fixing screws tightened securely?	☐

5 Electrical connection

WARNING

Live parts! Incorrect work performed on the electrical connections can result in an electric shock.

- ▶ Set up a disconnecting device (switch or power-circuit breaker) to easily disconnect the device from the supply voltage.
- ▶ In addition to the device fuse, include an overcurrent protection unit with max. 10 A in the plant installation.

5.1 Electrical safety

In accordance with applicable national regulations.

5.2 Connection requirements

5.2.1 Required tools

- For cable entries: use appropriate tool
- For securing clamp: Allen key 3 mm
- Wire stripper
- When using stranded cables: crimper for wire end ferrule
- For removing cables from terminal: flat blade screwdriver ≤ 3 mm (0.12 in)

5.2.2 Requirements for connection cable

The connecting cables provided by the customer must fulfill the following requirements.

Protective grounding cable for the outer ground terminal

Conductor cross-section $< 6 \text{ mm}^2$ (10 AWG)

Larger cross-sections can be connected using a cable lug.

The grounding impedance must be less than 2Ω .

Permitted temperature range

- The installation guidelines that apply in the country of installation must be observed.
- The cables must be suitable for the minimum and maximum temperatures to be expected.

Power supply cable (incl. conductor for the inner ground terminal)

Standard installation cable is sufficient.

Cable diameter

- Cable glands supplied:
M20 $\times$ 1.5 with cable $\varnothing$ 6 to 12 mm (0.24 to 0.47 in)
- Spring-loaded terminals: Suitable for strands and strands with ferrules.
Conductor cross-section 0.2 to 2.5 mm^2 (24 to 12 AWG).

Signal cable

 For custody transfer, all signal lines must be shielded cables (tinned copper braiding, optical coverage $\geq 85\%$). The cable shield must be connected on both sides.

4 to 20 mA current input

Standard installation cable is sufficient.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Relay output

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

Ethernet-APL

Shielded twisted-pair cable. Cable type A is recommended.

 See <https://www.profibus.com> Ethernet-APL White Paper "

5.2.3 Connecting cable

Standard cable

A standard cable can be used as the connecting cable.

Standard cable	4 cores (2 pairs); pair-stranded with common shield
Shielding	Tin-plated copper braid, optical cover ≥ 85 %
Cable length	Maximum 300 m (1 000 ft), see the following table.

Cross-section	Cable lengths for use in	
	Non-hazardous area, Ex Zone 2, Class I, Division 2	Hazardous area, Ex Zone 1, Class I, Division 1
0.34 mm ² (AWG 22)	80 m (270 ft)	50 m (165 ft)
0.50 mm ² (AWG 20)	120 m (400 ft)	60 m (200 ft)
0.75 mm ² (AWG 18)	180 m (600 ft)	90 m (300 ft)
1.00 mm ² (AWG 17)	240 m (800 ft)	120 m (400 ft)
1.50 mm ² (AWG 15)	300 m (1 000 ft)	180 m (600 ft)
2.50 mm ² (AWG 13)	300 m (1 000 ft)	300 m (1 000 ft)

5.2.4 Terminal assignment

Transmitter: supply voltage, input/outputs

The terminal assignment of the inputs and outputs depends on the individual order version of the device. The device-specific terminal assignment is documented on an adhesive label in the terminal cover.

Modbus TCP

Supply voltage		Input/output 1 (Port 1 ¹⁾)		Input/output 2		Input/output 3		Input/output 4 ²⁾		Service interface (Port 2) ¹⁾
1 (+)	2 (-)	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)	CDI-RJ45
Device-specific terminal assignment: adhesive label in terminal cover										

- 1) For Modbus TCP communication, either port 1 OR port 2 can be used.
- 2) Input/output only available for Proline 500 - digital.

Transmitter and sensor connection housing: connecting cable

The sensor and transmitter, which are mounted in separate locations, are interconnected by a connecting cable. The cable is connected via the sensor connection housing and the transmitter housing.



Terminal assignment and connection of the connecting cable → 22.

5.2.5 Preparing the measuring instrument

Carry out the steps in the following order:

1. Mount the sensor and transmitter.
2. Sensor connection housing: Connect connecting cable.
3. Transmitter: Connect connecting cable.
4. Transmitter: Connect signal cable and cable for supply voltage.

NOTICE

Insufficient sealing of the housing!

Operational reliability of the measuring device could be compromised.

► Use suitable cable glands corresponding to the degree of protection.

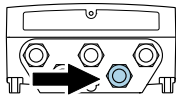
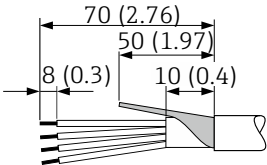
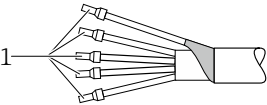
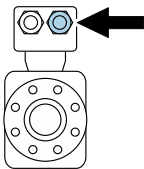
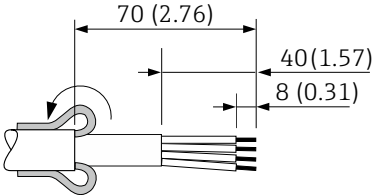
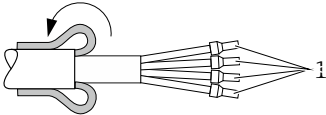
1. Remove dummy plug if present.
2. If the measuring instrument is supplied without cable glands:
Provide suitable cable gland for corresponding connecting cable.
3. If the measuring instrument is supplied with cable glands:
Observe requirements for connecting cables → 16.

5.2.6 Preparing the connecting cable

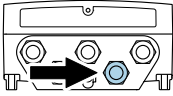
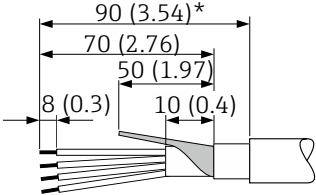
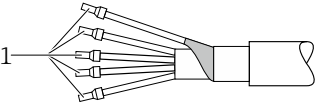
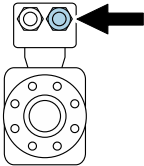
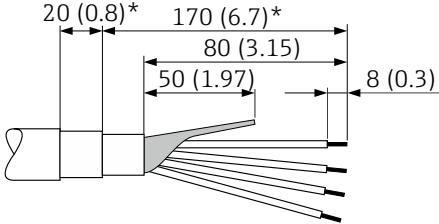
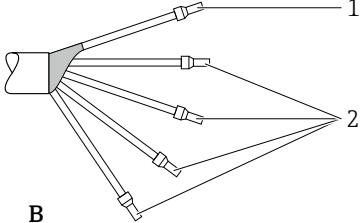
When terminating the connecting cable, pay attention to the following points:

- For cables with fine-wire cores (stranded cables):
Fit the cores with ferrules.

Preparing the connecting cable: Promag H

Transmitter	Sensor
   A0029546	   A0029442
Engineering unit mm (in) A = Terminate the cable B = Fit ferrules on cables with fine-wire cores (stranded cables) 1 = Red ferrules, ϕ 1.0 mm (0.04 in)	

Preparing the connecting cable: Promag P and Promag W

Transmitter	Sensor
  A  B A0029330	  A  B A0029443
Unit mm (in) A = Terminate the cable B = Fit ferrules on cables with fine-wire cores (stranded cables) 1 = Red ferrules, ϕ 1.0 mm (0.04 in) 2 = White ferrules, ϕ 0.5 mm (0.02 in) * = Stripping only for reinforced cables	

5.3 Connecting the device

NOTICE

An incorrect connection compromises electrical safety!

- ▶ Only properly trained specialist staff may perform electrical connection work.
- ▶ Observe applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.
- ▶ Always connect the protective ground cable ⊕ before connecting additional cables.
- ▶ When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation.

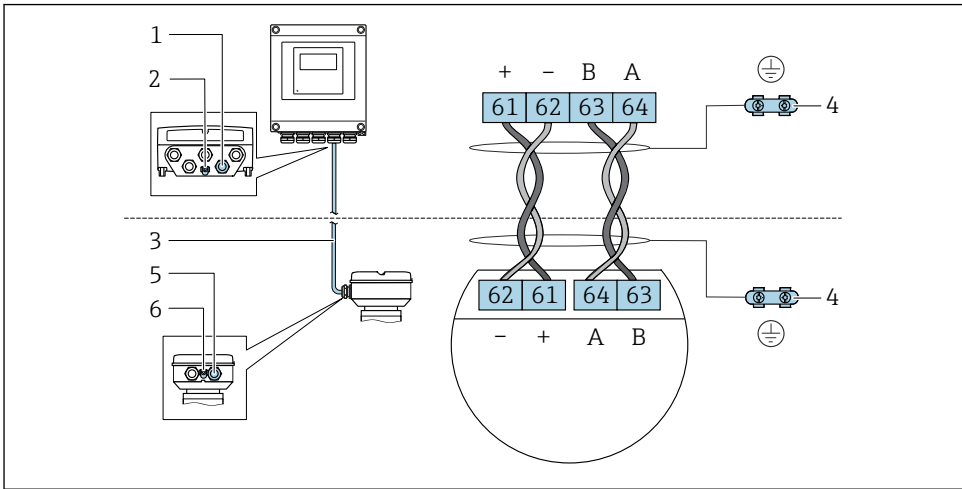
5.3.1 Connecting the connecting cable

NOTICE

Risk of damaging the electronic components!

- ▶ Connect the sensor and transmitter to the same potential equalization.
- ▶ Only connect the sensor to a transmitter with the same serial number.
- ▶ Ground the connection housing of the sensor via the external screw terminal.

Connecting cable terminal assignment



A0028198

- 1 Cable entry for cable on transmitter housing
- 2 Protective earth (PE)
- 3 Connecting cable ISEM communication
- 4 Grounding via ground connection; in the version with a device plug, grounding is ensured through the plug itself
- 5 Cable entry for cable or connection of device plug on sensor connection housing
- 6 Protective earth (PE)

Connecting the connecting cable to the sensor connection housing

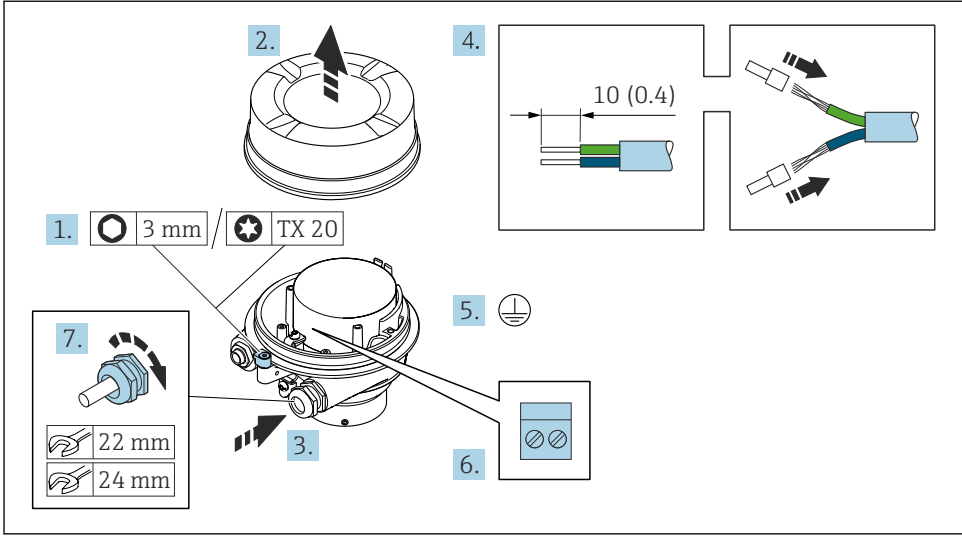
Connection via terminals with order code for "Housing"		Available for sensor
Option A "Aluminum, coated"	→  24	Promag P, W
Option B "Stainless"	→  25	Promag H
Option L "Cast, stainless"	→  24	Promag P

Connection via connectors with order code for "Sensor connection housing"		Available for sensor
Option C "Ultra-compact hygienic, stainless"	→  26	Promag H

Connecting the connecting cable to the transmitter

The cable is connected to the transmitter via terminals →  27.

Connecting the sensor connection housing via terminals



A0029616

1. Loosen the securing clamp of the housing cover.
2. Unscrew the housing cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
5. Connect the protective ground.
6. Connect the cable in accordance with the connecting cable terminal assignment
→ 22.
7. Firmly tighten the cable glands.
↳ This concludes the process for connecting the connecting cable.

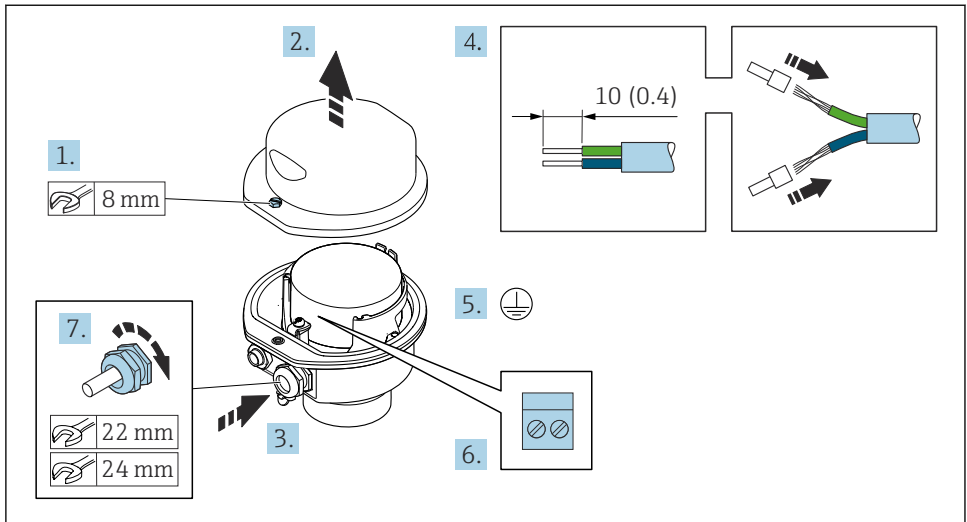
⚠ WARNING

Housing degree of protection voided due to insufficient sealing of the housing.

- ▶ Screw in the thread on the cover without using any lubricant. The thread on the cover is coated with a dry lubricant.

8. Screw on the housing cover.
9. Tighten the securing clamp of the housing cover.

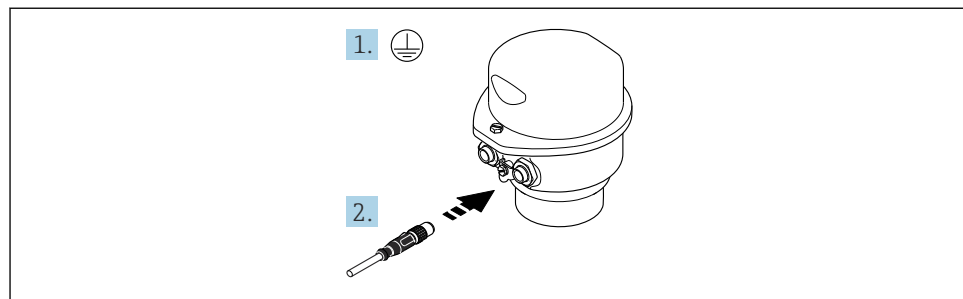
Connecting the sensor connection housing via terminals



A0029613

1. Release the securing screw of the housing cover.
2. Open the housing cover.
3. Push the cable through the cable entry . To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
5. Connect the protective ground.
6. Connect the cable in accordance with the connecting cable terminal assignment
→ 22.
7. Firmly tighten the cable glands.
↳ This concludes the process for connecting the connecting cable.
8. Close the housing cover.
9. Tighten the securing screw of the housing cover.

Connecting the sensor connection housing via the connector

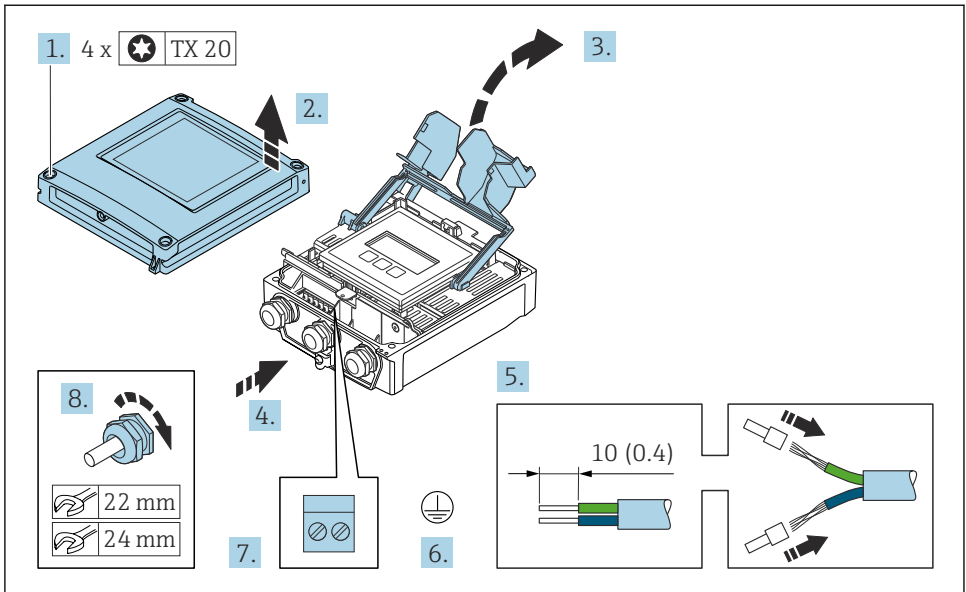


A0029615

1. Connect the protective ground.

2. Connect the connector.

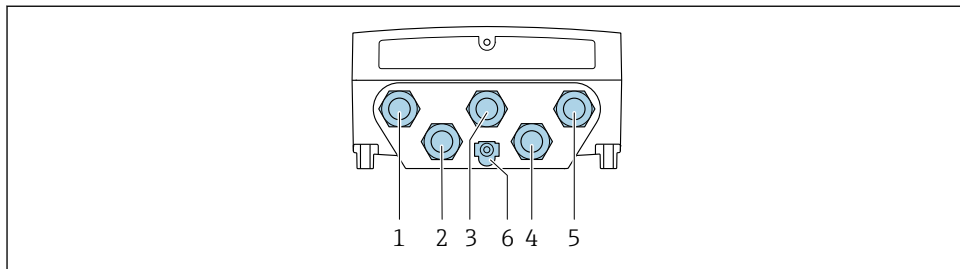
Connecting the connecting cable to the transmitter



A0029597

1. Loosen the 4 fixing screws on the housing cover.
2. Open the housing cover.
3. Fold open the terminal cover.
4. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
5. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
6. Connect the protective ground.
7. Connect the cable according to the terminal assignment for the connecting cable
→ 22.
8. Firmly tighten the cable glands.
↳ The process for connecting the connecting cable is now complete.
9. Close the housing cover.
10. Tighten the securing screw of the housing cover.
11. After connecting the connecting cable:
Connect the signal cable and the supply voltage cable → 28.

5.3.2 Connecting the transmitter



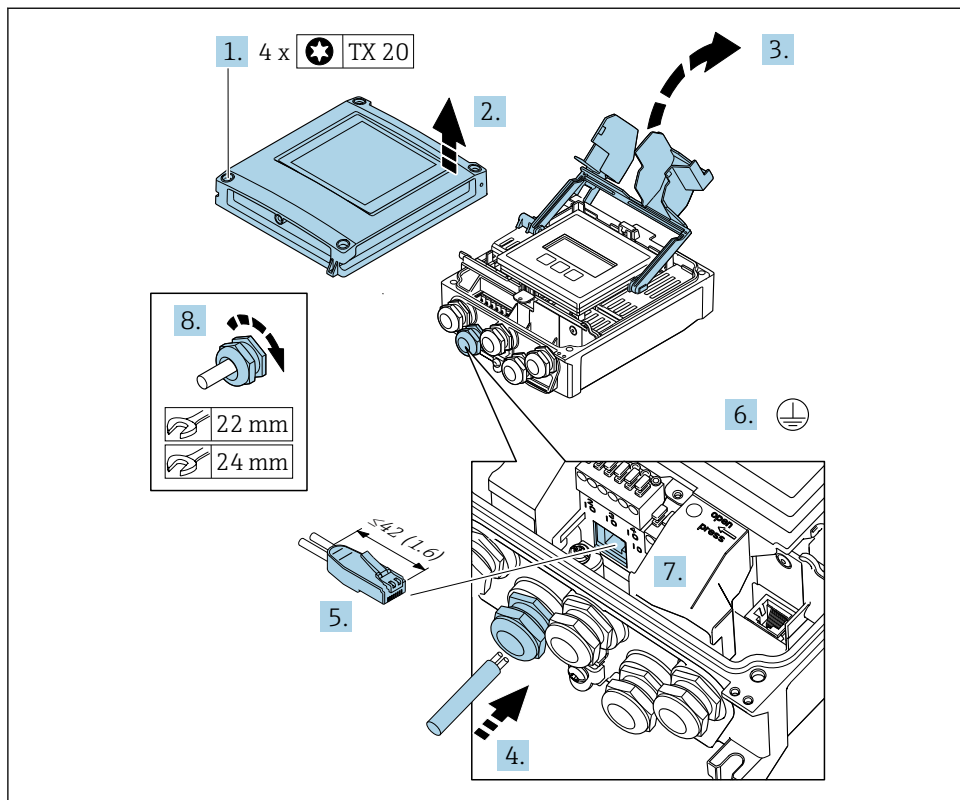
A0028200

- 1 Terminal connection for supply voltage
- 2 Terminal connection for signal transmission, input/output
- 3 Terminal connection for signal transmission, input/output
- 4 Terminal connection for connecting cable between sensor and transmitter
- 5 Terminal connection for signal transmission, input/output; optional: connection for external WLAN antenna
- 6 Protective earth (PE)



In addition to connecting the device via and the available input/outputs, additional connection options are also available:
Integrate into a network via the service interface (CDI-RJ45) .

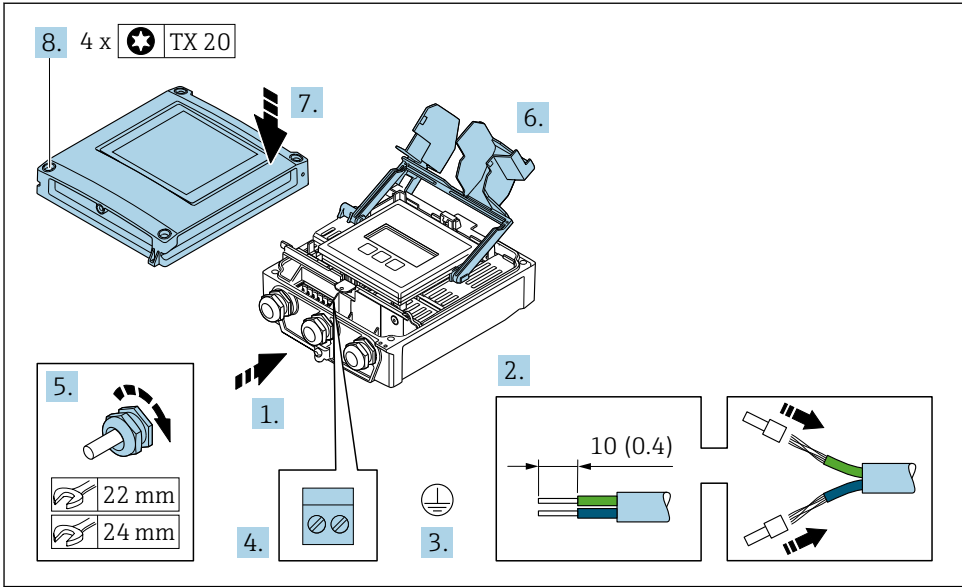
Connecting the plug



A0033987

1. Loosen the 4 fixing screws on the housing cover.
2. Open the housing cover.
3. Fold open the terminal cover.
4. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
5. Strip the cable and cable ends and connect to the RJ45 connector.
6. Connect the protective ground.
7. Plug in the RJ45 connector.
8. Firmly tighten the cable glands.
 - This concludes the connection process.

Connecting the supply voltage and additional inputs/outputs



A0033831

1. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
2. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
3. Connect the protective ground.
4. Connect the cable according to the terminal assignment.
 - ↳ **Signal cable terminal assignment:** The device-specific terminal assignment is documented on an adhesive label in the terminal cover.
 - Supply voltage terminal assignment:** Adhesive label in the terminal cover or → 18.
5. Firmly tighten the cable glands.
 - ↳ This concludes the cable connection process.
6. Close the terminal cover.
7. Close the housing cover.

WARNING

Housing degree of protection may be voided due to insufficient sealing of the housing.

- ▶ Screw in the screw without using any lubricant.

NOTICE

Excessive tightening torque applied to the fixing screws!

Risk of damaging the plastic transmitter.

- ▶ Tighten the fixing screws as per the tightening torque: 2.5 Nm (1.8 lbf ft)

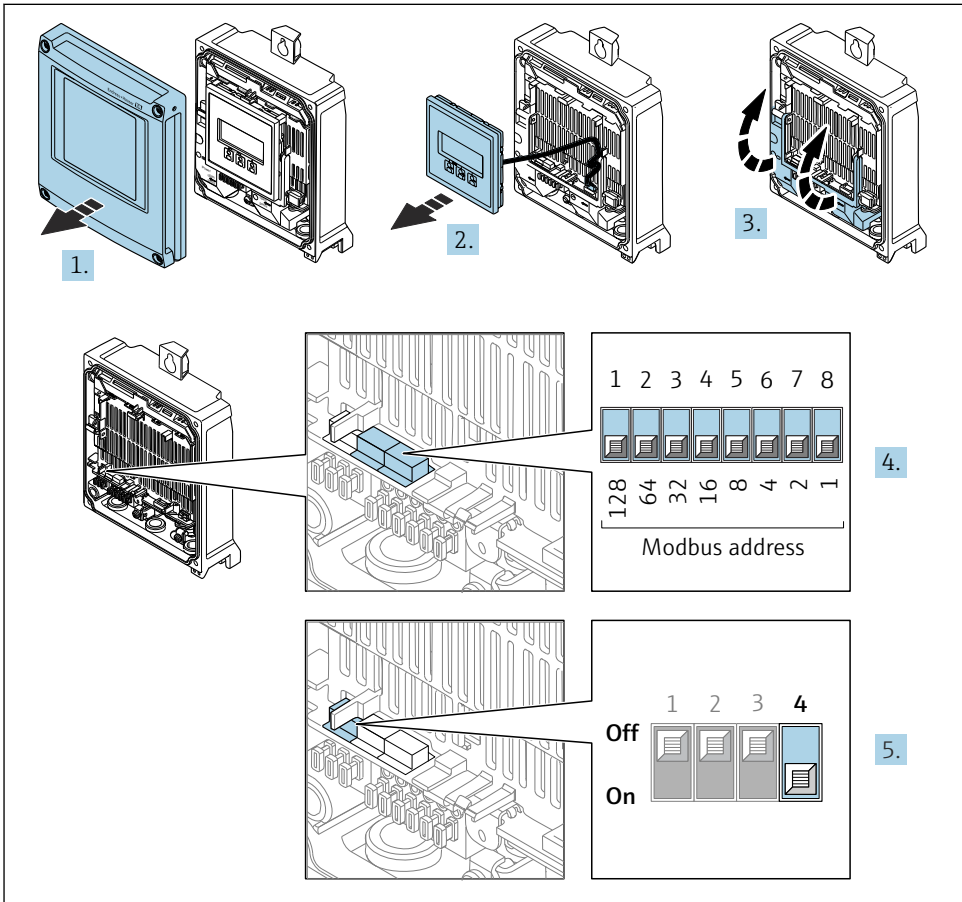
8. Tighten the 4 fixing screws on the housing cover.

5.4 Hardware settings

5.4.1 Setting the device address

The device address must always be configured for a Modbus slave. The valid device addresses are in the range from 1 to 247. Each address may only be assigned once in a Modbus RS485 network. If an address is not configured correctly, the measuring device is not recognized by the Modbus master. All measuring devices are delivered from the factory with the device address 247 and with the "software addressing" address mode.

Hardware addressing



A0029677

1. Open the housing cover.
2. Remove the display module.
3. Fold open the terminal cover.

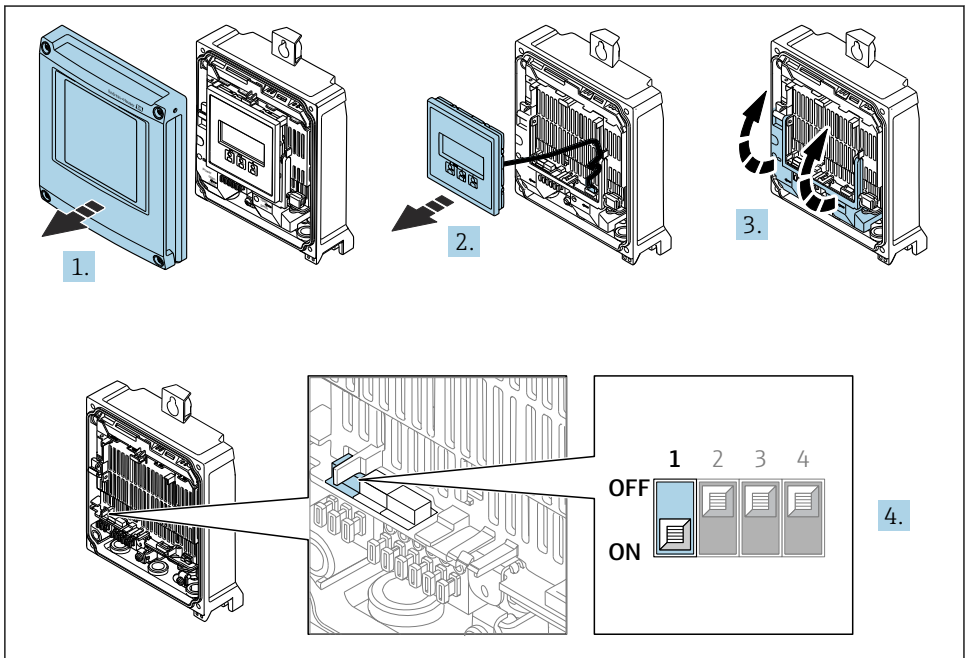
4. Set the desired device address using the DIP switches.
5. To switch addressing from software addressing to hardware addressing: set the DIP switch to **On**.
 - ↳ The change of device address takes effect after 10 seconds.

Software addressing

- ▶ To switch addressing from hardware addressing to software addressing: set the DIP switch to **Off**.
 - ↳ The device address configured in the **Device address** parameter takes effect after 10 seconds.

5.4.2 Activating the terminating resistor

To avoid incorrect communication transmission caused by impedance mismatch, terminate the Modbus RS485 cable correctly at the start and end of the bus segment.



A0029675

1. Open the housing cover.
2. Remove the display module.
3. Fold open the terminal cover.
4. Switch DIP switch no. 3 to **On**.

5.5 Ensuring potential equalization

5.5.1 Proline Promag H

CAUTION

Insufficient or faulty potential equalization.

May destroy the electrodes and thus result in the complete failure of the device!

- ▶ Pay attention to in-house grounding concepts
- ▶ Take account of operating conditions like the pipe material and grounding
- ▶ Connect the medium, sensor and transmitter to the same electrical potential
- ▶ Use a ground cable with a minimum cross-section of 6 mm² (0.0093 in²) and a cable lug for potential equalization connections



For devices intended for use in hazardous locations, please observe the guidelines in the Ex documentation (XA).

Metal process connections

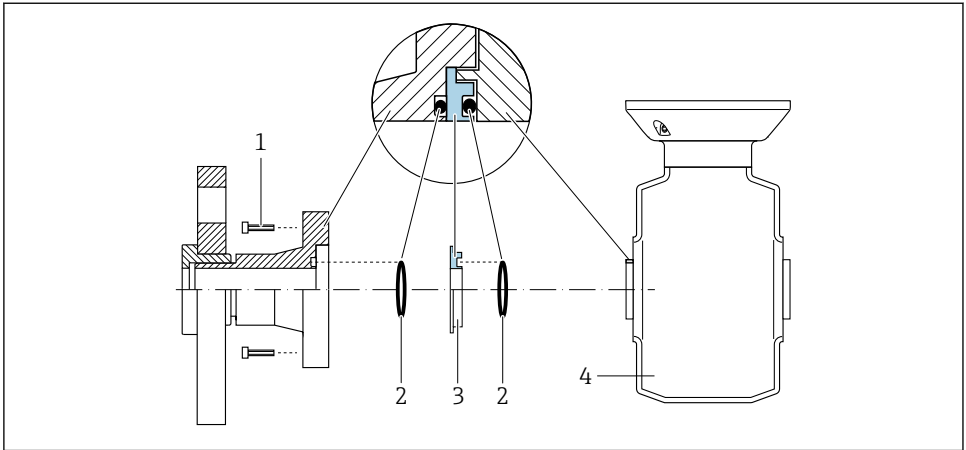
Potential equalization is generally via the metal process connections that are in contact with the medium and mounted directly on the sensor. Therefore there is generally no need for additional potential equalization measures.

Plastic process connections

In the case of plastic process connections, additional grounding rings or process connections with an integrated grounding electrode must be used to ensure potential matching between the sensor and the fluid. If there is no potential matching, this can affect the measuring accuracy or cause the destruction of the sensor as a result of the electrochemical decomposition of the electrodes.

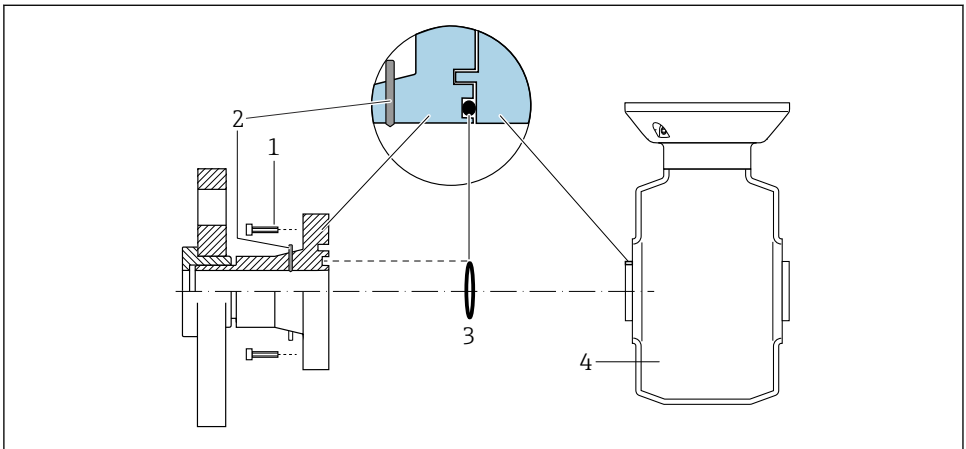
Note the following when using grounding rings:

- Depending on the option ordered, plastic disks are used instead of grounding rings on some process connections. These plastic disks only act as "spacers" and do not have any potential matching function. Furthermore, they also perform a significant sealing function at the sensor/connection interface. Therefore, in the case of process connections without metal grounding rings, these plastic disks/seals should never be removed and should always be installed!
- Grounding rings can be ordered separately as accessory DK5HR* from Endress+Hauser (does not contain any seals). When ordering make sure that the grounding rings are compatible with the material used for the electrodes, as otherwise there is the danger that the electrodes could be destroyed by electrochemical corrosion!
- If seals are required, they can be additionally ordered with seal set DK5G*.
- Grounding rings including seals are mounted inside the process connections. This does not affect the installed length.

Potential equalization via additional grounding ring

A0028971

- 1 Hexagonal-headed bolts of process connection
- 2 O-ring seals
- 3 Plastic disk (spacer) or grounding ring
- 4 Sensor

Potential equalization via grounding electrodes on process connection

A0028972

- 1 Hexagonal-headed bolts of process connection
- 2 Integrated grounding electrodes
- 3 O-ring seal
- 4 Sensor

5.5.2 Promag P and Promag W

⚠ CAUTION

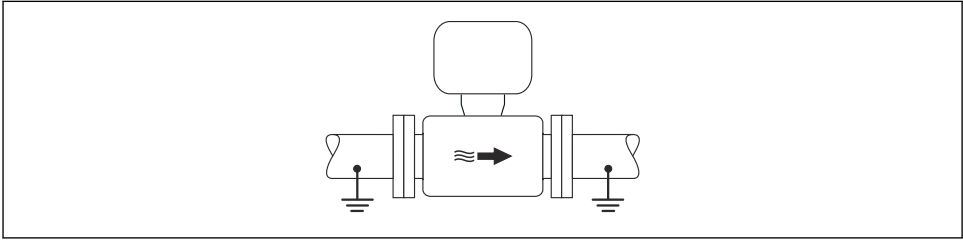
Insufficient or faulty potential equalization.

May destroy the electrodes and thus result in the complete failure of the device!

- ▶ Pay attention to in-house grounding concepts
- ▶ Take account of operating conditions like the pipe material and grounding
- ▶ Connect the medium, sensor and transmitter to the same electrical potential
- ▶ Use a ground cable with a minimum cross-section of 6 mm² (0.0093 in²) and a cable lug for potential equalization connections

 For devices intended for use in hazardous locations, please observe the guidelines in the Ex documentation (XA).

Metal, grounded pipe



A0016315

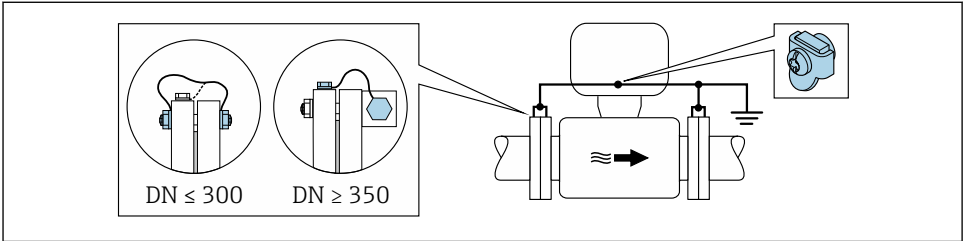
 4 *Potential equalization via measuring tube*

Unlined and ungrounded metal pipe

This connection method also applies in situations where:

- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least 6 mm ² (0.0093 in ²)
---------------------	---



A0029338

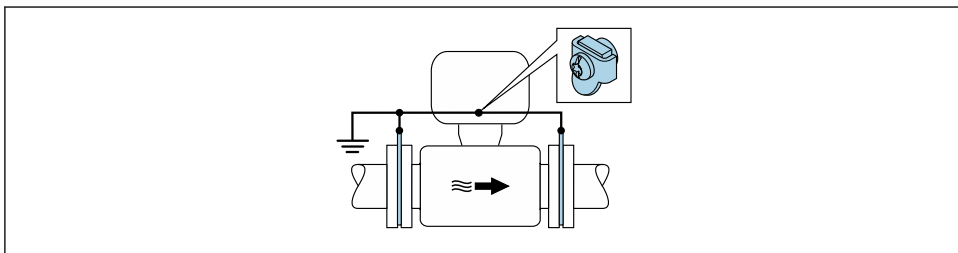
 5 *Potential equalization via ground terminal and pipe flanges*

1. Connect both sensor flanges to the pipe flange via a ground cable and ground them.
2. If $DN \leq 300$ (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
3. If $DN \geq 350$ (14"): Mount the ground cable directly on the metal transport bracket. Observe screw tightening torques: see the Sensor Brief Operating Instructions.
4. Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for the purpose.

Pipe with insulating liner or plastic pipe

This connection method also applies in situations where:

- Standard company potential equalization cannot be guaranteed
- Equalizing currents can be expected



A0029339

6 Potential equalization via ground terminal and ground disks ($PE = P_{FL} = P_M$)

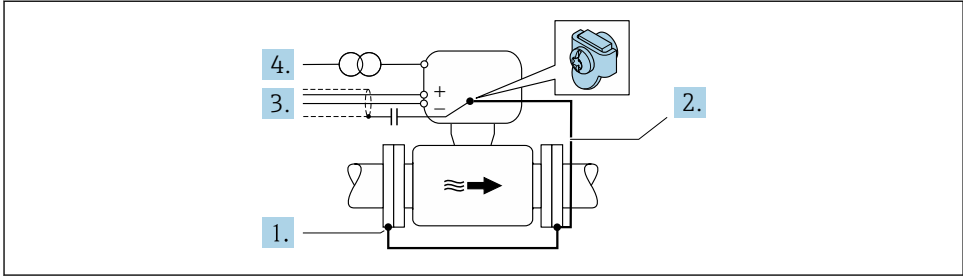
1. Connect the ground disks to the ground terminal via the ground cable.
2. Connect the ground disks to ground potential.
 $\hookrightarrow PE = P_{FL} = P_M$

Pipe with a cathodic protection unit

This connection method is only used if the following two conditions are met:

- Metal pipe without liner or pipe with electrically conductive liner
- Cathodic protection is integrated in the personal protection equipment

Ground cable	Copper wire, at least 6 mm^2 (0.0093 in^2)
--------------	--



A0029340

Prerequisite: The sensor is installed in the pipe in a way that provides electrical insulation.

1. Connect the two flanges of the pipe to one another via a ground cable.
2. Connect the flange to the ground terminal via the ground cable.
3. Route the signal line shielding via a capacitor (recommended value 1.5 µF/50 V).
4. Connect the device to the power supply such that it is floating in relation to the ground potential (PE), (this step is not necessary if using a power supply without ground potential (PE)).

↳ $PE \neq P_{FL} = P_M$

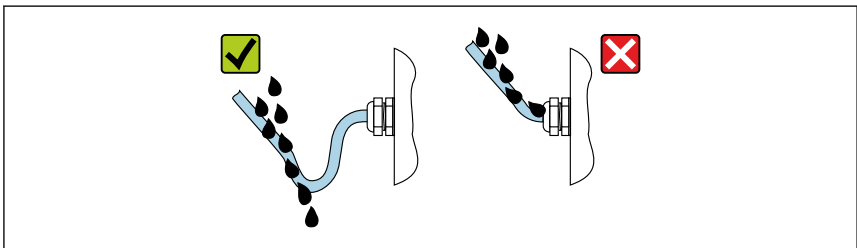
5.6 Ensuring the degree of protection

The measuring instrument fulfills all the requirements for the degree of protection IP66/67, Type 4X enclosure.

To guarantee the degree of protection IP66/67, Type 4X enclosure, carry out the following steps after the electrical connection:

1. Check that the housing seals are clean and fitted correctly.
2. Dry, clean or replace the seals if necessary.
3. Tighten all housing screws and screw covers.
4. Firmly tighten the cable glands.
5. To ensure that moisture does not enter the cable entry:
Route the cable so that it loops down before the cable entry ("water trap").

↳



A0029278

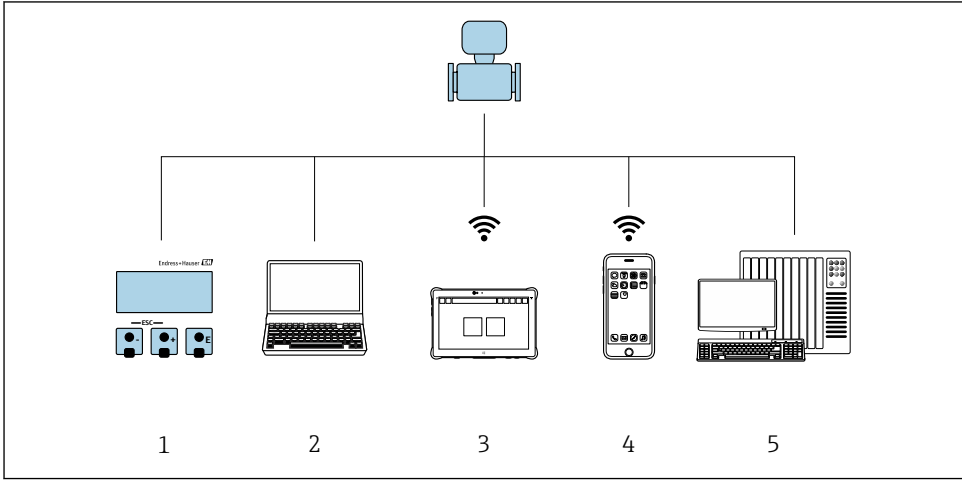
6. The supplied cable glands and plastic dummy plugs, which are used for the threaded cable entries, do not guarantee the degree of protection IP66/67, Type 4X enclosure. To achieve this degree of protection, cable glands and plastic dummy plugs that are not used must be replaced by threaded dummy plugs with the degree of protection IP66/67, Type 4x enclosure.

5.7 Post-connection check

Are the device and cable undamaged (visual inspection)?	☐
Is the protective earthing established correctly?	☐
Do the cables used meet the requirements ?	☐
Are the mounted cables strain-relieved and fixed securely in place?	☐
Are all cable glands installed, securely tightened and leak-tight? Cable run with "water trap" →  38?	☐
Is the terminal assignment correct ?	☐
Is the potential equalization established correctly ?	☐
Are dummy plugs inserted in unused cable entries and have transportation plugs been replaced with dummy plugs?	☐

6 Operation options

6.1 Overview of operation options

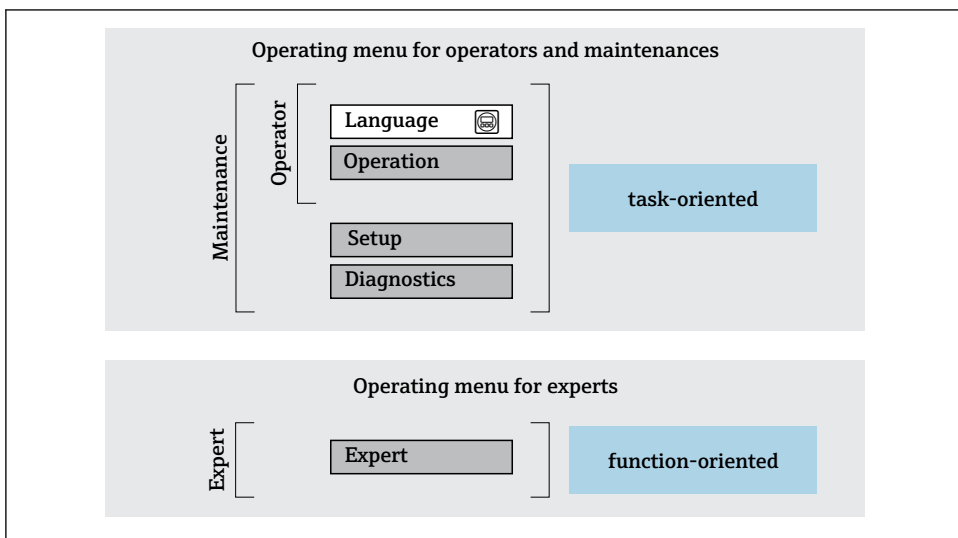


A0046226

- 1 Local operation via display module
- 2 Computer with web browser or with operating tool (e.g. FieldCare, DeviceCare, SIMATIC PDM)
- 3 Field Xpert SMT70
- 4 Mobile handheld terminal
- 5 Automation system (e.g. PLC)

6.2 Structure and function of the operating menu

6.2.1 Structure of the operating menu



A0014058-EN

 7 Schematic structure of the operating menu

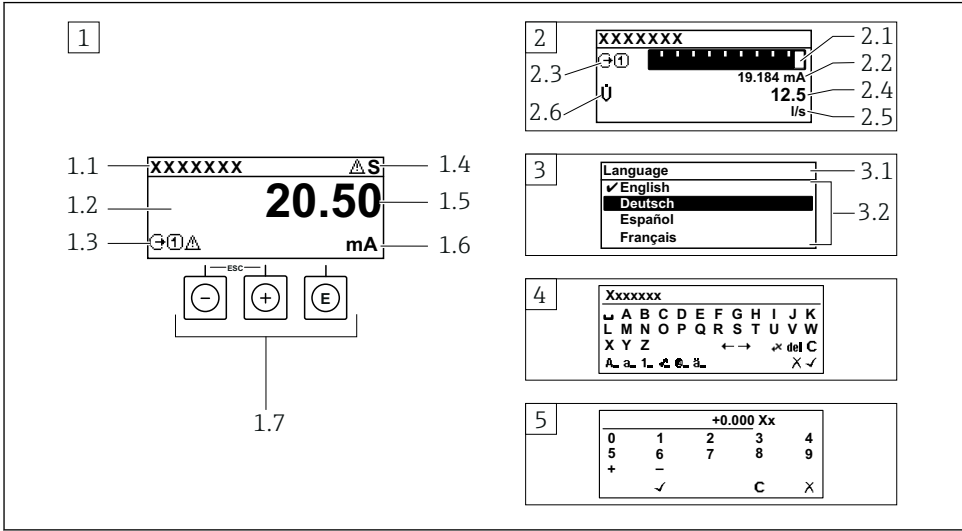
6.2.2 Operating philosophy

The individual parts of the operating menu are assigned to certain user roles (e.g. operator, maintenance etc.). Each user role contains typical tasks within the device life cycle.



For detailed information on the operating philosophy, see the Operating Instructions for the device. →  3

6.3 Access to operating menu via local display



A0014013

- 1 Operational display with measured value shown as "1 value, max." (example)
 - 1.1 Device tag
 - 1.2 Display area for measured values (4-line)
 - 1.3 Explanatory symbols for measured value: Measured value type, measuring channel number, symbol for diagnostic behavior
 - 1.4 Status area
 - 1.5 Measured value
 - 1.6 Unit for the measured value
 - 1.7 Operating elements
- 2 Operational display with measured value shown as "1 bar graph + 1 value" (example)
 - 2.1 Bar graph display for measured value 1
 - 2.2 Measured value 1 with unit
 - 2.3 Explanatory symbols for measured value 1: measured value type, measuring channel number
 - 2.4 Measured value 2
 - 2.5 Unit for measured value 2
 - 2.6 Explanatory symbols for measured value 2: measured value type, measuring channel number
- 3 Navigation view: picklist of a parameter
 - 3.1 Navigation path and status area
 - 3.2 Display area for navigation: ✓ designates the current parameter value
- 4 Editing view: text editor with input mask
- 5 Editing view: numeric editor with input mask

6.3.1 Operational display

Explanatory symbols for the measured value	Status area
▪ Depends on the device version, e.g.: ▪ : Volume flow ▪ : Mass flow ▪ : Density ▪ : Conductance ▪ : Temperature ▪ : Totalizer ▪ : Output ▪ : Input ▪ : Measurement channel number ¹⁾ ▪ Diagnostic behavior ²⁾ ▪ : Alarm ▪ : Warning	The following symbols appear in the status area of the operational display at the top right: ▪ Status signals ▪ : Failure ▪ : Function check ▪ : Out of specification ▪ : Maintenance required ▪ Diagnostic behavior ▪ : Alarm ▪ : Warning ▪ : Locking (locked via hardware)) ▪ : Communication via remote operation is active.

- 1) If there is more than one channel for the same measured variable type (totalizer, output etc.).
 2) For a diagnostic event that concerns the displayed measured variable.

6.3.2 Navigation view

Status area	Display area
The following appears in the status area of the navigation view in the top right corner: ▪ In the submenu ▪ The direct access code for the parameter you are navigating to (e.g. 0022-1) ▪ If a diagnostic event is present, the diagnostic behavior and status signal ▪ In the wizard ▪ If a diagnostic event is present, the diagnostic behavior and status signal	▪ Icons for menus ▪ : Operation ▪ : Setup ▪ : Diagnostics ▪ : Expert ▪ : Submenus ▪ : Wizard ▪ : Parameters within a wizard ▪ : Parameter locked

6.3.3 Editing view

Text editor	Text correction symbols under
Confirms selection.	Clears all entered characters.
Exits the input without applying the changes.	Moves the input position one position to the right.
Clears all entered characters.	Moves the input position one position to the left.
Switches to the selection of the correction tools.	Deletes one character immediately to the left of the input position.
Toggle ▪ Between upper-case and lower-case letters ▪ For entering numbers ▪ For entering special characters	

Numeric editor	
 Confirms selection.	 Moves the input position one position to the left.
 Exits the input without applying the changes.	 Inserts decimal separator at the cursor position.
 Inserts minus sign at the cursor position.	 Clears all entered characters.

6.3.4 Operating elements

Operating key	Meaning
	Minus key <i>In menu, submenu</i> Moves the selection bar upwards in a picklist <i>In wizards</i> Goes to previous parameter <i>In the text and numeric editor</i> Move the entry position to the left.
	Plus key <i>In menu, submenu</i> Moves the selection bar downwards in a picklist <i>In wizards</i> Goes to the next parameter <i>In the text and numeric editor</i> Move the entry position to the right.
	Enter key <i>In the operational display</i> Pressing the key briefly opens the operating menu. <i>In menu, submenu</i> - Pressing the key briefly: - Opens the selected menu, submenu or parameter. - Starts the wizard. - If help text is open, closes the help text of the parameter. - Pressing the key for 2 s in a parameter: If present, opens the help text for the function of the parameter. <i>In wizards</i> Opens the editing view of the parameter and confirms the parameter value <i>In the text and numeric editor</i> - Pressing the key briefly confirms your selection. - Pressing the key for 2 s confirms your entry.

Operating key	Meaning
 + 	Escape key combination (press keys simultaneously) <i>In menu, submenu</i> - Pressing the key briefly: - Exits the current menu level and takes you to the next higher level. - If help text is open, closes the help text of the parameter. - Pressing the key for 2 s returns you to the operational display ("home position"). <i>In wizards</i> Exits the wizard and takes you to the next higher level <i>In the text and numeric editor</i> Exits the Editing view without applying the changes.
 + 	Minus/Enter key combination (press and hold down the keys simultaneously) - If keypad lock is active: Pressing the key for 3 s deactivates the keypad lock. - If keypad lock is not active: Pressing the key for 3 s opens the context menu including the option for activating the keypad lock.

6.3.5 Further information



Further information on the following subjects:

- Calling up help text
- User roles and related access authorization
- Disabling write protection via access code
- Enabling and disabling the keypad lock

Operating instructions for the device →  3

6.4 Access to the operating menu via the operating tool



For detailed information on access via FieldCare and DeviceCare, see the Operating Instructions for the device →  3

6.5 Access to the operating menu via the web server



The operating menu can also be accessed via the web server. See the Operating Instructions for the device. →  3

7 Modbus TCP system integration



For detailed information on system integration, see the Special Documentation for the Modbus TCP system integration with the device:

→  4

8 Commissioning

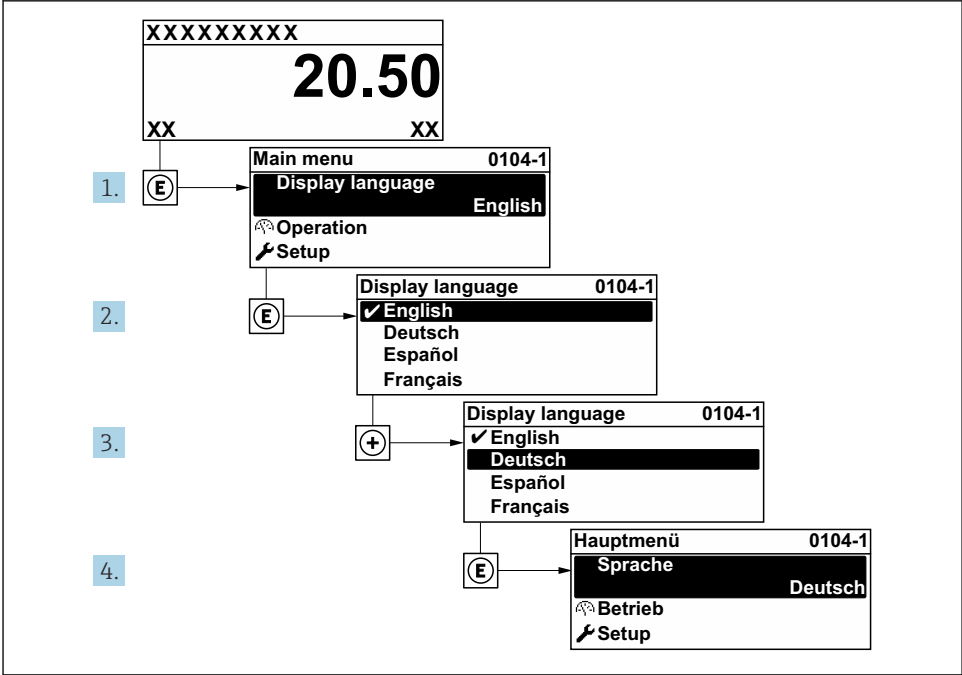
8.1 Installation and function check

Before commissioning the device:

- ▶ Make sure that the post-installation and post-connection checks have been performed successfully.
- "Post-mounting check" checklist → 15
- "Post-connection check" checklist → 39

8.2 Setting the operating language

Factory setting: English or ordered local language



A0029420

8 Taking the example of the local display

8.3 Configuring the device

The **Setup** menu with its submenus and various guided wizards is used for fast commissioning of the measuring device. They contain all the parameters required for configuration, such as for measurement or communication.



The number of submenus and parameters can vary depending on the device version. The selection can vary depending on the order code.

Example: Available submenus, wizards	Meaning
System units	Configuration of the units for all measured values
Display	Configuration of the display format on the local display
Low flow cut off	Configuration of the low flow cut off
Empty pipe detection	Configuration of empty pipe detection
Advanced setup	Additional parameters for configuration: ■ Sensor adjustment ■ Totalizer ■ Display ■ Electrode cleaning ■ WLAN settings ■ Data backup ■ Administration

8.4 Protecting settings from unauthorized access

The following write protection options exist in order to protect the configuration of the measuring device from unintentional modification:

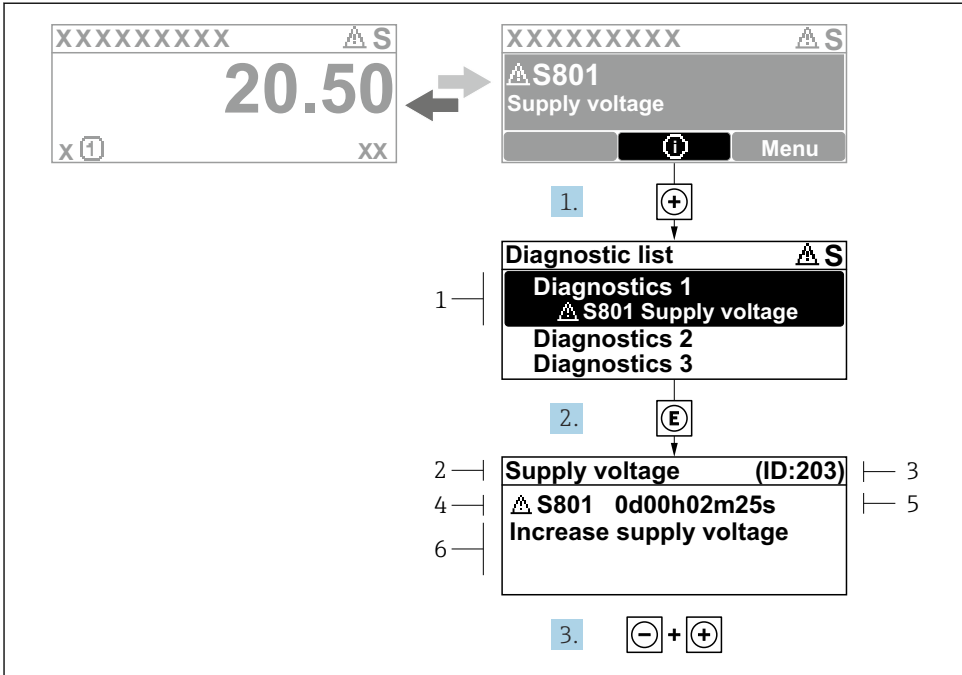
- Protect access to parameters via access code
- Protect access to local operation via key locking
- Protect access to measuring device via write protection switch



For detailed information on protecting settings against unauthorized access, see the Operating Instructions for the device. → 3

9 Diagnostic information

Faults detected by the self-monitoring system of the measuring device are displayed as a diagnostic message in alternation with the operational display. The message about remedial measures can be called up from the diagnostic message, and contains important information on the fault.



A0029431-EN

9 Message for remedial actions

- 1 Diagnostic information
- 2 Event text
- 3 Service ID
- 4 Diagnostic behavior with diagnostic code
- 5 Operating time of occurrence
- 6 Remedial actions

1. The user is in the diagnostic message.
Press $\oplus$ (① symbol).
↳ The **Diagnostic list** submenu opens.
2. Select the desired diagnostic event with $\oplus$ or $\ominus$ and press $\boxplus$.
↳ The message about the remedial measures opens.
3. Press $\ominus + \oplus$ simultaneously.
↳ The message about the remedial measures closes.



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