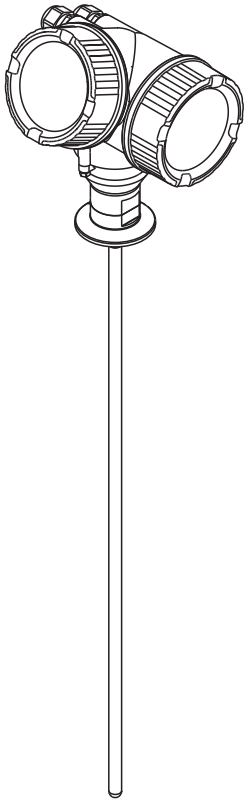
BA01002F/00/EN/18.16
71344065
01.03.zz (Device firmware)

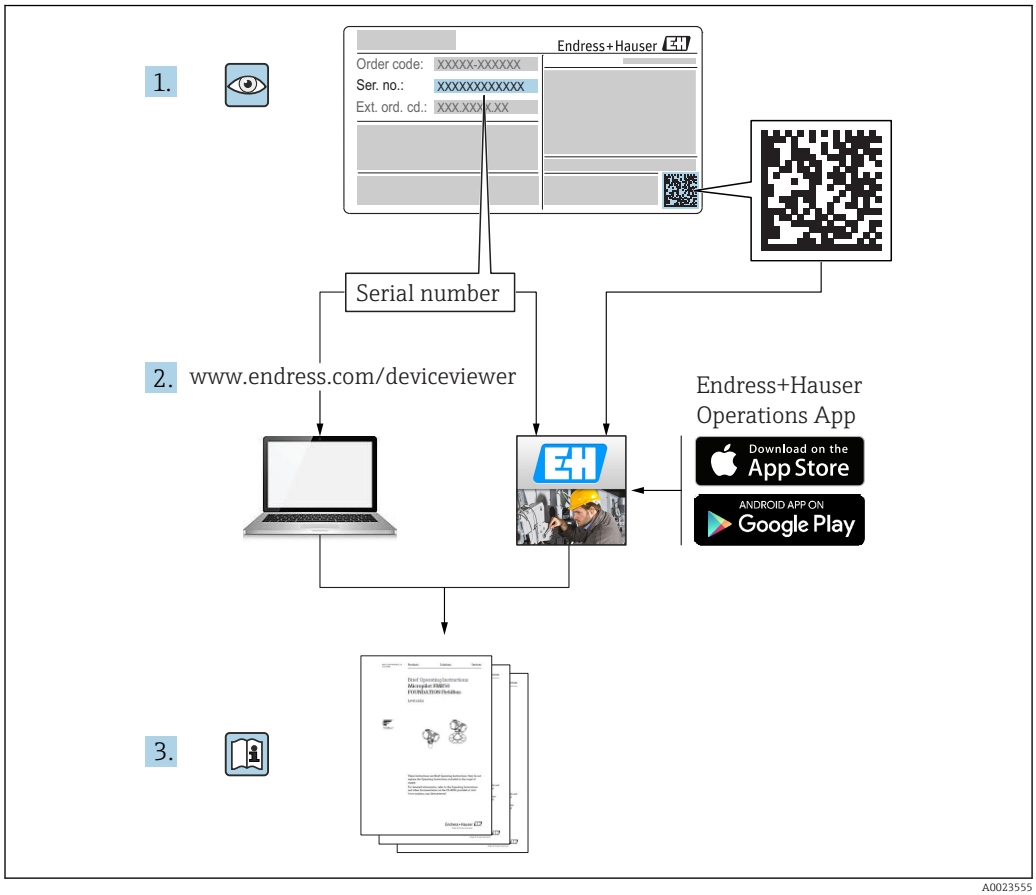
Operating Instructions
Levelflex FMP53
HART

Guided wave radar

HART COMMUNICATION PROTOCOL



Endress+Hauser
People for Process Automation


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

A0023555

Table of contents

1 Important document information

1.1 Document function

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

1.2 Symbols

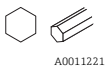
1.2.1 Safety symbols

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

1.2.2 Electrical symbols

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.
⏚	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
⏚	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

1.2.3 Tool symbols

Symbol	Meaning
 A0013442	Torx screwdriver
 A0011220	Flat blade screwdriver
 A0011219	Cross-head screwdriver
 A0011221	Allen key
 A0011222	Hexagon wrench

1.2.4 Symbols for certain types of information

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
	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.5 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
1., 2., 3...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

Symbol	Meaning
	**Hazardous area** Indicates a hazardous area.
	**Safe area (non-hazardous area)** Indicates the non-hazardous area.

1.2.6 Symbols at the device

Symbol	Meaning
	**Safety instructions** Observe the safety instructions contained in the associated Operating Instructions.
	**Temperature resistance of the connection cables** Specifies the minimum value of the temperature resistance of the connection cables.

1.3 Supplementary documentation

Document	Purpose and content of the document
Technical Information TI01002F (FMP53)	**Planning aid for your device** 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.
Brief Operating Instructions KA01078F (FMP53, HART)	**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.
Description of Device Parameters GP01000F (FMP5x, HART)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter in the operating menu. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Special documentation SD00326F	**Functional Safety Manual** The document is part of the Operating Instructions and serves as a reference for application-specific parameters and notes.
Special documentation SD01872F	**Manual for Heartbeat Verification and Heartbeat Monitoring** The document contains descriptions of the additonal parameters and technical data which are available with the **Heartbeat Verification** and **Heartbeat Monitoring** application packages.

For an overview of the scope of the associated Technical Documentation, refer to the following:

- The *W@M Device Viewer* : Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2-D matrix code (QR code) on the nameplate.

1.3.1 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.

Feature 010	Approval	Available for	Feature 020: "Power Supply; Output"				
			A [1]	B [2]	C [3]	E [4]/G [5]	K [6]/L [7]
BA	ATEX II 1G Ex ia IIC T6 Ga	FMP53	XA00496F	XA01125F	XA01126F	XA00516F	-
BB	ATEX II 1/2G Ex ia IIC T6 Ga/Gb	FMP53	XA00496F	XA01125F	XA01126F	XA00516F	-
BC	ATEX II 1/2G Ex d[ia] IIC T6 Ga/Gb	FMP53	XA00499F	XA00499F	XA00499F	XA00519F	XA01133F
BG	ATEX II 3G Ex nA IIC T6 Gc	FMP53	XA00498F	XA01130F	XA01131F	XA00518F	XA01132F
BH	ATEX II 3G Ex ic IIC T6 Gc	FMP53	XA00498F	XA01130F	XA01131F	XA00518F	-
B2	ATEX II 1/2G Ex ia IIC T6 Ga/Gb, 1/2D Ex ia IIIC Da/Db	FMP53	XA00502F	XA00502F	XA00502F	XA00522F	-
B3	ATEX II 1/2G Ex d[ia] IIC T6 Ga/Gb, 1/2 D Ex t IIIC Da/Db	FMP53	XA00503F	XA00503F	XA00503F	XA00523F	XA01136F
B4	ATEX II 1/2G Ex ia IIC T6 Ga/Gb, Ex d[ia] IIC T6 Ga/Gb	FMP53	XA00500F	XA01134F	XA01135F	XA00520F	-
C2	CSA C/US IS Cl.I,II,III Div.1 Gr.A-G, NI Cl.1 Div.2, Ex ia	FMP53	XA00530F	XA00530F	XA00530F	XA00571F	XA00530F
C3	CSA C/US XP Cl.I,II,III Div.1 Gr.A-G, NI Cl.1 Div.2, Ex d	FMP53	XA00529F	XA00529F	XA00529F	XA00570F	XA00529F
FB	FM IS Cl.I,II,III Div.1 Gr.A-G, AEx ia, NI Cl.1 Div.2	FMP53	XA00531F	XA00531F	XA00531F	XA00573F	XA00531F
FD	FM XP Cl.I,II,III Div.1 Gr.A-G, AEx d, NI Cl.1 Div.2	FMP53	XA00532F	XA00532F	XA00532F	XA00572F	XA00532F
GA	EAC Ex ia IIC T6 Ga	FMP53	XA01380F	XA01380F	XA01380F	XA01381F	XA01380F
GB	EAC Ex ia IIC T6 Ga/Gb	FMP53	XA01380F	XA01380F	XA01380F	XA01381F	XA01380F
GC	EAC Ex d[ia] IIC T6 Ga/Gb	FMP53	XA01382F	XA01382F	XA01382F	XA01383F	XA01382F
IA	IEC Ex ia IIC T6 Ga	FMP53	XA00496F	XA01125F	XA01126F	XA00516F	-
IB	IEC Ex ia IIC T6 Ga/Gb	FMP53	XA00496F	XA01125F	XA01126F	XA00516F	-
IC	IEC Ex d[ia] IIC T6 Ga/Gb	FMP53	XA00499F	XA00499F	XA00499F	XA00519F	XA01133F
IG	IEC Ex nA IIC T6 Gc	FMP53	XA00498F	XA01130F	XA01131F	XA00518F	XA01132F
IH	IEC Ex ic IIC T6 Gc	FMP53	XA00498F	XA01130F	XA01131F	XA00518F	-
I2	IEC Ex ia IIC T6 Ga/Gb, Ex ia IIIC Da/Db	FMP53	XA00502F	XA00502F	XA00502F	XA00522F	-
I3	IEC Ex d [ia] IIC T6 Ga/Gb, Ex t IIIC Da/Db	FMP53	XA00503F	XA00503F	XA00503F	XA00523F	XA01136F
I4	IEC Ex II 1/2G Ex ia IIC T6 Ga/Gb, Ex d[ia] IIC T6 Ga/Gb	FMP53	XA00500F	XA01134F	XA01135F	XA00520F	-
KA	KC Ex ia IIC T6 Ga	FMP53	XA01169F	-	XA01169F	-	-
KB	KC Ex ia IIC T6 Ga/Gb	FMP53	XA01169F	-	XA01169F	-	-
KC	KC Ex d[ia] IIC T6	FMP53	-	-	XA01170F	-	-
MA	INMETRO Ex ia IIC T6 Ga	FMP53	XA01038F	XA01038F	XA01038F	-	XA01038F
MC	INMETRO Ex d[ia] IIC T6 Ga/Gb	FMP53	XA01041F	XA01041F	XA01041F	-	XA01041F
MH	INMETRO Ex ic IIC T6 Gc	FMP53	XA01040F	XA01040F	XA01040F	-	XA01040F
NA	NEPSI Ex ia IIC T6 Ga	FMP53	XA00634F	XA00634F	XA00634F	XA00640F	XA00634F
NB	NEPSI Ex ia IIC T6 Ga/Gb	FMP53	XA00634F	XA00634F	XA00634F	XA00640F	XA00634F
NC	NEPSI Ex d[ia] IIC T6 Ga/Gb	FMP53	XA00636F	XA00636F	XA00636F	XA00642F	XA00636F
NG	NEPSI Ex nA II T6 Gc	FMP53	XA00635F	XA00635F	XA00635F	XA00641F	XA00635F
NH	NEPSI Ex ic IIC T6 Gc	FMP53	XA00635F	XA00635F	XA00635F	XA00641F	XA00635F
N2	NEPSI Ex ia IIC T6 Ga/Gb, Ex iaD 20/21 T85...90°C	FMP53	XA00638F	XA00638F	XA00638F	XA00644F	XA00638F

Feature 010	Approval	Available for	Feature 020: "Power Supply; Output"				
			A [1]	B [2]	C [3]	E [4]/G [5]	K [6]/L [7]
N3	NEPSI Ex d[ia] IIC T6 Ga/Gb, DIP A20/21 T85…90°C IP66	FMP53	XA00639F	XA00639F	XA00639F	XA00645F	XA00639F
8A	FM/CSA IS+XP Cl.I,II,III Div.1 Gr.A-G	FMP53	XA00531F XA00532F	XA00531F XA00532F	XA00531F XA00532F	XA00572F XA00573F	XA00531F XA00532F

1) A: 2-wire; 4-20mA HART
2) B: 2-wire; 4-20mA HART, switch output
3) C: 2-wire; 4-20mA HART, 4-20mA
4) E: 2-wire; FOUNDATION Fieldbus, switch output
5) G: 2-wire; PROFIBUS PA, switch output
6) K: 4-wire 90-253VAC; 4-20mA HART
7) L: 4-wire 10,4-48VDC; 4-20mA HART

For certified devices the relevant Safety Instructions (XA) are indicated on the nameplate.

Ex-marking in case of connected FHX50 remote display

If the device is prepared for the remote display FHX50 (product structure: feature 030: Display, Operation", option L or M), the Ex marking of some certificates changes according to the following table [1]:

Feature 010 ("Approval")	Feature 030 ("Display, Operation")	Ex-marking
BG	L or M	ATEX II 3G Ex nA [ia Ga] IIC T6 Gc
BH	L or M	ATEX II 3G Ex ic [ia Ga] IIC T6 Gc
B3	L or M	ATEX II 1/2G Ex d [ia] IIC T6 Ga/Gb, ATEX II 1/2D Ex ta [ia Db] IIIC Txx°C Da/Db
IG	L or M	IECEx Ex nA [ia Ga] IIC T6 Gc
IH	L or M	IECEx Ex ic [ia Ga] IIC T6 Gc
I3	L or M	IECEx Ex d [ia] IIC T6 Ga/Gb, IECEx Ex ta [ia Db] IIIC Txx°C Da/Db

1) The marking of certificates not mentioned in this table are not affected by the FHX50.

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- 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.

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

2.2 Designated use

Application and measured materials
The measuring device described in these Operating Instructions is intended only for level measurement of liquids. Depending on the version ordered the device can also measure potentially explosive, flammable, poisonous and oxidizing materials.

Observing the limit values specified in the "Technical data" and listed in the Operating Instructions and supplementary documentation, the measuring device may be used for the following measurements only:
- Measured process variables: level
- Calculated process variables: Volume or mass in arbitrarily shaped vessels (calculated from the level by the linearization functionality)

To ensure that the measuring device remains in proper condition for the operation time:
- Use the measuring device only for measured materials against which the process-wetted materials are adequately resistant.
- Observe the limit values in "Technical data".

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

Verification for borderline cases:
- For special measured materials and cleaning agents, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of wetted materials, but does not accept any warranty or liability.

Residual risk
The electronics housing and its built-in components such as display module, main electronics module and I/O electronics module may heat to 80 °C (176 °F) during operation through heat transfer from the process as well as power dissipation within the electronics. During operation the sensor may assume a temperature near the temperature of the measured material.

Danger of burns due to heated surfaces!
- For high process temperatures: Install protection against contact in order to prevent burns.

2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.

With divisible probe rods, medium may penetrate into the joints between the indivual parts of the rod. This medium may escape when loosening the joints. In the case of dangerous (e.g. aggressive or toxic) media this may cause injuries.
- When loosening the joints between the individual parts of the probe rod: Wear appropriate protective equipment according to the medium.

2.4 Operational safety

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

Conversions to the device

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

Repair

To ensure continued operational safety and reliability,
- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to repair of an electrical device.
- Use original spare parts and accessories from the manufacturer only.

Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):
- Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
- Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.5 Product safety

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

2.5.1 CE mark

The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied.

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

2.5.2 EAC conformity

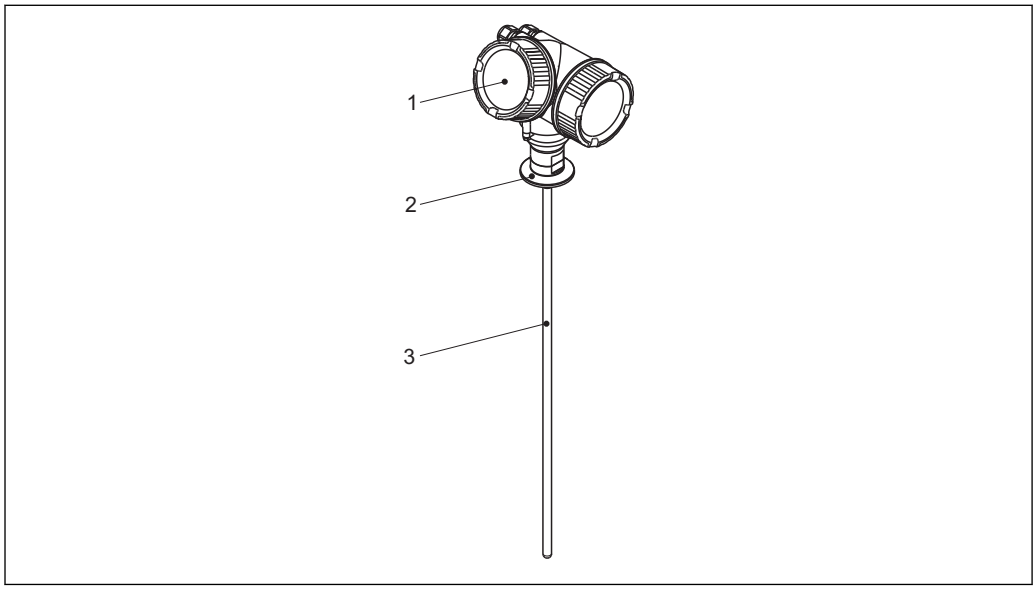
The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.

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

3 Product description

3.1 Product design

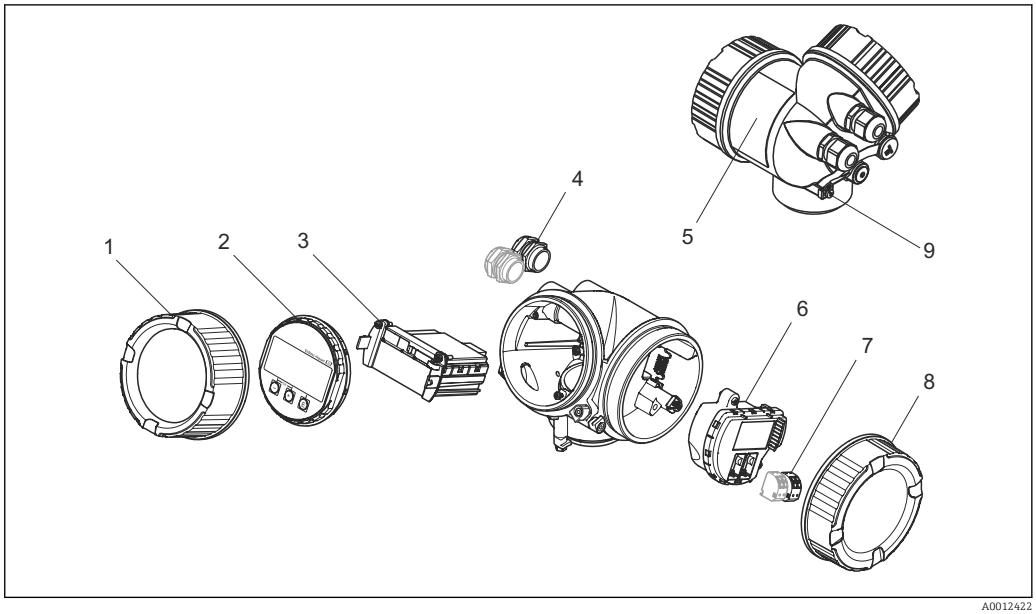
3.1.1 Levelflex FMP53



1 Design of the Levelflex

1 Electronics housing
2 Process connection
3 Rod probe

3.1.2 Electronics housing



2 *Design of the electronics housing*

1 *Electronics compartment cover*
2 *Display module*
3 *Main electronics module*
4 *Cable glands (1 or 2, depending on instrument version)*
5 *Nameplate*
6 *I/O electronics module*
7 *Terminals (pluggable spring terminals)*
8 *Connection compartment cover*
9 *Grounding terminal*

3.2 Registered trademarks

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

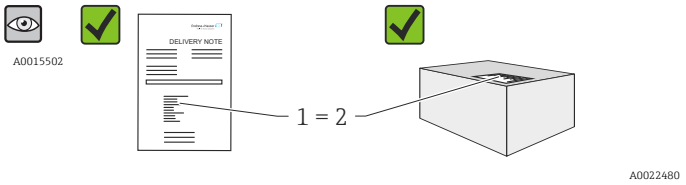
KALREZ®, VITON®
Registered trademark of DuPont Performance Elastomers L.L.C., Wilmington, USA

TEFLON®
Registered trademark of E.I. DuPont de Nemours & Co., Wilmington, USA

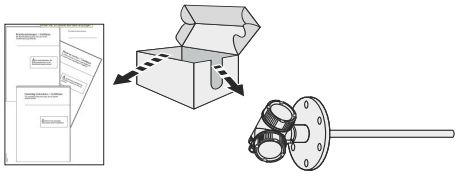
TRI CLAMP®
Registered trademark of Alfa Laval Inc., Kenosha, USA

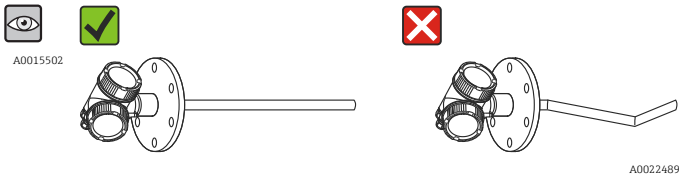
4 Incoming acceptance and product identification

4.1 Incoming acceptance

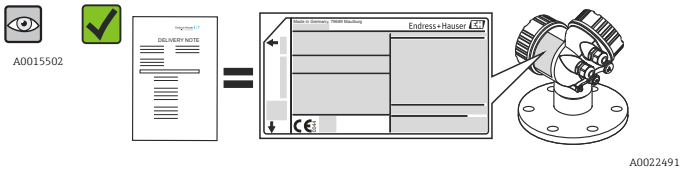


Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?





Are the goods undamaged?



Do the nameplate data match the ordering information on the delivery note?

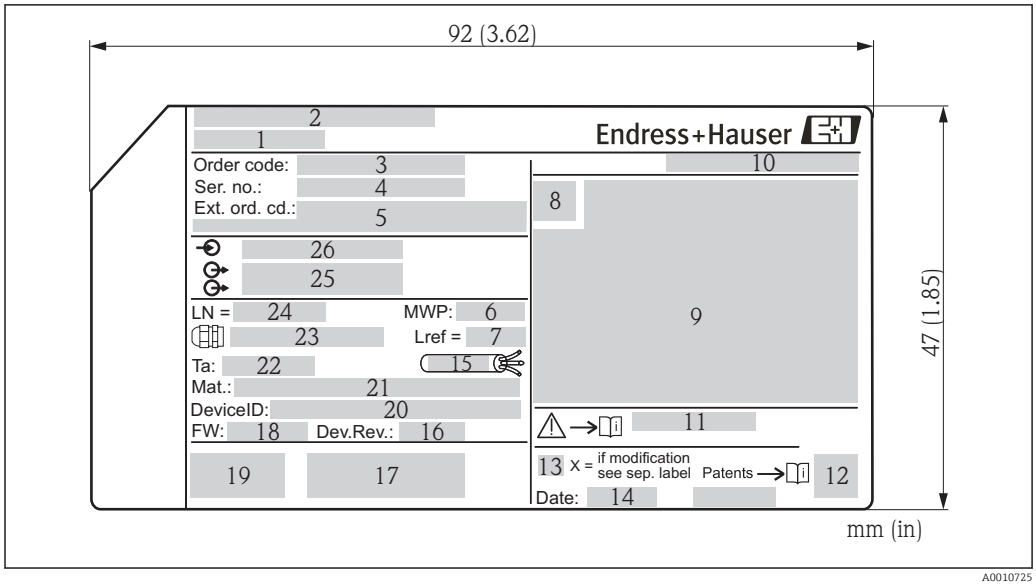
Is the DVD (operating tool) present?
If required (see nameplate): Are the Safety Instructions (XA) present?

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

4.2 Product identification

The following options are available for identification of the measuring device:
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter serial numbers from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): All information about the measuring device is displayed.
- Enter the serial number from the nameplates 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 for the measuring device is displayed.

4.2.1 Nameplate



3 *Nameplate of the Levelflex*

1 *Device name*
2 *Address of manufacturer*
3 *Order code*
4 *Serial number (Ser. no.)*
5 *Extended order code (Ext. ord. cd.)*
6 *Process pressure*
7 *Gas phase compensation: reference distance*
8 *Certificate symbol*
9 *Certificate and approval relevant data*
10 *Degree of protection: e.g. IP, NEMA*
11 *Document number of the Safety Instructions: e.g. XA, ZD, ZE*
12 *2-D matrix code (QR code)*
13 *Modification mark*
14 *Manufacturing date: year-month*
15 *Permitted temperature range for cable*
16 *Geräterevision (Dev.Rev.)*
17 *Additional information about the device version (certificates, approvals, communication): e.g. SIL, PROFIBUS*
18 *Firmware version (FW)*
19 *CE mark, C-Tick*
20 *DeviceID*
21 *Material in contact with process*
22 *Permitted ambient temperature (T_a)*
23 *Size of the thread of the cable glands*
24 *Length of probe*
25 *Signal outputs*
26 *Operating voltage*

Only 33 digits of the extended order code can be indicated on the nameplate. If the extended order code exceeds 33 digits, the rest will not be shown. However, the complete extended order code can be viewed in the operating menu of the device in the **Extended order code 1 to 3** parameter.

5 Storage, Transport

5.1 Storage conditions

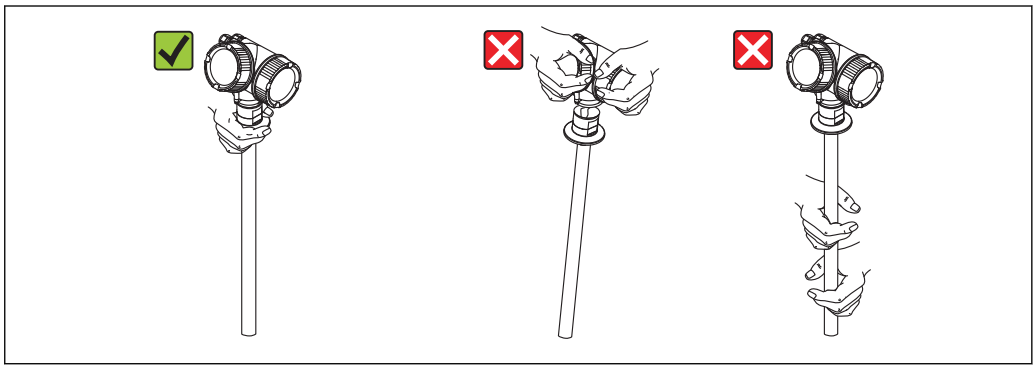
- Permitted storage temperature: −40 to +80 °C (−40 to +176 °F)
- Use the original packaging.

5.2 Transport product to the measuring point

⚠ WARNING

Housing or probe may be damaged or break away.
Risk of injury!

- ▶ Transport the measuring device to the measuring point in its original packaging or at the process connection.
- ▶ Do not fasten lifting devices (hoisting slings, lifting eyes etc.) at the housing or the probe but at the process connection. Take into account the mass center of the device in order to avoid unintended tilting.
- ▶ Comply with the safety instructions, transport conditions for devices over 18kg (39.6lbs) (IEC61010).



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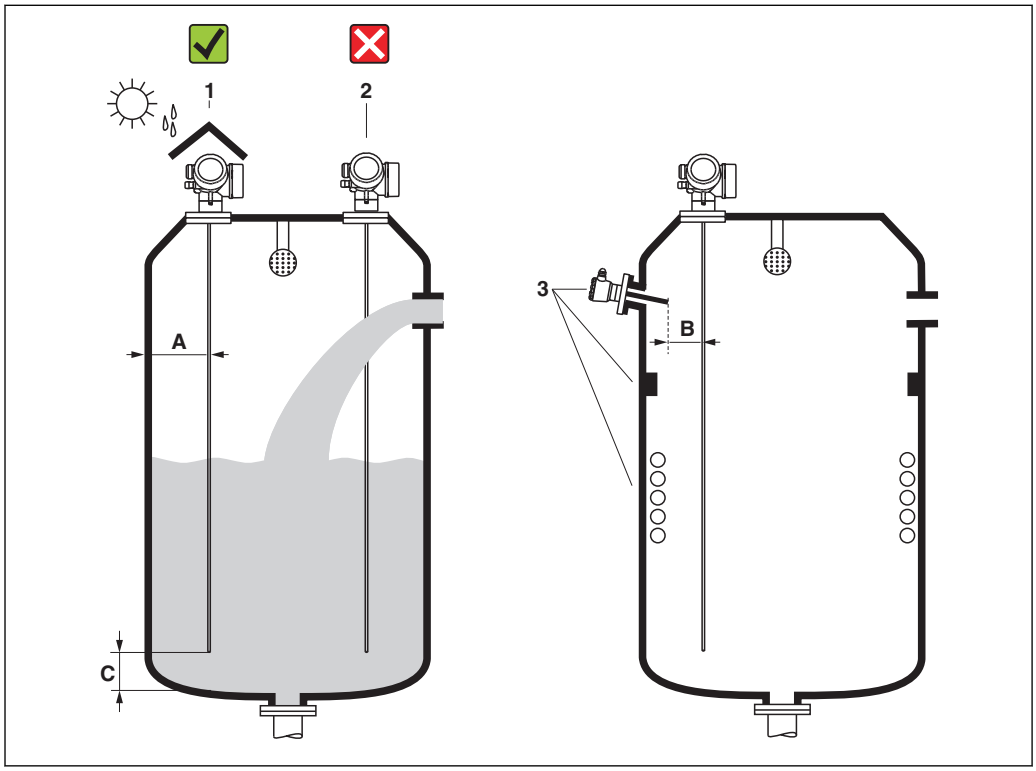
6 Mounting

6.1 Mounting requirements

6.1.1 Suitable mounting position



4 *Mounting requirements for Levelflex*

Mounting distances

- Distance (A) between wall and rod probe:
  - for smooth metallic walls: > 50 mm (2 in)
  - for plastic walls: > 300 mm (12 in) to metallic parts outside the vessel
- Distance (B) between rod probe and internal fittings (3) in the vessel: > 300 mm (12 in)
- When using more than one Levelflex:
  Minimum distance between the sensor axes: 100 mm (3.94 in)
- Distance (C) from end of probe to bottom of the vessel: > 10 mm (0.4 in).

Additional conditions

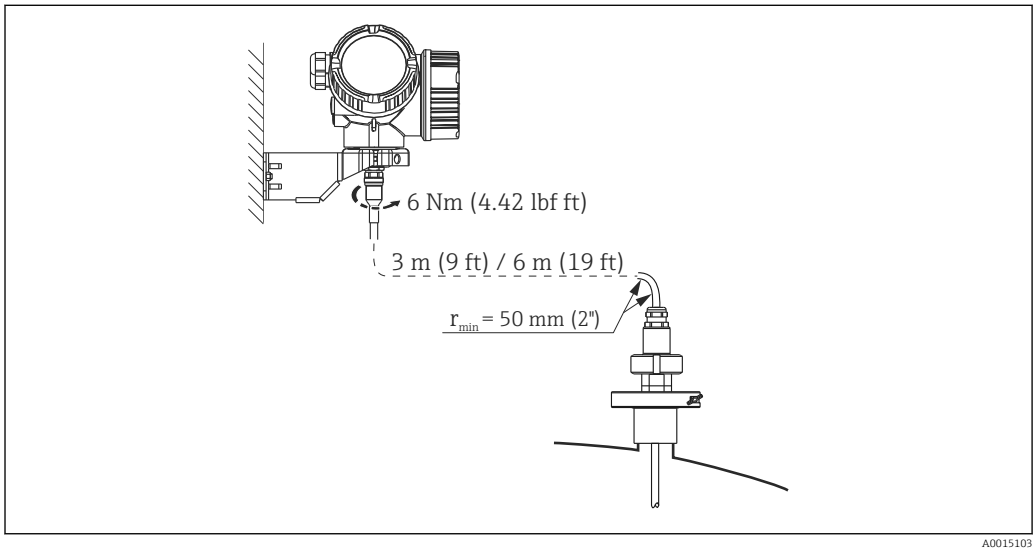
- When mounting in the open, a weather protection cover (1) may be installed to protect the device against extreme weather conditions.
- Do not mount the probe in the filling curtain (2).

When mounting the electronics housing into a recess (e.g. in a concrete ceiling), observe a minimum distance of 100 mm (4 inch) between the cover of the terminal compartment / electronics compartment and the wall. Otherwise the connection compartment / electronics compartment is not accessible after installation.

6.1.2 Applications with restricted mounting space

Mounting with remote sensor

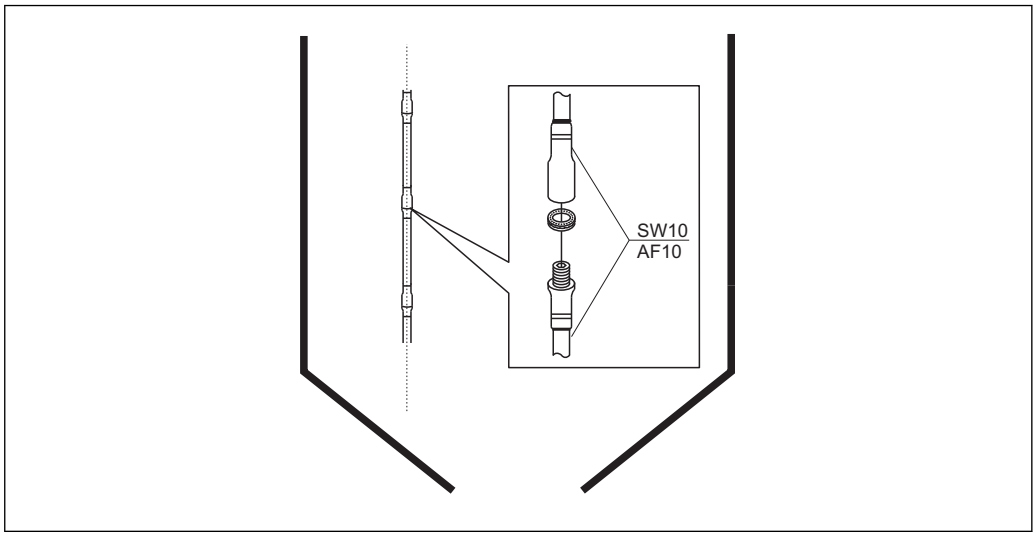
The device version with a remote sensor is suited for applications with restricted mounting space. In this case the electronics housing is mounted at a separate position from which it is easier accessible.



- Levelflex version (see product structure):
  Feature 600 "Probe Design"
  - Option MB "Sensor remote, 3m/9ft cable, detachable+mounting bracket"
  - Option MC "Sensor remote, 6m/18ft cable, detachable+mounting bracket"
- On delivery, the connection cable is fixed to the probe.
  - Length: 3 m (9 ft) or 6 m (19 ft)
  - Minimum bending radius: 50 mm (2 inch)
- A mounting bracket for the electronics housing is supplied with this device version.
  Mounting options:
  - Wall mounting
  - Pipe mounting; diameter: 42 to 60 mm (1-1/4 to 2 inch)

The probe with connection cable and the electronics are adjusted to match each other. They are marked by a common serial number. Only components with the same serial number shall be connected to each other.

Divisible probes



A0014166

If there is little mounting space (distance to the ceiling), it is advisable to use divisible rod probes (⌀ 8 mm).

- max. probe length 6 m/236 inch
- max. sideways capacity 10 Nm
- probes are separable several times with the following lengths of the individual parts:
  - 500 mm (20 in)
  - 1 000 mm (40 in)
- torque: 4.5 Nm
- The joints are sealed seamlessly with an O-ring.

In order to avoid damages of the probe surface: Use plumber wrenches with plastic surface to mount the probe rod.

6.1.3 Notes on the mechanical load of the probe

Bending strength of rod probes

Sensor	Feature 060	Probe	Bending strength [Nm]
FMP53	DA, DB, EA, EB	Rod 8mm (0.31") 316L	10
	FA, FB, GA, GB, HA, HB, IA, IB	Rod 8mm (0.31") 316L divisible	10

Bending load (torque) through fluid flow

The formula for calculating the bending torque M impacting on the probe:

$M = c_w \cdot \rho/2 \cdot v^2 \cdot d \cdot L \cdot (L_N - 0.5 \cdot L)$

with:

c_w: Friction factor

ρ [kg/m³]: Density of the medium

v [m/s]: Velocity of the medium perpendicular to the probe rod

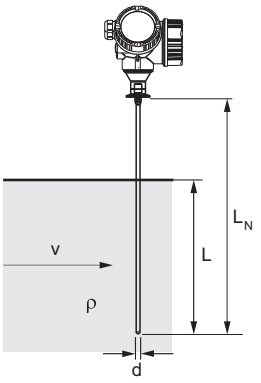
d [m]: Diameter of the probe rod

L [m]: Level

LN [m]: Probe length

Calculation example

Friction factor c_w	0,9 (on the assumption of a turbulent current - high Reynolds number)
Density ρ [kg/m³]	1000 (e.g. water)
Probe diameter d [m]	0,008
$L = L_N$	(worst case)



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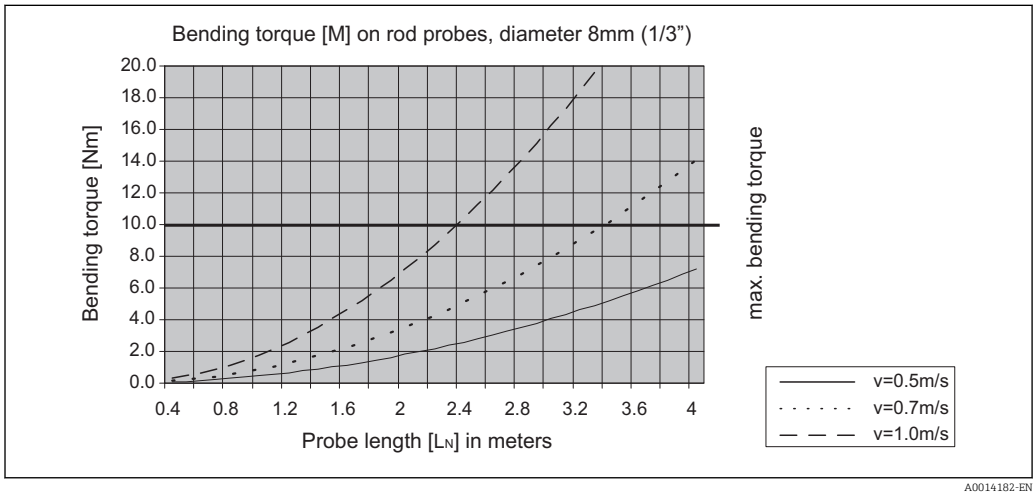

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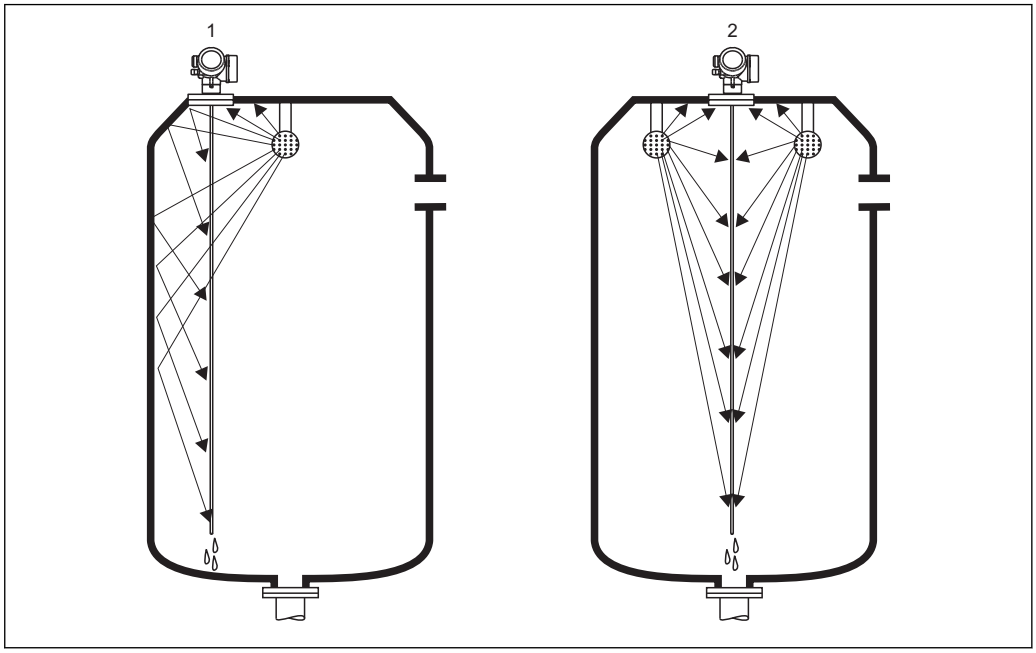
6.1.4 Special mounting conditions

Tanks with spray ball for cleaning the probe



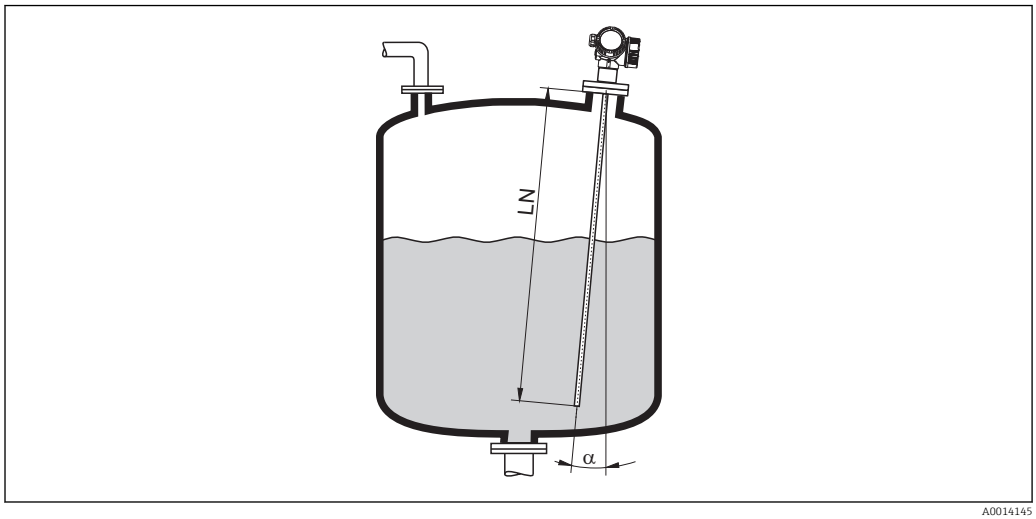
Installation close to tank wall

By installing the probe close to the tank wall, the cleaning effect is improved in cases where a spray ball is used. The cleaning jet is deflected against the tank wall and onto the probe. This means that those parts of the probe are cleaned which would normally not be reached by the spray ball jet. If the probe is positioned in this way, only one spray ball is needed.

Installation in the center of the tank

If the probe is mounted in the center of the tank, it may be necessary to use a second spray ball. The spray balls should then be mounted to the left and right of the probe.

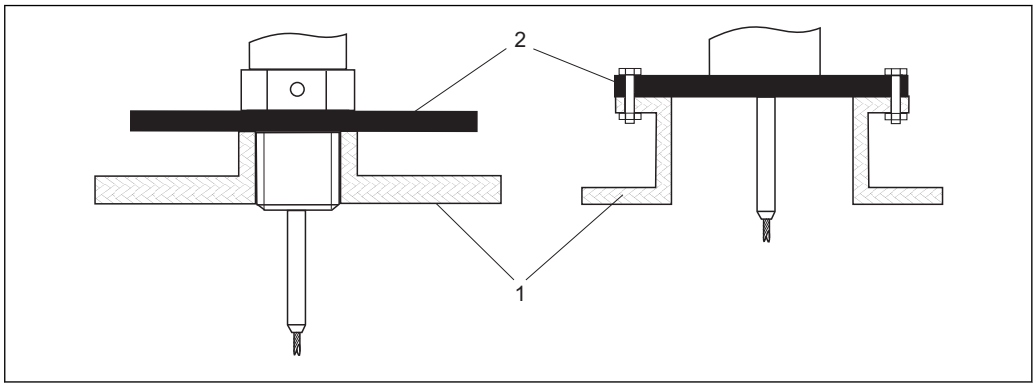
Installation at an angle



A0014145

- For mechanical reasons, the probe should be installed as vertically as possible.
- With inclined installations the probe length has to be adjusted in dependence to the installation angle.
  - Up to LN = 1 m (3.3 ft): α = 30°
  - Up to LN = 2 m (6.6 ft): α = 10°
  - Up to LN = 4 m (13.1 ft): α = 5°

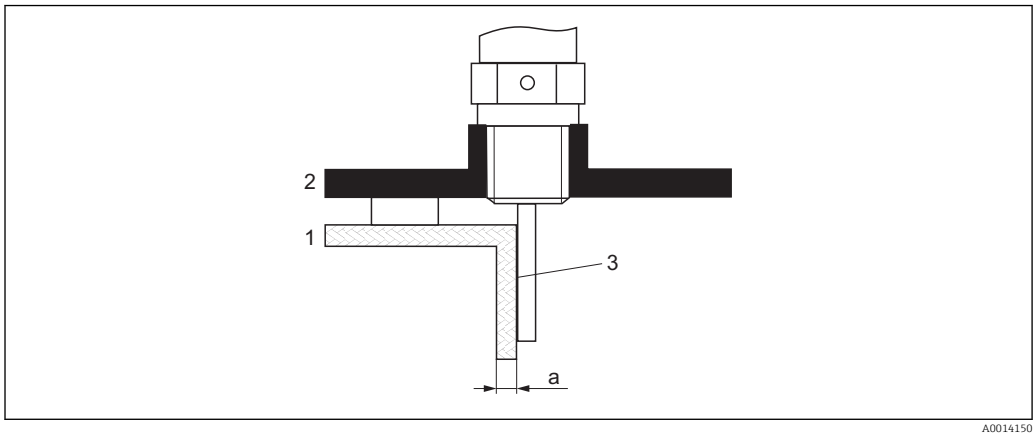
Non-metallic vessels



1 Non-metallic vessel
2 Metal sheet or metal flange

To ensure reliable measurements in non-metallic vessels mount a metal sheet with a diameter of at least 200 mm (8 in) to the probe at the process connection. Its orientation must be perpendicular to the probe.

Plastic or glass tanks: Mounting the probe externally at the wall



A0014150

1 Plastic or glass tank
2 Metall sheet with threaded sleeve
3 No free space between tank wall and probe!

Requirements
- The dielectric constant of the medium must be at least DC > 7.
- The tank wall must be non-conductvie.
- Maximum wall thickness (a):
  – Plastic: < 15 mm (0.6")
  – Glass: < 10 mm (0.4")
- There may be no metallic reinforcements fixed to the tank.

Mounting conditions:
- The probe must be mounted directly to the tank wall (no open space)
- A plastic half pipe with a diameter of approx. 200 mm (8"), or some other protective unit, must be affixed externally to the probe to prevent any influences on the measurement.
- If the tank diameter is less than 300 mm (12"):
  A metallic grounding sheet must be installed at the opposite side of the tank. The sheet must be conductively connected to the process connection and cover about the half of the vessel's circumference.
- If the tank diameter exceeds 300 mm (12"):
  A metal sheet with a diameter of at least 200 mm (8") must be mounted to the probe at the process connection. Its orientation must be perpendicular to the probe (see above).

Calibration for external probe mounting

If the probe is mounted externally at the wall of the tank, the speed of signal propagation will be reduced. There are two possibilities to compensate for this effect.

Compensation with the gas phase compensation factor

The effect of the dielectric wall can be compared to the effect of a dielectric gas phase. Thus it can be compensated for in the same manner. The compensation factor if given by the quotient of the actual probe length LN and the probe length meausred when the tank is empty.

The device looks for the end of probe signal in the subtracted curve. Thus, the value of the measured probe length depends on the mapping. In order to obtain an exact value, it is advisable to determine the probe length manually using the envelope curve display in FieldCare.

Step	Parameter	Action
1	Expert → Sensor → Gas phase compensation → GPC mode	Select the **Const. GPC factor** option.
2	Expert → Sensor → Gas phase compensation → Const. GPC factor	Enter quotient: "(Actual probe length)/ (Measured probe length)".

Compensation via the calibration parameters

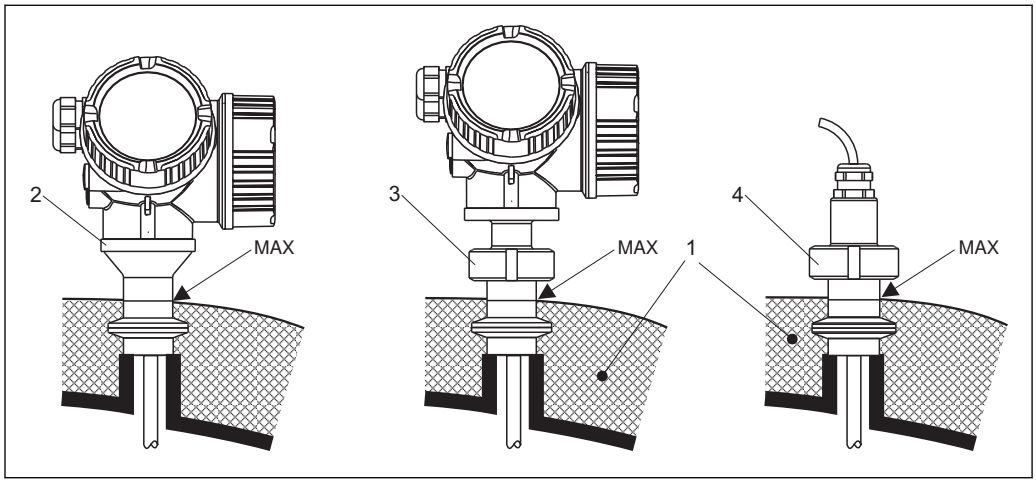
If an acutal gas phase has to be compensated for, the gas phase compensation functionality is no longer available for a correction of the external mounting. In this case the calibration parameters (**Empty calibration** and **Full calibration**) must be adjusted and a value longer than the actual probe length has to be entered into the **Present probe length** parameter. The correction factor for these three parameters is given by the quotient of the probe length measured when the tank is empty and the acutal probe length LN.

The device looks for the end of probe signal in the subtracted curve. Thus, the value of the measured probe length depends on the mapping. In order to obtain an exact value, it is advisable to determine the probe length manually using the envelope curve display in FieldCare.

Step	Parameter	Action
1	Setup → Empty calibration	Increase parameter value by "(Measured probe length)/(Actual probe length)".
2	Setup → Full calibration	Increase parameter value by "(Measured probe length)/(Actual probe length)".
3	Setup → Advanced setup → Probe settings → Probe length correction → Confirm probe length	Select the **Manual input** option.
4	Setup → Advanced setup → Probe settings → Probe length correction → Present probe length	Enter measured probe length.

Vessels with heat insulation

If process temperatures are high, the device must be included in normal tank insulation to prevent the electronics heating up as a result of heat radiation or convection. The insulation may not exceed beyond the points labeled "MAX" in the drawings.



5 *Hygienic process connections - FMP53*

1 *Tank insulation*
2 *Compact device*
3 *Compct device, detachable (feature 600)*
4 *Sensor remote (feature 600)*

6.2 Mounting the device

6.2.1 Required mounting tools

- To shorten rod or coax probes: Saw
- For flanges and other process connections: appropriate mounting tools
- To turn the housing: Hexagonal wrench 8 mm

6.2.2 Mounting the "Sensor remote" version

This section is only valid for devices of the version "Probe Design" = "Sensor remote" (feature 600, option MB or MC).

For the version "Probe design" = "Sensor remote" the following is supplied:

- The probe with the process connection and the connection cable (3m/9ft or 6m/18ft)
- The electronics housing
- The mounting bracket for wall or pipe mounting of the electronics housing

The connection cable is fixed to the probe on delivery.

The probe with connection cable and the electronics are adjusted to match each other. They are marked by a common serial number. Only components with the same serial number shall be connected to each other.

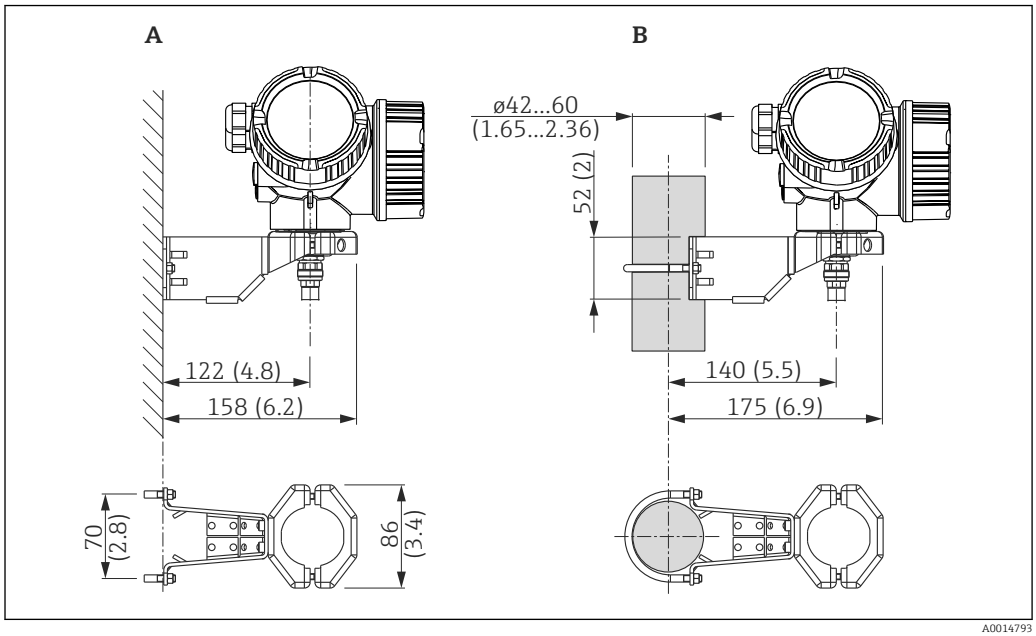
⚠ CAUTION

Mechanical stress may damage the plugs of the connection cable or cause accidental loosening of the plugs.

- ▶ Mount the probe and the electronics housing tightly before connecting the cable.
- ▶ Lay the cable such that it is not exposed to mechanical stress. Minimum bending radius: 50 mm (2").
- ▶ Torque for the coupling nut at the elctronics housing: 6 Nm
- ▶ Torque for the coupling nut at the probe: 20 Nm

If the measuring point is exposed to strong vibrations, an additional locking compound (e.g. Loctite 243) can be applied at the plug connector of the electronics housing.

Mounting the electronics housing

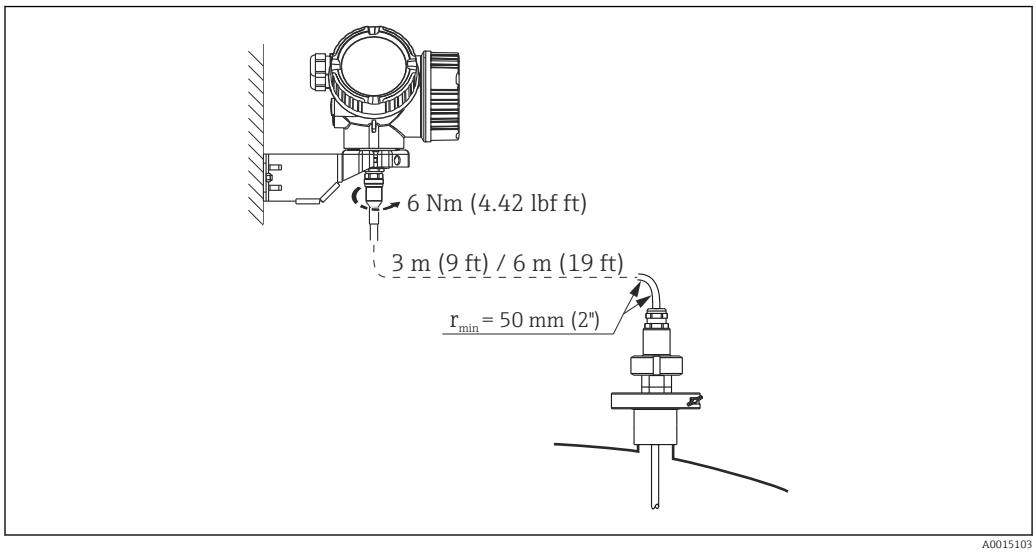


6 Mounting the electronics housing using the mounting bracket; dimensions: mm (In)

A Wall mounting
B Pipe mounting

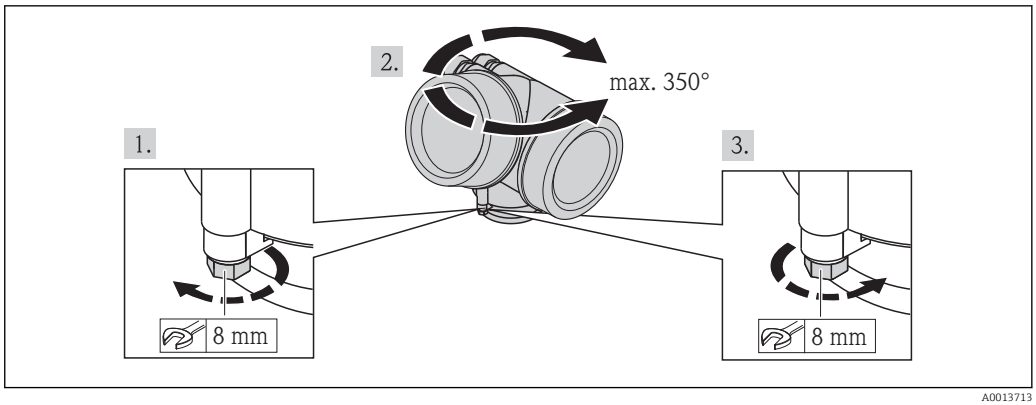
Connecting the cable

Required tools:
- For the coupling nut at the housing side of the cable: Open-end wrench AF 18mm
- For the coupling nut at the probe side of the cable: 54mm (2.1") hook wrench and 27 mm (1-1/16") open-end wrench



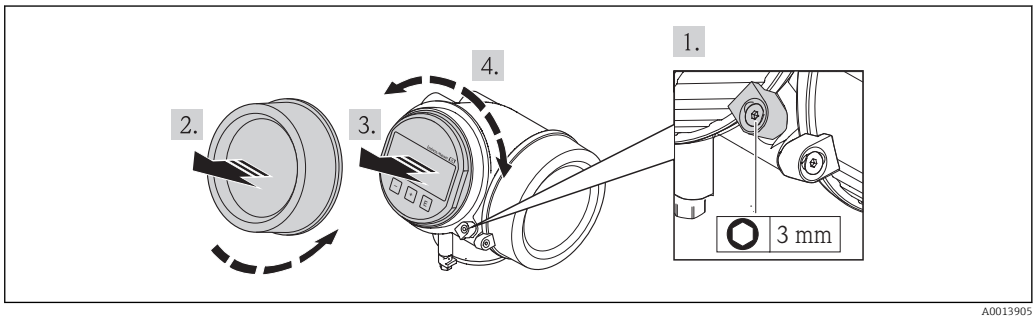
6.2.3 Turning the transmitter housing

To provide easier access to the connection compartment or display module, the transmitter housing can be turned:



1. Unscrew the securing screw using an open-ended wrench.
2. Rotate the housing in the desired direction.
3. Tighten the securing screw (1,5 Nm for plastics housing; 2,5 Nm for aluminium or stainless steel housing).

6.2.4 Turning the display module



1. If present: Loosen the screw of the securing clamp of the electronics compartment cover using an Allen key and turn the clamp 90° conterclockwise.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Pull out the display module with a gentle rotation movement.
4. Rotate the display module into the desired position: Max. 8 × 45 ° in each direction.
5. Feed the spiral cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment until it engages.
6. Screw the cover of the electronics compartment firmly back onto the transmitter housing.
7. Tighten the securing clamp again using the Allen key (Torque: 2.5 Nm).

6.3 Post-installation check

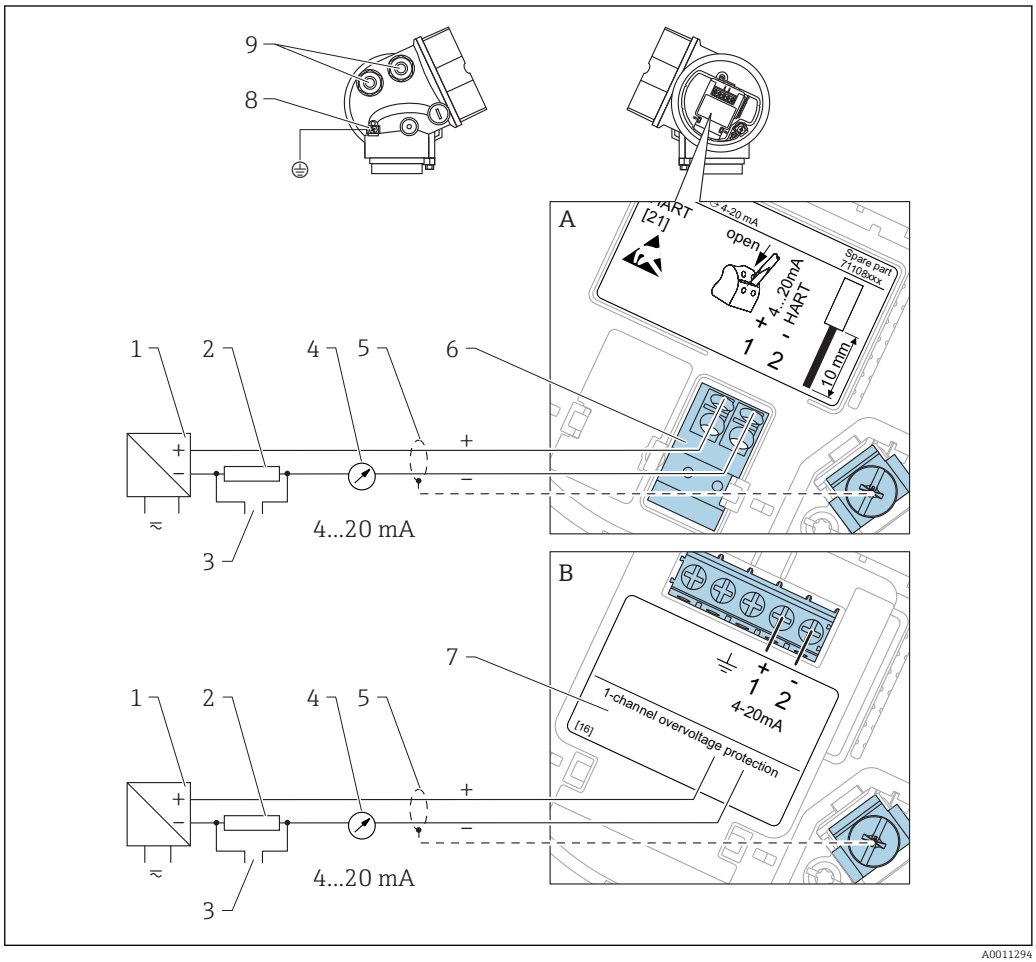
❍	Is the device undamaged (visual inspection)?
❍	Does the device conform to the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure (refer to the chapter on "Material load curves" of the "Technical Information" document) ▪ Ambient temperature range ▪ Measuring range
❍	Are the measuring point identification and labeling correct (visual inspection)?
❍	Is the device adequately protected from precipitation and direct sunlight?
❍	Are the securing screw and securing clamp tightened securely?

7 Electrical connection

7.1 Connection conditions

7.1.1 Terminal assignment

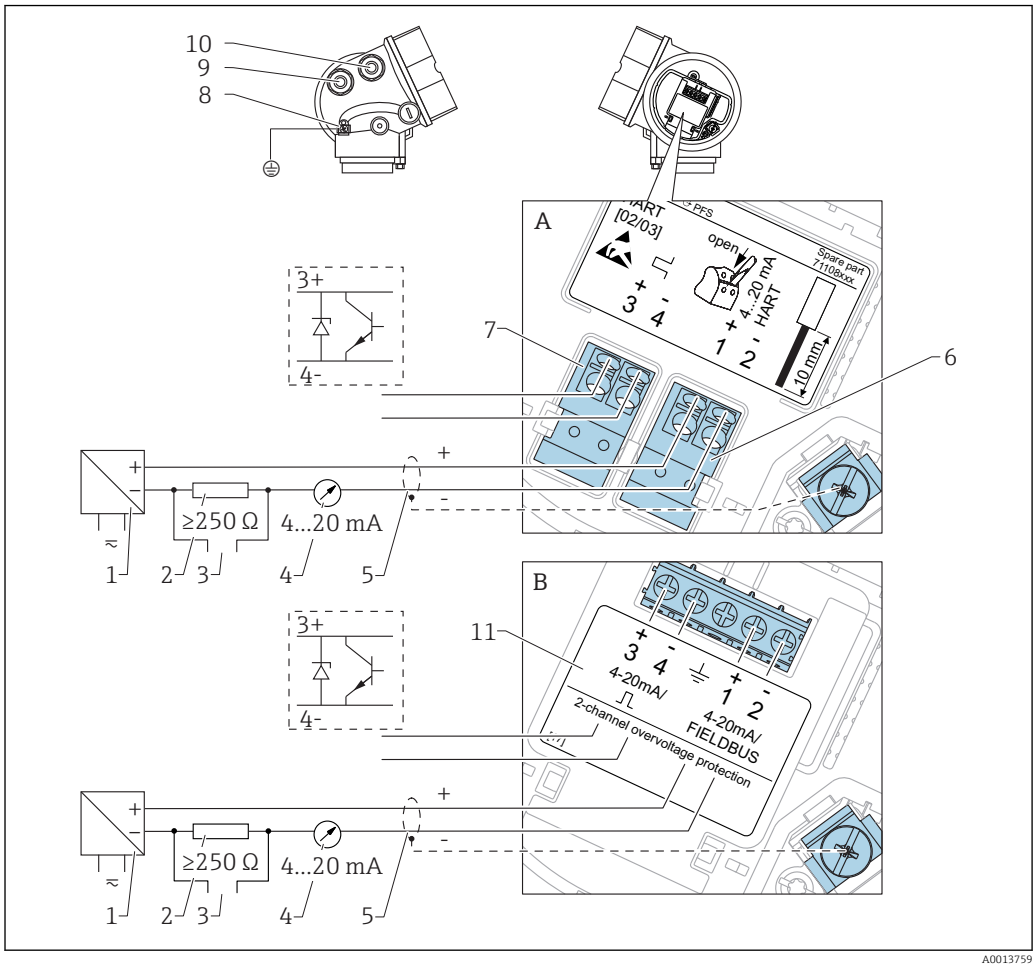
2-wire: 4-20mA HART



7 *Terminal assignment 2-wire; 4-20mA HART*

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage
2 HART communication resistor (≥ 250 Ω): Observe maximum load
3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
4 Analog display device: Observe maximum load
5 Cable screen; observe cable specification
6 4-20mA HART (passive): Terminals 1 and 2
7 Overvoltage protection module
8 Terminal for potential equalization line
9 Cable entry

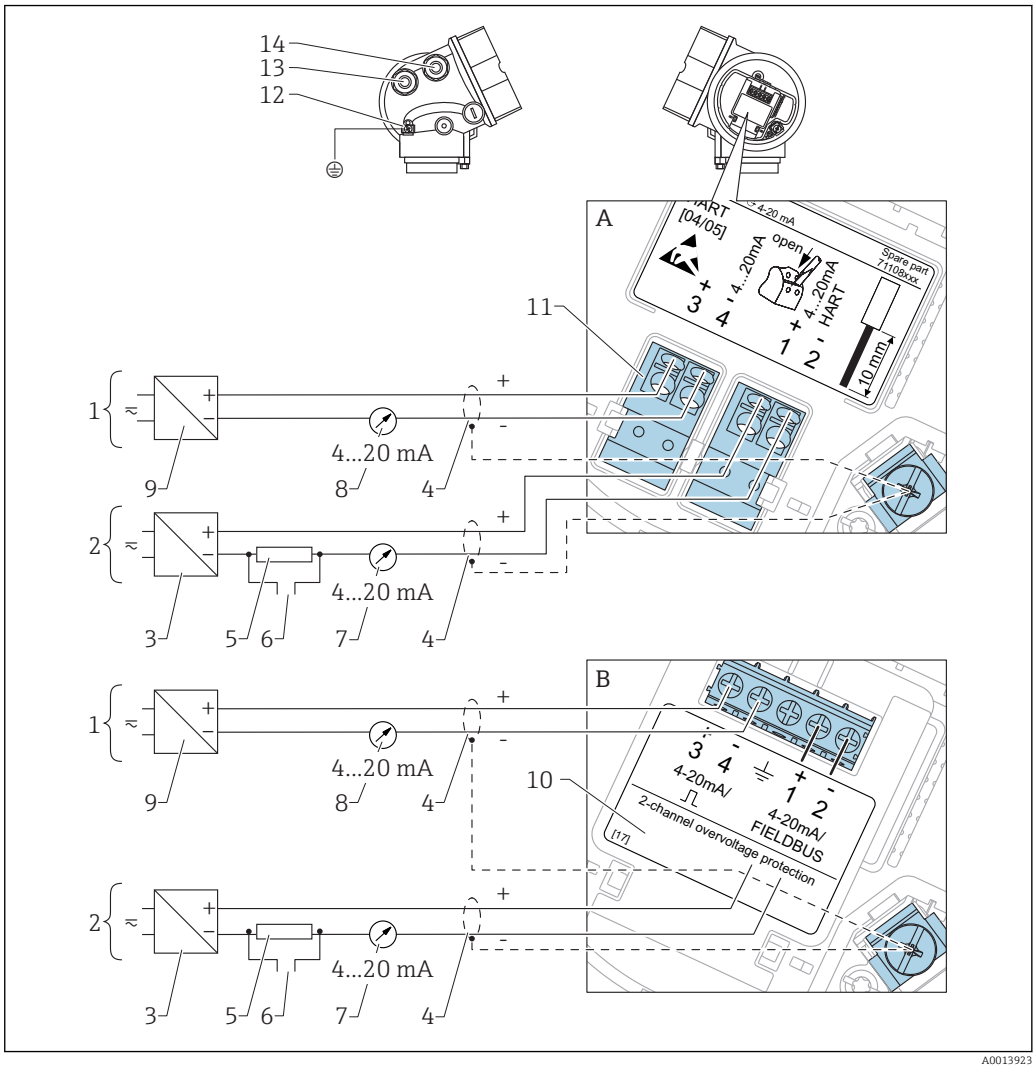
2-wire: 4-20mA HART, switch output



8 Terminal assignment 2-wire; 4-20mA HART, switch output

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage
2 HART communication resistor (≥ 250 Ω): Observe maximum load
3 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
4 Analog display device: Observe maximum load
5 Cable screen; observe cable specification
6 4-20mA HART (passive): Terminals 1 and 2
7 Switch output (open collector): Terminals 3 and 4
8 Terminal for potential equalization line
9 Cable entry for 4-20mA HART line
10 Cable entry for switch output line
11 Overvoltage protection module

2-wire: 4-20mA HART, 4-20mA

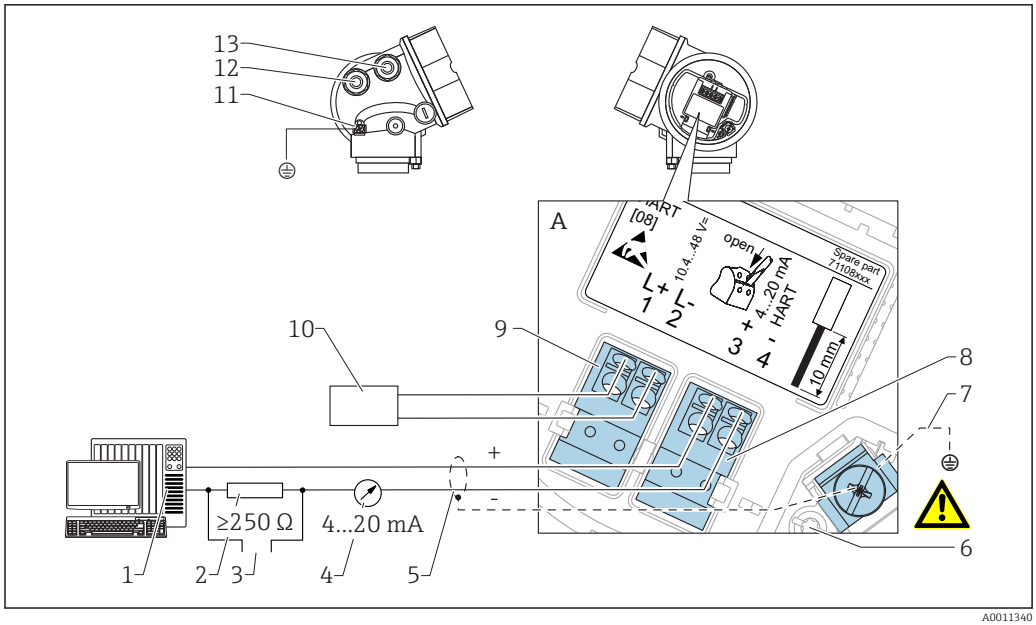


9 *Terminal assignment 2-wire, 4-20 mA HART, 4...20mA*

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Connection current output 2
2 Connection current output 1
3 Supply voltage for current output 1 (e.g. RN221N); Observe terminal voltage
4 Cable screen; observe cable specification
5 HART communication resistor (≥ 250 Ω): Observe maximum load
6 Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)
7 Analog display device ; observe maximum load
8 Analog display device ; observe maximum load
9 Supply voltage for current output 2 (e.g. RN221N); Obeserve terminal voltage
10 Overvoltage protection module
11 Current output 2: Terminals 3 and 4
12 Terminal for the potential equalization line
13 Cable entry for current output 1
14 Cable entry for current output 2

This version is also suited for single-channel operation. In this case, current output 1 (terminals 1 and 2) must be used.

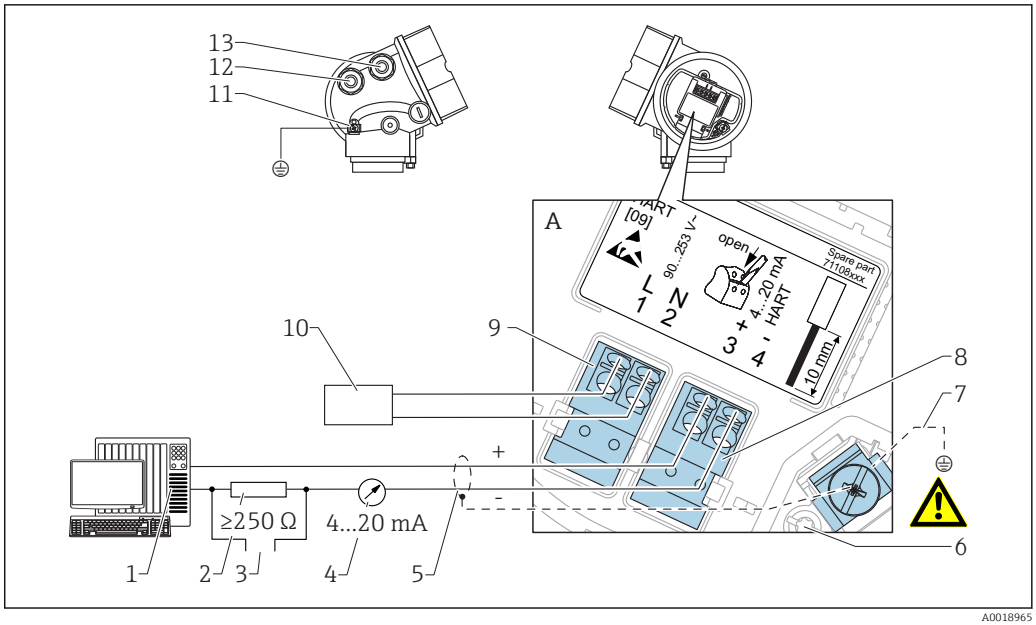
4-wire: 4-20mA HART (10.4 to 48 V_{DC})



10 *Terminal assignment 4-wire; 4-20mA HART (10.4 to 48 V_{DC})*

1 *Evaluation unit, e.g. PLC*
2 *HART communication resistor (≥ 250 Ω): Observe maximum load*
3 *Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)*
4 *Analog display device: Observe maximum load*
5 *Signal cable including screening (if required), observe cable specification*
6 *Protective connection; do not disconnect!*
7 *Protective earth, observe cable specification*
8 *4...20mA HART (active): Terminals 3 and 4*
9 *Supply voltage: Terminals 1 and 2*
10 *Supply voltage: Observe terminal voltage, observe cable specification*
11 *Terminal for potential equalization*
12 *Cable entry for signal line*
13 *Cable entry for power supply*

4-wire: 4-20mA HART (90 to 253 V_{AC})



11 *Terminal assignment 4-wire; 4-20mA HART (90 to 253 V_{AC})*

1 *Evaluation unit, e.g. PLC*
2 *HART communication resistor (≥ 250 Ω): Observe maximum load*
3 *Connection for Commubox FXA195 or FieldXpert SFX350/SFX370 (via VIATOR Bluetooth modem)*
4 *Analog display device: Observe maximum load*
5 *Signal cable including screening (if required), observe cable specification*
6 *Protective connection; do not disconnect!*
7 *Protective earth, observe cable specification*
8 *4...20mA HART (active): Terminals 3 and 4*
9 *Supply voltage: Terminals 1 and 2*
10 *Supply voltage: Observe terminal voltage, observe cable specification*
11 *Terminal for potential equalization*
12 *Cable entry for signal line*
13 *Cable entry for power supply*

⚠ CAUTION

To ensure electrical safety:

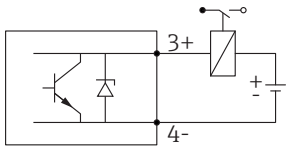
- ▶ Do not disconnect the protective connection (6).
- ▶ Disconnect the supply voltage before disconnecting the protective earth (7).

Connect protective earth to the internal ground terminal (7) before connecting the supply voltage. If necessary, connect the potential matching line to the external ground terminal (11).

In order to ensure electromagnetic compatibility (EMC): Do not only ground the device via the protective earth conductor of the supply cable. Instead, the functional grounding must also be connected to the process connection (flange or threaded connection) or to the external ground terminal.

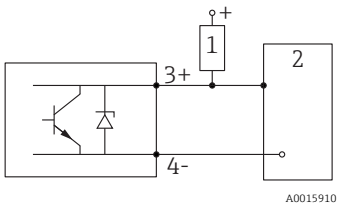
An easily accessible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN61010).

Connection examples for the switch output



12 Connection of a relay

Suitable relays (examples):
- Solid-state relay: Phoenix Contact OV-24DC/480AC/5 with mounting rail connector UMK-1 OM-R/AMS
- Electromechanical relay: Phoenix Contact PLC-RSC-12DC/21



13 Connection of a digital input

1 Pull-up resistor
2 Digital input

For optimum interference immunity we recommend to connect an external resistor (internal resistance of the relay or Pull-up resistor) of < 1 000 Ω.

7.1.2 Cable specification

- **Devices without integrated overvoltage protection**
  Pluggable spring-force terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- **Devices with integrated overvoltage protection**
  Screw terminals for wire cross-sections 0.2 to 2.5 mm² (24 to 14 AWG)
- For ambient temperature $T_U \geq 60$ °C (140 °F): use cable for temperature T_U +20 K.

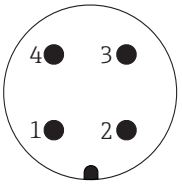
HART

- A normal device cable suffices if only the analog signal is used.
- A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- For 4-wire devices: Standard device cable is sufficient for the power line.

7.1.3 Device plug connectors

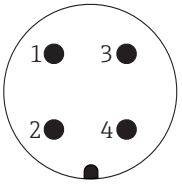
For the versions with fieldbus plug connector (M12 or 7/8"), the signal line can be connected without opening the housing.

Pin assignment of the M12 plug connector



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

Pin assignment of the 7/8" plug connector

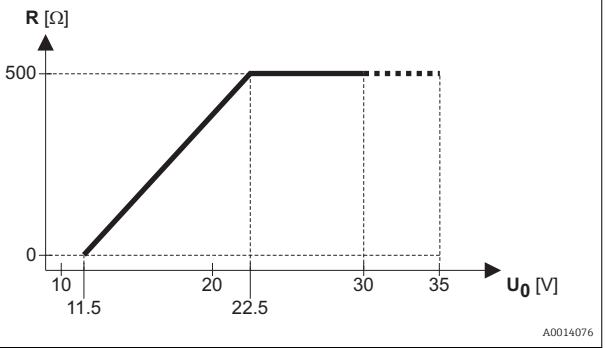
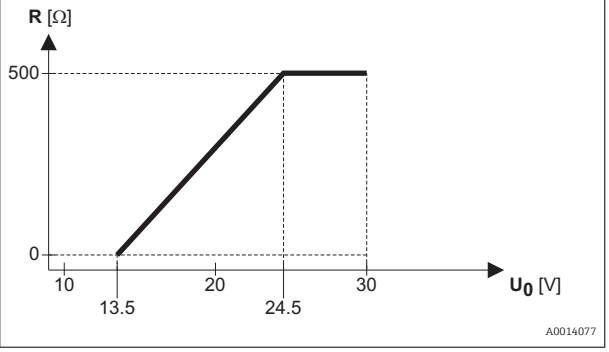


Pin	Meaning
1	Signal -
2	Signal +
3	Not connected
4	Screen

7.1.4 Power supply

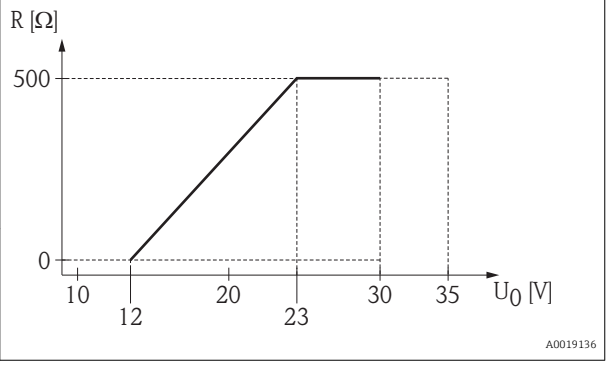
2-wire, 4-20mA HART, passive

2-wire; 4-20mA HART [1)]

"Approval" [2)]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
▪ Non-Ex ▪ Ex nA ▪ CSA GP	11.5 to 35 V [3)]	
Ex ic	11.5 to 32 V	
Ex ia / IS	11.5 to 30 V	
▪ Ex d / XP ▪ Ex ic[ia] ▪ Ex tD / DIP	13.5 to 30 V [4)]	

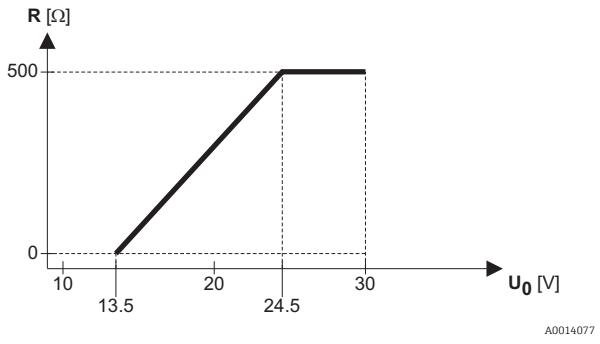
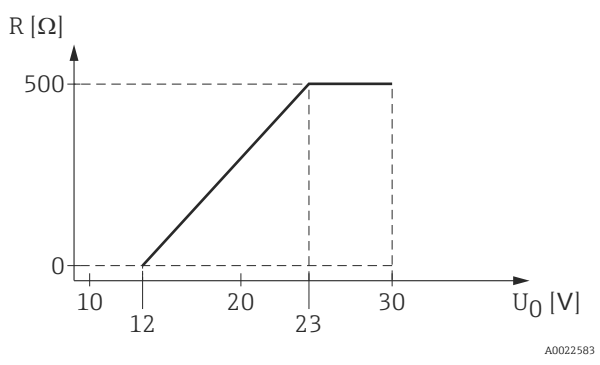
1) Feature 020 of the product structure: option A
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -30 °C (-22 °F) a minimum voltage of 14 V is required for the sartup of the device at the MIN error current (3,6 mA). The startup current can be parametrized. If the device is operated with a fixed current I ≥ 4,5 mA (HART multidrop mode), a voltage of U ≥ 11,5 V is sufficient throughout the entire range of ambient temperatures.
4) For ambient temperatures $T_a \leq$ -20 °C (-4 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

2-wire; 4-20 mA HART, switch output [1)]

"Approval" [2)]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
▪ Non-Ex ▪ Ex nA ▪ Ex nA[ia] ▪ Ex ic ▪ Ex ic[ia] ▪ Ex d[ia] / XP ▪ Ex ta / DIP ▪ CSA GP	12 to 35 V [3)]	
▪ Ex ia / IS ▪ Ex ia + Ex d[ia] / IS + XP	12 to 30 V [3)]	

1) Feature 020 of the product structure: option B
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -30 °C (-22 °F) a minimum voltage of 14 V is required for the startup of the device at the MIN error current (3.6 mA).

2-wire; 4-20mA HART, 4-20mA [1)]

"Approval" [2)]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
any	**Channel 1:** 13.5 to 30 V [3)]	
	Channel 2: 12 to 30 V	

1) Feature 020 of the product structure: option C
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -30 °C (-22 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

Polarity reversal protection	Yes
Admissible residual ripple at f = 0 to 100 Hz	U_{SS} < 1 V
Admissible residual ripple at f = 100 to 10000 Hz	U_{SS} < 10 mV

4-wire, 4-20mA HART, active

"Power supply; Output" [1]	Terminal voltage	Maximum load R_{max}
K: 4-wire 90-253VAC; 4-20mA HART	90 to 253 V_{AC} (50 to 60 Hz), overvoltage category II	500 Ω
L: 4-wire 10,4-48VDC; 4-20mA HART	10.4 to 48 V_{DC}	

1) Feature 020 of the product structure

7.1.5 Overvoltage protection

If the measuring device is used for level measurement in flammable liquids which requires the use of overvoltage protection according to DIN EN 60079-14, standard for test procedures 60060-1 (10 kA, pulse 8/20 µs), overvoltage protection has to be ensured by an integrated or external overvoltage protection module.

Integrated overvoltage protection

An integrated overvoltage protection module is available for 2-wire HART as well as PROFIBUS PA and FOUNDATION Fieldbus devices.

Product structure: Feature 610 "Accessory mounted", option NA "Overvoltage protection".

Technical data	
Resistance per channel	2 × 0.5 Ω max.
Threshold DC voltage	400 to 700 V
Threshold impulse voltage	< 800 V
Capacitance at 1 MHz	< 1.5 pF
Nominal arrest impulse voltage (8/20 µs)	10 kA

External overvoltage protection

HAW562 or HAW569 from Endress+Hauser are suited as external overvoltage protection.

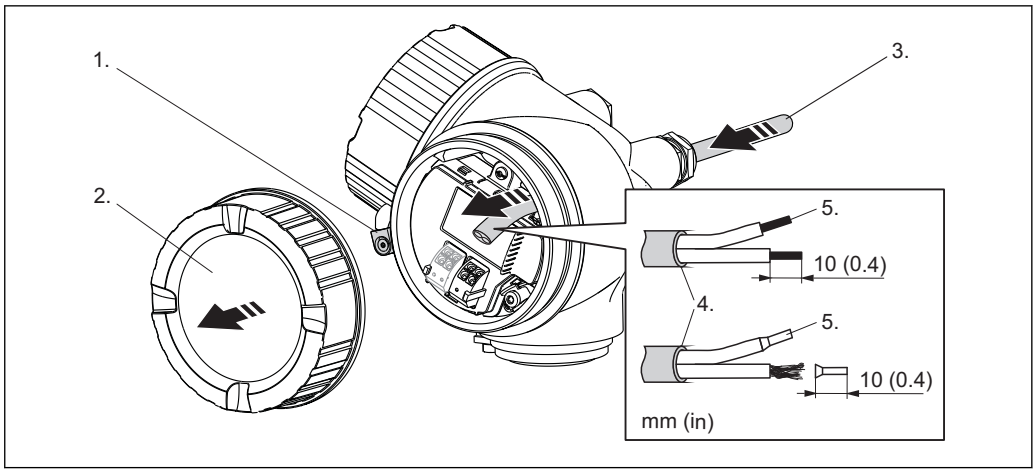
For detailed information please refer to the following documents:
- HAW562: TI01012K
- HAW569: TI01013K

7.2 Connecting the device

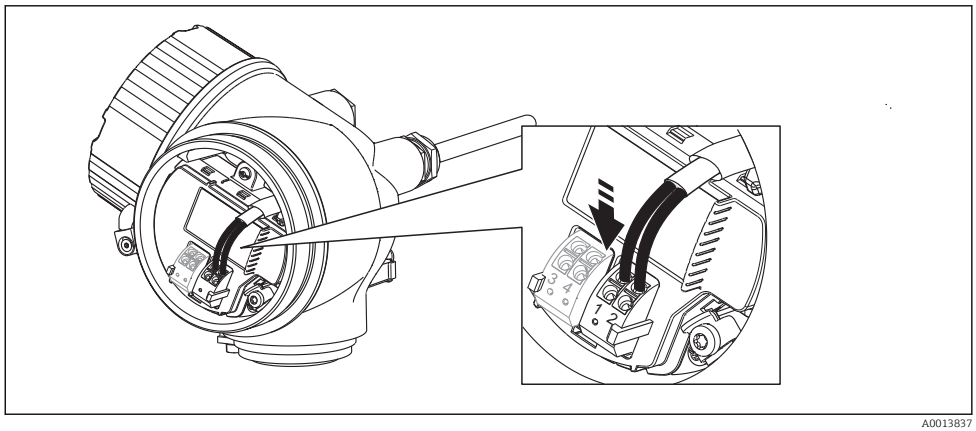
⚠ WARNING

Explosion hazard!
- ▶ Comply with the relevant national standards.
- ▶ Observe the specifications in the Safety Instructions (XA).
- ▶ Only use the specified cable glands.
- ▶ Check whether the supply voltage matches the specifications on the nameplate.
- ▶ Before connecting the device: Switch the supply voltage off.
- ▶ Before switching on the supply voltage: Connect the potential bonding line to the exterior ground terminal.

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



A0012619

1. Loosen the screw of the securing clamp of the connection compartment cover and turn the clamp 90° counterclockwise.
2. Unscrew the connection compartment cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable.
5. Strip the cable ends 10 mm (0.4 in). For stranded cables, also attach wire end ferrules.
6. Firmly tighten the cable glands.
7. 

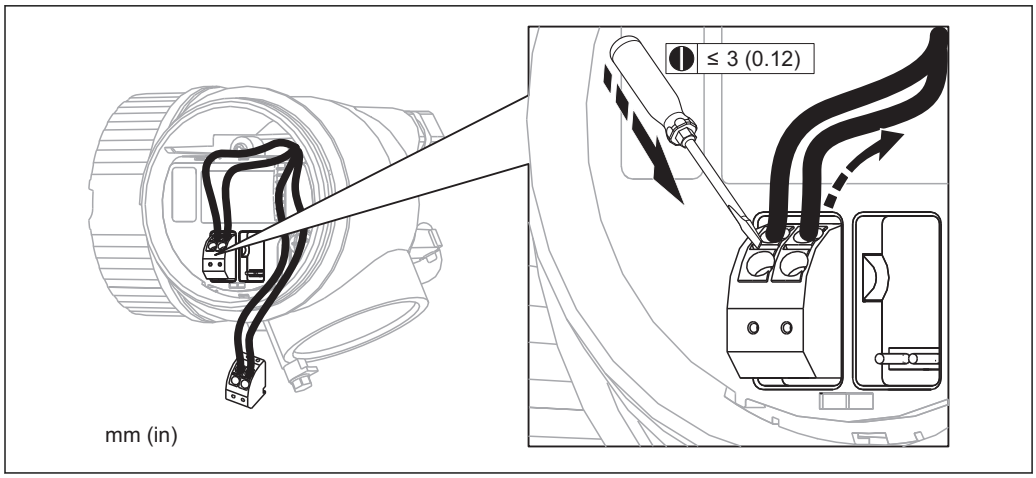
A0013837

   Connect the cable in accordance with the terminal assignment → 35.
8. When using screened cable: Connect the cable screen to the ground terminal.
9. Screw the cover onto the connection compartment.
10. For instruments with safety pin for the lid: Adjust the safety pin so that its edge is over the edge of the display lid. Tighten the safety pin.

7.2.1 Pluggable spring-force terminals

Instruments without integrated overvoltage protection have pluggable spring-force terminals. Rigid conductors or flexible conductors with cable sleeve can directly be inserted and are contacted automatically.

To remove cables from the terminal: Press on the groove between the terminals using a flat-tip screwdriver ≤ 3 mm (0.12 inch) while pulling the cables out of the terminals.



A0013661

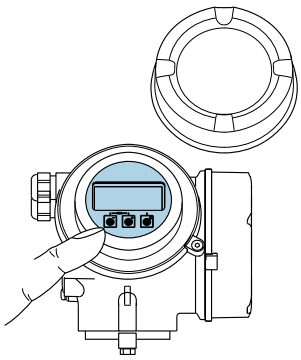
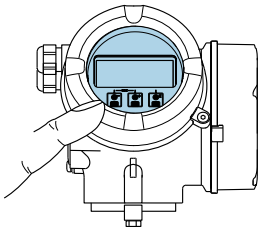
7.3 Post-connection check

❍	Are cables or the device undamaged (visual inspection)?
❍	Do the cables comply with the requirements?
❍	Do the cables have adequate strain relief?
❍	Are all cable glands installed, firmly tightened and correctly sealed?
❍	Does the supply voltage match the specifications on the transmitter nameplate?
❍	Is the terminal assignment correct → 🖹 35?
❍	If required: Is the protective earth connected correctly ?
❍	If supply voltage is present: Is the device ready for operation and do values appear on the display module?
❍	Are all housing covers installed and firmly tightened?
❍	Is the securing clamp tightened correctly?

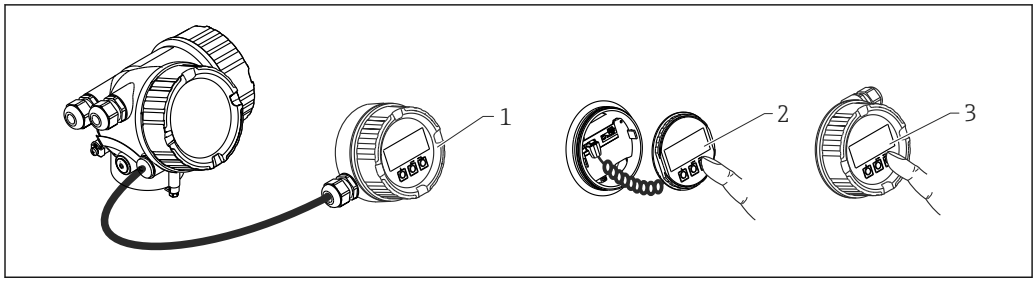
8 Operation options

8.1 Overview

8.1.1 Local operation

Operation with	*Pushbuttons*	*Touch Control*
Order code for "Display; Operation"	Option **C** "SD02"	Option **E** "SD
	 A0032219	 A0032221
Display elements	4-line display	4-line display white background lighting; switches to red in event of device error
	Format for displaying measured variables and status variables can be individually configured	
	Permitted ambient temperature for the display: −20 to +70 °C (−4 to +158 °F) The readability of the display may be impaired at temperatures outside the temperature range.	
Operating elements	local operation with 3 push buttons (⊞, ⊟, Ⓔ)	external operation via touch control; 3 optical keys: ⊞, ⊟, Ⓔ
	Operating elements also accessible in various hazardous areas	
Additional functionality	Data backup function The device configuration can be saved in the display module.	
	Data comparison function The device configuration saved in the display module can be compared to the current device configuration.	
	Data transfer function The transmitter configuration can be transmitted to another device using the display module.	

8.1.2 Operation with remote display and operating module FHX50

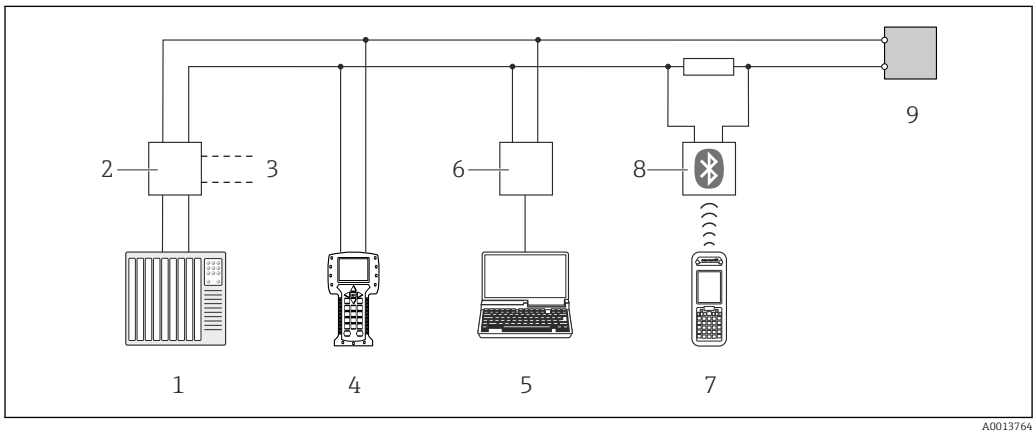


14 *FHX50 operating options*

1 *Housing of the remote display and operating module FHX50*
2 *Display and operating module SD02, push buttons; cover must be removed*
3 *Display and operating module SD03, optical keys; can be operated through the glass of the cover*

8.1.3 Remote operation

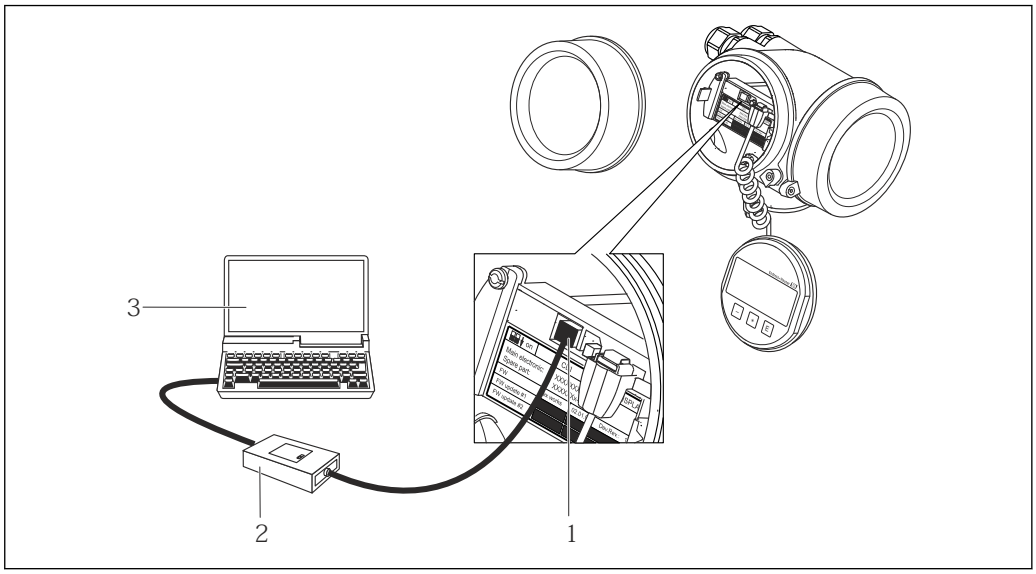
Via HART protocol



15 *Options for remote operation via HART protocol*

1 *PLC (programmable logic controller)*
2 *Transmitter power supply unit, e.g. RN221N (with communication resistor)*
3 *Connection for Commubox FXA191, FXA195 and Field Communicator 375, 475*
4 *Field Communicator 475*
5 *Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)*
6 *Commubox FXA191 (RS232) or FXA195 (USB)*
7 *Field Xpert SFX350/SFX370*
8 *VIATOR Bluetooth modem with connecting cable*
9 *Transmitter*

Via service interface (CDI)



1 Service interface (CDI) of the measuring device (= Endress+Hauser Common Data Interface)
2 Commubox FXA291
3 Computer with "FieldCare" operating tool

8.2 Structure and function of the operating menu

8.2.1 Structure of the operating menu

Menu	Submenu / parameter	Meaning
	Language [1]	Defines the operating language of the on-site display.
Commissioning [2]		Opens the interactive wizard for a guided commissioning of the device. As a rule, no additional settings in the other menus are required after the completion of the wizard.
Setup	Parameter 1 ... Parameter N	When all these parameters have been assigned appropriate values, the measured should be completely configured in a standard application.
	Advanced setup	Contains further submenus and parameters: ▪ to adapt the device to special measuring conditions. ▪ to process the measured value (scaling, linearization). ▪ to configure the signal output.
Diagnostics	**Diagnostic list**	Contains up to 5 currently active error messages.
	Event logbook [3]	Contains the last 20 messages (which are no longer active).
	Device information	Contains information needed to identify the device.
	Measured values	Contains all current measured values.
	Data logging	Contains the history of the individual measuring values.
	Simulation	Used to simulate measured values or output values.
	Device check	Contains all parameters needed to check the measurement capability of the device.
	Heartbeat [4]	Contains all wizards for the **Heartbeat Verification** and **Heartbeat Monitoring** application packages.
Expert [5] Contains all parameters of the device (including those which are already contained in one of the above submenus). This menu is organized according to the function blocks of the device. The parameter of the **Expert** menu are described in: GP01014F (HART)	**System**	Contains all general device parameters which do not affect the measurement or the communication interface.
	Sensor	Contains all parameters needed to configure the measurement.
	Output	▪ Contains all parameters needed to configure the current output. ▪ Contains all parameters neeed to configure the switch output (PFS).

Menu	Submenu / parameter	Meaning
	Communication	Contains all parameters needed to configure the digital communication interface.
	Diagnostics	Contains all parameters needed to detect and analyze operational errors.

1) In case of operation via operating tools (e.g. FieldCare), the "Language" parameter is located at "Setup → Advanced setup → Display"
2) only for operation via a FDT/DTM system
3) only available with local operation
4) only available for operation via DeviceCare or FieldCare
5) On entering the "Expert" menu, an access code is always requested. If a customer specific access code has not been defined, "0000" has to be entered.

8.2.2 User roles and related access authorization

The two user roles **Operator** and **Maintenance** have different write access to the parameters if a device-specific access code has been defined. This protects the device configuration via the local display from unauthorized access → 53.

Access authorization to parameters

User role	Read access		Write access	
	Without access code (from the factory)	With access code	Without access code (from the factory)	With access code
Operator	✔	✔	✔	--
Maintenance	✔	✔	✔	✔

If an incorrect access code is entered, the user obtains the access rights of the **Operator** role.

The user role with which the user is currently logged on is indicated by the **Access status display** parameter (for display operation) or **Access status tooling** parameter (for tool operation).

8.2.3 Write protection via access code

Using the device-specific access code, the parameters for the measuring device configuration are write-protected and their values can no longer be changed via local operation.

Define access code via local display

1. Navigate to: Setup → Advanced setup → Administration → Define access code → Define access code
2. Define a max. 4-digit numeric code as an access code.
3. Repeat the same code in **Confirm access code** parameter.
   ↳ The 🔒-symbol appears in front of all write-protected parameters.

Define access code via operating tool (e.g. FieldCare)

1. Navigate to: Setup → Advanced setup → Administration → Define access code
2. Define a max. 4-digit numeric code as an access code.
   ↳ Write protection is active.

Parameters that can always be changed

The write protection does not include certain parameters that do not affect the measurement. Despite the defined access code, they can always be modified, even if the other parameters are locked.

If no key is pressed for 10 minutes in the navigation and editing mode, the device automatically locks the write-protected parameters. If the user goes from the navigation and editing mode back to the measured value display mode, the device automatically locks the write-protected parameters after 60 s.

- If write access is activated via access code, it can be also be deactivated only via the access code → 📄 54.
- In the "Description of Device Parameters" documents, each write-protected parameter is identified with the 🔒-symbol.

8.2.4 Disabling write protection via access code

If the 🔒-symbol appears on the local display in front of a parameter, the parameter is write-protected by a device-specific access code and its value cannot be changed at the moment using the local display → 🖹 53.

The locking of the write access via local operation can be disabled by entering the device-specific access code.

1. After you press E, the input prompt for the access code appears.
2. Enter the access code.
   ↳ The 🔒-symbol in front of the parameters disappears; all previously write-protected parameters are now re-enabled.

8.2.5 Deactivation of the write protection via access code

Via local display

1. Navigate to Setup → Advanced setup → Administration → Define access code → Define access code
2. Enter **0000**.
3. Repeat **0000** in **Confirm access code** parameter.
   ↳ The write protection is deactivated. Parameters can be changed without entering an access code.

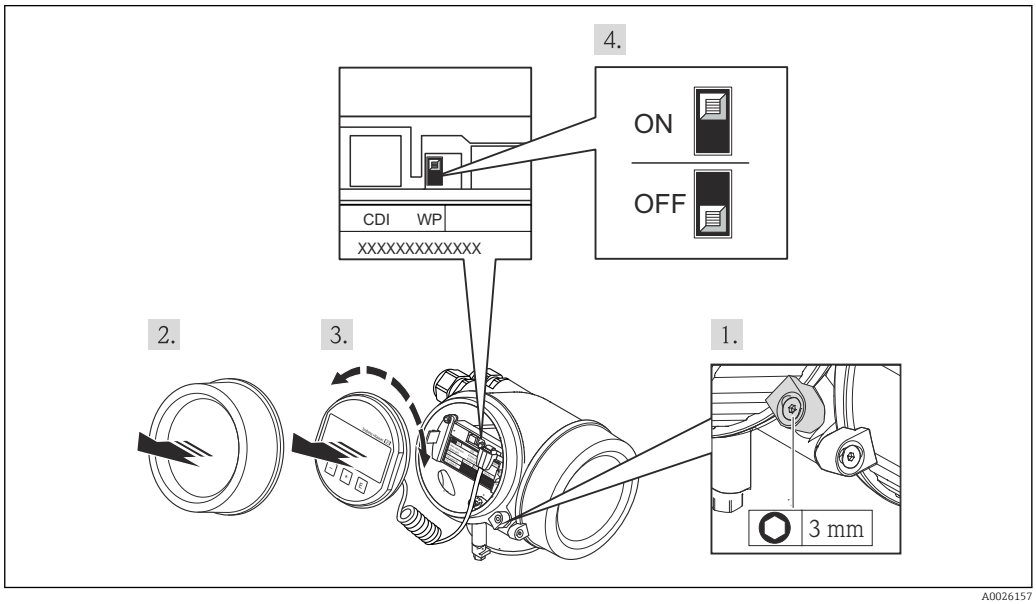
Via operating tool (e.g. FieldCare)

1. Navigate to Setup → Advanced setup → Administration → Define access code
2. Enter **0000**.
   ↳ The write protection is deactivated. Parameters can be changed without entering an access code.

8.2.6 Write protection via write protection switch

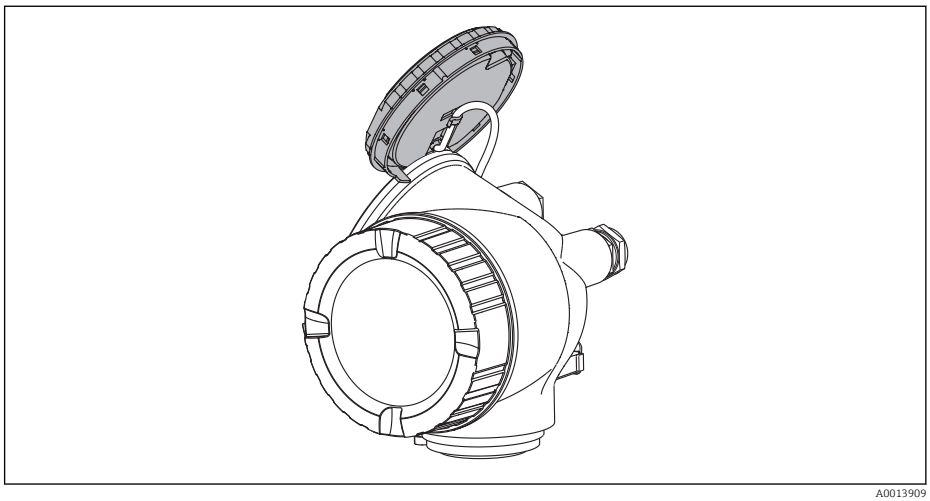
Unlike parameter write protection via a user-specific access code, this allows write access to the entire operating menu - except for the **"Contrast display" parameter** - to be locked.

The parameter values are now read only and cannot be edited any more (exception **"Contrast display" parameter**):
- Via local display
- Via service interface (CDI)
- Via HART protocol



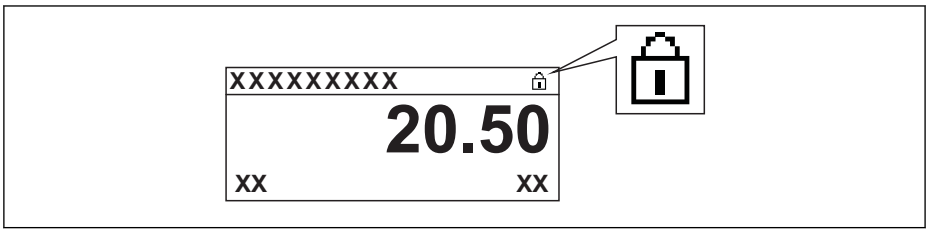
A0026157

1. Loosen the securing clamp.
2. Unscrew the housing cover.
3. Pull out the display module with a gentle rotation movement. To make it easier to access the lock switch, attach the display module to the edge of the electronics compartment.
   ↳ Display module is attached to the edge of the electronics compartment.



A0013909

4. Installing the lock switch (WP) on the main electronics module in the **ON** position enables the hardware write protection. Installing the lock switch (WP) on the main electronics module in the **OFF** position (factory setting) disables the hardware write protection.
   ↳ If the hardware write protection is enabled: The **Hardware locked** option is displayed in the **Locking status** parameter. In addition to this, the 🔒-symbol appears in the header of the measured value display and in the navigation view in front of the parameters.



   If the hardware write protection is disabled: No option is displayed in the **Locking status** parameter. The 🔒-symbol disappears in the header of the measured value display and in the navigation view in front of the parameters.

5. Feed the spiral cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment in the desired direction until it engages.
6. Screw the electronics compartment cover closed and tighten the securing clamp.

8.2.7 Enabling and disabling the keypad lock

The keypad lock allows to disable access to the entire operating menu via local operation. Thus navigating through the operating menu or modifying the values of individual parameters is no longer possible. Only the measured values on the measured value display can be read off.

The keylock is enabled and disabled via a context menu.

Enabling the keylock

For the SD03 display:
The keylock is automatically activated:
- If the device has not been operated via the display for > 1 minute.
- After a restart of the device.

To activate the keylock manually:

1. The device is in the measured value display.
   Press E for at least 2 seconds.
   ↳ A context menu appears.
2. Select **Keylock on** from the context menu.
   ↳ The keylock is enabled.

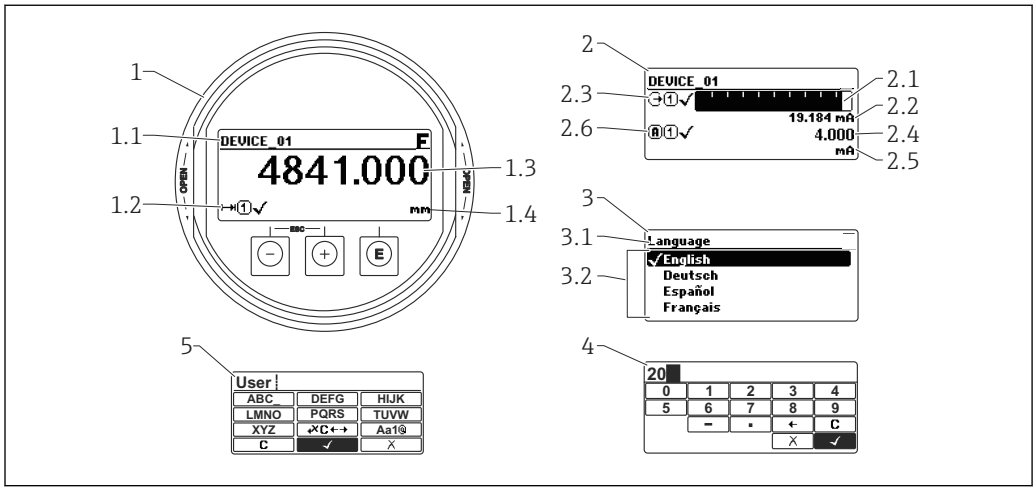
When attempting to access the operating menu while the keylock is enabled, the **Keylock on** message appears.

Disabling the keylock

1. The keylock is enabled.
   Press E for at least 2 seconds.
   ↳ A context menu appears.
2. Select **Keylock off** from the context menu.
   ↳ The keylock is disabled.

8.3 Display and operating module

8.3.1 Display appearance



16 *Appearance of the display and operation module for on-site operation*

1 Measured value display (1 value max. size)
1.1 Header containing tag and error symbol (if an error is active)
1.2 Measured value symbols
1.3 Measured value
1.4 Unit
2 Measured value display (1 bargraph + 1 value)
2.1 Bargraph for measured value 1
2.2 Measured value 1 (including unit)
2.3 Measured value symbols for measured value 1
2.4 Measured value 2
2.5 Unit for measured value 2
2.6 Measured value symbols for measured value 2
3 Representation of a parameter (here: a parameter with selection list)
3.1 Header containing parameter name and error symbol (if an error is active)
3.2 Selection list; ☑ marks the current parameter value.
4 Input matrix for numbers
5 Input matrix for alphanumeric and special characters

Display symbols for the submenus

Symbol	Meaning
 A0011975	**Display/operation** Is displayed: ▪ in the main menu next to the selection "Display/operation" ▪ in the header, if you are in the "Display/operation" menu
 A0011974	**Setup** Is displayed: ▪ in the main menu next to the selection "Setup" ▪ in the header, if you are in the "Setup" menu
 A0011976	**Expert** Is displayed: ▪ in the main menu next to the selection "Expert" ▪ in the header, if you are in the "Expert" menu
 A0011977	**Diagnostics** Is displayed: ▪ in the main menu next to the selection "Diagnostics" ▪ in the header, if you are in the "Diagnostics" menu

Status signals

F A0013956	**"Failure"** A device error is present. The measured value is no longer valid.
C A0013959	**"Function check"** The device is in service mode (e.g. during a simulation).
S A0013958	**"Out of specification"** The device is operated: ▪ Outside of its technical specifications (e.g. during startup or a cleaning) ▪ Outside of the configuration carried out by the user (e.g. level outside configured span)
M A0013957	**"Maintenance required"** Maintenance is required. The measured value is still valid.

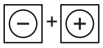
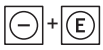
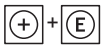
Display symbols for the locking state

Symbol	Meaning
 A0011978	**Display parameter** Marks display-only parameters which can not be edited.
 A0011979	**Device locked** ▪ In front of a parameter name: The device is locked via software and/or hardware. ▪ In the header of the measured value screen: The device is locked via hardware.

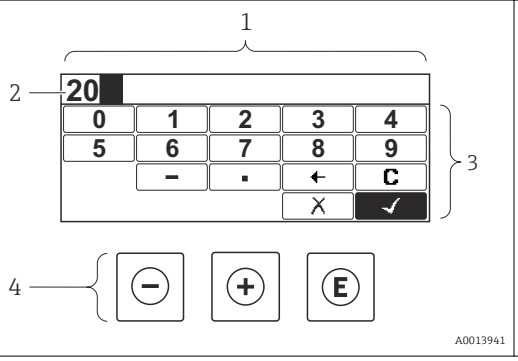
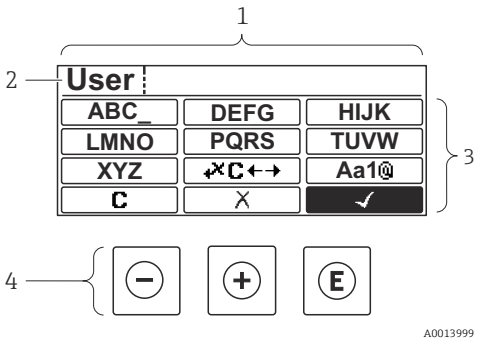
Measured value symbols

Symbol	Meaning
Measured values	
 A0011995	**Level**
 A0011996	**Distance**
 A0011998	**Current output**
 A0011999	**Measured current**
 A0012106	**Terminal voltage**
 A0012104	**Temperature of the electronics or the sensor**
Measuring channels	
 A0012000	**Measuring channel 1**
 A0012107	**Measuring channel 2**
Status of the measured value	
 A0012102	**Status "Alarm"** The measurment is interrupted. The output assumes the defined alarm value. A diagnostic message is generated.
 A0012103	**Status "Warning"** The device continues measuring. A diagnostic message is generated.

8.3.2 Operating elements

Key	Meaning
 A0013969	**Minus key** *For menu, submenu* Moves the selection bar upwards in a picklist. *For text and numeric editor* In the input mask, moves the selection bar to the left (backwards).
 A0013970	**Plus key** *For menu, submenu* Moves the selection bar downwards in a picklist. *For text and numeric editor* In the input mask, moves the selection bar to the right (forwards).
 A0013952	**Enter key** *For measured value display* ▪ Pressing the key briefly opens the operating menu. ▪ Pressing the key for 2 s opens the context menu. *For menu, submenu* ▪ Pressing the key briefly Opens the selected menu, submenu or parameter. ▪ Pressing the key for 2 s for parameter: If present, opens the help text for the function of the parameter. *For text and numeric editor* ▪ Pressing the key briefly – Opens the selected group. – Carries out the selected action. ▪ Pressing the key for 2 s confirms the edited parameter value.
 A0013971	**Escape key combination (press keys simultaneously)** *For menu, submenu* ▪ Pressing the key briefly – Exits the current menu level and takes you to the next higher level. – If help text is open, closes the help text of the parameter. ▪ Pressing the key for 2 s returns you to the measured value display ("home position"). *For text and numeric editor* Closes the text or numeric editor without applying changes.
 A0013953	**Minus/Enter key combination (press and hold down the keys simultaneously)** Reduces the contrast (brighter setting).
 A0013954	**Plus/Enter key combination (press and hold down the keys simultaneously)** Increases the contrast (darker setting).
 A0013955	**Minus/Plus/Enter key combination (press and hold down the keys simultaneously)** *For measured value display* Enables or disables the keypad lock.

8.3.3 Entering numbers and text

Numeric editor	Text editor
	

1 *Editing view*
2 *Display area of the entered values*
3 *Input mask*
4 *Operating elements*

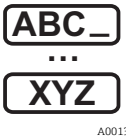
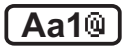
Input mask

The following input symbols are available in the input mask of the numeric and text editor:

Numeric editor symbols

Symbol	Meaning
	Selection of numbers from 0 to 9.
	Inserts decimal separator at the input position.
	Inserts minus sign at the input position.
	Confirms selection.
	Moves the input position one position to the left.
	Exits the input without applying the changes.
	Clears all entered characters.

Text editor symbols

Symbol	Meaning
	Selection of letters from A to Z
	Toggle ▪ Between upper-case and lower-case letters ▪ For entering numbers ▪ For entering special characters

 A0013985	Confirms selection.
 A0013987	Switches to the selection of the correction tools.
 A0013986	Exits the input without applying the changes.
 A0014040	Clears all entered characters.

Correction symbols under	
 A0013989	Clears all entered characters.
 A0013991	Moves the input position one position to the right.
 A0013990	Moves the input position one position to the left.
 A0013988	Deletes one character immediately to the left of the input position.

8.3.4 Opening the context menu

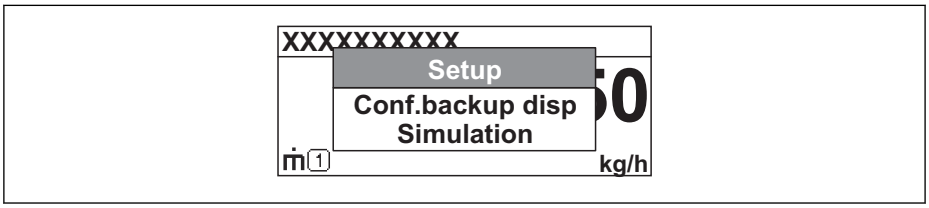
Using the context menu, the user can call up the following menus quickly and directly from the operational display:

- Setup
- Conf. backup disp.
- Simulation

Calling up and closing the context menu

The user is in the operational display.

1. Press E for 2 s.
   ↳ The context menu opens.



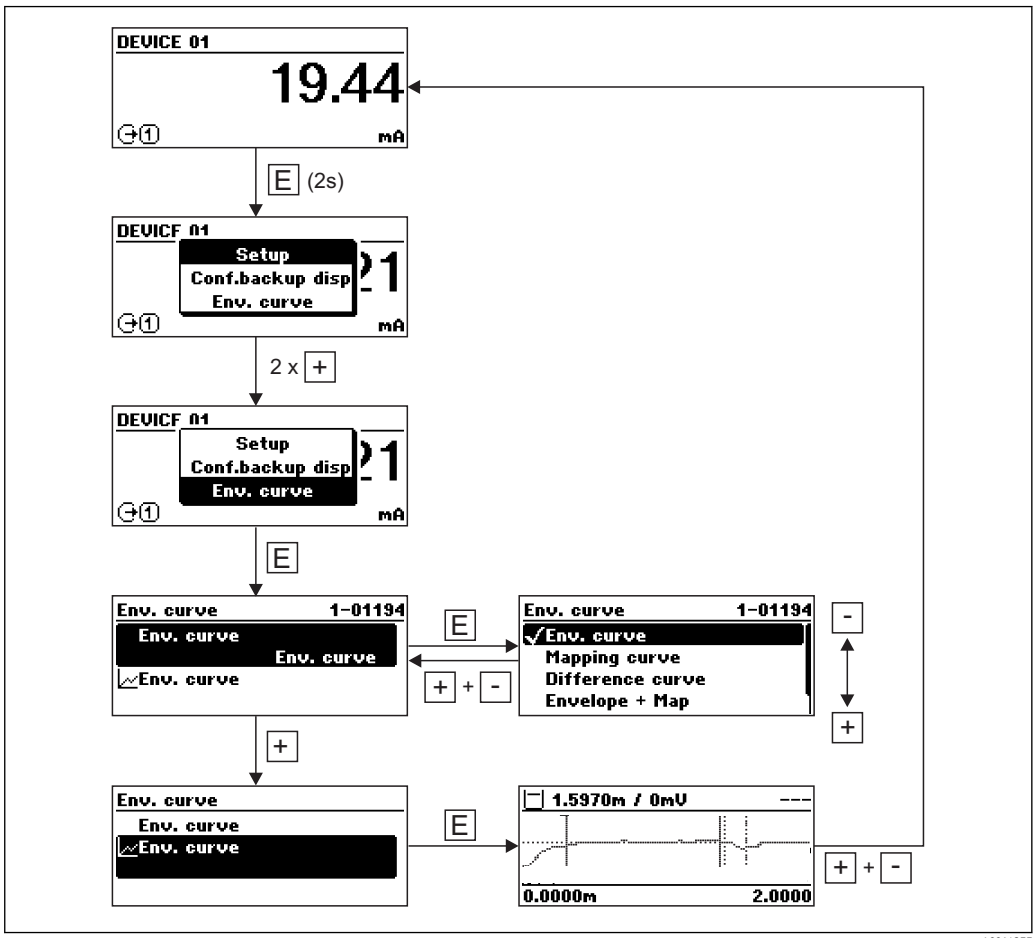
2. Press − + + simultaneously.
   ↳ The context menu is closed and the operational display appears.

Calling up the menu via the context menu

1. Open the context menu.
2. Press + to navigate to the desired menu.
3. Press E to confirm the selection.
   ↳ The selected menu opens.

8.3.5 Envelope curve on the display and operating module

In order to assess the measuring signal, the envelope curve and - if a mapping has been recorded - the mapping curve can be displayed:



9 Device integration via the HART protocol

9.1 Overview of the Device Description files (DD)

HART

Manufacturer ID	0x11
Device type	0x1122
HART specification	7.0
DD files	For information and files see: ▪ www.endress.com ▪ www.hartcomm.org

9.2 HART device variables and measuring values

On delivery the following measruing values are assigned to the HART device varaibles:

Device variables for level measurements

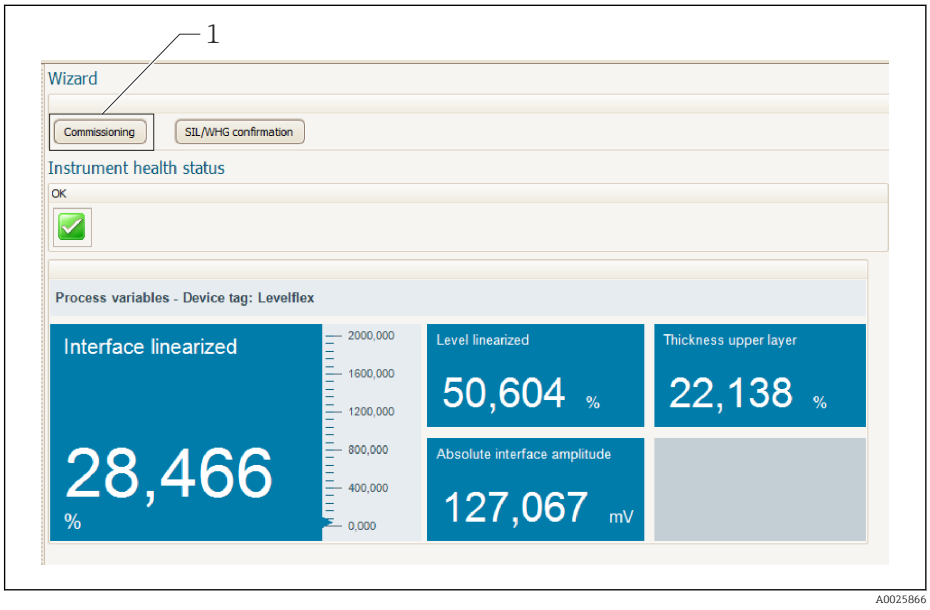
Device variable	Measuring value
Primary variable (PV)	Level linearized
Secondary variable (SV)	Unfiltered distance
Tertiary variable (TV)	Absolute echo amplitude
Quaternary variable (QV)	Relative echo amplitude

The allocation of the measuring values to the device variables can be changed in the following submenu:
Expert → Communication → Output

10 Commissioning via wizard

A wizard guiding the user through the initial setup is available in FieldCare and DeviceCare.

1. Connect the device to FieldCare or DeviceCare → 📄 48.
2. Open the device in FieldCare or DeviceCare.
   ↳ The dashboard (home page) of the device appears:



1 "Commissioning" button calls up the wizard.

3. Click on "Commissioning" to call up the wizard.
4. Enter or select the appropriate value for each parameter. These values are immediately written to the device.
5. Click "Next" to switch to the next page.
6. After finishing the last page, click "End of sequence" to close the wizard.

If the wizard is cancelled before all necessary parameters have been set, the device may be in an undefined state. A reset to the default settings is recommended in this case.

11 Commissioning via operating menu

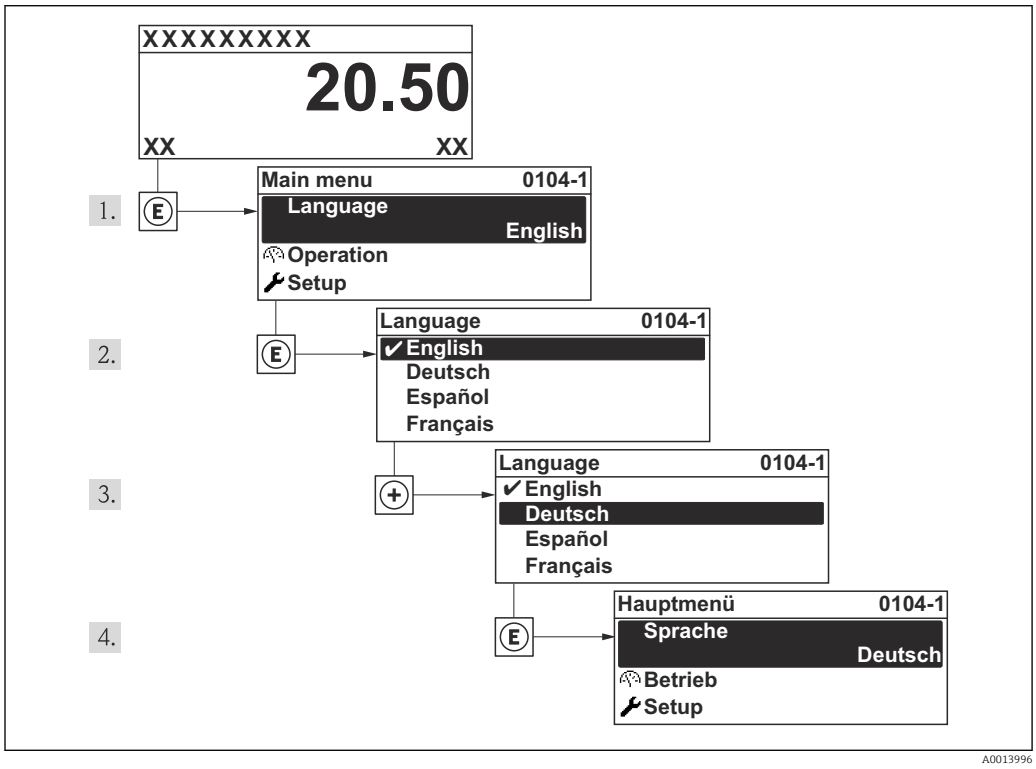
11.1 Installation and function check

Make sure that all final checks have been completed before you start up your measuring point:

- Checklist "Post-installation check" → 34
- Checklist "Post-connection check" → 46

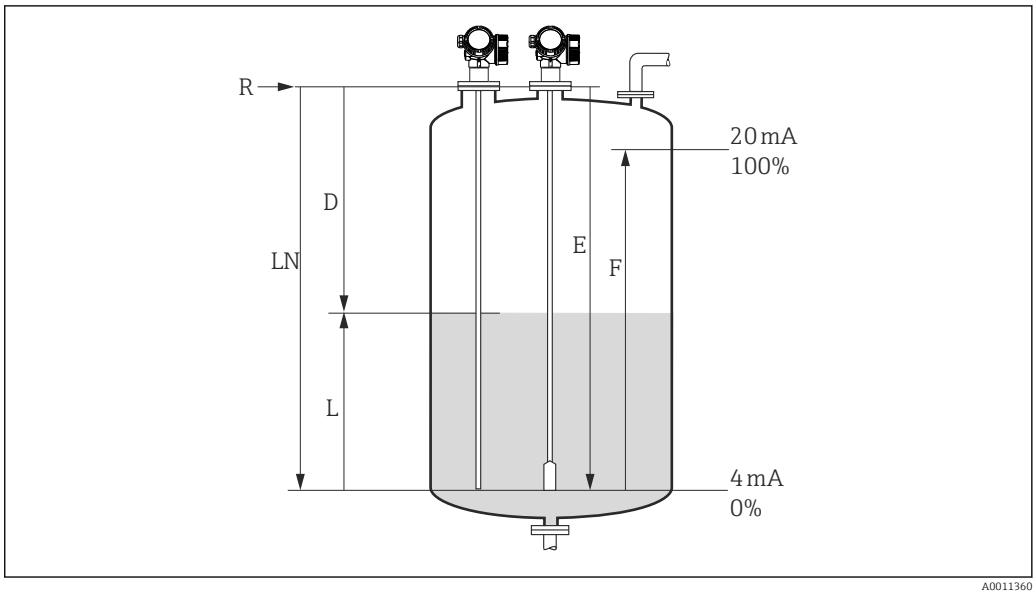
11.2 Setting the operating language

Factory setting: English or ordered local language



17 *Using the example of the local display*

11.3 Configuration of a level measurement



18 *Configuration parameters for level measurements in liquids*

LN *Length of probe*
R *Reference point of the measurement*
D *Distance*
L *Level*
E *Empty calibration (= Zero point)*
F *Full calibration (= Span)*

If for rope probes the DC value is less than 7, then measurement is not possible in the area of the straining weight. In these cases, the maximum recommended value for the empty calibration E is *LN* - 250 mm (*LN* - 10 in).

1. Setup → Device tag
   ↳ Enter tag for measuring point.
2. Navigate to: Setup → Distance unit
   ↳ Select distance unit.
3. Navigate to: Setup → Tank type
   ↳ Select tank type.
4. For Tank type = Bypass / pipe:
   Navigate to: Setup → Tube diameter
   ↳ Enter the diameter of the bypass or stilling well.
5. Navigate to: Setup → Medium group
   ↳ Select medium group: (**Water based (DC >= 4)** or **Others**)
6. Navigate to: Setup → Empty calibration
   ↳ Enter the distance E between the reference point R and the minimum level (0%).
7. Navigate to: Setup → Full calibration
   ↳ Enter distance F between the minimum (0%) and maximum (100%) level.
8. Navigate to: Setup → Level
   ↳ Displays the measured level L.
9. Navigate to: Setup → Distance
   ↳ Displays the distance D between the reference point R and the level L.
10. Navigate to: Setup → Signal quality
    ↳ Displays the signal quality of the level echo.

11. For operation via local display:
    Navigate to: Setup → Mapping → Confirm distance
    ↳ Compare the displayed distance to the real distance in order to start the recording of the mapping curve if required.
12. For operation via operating tool:
    Navigate to: Setup → Confirm distance
    ↳ Compare the displayed distance to the real distance in order to start the recording of the mapping curve if required.

11.4 Recording the reference curve

After the configuration of the measurement it is recommended to record the current envelope curve as a reference curve. The reference curve can be used later on in the process for diagnostic purposes. To record the reference curve use the **Save reference curve** parameter.

Navigation in the menu
Expert → Diagnostics → Envelope diagnostics → Save reference curve

Meaning of the options
- No
  No action
- Yes
  The current envelope curve is saved as reference curve.

In devices which have been delivered with software version 01.00.zz or 01.01.zz, this submenu is only visible for the "Service" user role.

The reference curve can only be displayed in the envelope curve diagram of FieldCare after it has been loaded from the device into FieldCare. This is performed by the "Load Reference Curve" function in FieldCare:

19 *The "Load Reference Curve" function*

11.5 Configuration of the on-site display

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

Parameter	Factory setting for devices with 1 current output	Factory setting for devices with 2 current outputs
Format display	1 value, max. size	1 value, max. size
Value 1 display	Level linearized	Level linearized
Value 2 display	Distance	Distance
Value 3 display	Current output 1	Current output 1
Value 4 display	None	Current output 2

11.5.2 Adjustment of the on-site display

The on-site display can be adjusted in the following menu:
Setup → Advanced setup → Display

11.6 Configuration of the current outputs

11.6.1 Factory setting of the current outputs for level measurements

Current output	Allocated measuring vlaue	4mA value	20mA value
1	Level linearized	0% or the corresponding linearized value	100% or the corresponding linearized value
2 [1)]	Relative echo amplitude	0 mV	2 000 mV

1) for devices with 2 current outputs

11.6.2 Adjustment of the current outputs

The current outputs can be adjusted in the following submenus:

Basic settings
Setup → Advanced setup → Current output 1 to 2

Advanced settings
Expert → Output 1 to 2 → Current output 1 to 2
See "Description of Device Parameters" GP01000F

11.7 Configuration management

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

Navigation path in the operating menu
Setup → Advanced setup → Configuration backup display → Configuration management

Meaning of the options
- **Cancel**
  No action is executed and the user exits the parameter.
- **Execute backup**
  A backup copy of the current device configuration in the HistoROM (built-in in the device) is saved to the display module of the device. The backup copy comprises the transmitter and sensor data of the device.
- **Restore**
  The last backup copy of the device configuration is copied from the display module to the HistoROM of the device. The backup copy comprises the transmitter and sensor data of the device.
- **Duplicate**
  The transmitter configuration is duplicated to another device using the transmitter display module. The following parameters, which characterize the individual measuring point are **not** included in the transmitted configuration:
  – HART date code
  – HART short tag
  – HART message
  – HART descriptor
  – HART address
  – Device tag
  – Medium type
- **Compare**
  The device configuration saved in the display module is compared to the current device configuration of the HistoROM. The result of this comparison is displayed in the **Comparison result** parameter.
- **Clear backup data**
  The backup copy of the device configuration is deleted from the display module of the device.

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

If an existing backup is restored to a different device using the **Restore** option, it may occur that some device functionalities are no longer available. In some cases even a device reset → 165 will not restore the original status.

In order to transmit a configuration to a different device, the **Duplicate** option should always be used.

11.8 Protection of the settings against unauthorized changes

There are two ways to protect the settings against unauthorized changes:

- Via parameter settings (software locking) → 53
- Via locking switch (hardware locking) → 55

12 Diagnostics and troubleshooting

12.1 General trouble shooting

12.1.1 General errors

Error	Possible cause	Remedial action
Device does not respond.	Supply voltage does not match the value indicated on the nameplate.	Connect the correct voltage.
	The polarity of the supply voltage is wrong.	Correct the polarity.
	The cables do not contact the terminals properly.	Ensure electrical contact between the cable and the terminal.
Values on the display invisible	Contrast setting is too weak or too strong.	▪ Increase contrast by pressing ⊞ and Ⓔ simultaneously. ▪ Decrease contrast by pressing ⊟ and Ⓔ simultaneously.
	The plug of the display cable is not connected correctly.	Connect the plug correctly.
	Display is defective.	Replace display.
"Communication error" is indicated on the display when starting the device or connecting the display	Electromagnetic interference	Check grounding of the device.
	Broken display cable or display plug.	Exchange display.
Output current < 3.6 mA	Signal cable connection incorrect.	Check connection.
	Electronics is defective.	Replace electronics.
HART communication does not function.	Communication resistor missing or incorrectly installed.	Install the communication resistor (250 Ω) correctly → 🖹 35.
	Commubox connected incorrectly.	Connect Commubox correctly → 🖹 48.
	Commubox not switched to HART mode.	Set the selection switch of the Commubox to the HART position.
CDI communication does not work.	Wrong setting of the COM port on the computer.	Check the setting of the COM port on the computer and change it if necessary.
Device measures incorrectly.	Parametrization error	Check and adjust parameterization.

12.1.2 Parametrization errors

Parametrization errors for level measurements

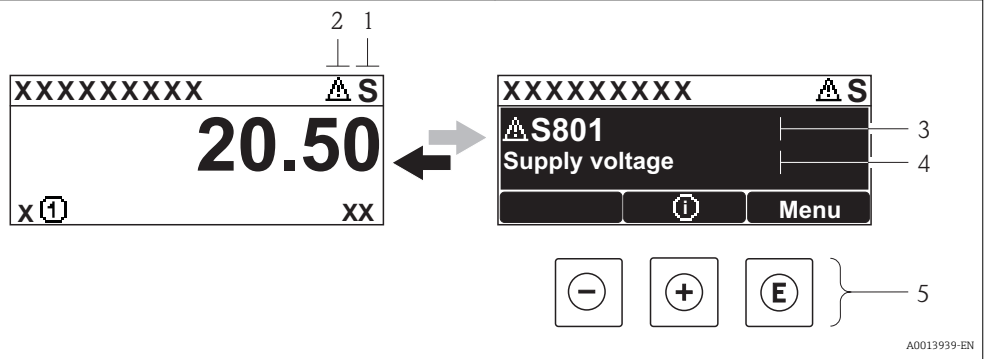
Error	Possible cause	Remedial action
Measured value wrong	If measured distance(Setup → Distance) matches the real distance: Calibration error	▪ Check and adjust the **Empty calibration** parameter (→ 🖹 114) if necessary. ▪ Check and adjust the **Full calibration** parameter (→ 🖹 114) if necessary. ▪ Check and adjust linearization if necessary (**Linearization** submenu (→ 🖹 129)).
	If measured distance (Setup → Distance) does not match the real distance: An interference echo affects the measurement.	Perform mapping (**Confirm distance** parameter (→ 🖹 117)).
No change of the measured value when emptying/filling the tank	An interference echo affects the measurement.	Perform mapping (**Confirm distance** parameter (→ 🖹 117)).
	Build-up at the probe.	Clean the probe.
	Error in the echo tracking	Deactivate echo tracking: Expert → Sensor → Echo tracking → Evaluation mode = **History off**).
The diagnostic message **Echo lost** appears after switching on the supply voltage.	Echo threshold too high.	Check the **Medium group** parameter (→ 🖹 113). If necessary select a more detailed setting in the **Medium property** parameter (→ 🖹 123).
	Level echo suppressed.	Delete mapping and record new mapping curve if required (**Record map** parameter (→ 🖹 118)).
Device displays a level when the tank is empty.	Incorrect probe length	Carry out probe length correction (**Confirm probe length** parameter (→ 🖹 144)).
	Interference echo	Carry out mapping over entire probe while the tank is empty (**Confirm distance** parameter (→ 🖹 117)).
Wrong slope of the level in the entire measuring range	Wrong tank type selected.	Set **Tank type** parameter (→ 🖹 112) correctly.

12.2 Diagnostic information on local display

12.2.1 Diagnostic message

Faults detected by the self-monitoring system of the measuring device are displayed as a diagnostic message in alternation with the measured value display.

Measured value display in alarm condition	Diagnostic message



1 *Status signal*
2 *Status symbol (symbol for event level)*
3 *Status symbol with diagnostics event*
4 *Event text*
5 *Operating elements*

Status signals

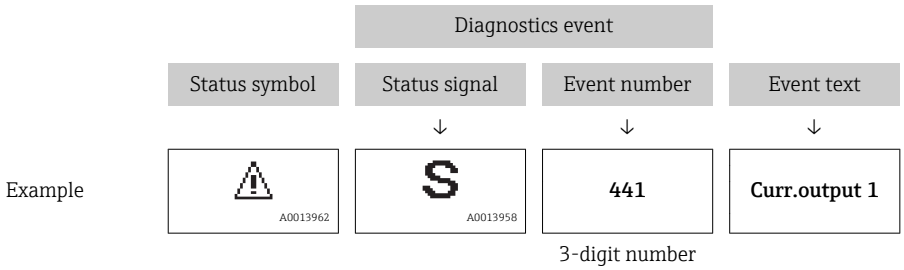
F A0013956	**"Failure"** A device error is present. The measured value is no longer valid.
C A0013959	**"Function check"** The device is in service mode (e.g. during a simulation).
S A0013958	**"Out of specification"** The device is operated: ▪ Outside of its technical specifications (e.g. during startup or a cleaning) ▪ Outside of the configuration carried out by the user (e.g. level outside configured span)
M A0013957	**"Maintenance required"** Maintenance is required. The measured value is still valid.

Status symbol (symbol for event level)

A0013961	**"Alarm" status** The measurement is interrupted. The signal outputs take on the defined alarm condition. A diagnostic message is generated.
A0013962	**"Warning" status** The device continues to measure. A diagnostic message is generated.

Diagnostics event and event text

The fault can be identified using the diagnostics event. The event text helps you by providing information about the fault. In addition, the corresponding symbol is displayed before the diagnostics event.



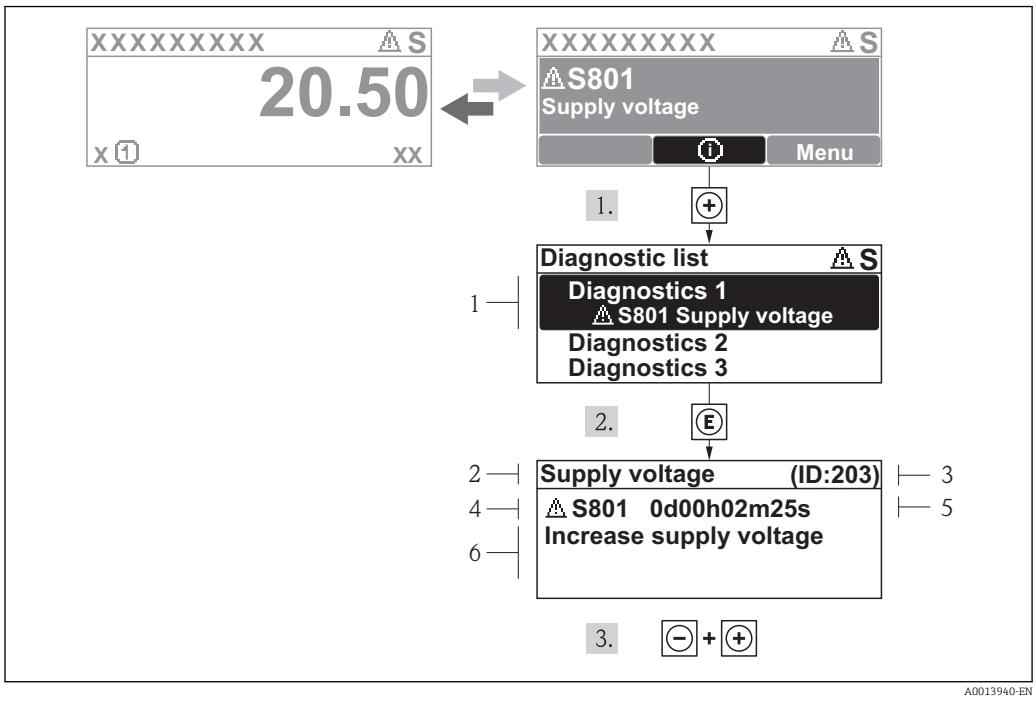
If two or more diagnostic messages are pending simultaneously, only the message with the highest priority is shown. Additional pending diagnostic messages can be shown in **Diagnostic list** submenu (→ 170).

Past diagnostic messages that are no longer pending are shown as follows:
- On the local display:
  in **Event logbook** submenu (→ 171)
- In FieldCare:
  via the "Event List /HistoROM" function.

Operating elements

Operating functions in menu, submenu	
A0013970	**Plus key** Opens the message about the remedial measures.
A0013952	**Enter key** Opens the operating menu.

12.2.2 Calling up remedial measures



20 *Message for remedial measures*

1 *Diagnostic information*
2 *Short text*
3 *Service ID*
4 *Diagnostic behavior with diagnostic code*
5 *Operation time of occurrence*
6 *Remedial measures*

The user is in the diagnostic message.

1. Press ⊞ (ⓘ symbol).
   ↳ **Diagnostic list** submenu opens.
2. Select the desired diagnostic event with ⊞ or ⊟ and press Ⓔ .
   ↳ The message for the remedial measures for the selected diagnostic event opens.
3. Press ⊟ + ⊞ simultaneously.
   ↳ The message for the remedial measures closes.

The user is in the **Diagnostics** menu at an entry for a diagnostics event, e.g. in **Diagnostic list** submenu or in **Previous diagnostics**.

1. Press Ⓔ.
   ↳ The message for the remedial measures for the selected diagnostic event opens.
2. Press ⊟ + ⊞ simultaneously.
   ↳ The message for the remedial measures closes.

12.3 Diagnostic event in the operating tool

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

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

Calling up remedial measures

1. Navigate to the **Diagnostics** menu.
   ↳ In the **Actual diagnostics** parameter, the diagnostic event is shown with event text.
2. On the right in the display range, hover the cursor over the **Actual diagnostics** parameter.
   ↳ A tool tip with remedial measures for the diagnostic event appears.

12.4 Diagnostic list

In the Diagnostic list submenu, up to 5 currently pending diagnostic messages can be displayed. If more than 5 messages are pending, the messages with the highest priority are shown on the display.

Navigation path
Diagnostics → Diagnostic list

Calling up and closing the remedial measures

1. Press ⓔ.
   ↳ The message for the remedial measures for the selected diagnostic event opens.
2. Press ⊟ + ⊞ simultaneously.
   ↳ The message about the remedial measures closes.

12.5 List of diagnostic events

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
003	Broken probe detected	1. Check map 2. Check sensor	F	Alarm
046	Build-up detected	Clean sensor	F	Alarm
104	HF cable	and check sealing 1. Dry HF cable connection 2. Change HF cable	F	Alarm
105	HF cable	1. Tighten HF cable connection 2. Check sensor 3. Change HF cable	F	Alarm
106	Sensor	1. Check sensor 2. Check HF cable 3. Contact service	F	Alarm
Diagnostic of electronic				
242	Software incompatible	1. Check software 2. Flash or change main electronics module	F	Alarm
252	Modules incompatible	1. Check electronic modules 2. Change I/O or main electronic module	F	Alarm
261	Electronic modules	1. Restart device 2. Check electronic modules 3. Change I/O Modul or main electronics	F	Alarm
262	Module connection	1. Check module connections 2. Change electronic modules	F	Alarm
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	1. Restart device 2. Change main electronic module	F	Alarm
272	Main electronic failure	1. Restart device 2. Contact service	F	Alarm
273	Main electronic failure	1. Emergency operation via display 2. Change main electronics	F	Alarm
275	I/O module defective	Change I/O module	F	Alarm
276	I/O module faulty	1. Restart device 2. Change I/O module	F	Alarm
276	I/O module failure		F	Alarm
282	Data storage	1. Restart device 2. Contact service	F	Alarm
283	Memory content	1. Transfer data or reset device 2. Contact service	F	Alarm
311	Electronic failure	Maintenance required! 1. Do not perform reset 2. Contact service	M	Warning
Diagnostic of configuration				
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
411	Up-/download active	Up-/download active, please wait	C	Warning
412	Processing download	Download active, please wait	C	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
431	Trim 1 to 2	Carry out trim	C	Warning
435	Linearization	Check linearization table	F	Alarm
437	Configuration incompatible	1. Restart device 2. Contact service	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
441	Current output 1 to 2	1. Check process 2. Check current output settings	S	Warning
484	Failure mode simulation	Deactivate simulation	C	Alarm
485	Simulation measured value	Deactivate simulation	C	Warning
491	Current output 1 to 2 simulation	Deactivate simulation	C	Warning
494	Switch output simulation	Deactivate simulation switch output	C	Warning
495	Diagnostic event simulation	Deactivate simulation	C	Warning
585	Simulation distance	Deactivate simulation	C	Warning
Diagnostic of process				
801	Energy too low	Increase supply voltage	S	Warning
803	Current loop	1. Check wiring 2. Change I/O module	F	Alarm
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
825	Operating temperature		F	Alarm
921	Change of reference	1. Check reference configuration 2. Check pressure 3. Check sensor	S	Warning
936	EMC interference	Check installation on EMC	F	Alarm
941	Echo lost	Check parameter 'DC value'	F	Alarm [1]
942	In safety distance	1. Check level 2. Check safety distance 3. Reset self holding	S	Alarm [1]
943	In blocking distance	Reduced accuracy Check level	S	Warning
944	Level range	Reduced accuracy Level at process connection	S	Warning
950	Advanced diagnostic 1 to 2 occured	Maintain your diagnostic event	M	Warning [1]

1) Diagnostic behavior can be changed.

12.6 Event logbook

12.6.1 Event history

A chronological overview of the event messages that have occurred is provided in the **Event list** submenu [2)].

Navigation path
Diagnostics → Event logbook → Event list

A maximum of 100 event messages can be displayed in chronological order.

The event history includes entries for:
- Diagnostic events
- Information events

In addition to the operation time of its occurrence, each event is also assigned a symbol that indicates whether the event has occurred or is ended:
- Diagnostic event
  - ⊕: Event has occurred
  - ⊖: Event has ended
- Information event
  ⊕: Event has occurred

Calling up and closing the remedial measures

1. Press E.
   ↳ The message for the remedial measures for the selected diagnostic event opens.
2. Press − + + simultaneously.
   ↳ The message about the remedial measures closes.

12.6.2 Filtering the event logbook

Using the **Filter options** parameter, you can define which category of event messages is displayed in the **Event list** submenu angezeigt werden.

Navigation path
Diagnostics → Event logbook → Filter options

Filter categories
- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information

12.6.3 Overview of information events

Info number	Info name
I1000	--------(Device ok)
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed

2) This submenu is only available for operation via local display. In the case of operation via FieldCare, the event list can be displayed with the "Event List / HistoROM" functionality of FieldCare.

Info number	Info name
I1092	Embedded HistoROM deleted
I1110	Write protection switch changed
I1137	Electronic changed
I1151	History reset
I1154	Reset terminal voltage min/max
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1184	Display connected
I1185	Display backup done
I1186	Restore via display done
I1187	Settings downloaded with display
I1188	Display data cleared
I1189	Backup compared
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off

12.7 Firmware history

Date	Software version	Modifications	Documentation (FMP53, HART)		
			Operating Instructions	Description of Parameters	Technical Information
07.2010	01.00.zz	Original software	BA01002F/00/EN/05.10	GP01000F/00/EN/05.10	TI01002F/00/EN/05.10
01.2011	01.01.zz	▪ SIL integrated ▪ Improvements and bugfixes ▪ additional languages	▪ BA01002F/00/EN/10.10 ▪ BA01002F/00/EN/13.11 ▪ BA01002F/00/EN/14.12	▪ GP01000F/00/EN/10.10 ▪ GP01000F/00/EN/13.11	▪ TI01002F/00/EN/10.10 ▪ TI01002F/00/EN/13.11 ▪ TI01002F/00/EN/14.12 ▪ TI01002F/00/EN/15.12
02.2014	01.02.zz	▪ Support of SD03 ▪ additional languages ▪ HistoROM functionality enhanced ▪ "Advanced Diagnostic" function block integrated ▪ Improvements and bugfixes	▪ BA01002F/00/EN/15.13 ▪ BA01002F/00/EN/16.14	▪ GP01000F/00/EN/14.13 ▪ GP01000F/00/EN/15.14	▪ TI01002F/00/EN/16.13 ▪ TI01002F/00/EN/17.14
04.2016	01.03.zz	▪ Update to HART 7 ▪ All 17 operating languages available in the device ▪ Improvements and bugfixes	▪ BA01002F/00/EN/17.16 ▪ BA01002F/00/EN/18.16 [1]	GP01000F/00/EN/16.16	▪ TI01002F/00/EN/18.16 ▪ TI01002F/00/EN/20.16 [1]

1) contains information on the Heartbeat wizards which are available in the latest DTM version for DeviceCare and FieldCare.

The firmware version can explicitly be ordered via the product structure. In this way it is possible to ensure compatibility of the firmware version with an existing or planned system integration.

13 Maintenance

The measuring device requires no special maintenance.

13.1 Exterior cleaning

When exterior-cleaning the device, always use cleaning agents that do not attack the surface of the hosuing and the seals.

13.2 Cleaning the probe

13.2.1 Cleaning the probe in the tank

If the device has been mounted in a suitable position, the probe can be cleaned in the tank using a spray ball → 25.

13.2.2 Cleaning the probe outside the tank

The probe can be disassembled so it can be cleaned better.

The disassembly requires the following tools:
- vise with fiber braces (surface protection for the polished probe rod)
- hook wrench ϕ 54 mm (21 in)
- open-ended wrench AF27 / AF32 with a torque adjustement up to 20 Nm

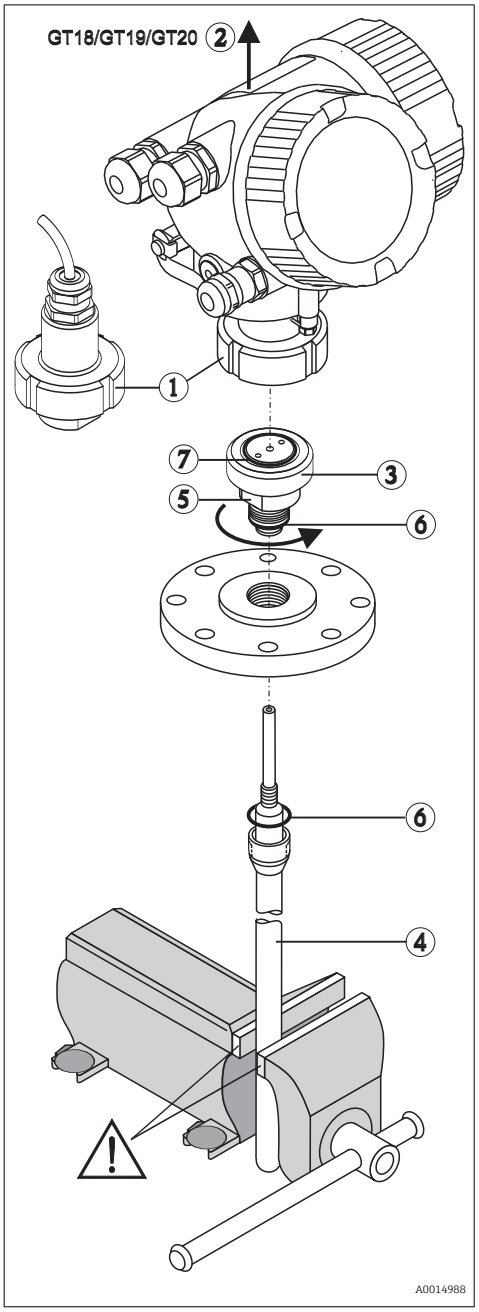
Caution!
- Before disassembly, it has to be made sure that the supply voltage for the instrument is switched off!
- When releasing the slotted nut (1) make sure to counterhold at the process connection ring (5) with an open-ended wrench as the adapter (3) could otherwise be released from the flange.

Unmounting the electronics housing
- Unscrew the grooved nut with a hook wrench.
- Remove the unscrewed housing (2) together with the housing adapter from the adapter (3) of the process connection. The housing adapter is still connected with the housing. For the remote version: remove only the cable adapter.
- Replace O-ring (7) where necessary.
  Order code: see Device Viewer → 🖹 90.

Disassembly of the rod probe
- Unscrew adapter (3) from the process connection (as example: flange): unscrew adapter at the wrench faces with hook wrench (AF27) and pull it out of the tank together with the rod probe (length max. 4 m).
- Clamp the probe rod (4) at the wrench flats or use fitting pliers.
  Caution: Protect the surface of the polished probe rod! Do not damage the surface by scratching or denting it.
- Unscrew adapter (3) from the probe rod (approx. 12 rotations counter-clockwise) and remove (plug connection). The probe rod is screwed in the insulating bush with 4.5 Nm.
- The O-rings (6) of the probe rod and adapter are now freely accessible and can be exchanged if necessary. The probe rod can be cleaned (autoclaved).
  Order code of the O-rings: see Device Viewer → 🖹 90.

Assembly of the probe

The assembly is done in reversed order:
- Screw adapter (3) with 4.5 Nm on the probe rod (4).
- Screw the adapter into the container process connection together with the probe rod and tighten with 20 Nm.
- Stick housing (2) with housing adapter on the adapter and bolt it with the grooved nut (1) - torque 20 Nm.



14 Repairs

14.1 General information on repairs

14.1.1 Repair concept

The Endress+Hauser repair concept assumes that the devices have a modular design and that repairs can be done by the Endress+Hauser service or specially trained customers.

Spare parts are contained in suitable kits. They contain the related replacement instructions.

For more information on service and spare parts, contact the Service Department at Endress+Hauser.

14.1.2 Repairs to Ex-approved devices

When carrying out repairs to Ex-approved devices, please note the following:

- Repairs to Ex-approved devices may only be carried out by trained personnel or by the Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry out the specified routine test on the device.
- Only Endress+Hauser Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

14.1.3 Replacement of an electronics module

If an electronics module has been replaced, it is not necessary to perform a new basic setup as the calibration parameters are stored in the HistoROM which is located in the housing. However, after exchanging the main electronics module it may be necessary to record a new mapping (interference echo suppression).

14.1.4 Replacement of a device

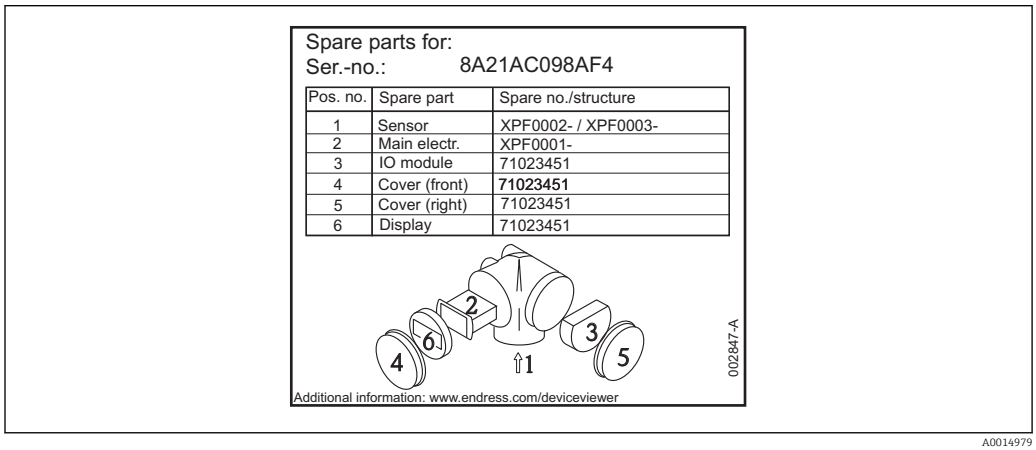
After a complete device or electronic module has been replaced, the parameters can be downloaded into the instrument again in one of the following ways:

- Via the display module
  Condition: The configuration of the old device has been saved in the display module → 162.
- Via FieldCare
  Condition: The configuration of the old device has been saved to the computer via FieldCare.

You can continue to measure without carrying out a new setup. Only a linearization and a tank map (interference echo suppression) have to be recorded again.

14.2 Spare parts

- A few interchangeable measuring device components are identified by a spare part nameplate. This contains information about the spare part.
- The connection compartment cover of the device contains a spare part nameplate that includes the following information:
  - A list of the most important spare parts for the measuring device, including their ordering information.
  - The URL for the *W@M Device Viewer* (www.endress.com/deviceviewer): There, all spare parts for the measuring device are listed, including the order code, and can be ordered. If available, the corresponding Installation Instructions can also be downloaded there.



21 *Example for spare part nameplate in connection compartment cover*

Measuring device serial number:
- Is located on the device and spare part nameplate.
- Can be read out via the "Serial number" parameter in the "Device information" submenu.

14.3 Return

The measuring device must be returned if it is need of repair or a factory calibration, or if the wrong measuring device has been delivered or ordered. Legal specifications require Endress+Hauser, as an ISO-certified company, to follow certain procedures when handling products that are in contact with the medium.

To ensure safe, swift and professional device returns, please refer to the procedure and conditions for returning devices provided on the Endress+Hauser website at http://www.endress.com/support/return-material

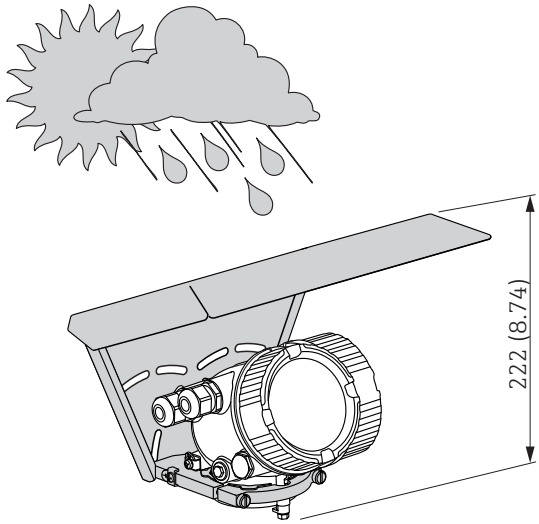
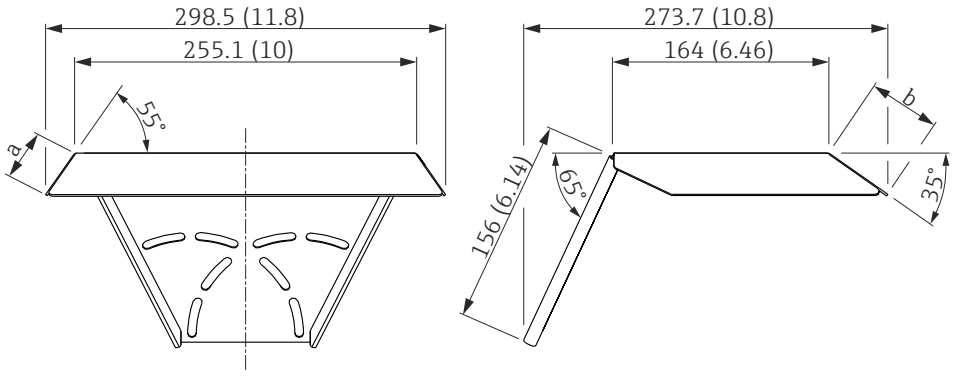
14.4 Disposal

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

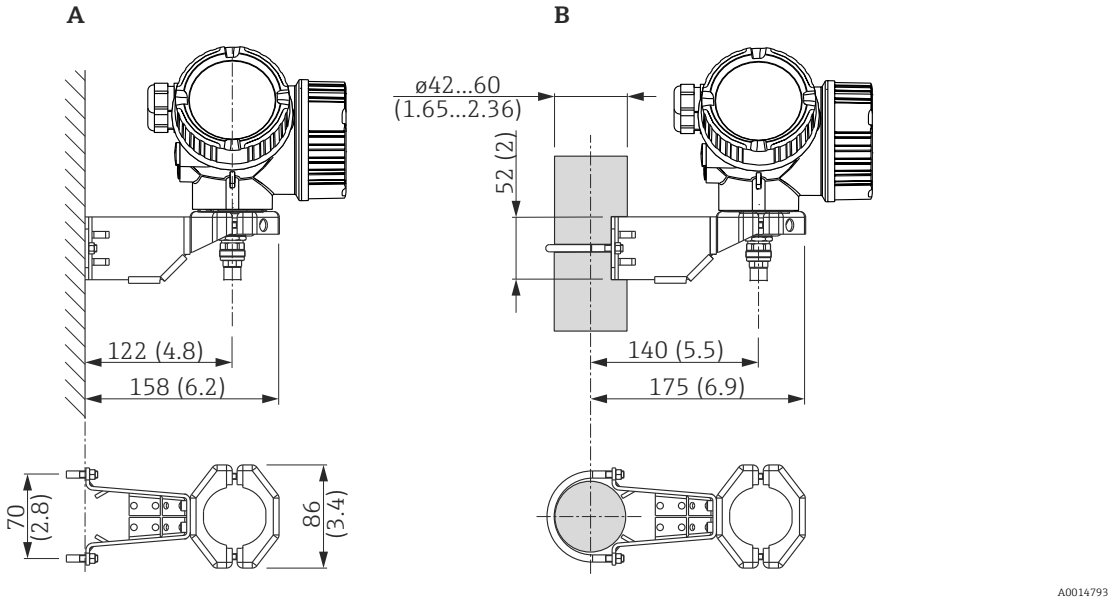
15 Accessories

15.1 Device-specific accessories

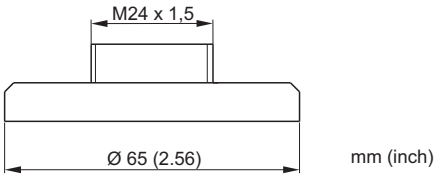
15.1.1 Weather protection cover

Accessory	Description
Weather protection cover	 A0015466  A0015472 *22 Weather protection cover; Dimensions: mm (in)* *a 37,8 mm (1,5 in)* *b 54 mm (2,1 in)* The weather protection cover can be ordered together with the device (product structure, feature 620 "Accessory Enclosed", option PB "Weather Protection Cover"). Alternatively, it can be separately ordered as an accessory; order code 71162242.

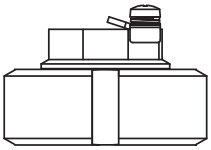
15.1.2 Mounting bracket for the electronics housing

Accessory	Description
Mounting bracket for the electronics housing	 *23 Mounting bracket for the electronics housing; Dimensions: mm (in)* *A Wall mounting* *B Pipe mounting* For the "Sensor remote" device version (see feature 060 of the product structure), the mounting bracket is part of the delivery. If required, it can also be ordered as an accessory (order code 71102216).

15.1.3 Weld-in adpater

Accessory	Description
Weld-in adpater M24 D65	 With M24x1.5 thread for flush-mounted sensors. Material: 1.4435 (AISI 316L) Weight: 0.22 kg (0.48 lbs) Order No. ▪ Standard version: 71041381 ▪ with 3.1 material certificate: 71041383 For details see Operating Instructions BA361F.

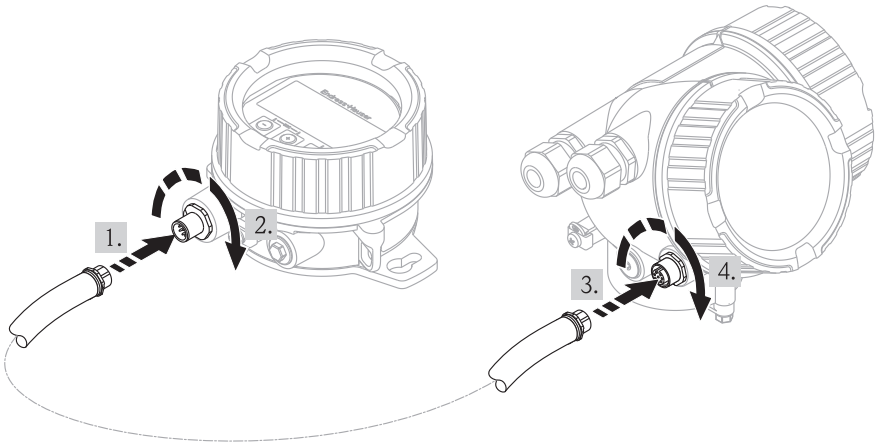
15.1.4 Protective cover

Accessory	Description
Protective cover	 A0013589 With the protective cover the probe can be locked with dismantled electronics. Order no.: 71041379 For details refer to Operating Instructions BA362F.

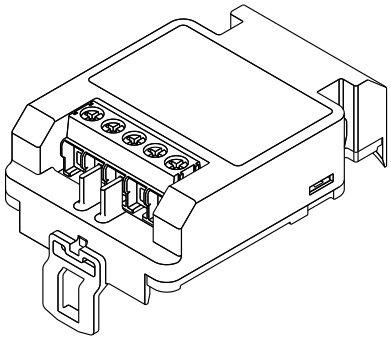
15.1.5 Calibration kit

Accessory	Description
Calibration kit	The calibration kit is used to regularly test the accuracy and reproducibility of the Levelflex FMP53 level measurement device. Order No.: 71041382 For details refer to Operating Instructions SD01003F.

15.1.6 Remote display FHX50

Accessory	Description
Remote display FHX50	 A0019128 ▪ Material: – Plastics PBT – CF3M (similar to 316L/1.4404) – Aluminum (in preparation) ▪ Ingress protection: IP68 / NEMA 6P and IP66 / NEMA 4x ▪ Suitable for the display modules: – SD02 (push buttons) – SD03 (touch control) ▪ Connection cable: – Cable with M12 plug; supplied with the FHX50; up to 30 m (98 ft) – Customer supplied standard cable; up to 60 m (196 ft) ▪ Ambient temperature: −40 to 80 °C (−40 to 176 °F) ▪ If the remote display is to be used, the device must be ordered in the version "Prepared for display FHX50" (feature 030, option L or M). For the FHX50, on the other hand, the option A: "Prepared for display FHX50" has to be selected in feature 050: "Option Measurement Device". ▪ If a device has not been ordered in the version "Prepared for display FHX50", but is nevertheless to be equipped with an FHX50, it is essential to select the option B: "Not prepared for display FHX50" in feature 050: "Option Measurement Device" of the FHX50. In this case, a retrofit kit, needed to prepare the device for the remote display, is supplied together with the FHX50. For transmitters with approval, application of the FHX50 may be restricted. A device may only be retrofitted with the FHX50 if option L or M ("Prepared for FHX50") is quoted under *Basic specifications*, position 4 "Display, operation" in the associated Safety Instructions (XA). In addition to this, observe the Safety Instructions (XA) of the FHX50. Do not retrofit transmitters with: ▪ approval for use in areas with combustible dusts (Dust-Ex approval) ▪ type of protection Ex nA For details refer to the document SD01007F.

15.1.7 Overvoltage protection

Accessory	Description
Overvoltage protection for 2-wire-devices OVP10 (1 channel) OVP20 (2 channel)	 A0021734 **Technical data** ▪ Resistance per channel: 2 * 0.5 Ω_{max} ▪ Threshold DC voltage: 400 to 700 V ▪ Threshold impulse voltage: < 800 V ▪ Capacitance at 1 MHz: < 1.5 pF ▪ Nominal arrest impulse voltage (8/20 µs): 10 kA ▪ Suited for wire cross-sections: 0.2 to 2.5 mm^2 (24 to 14 AWG) **Ordering with device** The overvoltage protection module is preferably ordered with the device. See product structure, feature 610 "Accessory mounted", option NA "Overvoltage protection". Separate ordering of the module is only necessary if a device is to retrofitted with the overvoltage protection. **Order code for retrofitting** ▪ For 1-channel devices (feature 020, option A) OVP10: 71128617 ▪ For 2-channel devices (feature 020, option B, C, E or G) OVP20 : 71128619 **Hosuing lid for retrofitting** In order to keep the necessary safety distances, the housing lid needs to be replaced if the device is retrofitted with the overvoltage protection. Depending on the housing type, the order code of the suitable lid is as follows: ▪ GT18 housing: Lid 71185516 ▪ GT19 housing: Lid 71185518 ▪ GT20 housing: Lid 71185516 **Restrictions for retrofitting** Depending on the approval of the transmitter the usage of the OVP module may be restricted. A device may only be retrofitted with an OVP module if the option *NA* (overvoltage protection) is quoted unter *Optional Specifications* in the Safety Instructions (XA) pertaining to the device. For details refer to SD01090F.

15.2 Communication-specific accessories

Accessory	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to Technical Information TI00404F

Accessory	Description
Commubox FXA291	Connects Endress+Hauser field devices with CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a computer. Order code: 51516983 For details refer to Technical Information TI00405C

Accessory	Description
HART Loop Converter HMX50	Evaluates the dynamic HART variables and converts them to analog current signals or limit values. Order code: 71063562 For details refer to Technical Information TI00429F and Operating Instructions BA00371F

Accessory	Description
WirelessHART Adapter SWA70	Connects field devices to a WirelessHART network. The WirelessHART adapter can be mounted directly at a HART device and is easly integrated into an existing HART network. It ensures safe data transmission and can be operated in parallel with other wireless networks. For details refer to Operating Instructions BA00061S

Accessory	Description
Fieldgate FXA320	Gateway for remote monitoring of connected 4-20mA measuring devices via web browser. For details refer to Technical Information TI00025S and Operating Instructions BA00053S

Accessory	Description
Fieldgate FXA520	Gateway for remote diagnosis and parametrization of connected HART measuring devices via web browser. For details refer to Technical Information TI00025S and Operating Instructions BA00051S

Accessory	Description
Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION fieldbus devices in the **non-Ex area**. For details, see Operating Instructions BA01202S

Accessory	Description
Field Xpert SFX370	Field Xpert SFX370 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION fieldbus devices in the **non-Ex area** and the **Ex area**. For details, see Operating Instructions BA01202S

15.3 Service-specific accessories

Accessory	Description
FieldCare / DeviceCare	Endress+Hauser's FDT-based Plant Asset Management tool. Helps to configure and maintain all field devices of your plant. By supplying status information it also supports the diagnosis of the devices. For details refer to Operating Instructions BA00027S and BA00059S.

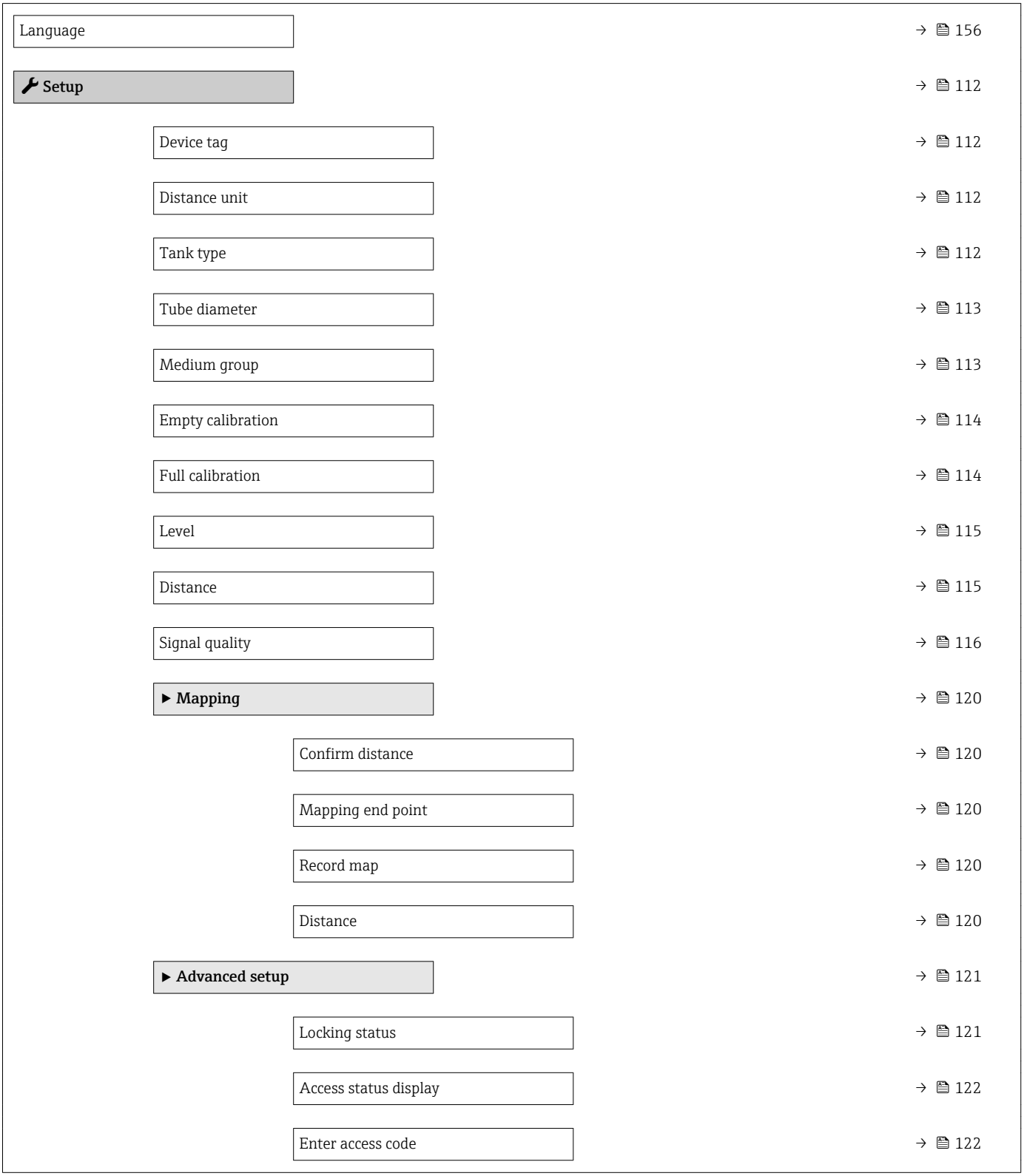
15.4 System components

Accessory	Description
Graphic Data Manager Memograph M	The graphic data manager Memograph M provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on an SD card or USB stick. For details refer to Technical Information TI00133R and Operating Instructions BA00247R
RN221N	Active barrier with power supply for safe separation of 4 to 20 mA current circuits. Provides bi-directional HART transmission. For details refer to Technical Information TI00073R and Operating Instructions BA00202R
RNS221	Transmitter supply for 2-wire sensors or transmitters exclusively for non-Ex areas. Provides bi-directional communication using the HART communication sockets. For details refer to Technical Information TI00081R and Operating Instructions KA00110R

16 Operating menu

16.1 Overview of the operating menu (display module)

Navigation Operating menu



- ▶ **Level** → 123
  - Medium type → 123
  - Medium property → 123
  - Process property → 124
  - Advanced process conditions → 125
  - Level unit → 126
  - Blocking distance → 126
  - Level correction → 127
- ▶ **Linearization** → 129
  - Linearization type → 131
  - Unit after linearization → 132
  - Free text → 133
  - Maximum value → 134
  - Diameter → 134
  - Intermediate height → 134
  - Table mode → 135
  - ▶ **Edit table**
    - Level → 136
    - Customer value → 137
  - Activate table → 137
- ▶ **Safety settings** → 138
  - Output echo lost → 138
  - Value echo lost → 138
  - Ramp at echo lost → 139
  - Blocking distance → 126

- ▶ **SIL/WHG confirmation** → 141
- ▶ **Deactivate SIL/WHG** → 142
  - Reset write protection → 142
  - Code incorrect → 142
- ▶ **Probe settings** → 143
  - Probe grounded → 143
  - ▶ **Probe length correction** → 145
    - Confirm probe length → 145
    - Present probe length → 145
- ▶ **Current output 1 to 2** → 146
  - Assign current output → 146
  - Current span → 147
  - Fixed current → 147
  - Damping output → 148
  - Failure mode → 148
  - Failure current → 149
  - Output current 1 to 2 → 149
- ▶ **Switch output** → 150
  - Switch output function → 150
  - Assign status → 150
  - Assign limit → 151
  - Assign diagnostic behavior → 151
  - Switch-on value → 152
  - Switch-on delay → 153
  - Switch-off value → 153

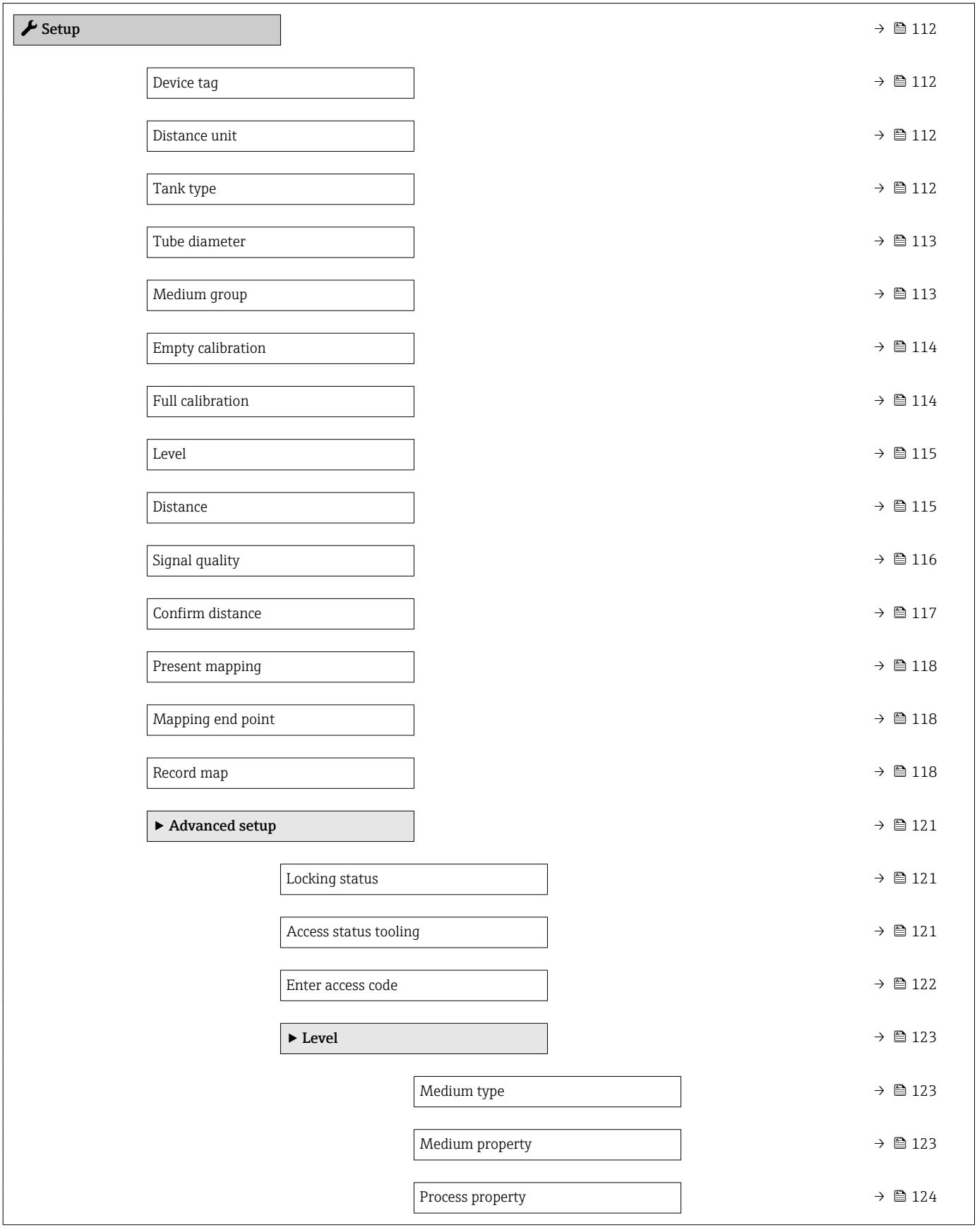
Switch-off delay	→ 154
Failure mode	→ 154
Switch status	→ 154
Invert output signal	→ 154
▶ Display	→ 156
Language	→ 156
Format display	→ 156
Value 1 to 4 display	→ 158
Decimal places 1 to 4	→ 158
Display interval	→ 158
Display damping	→ 159
Header	→ 159
Header text	→ 159
Separator	→ 160
Number format	→ 160
Decimal places menu	→ 160
Backlight	→ 161
Contrast display	→ 161
▶ Configuration backup display	→ 162
Operating time	→ 162
Last backup	→ 162

- Configuration management → 162
- Comparison result → 163
- ▶ **Administration** → 165
  - ▶ **Define access code** → 167
    - Define access code → 167
    - Confirm access code → 167
  - Device reset → 165
- **Diagnostics** → 168
  - Actual diagnostics → 168
  - Previous diagnostics → 168
  - Operating time from restart → 169
  - Operating time → 162
  - ▶ **Diagnostic list** → 170
    - Diagnostics 1 to 5 → 170
  - ▶ **Event logbook** → 171
    - Filter options → 171
    - ▶ **Event list** → 171
  - ▶ **Device information** → 172
    - Device tag → 172
    - Serial number → 172
    - Firmware version → 172
    - Device name → 172
    - Order code → 173
    - Extended order code 1 to 3 → 173
    - Device revision → 173

	Last check time	→ 185
	Level signal	→ 186
	Launch signal	→ 186

16.2 Overview of the operating menu (operating tool)

Navigation Operating menu



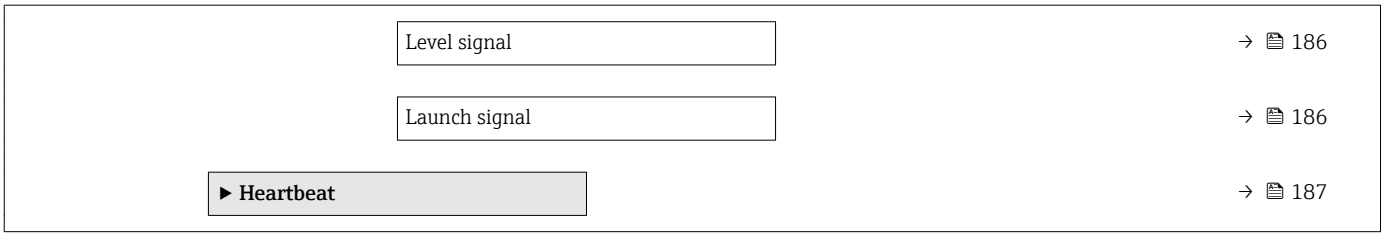
- Advanced process conditions → 125
- Level unit → 126
- Blocking distance → 126
- Level correction → 127
- ▶ **Linearization** → 129
  - Linearization type → 131
  - Unit after linearization → 132
  - Free text → 133
  - Level linearized → 133
  - Maximum value → 134
  - Diameter → 134
  - Intermediate height → 134
  - Table mode → 135
  - Table number → 136
  - Level → 136
  - Level → 137
  - Customer value → 137
  - Activate table → 137
- ▶ **Safety settings** → 138
  - Output echo lost → 138
  - Value echo lost → 138
  - Ramp at echo lost → 139
  - Blocking distance → 126
- ▶ **SIL/WHG confirmation** → 141

- ▶ **Deactivate SIL/WHG** → 142
  - Reset write protection → 142
  - Code incorrect → 142
- ▶ **Probe settings** → 143
  - Probe grounded → 143
  - Present probe length → 143
  - Confirm probe length → 144
- ▶ **Current output 1 to 2** → 146
  - Assign current output → 146
  - Current span → 147
  - Fixed current → 147
  - Damping output → 148
  - Failure mode → 148
  - Failure current → 149
  - Output current 1 to 2 → 149
- ▶ **Switch output** → 150
  - Switch output function → 150
  - Assign status → 150
  - Assign limit → 151
  - Assign diagnostic behavior → 151
  - Switch-on value → 152
  - Switch-on delay → 153
  - Switch-off value → 153
  - Switch-off delay → 154
  - Failure mode → 154

	Switch status	→ 154
	Invert output signal	→ 154
▶ **Display**		→ 156
	Language	→ 156
	Format display	→ 156
	Value 1 to 4 display	→ 158
	Decimal places 1 to 4	→ 158
	Display interval	→ 158
	Display damping	→ 159
	Header	→ 159
	Header text	→ 159
	Separator	→ 160
	Number format	→ 160
	Decimal places menu	→ 160
	Backlight	→ 161
	Contrast display	→ 161
▶ **Configuration backup display**		→ 162
	Operating time	→ 162
	Last backup	→ 162
	Configuration management	→ 162

- Backup state → 163
- Comparison result → 163
- ▶ **Administration** → 165
  - Define access code → 167
  - Device reset → 165
- **Diagnostics** → 168
  - Actual diagnostics → 168
  - Timestamp → 168
  - Previous diagnostics → 168
  - Timestamp → 169
  - Operating time from restart → 169
  - Operating time → 162
  - ▶ **Diagnostic list** → 170
    - Diagnostics 1 to 5 → 170
    - Timestamp 1 to 5 → 170
  - ▶ **Device information** → 172
    - Device tag → 172
    - Serial number → 172
    - Firmware version → 172
    - Device name → 172
    - Order code → 173
    - Extended order code 1 to 3 → 173
    - Device revision → 173
    - Device ID → 173

- Device type → 174
- Manufacturer ID → 174
- ▶ **Measured values** → 175
  - Distance → 115
  - Level linearized → 133
  - Output current 1 to 2 → 149
  - Measured current 1 → 176
  - Terminal voltage 1 → 176
- ▶ **Data logging** → 177
  - Assign channel 1 to 4 → 177
  - Logging interval → 178
  - Clear logging data → 178
- ▶ **Simulation** → 181
  - Assign measurement variable → 182
  - Process variable value → 182
  - Current output 1 to 2 simulation → 183
  - Value current output 1 to 2 → 183
  - Switch output simulation → 183
  - Switch status → 184
  - Device alarm simulation → 184
- ▶ **Device check** → 185
  - Start device check → 185
  - Result device check → 185
  - Last check time → 185


Level signal
→ 186
Launch signal
→ 186
▶ Heartbeat
→ 187

16.3 "Setup" menu

- : Marks the navigation path to the parameter via the display and operating module.
- : Marks the navigation path to the parameter via an operating tool (e.g. FieldCare).
- : Marks parameters which can be locked via the software locking → 53.

Navigation Setup

Device tag

Navigation Setup → Device tag

Description Enter a unique name for the measuring point to identify the device quickly within the plant.

Factory setting FMP5x

Distance unit

Navigation Setup → Distance unit

Description Select distance unit.

Selection

SI units
- mm
- m

US units
- ft
- in

Factory setting m

Tank type

Navigation Setup → Tank type

Prerequisite **Medium type (→ 123) = Liquid**

Description Select tank type.

Selection
- Metallic
- Bypass / pipe
- Non metallic
- Mounted outside
- Coaxial

Factory setting Depending on the probe

Additional information

- Depending on the probe some of the options mentioned above may not be available or there may be additional options.
- For probes with metallic center washer, **Tank type = Bypass / pipe** is preset and can not be changed.

Tube diameter

Navigation Setup → Tube diameter

Prerequisite **Tank type (→ 112) = Bypass / pipe**

Description Specify diameter of bypass or stilling well.

User entry 0 to 9.999 m

Factory setting 0.0384 m

Medium group

Navigation Setup → Medium group

Prerequisite **Medium type (→ 123) = Liquid**

Description Select medium group.

Selection

- Others
- Water based (DC >= 4)

Factory setting Others

Additional information This parameter roughly specifies the dielectric constant (DC) of the medium. For a more detailed definition of the DC use the **Medium property** parameter (→ 123).

The **Medium group** parameter presets the **Medium property** parameter (→ 123) as follows:

Medium group	Medium property (→ 123)
Others	Unknown
Water based (DC >= 4)	DC 4 … 7

The **Medium property** parameter can be changed at a later point of time. However, when doing so, the **Medium group** parameter retains its value. Only the **Medium property** parameter is relevant for the signal evaluation.

The measuring range may be reduced for small dielectric constants. For details refer to the Technical Information (TI) of the respective device.

Empty calibration

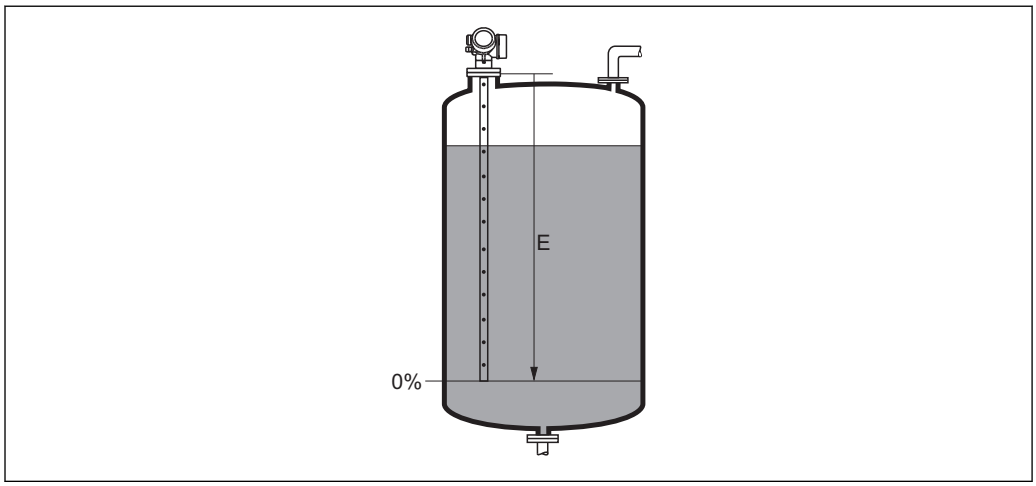
Navigation Setup → Empty calibr.

Description Specify the distance E between the process connection and the minimum level (0%). This defines the starting point of the measuring range.

User entry Depending on the probe

Factory setting Depending on the probe

Additional information



24 Empty calibration (E) for level measurements in liquids

Full calibration

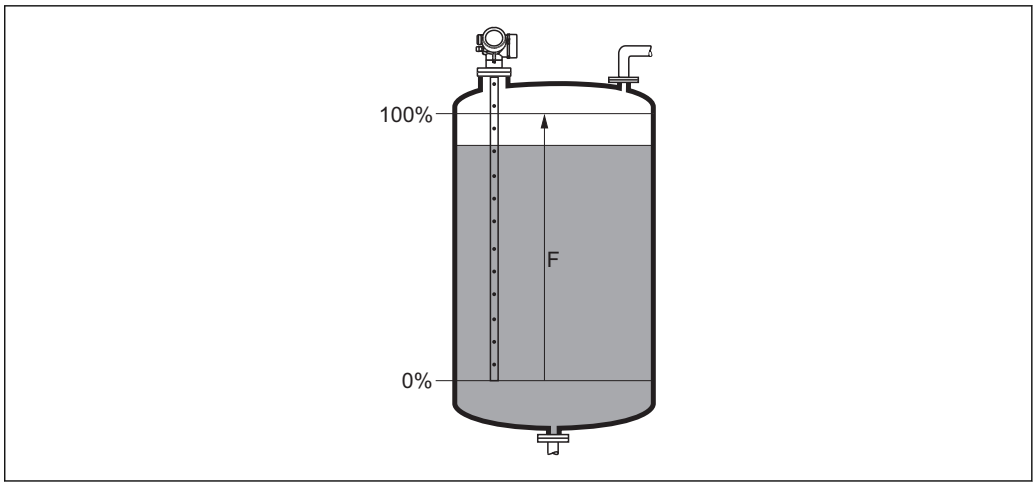
Navigation Setup → Full calibr.

Description Specify the distance F between the minimum level (0%) and the maximum level (100%).

User entry Depending on the probe

Factory setting Depending on the probe

Additional information



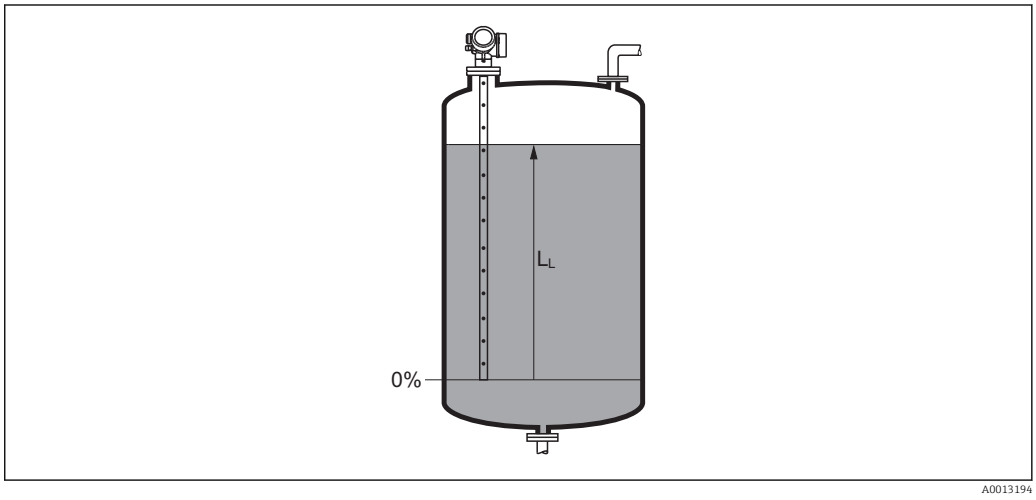
25 *Full calibration (F) for level measurements in liquids*

Level

Navigation Setup → Level

Description Displays measured level L_L (before linearization).

Additional information



26 *Level in case of liquid measurements*

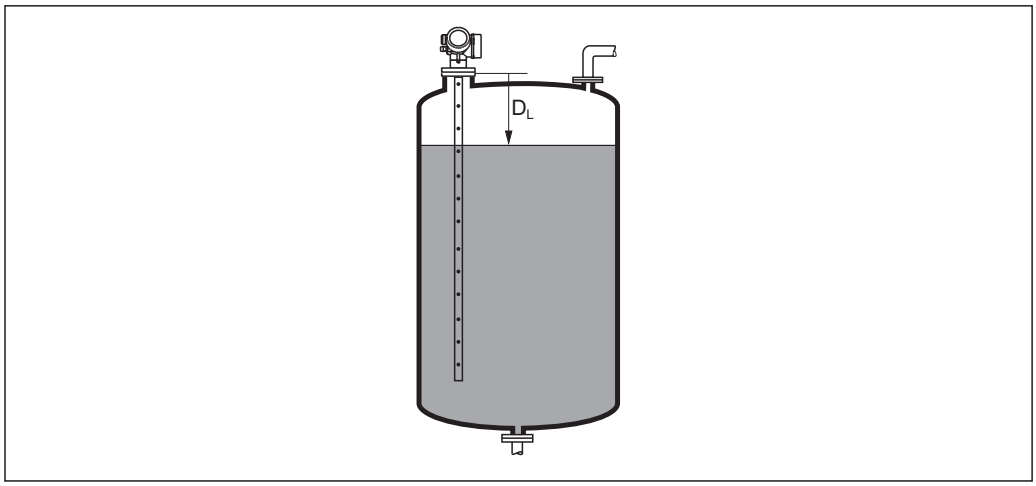
The unit is defined in the **Level unit** parameter (→ 126).

Distance

Navigation Setup → Distance

Description Displays the measured distance D_L between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



27 *Distance for liquid measurements*

The unit is defined in the **Distance unit** parameter (→ 112).

Signal quality

Navigation Setup → Signal quality

Description Displays the signal quality of the evaluated echo.

Additional information

Meaning of the display options

- **Strong**
  The evaluated echo exceeds the threshold by at least 10 mV.
- **Medium**
  The evaluated echo exceeds the threshold by at least 5 mV.
- **Weak**
  The evaluated echo exceeds the threshold by less than 5 mV.
- **No signal**
  The device does not find a usable echo.

The signal quality indicated in this parameter always refers to the currently evaluated echo: either the level/interface echo [3] or the end-of-probe echo. To differentiate between these two, the quality of the end-of-probe echo is always displayed in brackets.

In case of a lost echo (**Signal quality = No signal**) the device generates the following error message:
- F941, for **Output echo lost (→ 138) = Alarm**.
- S941, if another option has been selected in **Output echo lost (→ 138)**.

3) Of these two echos the one with the lower quality is indicated.

Confirm distance

Navigation Setup → Confirm distance

Description Specify, whether the measured distance matches the real distance.

Depending on the selection the device automatically sets the range of mapping.

Selection
- Manual map
- Distance ok
- Distance unknown
- Distance too small *
- Distance too big *
- Tank empty
- Delete map

Factory setting Distance unknown

Additional information

Meaning of the options
- **Manual map**
  To be selected if the range of mapping is to be defined manually in the **Mapping end point** parameter (→ 118). In this case it is not necessary to confirm the distance.
- **Distance ok**
  To be selected if the measured distance matches the actual distance. The device performs a mapping.
- **Distance unknown**
  To be selected if the actual distance is unknown. A mapping can not be performed in this case.
- **Distance too small**
  To be selected if the measured distance is smaller than the actual distance. The device searches for the next echo and returns to the **Confirm distance** parameter. The distance is recalculated and displayed. The comparison must be repeated until the displayed distance matches the actual distance. After this, the recording of the map can be started by selecting **Distance ok**.
- **Distance too big** 4)
  To be selected if the measured distance exceeds the actual distance. The device adjusts the signal evaluation and returns to the **Confirm distance** parameter. The distance is recalculated and displayed. The comparison must be repeated until the displayed distance matches the actual distance. After this, the recording of the map can be started by selecting **Distance ok**.
- **Tank empty**
  To be selected if the tank is completely empty. The device records a mapping covering the complete measuring range.
  To be selected if the tank is completely empty. The device records a mapping covering the complete measuring range minus **Map gap to LN**.
- **Factory map**
  To be selected if the present mapping curve (if one exists) is to be deleted. The device returns to the **Confirm distance** parameter and a new mapping can be recorded.

When operating via the display module, the measured distance is displayed together with this parameter for reference purposes.

If the teaching procedure with the **Distance too small** option or the **Distance too big** option is quit before the distance has been confirmed, a map is **not** recorded and the teaching procedure is reset after 60 s.

* Visibility depends on order options or device settings
4) Only available for "Expert → Sensor → Echo tracking → **Evaluation mode** parameter" = "Short time history" or "Long time history"

Present mapping

Navigation Setup → Present mapping

Description Indicates up to which distance a mapping has already been recorded.

Mapping end point

Navigation Setup → Map. end point

Prerequisite **Confirm distance (→ 117)** = **Manual map** or **Distance too small**

Description Specify new end of the mapping.

User entry 0 to 200 000.0 m

Factory setting 0.1 m

Additional information This parameter defines up to which distance the new mapping is to be recorded. The distance is measured from the reference point, i.e. from the lower edge of the mounting flange or the threaded connection.

For reference purposes the **Present mapping** parameter (→ 118) is displayed together with this parameter. It indicates up to which distance a mapping has already been recorded.

Record map

Navigation Setup → Record map

Prerequisite **Confirm distance (→ 117)** = **Manual map** or **Distance too small**

Description Start recording of the map.

Selection
- No
- Record map
- Delete map

Factory setting No

Additional information

Meaning of the options

- **No**
  The map is not recorded.
- **Record map**
  The map is recorded. After the recording is completed, the new measured distance and the new mapping range appear on the display. When operating via the local display, these values must be confirmed by pressing ☑.
- **Delete map**
  The mapping (if one exists) is deleted and the device displays the recalculated measured distance and the mapping range. When operating via the local display, these values must be confirmed by pressing ☑.

16.3.1 "Mapping" wizard

The **Mapping** wizard is only available when operating via the local display. When operating via an operating tool, all parameters concerning the mapping are located directly in the **Setup** menu (→ 112).

In the **Mapping** wizard two parameters are displayed simultaneously on the display module at any one time. The upper parameter can be edited, whereas the lower parameter is displayed for reference purposes only.

Navigation Setup → Mapping

Confirm distance

Navigation Setup → Mapping → Confirm distance

Description → 117

Mapping end point

Navigation Setup → Mapping → Map. end point

Description → 118

Record map

Navigation Setup → Mapping → Record map

Description → 118

Distance

Navigation Setup → Mapping → Distance

Description → 115

16.3.2 "Advanced setup" submenu

Navigation Setup → Advanced setup

Locking status

Navigation Setup → Advanced setup → Locking status

Description Indicates the write protection with the highest priority that is currently active.

User interface
- Hardware locked
- SIL locked
- CT active - defined parameters
- WHG locked
- Temporarily locked

Additional information

Meaning and priorities of the types of write protection
- **Hardware locked (priority 1)**
  The DIP switch for hardware locking is activated on the main electronics module. This locks write access to the parameters.
- **SIL locked (priority 2)**
  The SIL mode is activated. Writing access to the relevant parameters is denied.
- **WHG locked (priority 3)**
  The WHG mode is activated. Writing access to the relevant parameters is denied.
- **Temporarily locked (priority 4)**
  Write access to the parameters is temporarily locked on account of internal processes in progress in the device (e.g. data upload/download, reset etc.). The parameters can be modified as soon as the processes are complete.

On the display module, the -symbol appears in front of parameters that cannot be modified since they are write-protected.

Access status tooling

Navigation Setup → Advanced setup → Access stat.tool

Description Indicates access authorization to parameters via operating tool (e.g. FieldCare).

User interface
- Operator
- Maintenance
- Service

Additional information

The access authorization can be changed via the **Enter access code** parameter (→ 122).

If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the **Locking status** parameter (→ 121).

Access status display

Navigation Setup → Advanced setup → Access stat.disp

Prerequisite The device has a local display.

Description Indicates access authorization to parameters via local display.

User interface
- Operator
- Maintenance
- Service

Additional information

If a symbol appears in front of a parameter, the parameter cannot be changed via the local display with the current access authorization.

The access authorization can be changed via the **Enter access code** parameter (→ 122).

If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the **Locking status** parameter (→ 121).

Enter access code

Navigation Setup → Advanced setup → Ent. access code

Description Enter access code to disable write protection of parameters.

User entry 0 to 9999

Additional information
- For local operation, the customer-specific access code, which has been defined in the **Define access code** parameter (→ 165), has to be entered.
- If an incorrect access code is entered, the user retains his current access authorization.
- The write protection affects all parameters marked with the -symbol in this document. On the local display, the -symbol in front of a parameter indicates that the parameter is write-protected.
- If no key is pressed for 10 min, or the user switches from the navigation and editing mode back to the measured value display mode, the device automatically locks the write-protected parameters after another 60 s.

Please contact your Endress+Hauser Sales Center if you lose your access code.

"Level" submenu

Navigation Setup → Advanced setup → Level

Medium type

Navigation Setup → Advanced setup → Level → Medium type

Description Specify type of medium.

User interface
- Liquid
- Solid

Factory setting FMP50, FMP51, FMP52, FMP53, FMP54, FMP55: **Liquid**

Additional information This parameter determines the value of several other parameters and strongly influences the complete signal evaluation. Therefore, it is strongly recommended **not to change** the factory setting.

Medium property

Navigation Setup → Advanced setup → Level → Medium property

Prerequisite **EOP level evaluation ≠ Fix DC**

Description Specify relative dielectric constant ε_r of the medium.

Selection
- Unknown
- DC 1.4 ... 1.6
- DC 1.6 ... 1.9
- DC 1.9 ... 2.5
- DC 2.5 ... 4
- DC 4 ... 7
- DC 7 ... 15
- DC > 15

Factory setting Dependent on **Medium type (→ 123)** and **Medium group (→ 113)**.

Additional information

Dependency on "Medium type" and "Medium group"

Medium type (→ 123)	Medium group (→ 113)	Medium property
Solid		Unknown
Liquid	Water based (DC >= 4)	DC 4 ... 7
	Others	Unknown

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

For **EOP level evaluation** = **Fix DC**, the exact dielectric constant has to be entered into the **DC value** parameter. Therefore, the **Medium property** parameter is not available in this case.

Process property

Navigation

Setup → Advanced setup → Level → Process property

Description

Specify typical rate of level change.

Selection

For "Medium type" = "Liquid"
- Very fast > 10 m (400 in)/min
- Fast > 1 m (40 in)/min
- Standard < 1 m (40in) /min
- Medium < 10 cm (4in) /min
- Slow < 1 cm (0.4in) /min
- No filter / test

For "Medium type" = "Solid"
- Very fast > 100 m (333 ft) /h
- Fast > 10 m (33 ft) /h
- Standard < 10 m (33 ft) /h
- Medium < 1 m (3ft) /h
- Slow < 0.1 m (0.3ft) /h
- No filter / test

Factory setting

Standard < 1 m (40in) /min

Additional information

The device adjusts the signal evaluation filters and the damping of the output signal to the typical rate of level change defined in this parameter:

For "Operating mode" = "Level" and "Medium type" = "Liquid"

Process property	Step response time / s
Very fast > 10 m (400 in)/min	5
Fast > 1 m (40 in)/min	5
Standard < 1 m (40in) /min	14
Medium < 10 cm (4in) /min	39
Slow < 1 cm (0.4in) /min	76
No filter / test	< 1

For "Operating mode" = "Level" and "Medium type" = "Solid"

Process property	Step response time / s
Very fast > 100 m (333 ft) /h	37
Fast > 10 m (33 ft) /h	37
Standard < 10 m (33 ft) /h	74
Medium < 1 m (3ft) /h	146
Slow < 0.1 m (0.3ft) /h	290
No filter / test	< 1

For "Operating mode" = "Interface" or "Interface with capacitance"

Process property	Step response time / s
Very fast > 10 m (400 in)/min	5
Fast > 1 m (40 in)/min	5
Standard < 1 m (40in) /min	23
Medium < 10 cm (4in) /min	47
Slow < 1 cm (0.4in) /min	81
No filter / test	2.2

Advanced process conditions

Navigation Setup → Advanced setup → Level → Adv. conditions

Description Specify additional process conditions (if required).

Selection
- None
- Oil/Water condensate
- Probe near tank bottom
- Build up
- Foam (>5cm/0,16ft)

Factory setting None

Additional information

Meaning of the options
- **Oil/Water condensate** (only **Medium type** = **Liquid**)
  Makes sure that in the case of two-phase media only the total level is detected (example: oil/condensate application).
- **Probe near tank bottom** (only for **Medium type** = **Liquid**)
  Improves the empty detection, especially if the probe is mounted close to the tank bottom.
- **Build up**
  Increases **EOP range upper area** in order to ensure a safe empty-detection even if the end-of-probe signal has shifted due to build-up.
  Enables a safe empty-detection even if the end-of-probe signal has shifted due to build-up.
- **Foam (>5cm/0,16ft)** (only for **Medium type** = **Liquid**)
  Optimizes the signal evaluation in applications with foam formation.

Level unit

Navigation Setup → Advanced setup → Level → Level unit

Description Select level unit.

Selection

SI units
- %
- m
- mm

US units
- ft
- in

Factory setting %

Additional information The level unit may differ from the distance unit defined in the **Distance unit** parameter (→ 112):

- The unit defined in the **Distance unit** parameter is used for the basic calibration (**Empty calibration (→ 114)** and **Full calibration (→ 114)**).
- The unit defined in the **Level unit** parameter is used to display the (unlinearized) level.

Blocking distance

Navigation Setup → Advanced setup → Level → Blocking dist.

Description Specify upper blocking distance UB.

User entry 0 to 200 m

Factory setting For rod and rope probes up to 8 m (26 ft): 200 mm (8 in)

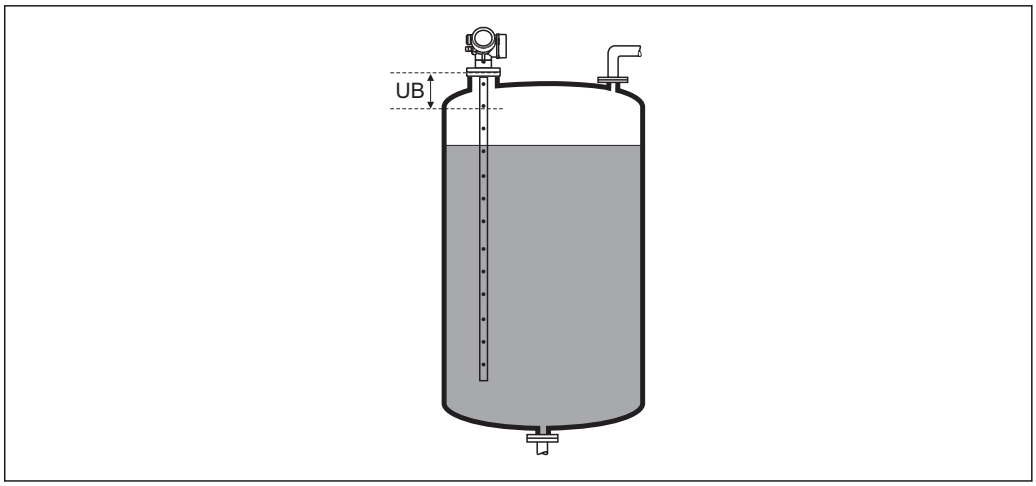
Additional information Signals in the upper blocking distance are only evaluated if they have been outside the blocking distance when the device was switched on and move into the blocking distance due to a level change during operation. Signals which are already in the blocking distance when the device is switched on, are ignored.

This behavior is only valid if the following two conditions are met:
- Expert → Sensor → Echo tracking → Evaluation mode = **Short time history** or **Long time history**)
- Expert → Sensor → Gas phase comp. → GPC mode= **On**, **Without correction** or **External correction**

If one of these conditions is not met, signals in the blocking distance will always be ignored.

A different behavior for signals in the blocking distance can be defined in the **Blocking distance evaluation mode** parameter.

If required, a different behavior for signals in the blocking distance can be defined by the Endress+Hauser service.



28 Blocking distance (UB) for liquid measurements

Level correction

Navigation Setup → Advanced setup → Level → Level correction

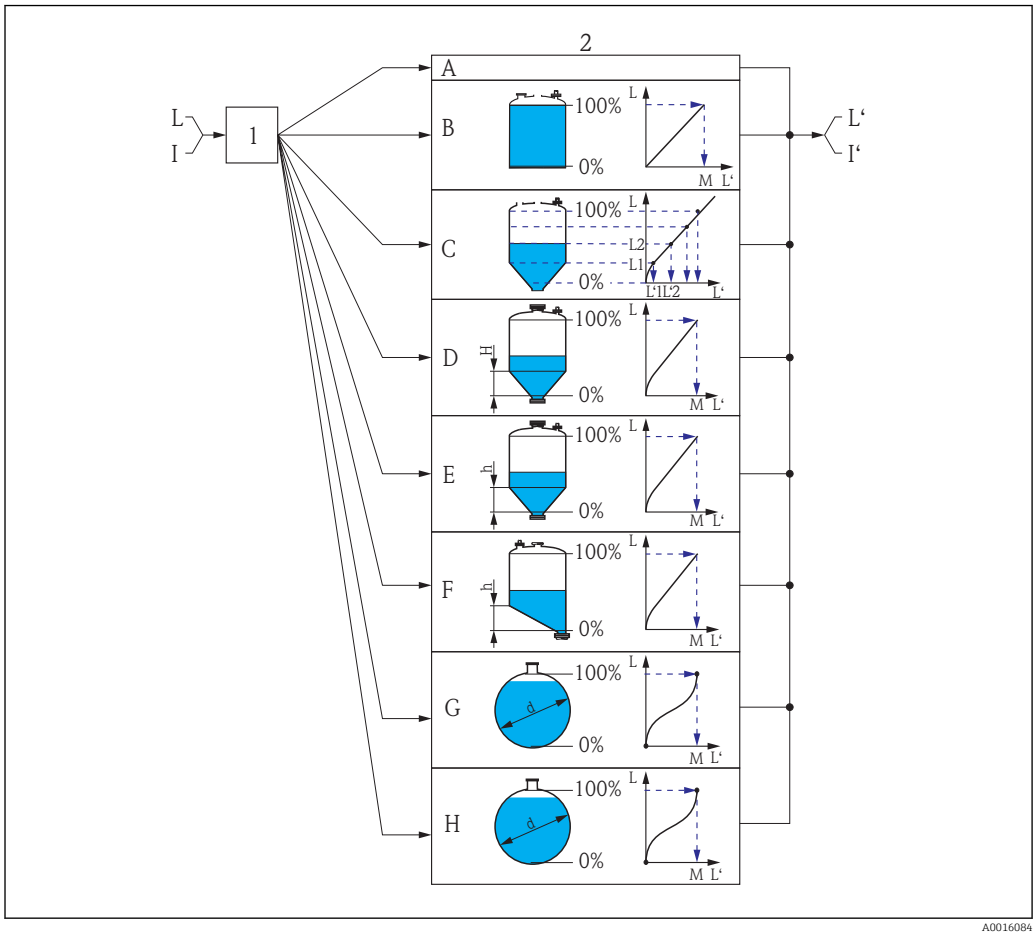
Description Specify level correction (if required).

User entry −200 000.0 to 200 000.0 %

Factory setting 0.0 %

Additional information The value specified in this parameter is added to the measured level (before linearization).

"Linearization" submenu

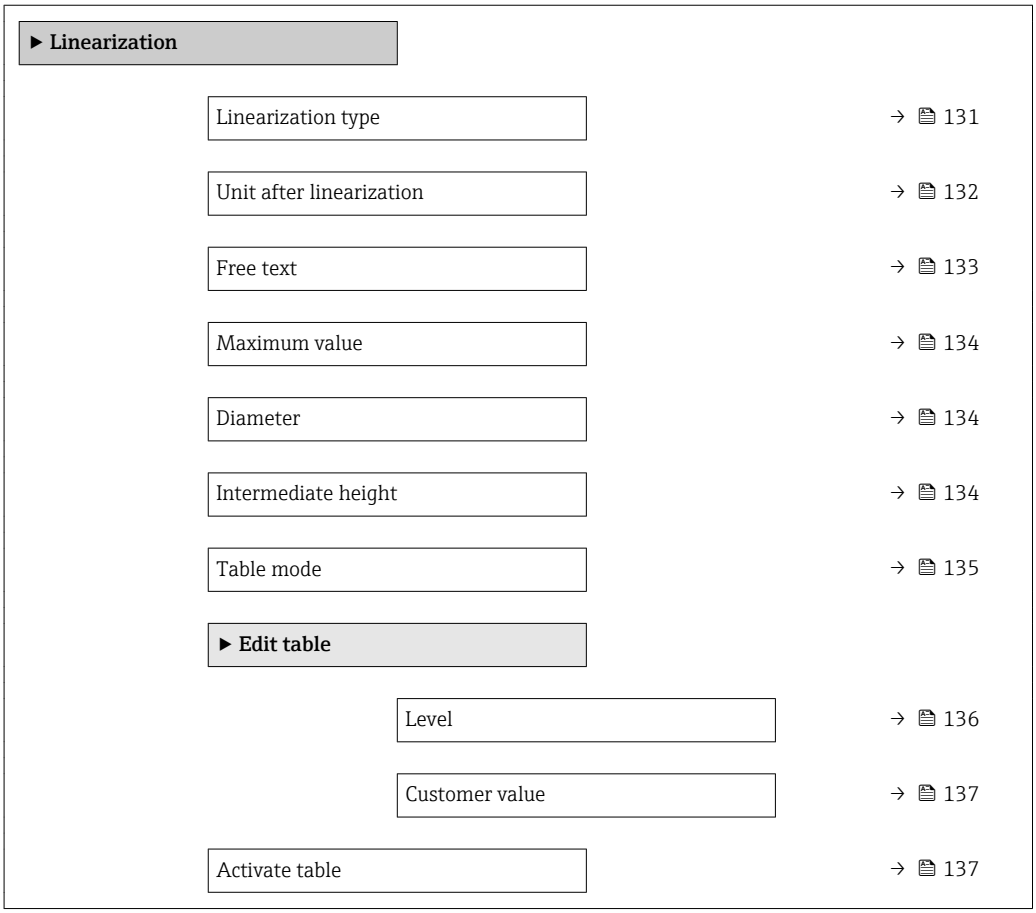


29 *Linearization: Transformation of the level and (if relevant) the interface height into a volume or weight; the transformation is dependent on the shape of the vessel.*

1 Selection of linearization type and unit
2 Configuration of the linearization
A Linearization type (→ 131) = None
B Linearization type (→ 131) = Linear
C Linearization type (→ 131) = Table
D Linearization type (→ 131) = Pyramid bottom
E Linearization type (→ 131) = Conical bottom
F Linearization type (→ 131) = Angled bottom
G Linearization type (→ 131) = Horizontal cylinder
H Linearization type (→ 131) = Sphere
I For "Operating mode" = "Interface" or "Interface with capacitance": Interface before linearization (measured in distance units)
I' For "Operating mode" = "Interface" or "Interface with capacitance": Interface after linearization (corresponds to volume or weight)
L Level before linearization (measured in distance units)
L' Level linearized (→ 133) (corresponds to volume or weight)
M Maximum value (→ 134)
d Diameter (→ 134)
h Intermediate height (→ 134)

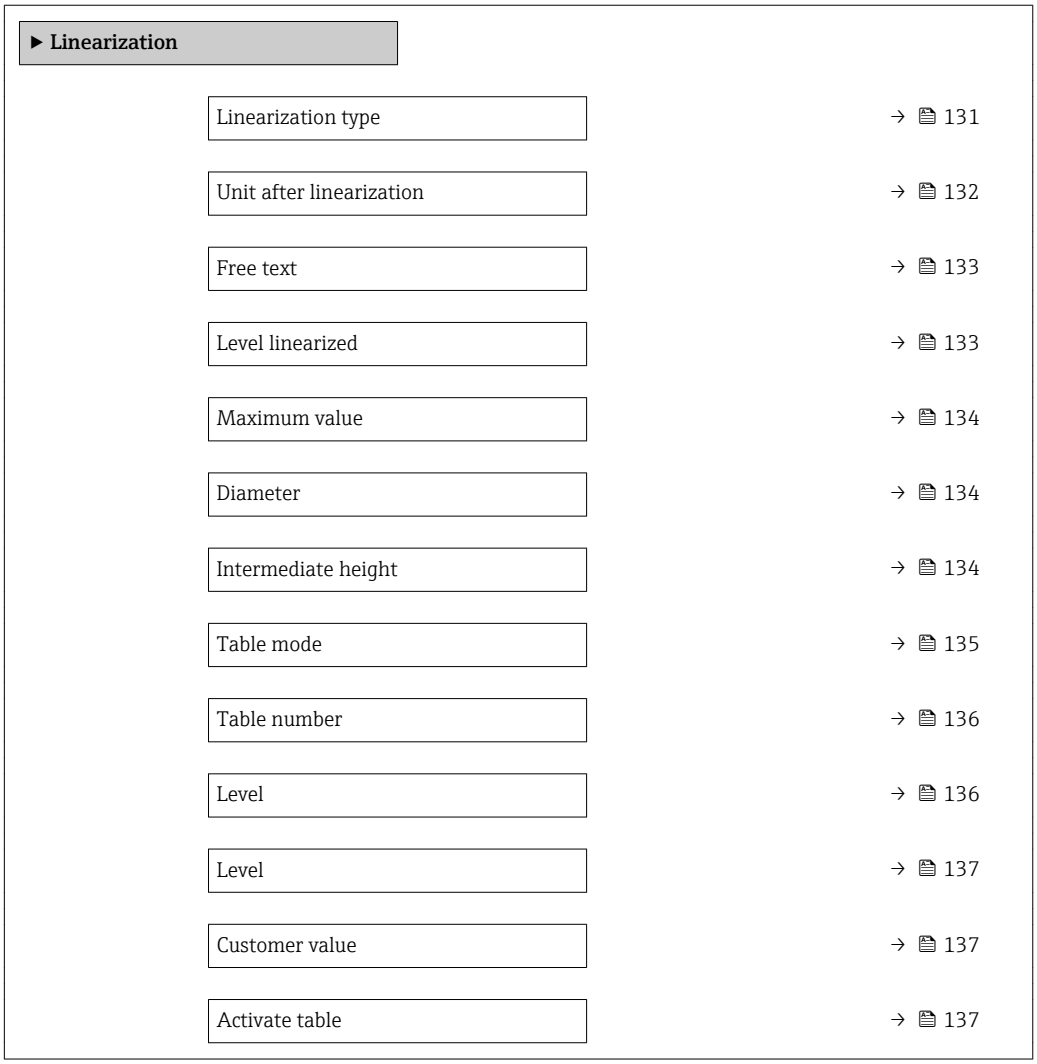
Structure of the submenu on the display module

Navigation Setup → Advanced setup → Linearization



Structure of the submenu in an operating tool (e.g. FieldCare)

Navigation Setup → Advanced setup → Linearization



Description of parameters

Navigation Setup → Advanced setup → Linearization

Linearization type

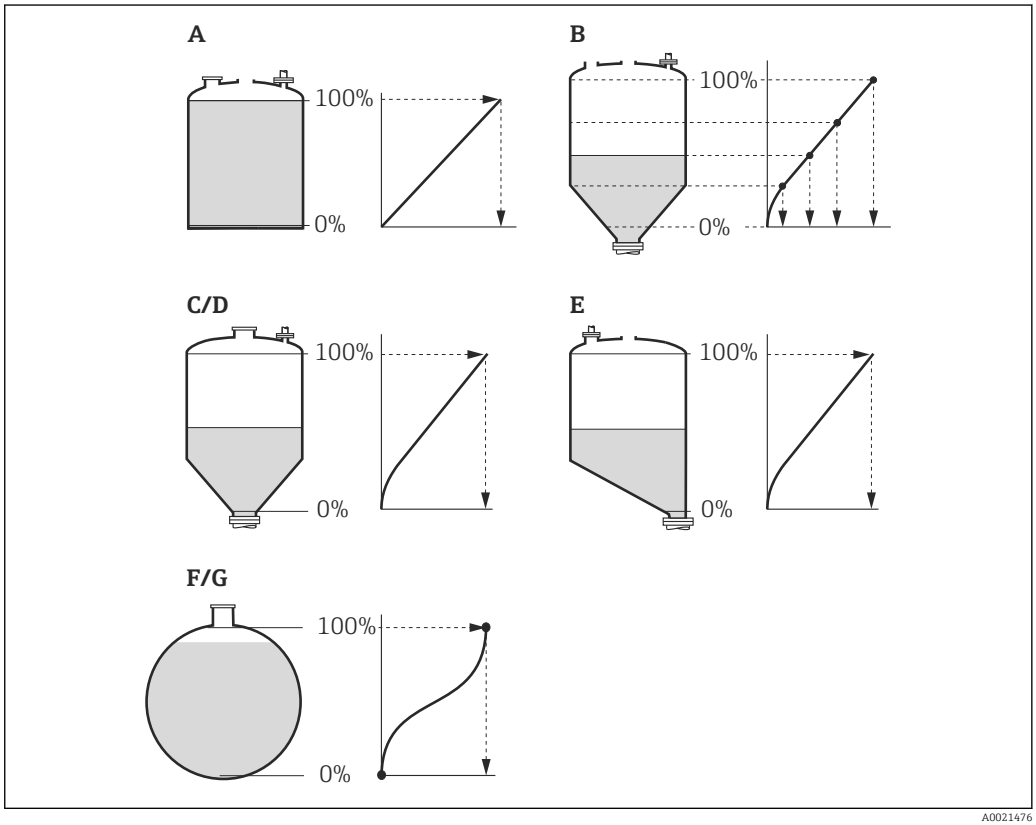
Navigation Setup → Advanced setup → Linearization → Lineariz. type

Description Select linearization type.

Selection
- None
- Linear
- Table
- Pyramid bottom
- Conical bottom
- Angled bottom
- Horizontal cylinder
- Sphere

Factory setting None

Additional information



30 Linearization types

A None
B Table
C Pyramid bottom
D Conical bottom
E Angled bottom
F Sphere
G Horizontal cylinder

Meaning of the options

- **None**
  The level is transmitted in the level unit without linearization.
- **Linear**
  The output value (volume/weight) is directly proportional to the level L. This is valid, for example, for vertical cylinders. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
- **Table**
  The relationship between the measured level L and the output value (volume/weight) is given by a linearization table consisting of up to 32 pairs of values "level - volume" or "level - weight", respectively. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Table mode (→ 🖹 135)**
  – For each table point: **Level (→ 🖹 136)**
  – For each table point: **Customer value (→ 🖹 137)**
  – **Activate table (→ 🖹 137)**
- **Pyramid bottom**
  The output value corresponds to the volume or weight in a silo with pyramid bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
  – **Intermediate height (→ 🖹 134)**: The height of the pyramid
- **Conical bottom**
  The output value corresponds to the volume or weight in a tank with conical bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
  – **Intermediate height (→ 🖹 134)**: The height of the conical part of the tank
- **Angled bottom**
  The output value corresponds to the volume or weight in a silo with an angled bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
  – **Intermediate height (→ 🖹 134)**: Height of the angled bottom
- **Horizontal cylinder**
  The output value corresponds to the volume or weight in a horizontal cylinder. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
  – **Diameter (→ 🖹 134)**
- **Sphere**
  The output value corresponds to the volume or weight in a spherical tank. The following additional parameters have to be specified:
  – **Unit after linearization (→ 🖹 132)**
  – **Maximum value (→ 🖹 134)**: Maximum volume or weight
  – **Diameter (→ 🖹 134)**

Unit after linearization

Navigation Setup → Advanced setup → Linearization → Unit lineariz.

Prerequisite **Linearization type (→ 🖹 131)** ≠ None

Description Select unit of the lineaized value.

Selection

SI units
- STon
- t
- kg
- cm^3
- dm^3
- m^3
- hl
- l
- %

US units
- lb
- UsGal
- ft^3

Imperial units
impGal

Custom-specific units
Free text

Factory setting

%

Additional information

The selected unit is only used to be indicated on the display. The measured value is **not** transformed according to the selected unit.

It is also possible to configure a distance-to-distance linearization, i.e. a transformation from the level unit to a different distance unit. To do so, select the **Linear** linearization mode. In order to define the new level unit, select the **Free text** option in the **Unit after linearization** parameter and enter the required unit into the **Free text** parameter (→ 133).

Free text

Navigation

Setup → Advanced setup → Linearization → Free text

Prerequisite

Unit after linearization (→ 132) = Free text

Description

Enter unit symbol.

User entry

Up to 32 alphanumerical characters (letters, numbers, special characters)

Factory setting

Free text

Level linearized

Navigation

Setup → Advanced setup → Linearization → Level linearized

Description

Displays linearized level.

Additional information

The unit is defined by the **Unit after linearization** parameter → 132.

Maximum value

Navigation Setup → Advanced setup → Linearization → Maximum value

Prerequisite **Linearization type (→ 131)** has one of the following values:
- Linear
- Pyramid bottom
- Conical bottom
- Angled bottom
- Horizontal cylinder
- Sphere

Description Specify the maximum content of the vessel (100%) measured in the units after linearization.

User entry −50 000.0 to 50 000.0 %

Factory setting 100.0 %

Diameter

Navigation Setup → Advanced setup → Linearization → Diameter

Prerequisite **Linearization type (→ 131)** has one of the following values:
- Horizontal cylinder
- Sphere

Description Specify tank diameter.

User entry 0 to 9 999.999 m

Factory setting 2 m

Additional information The unit is defined in the **Distance unit** parameter (→ 112).

Intermediate height

Navigation Setup → Advanced setup → Linearization → Intermed. height

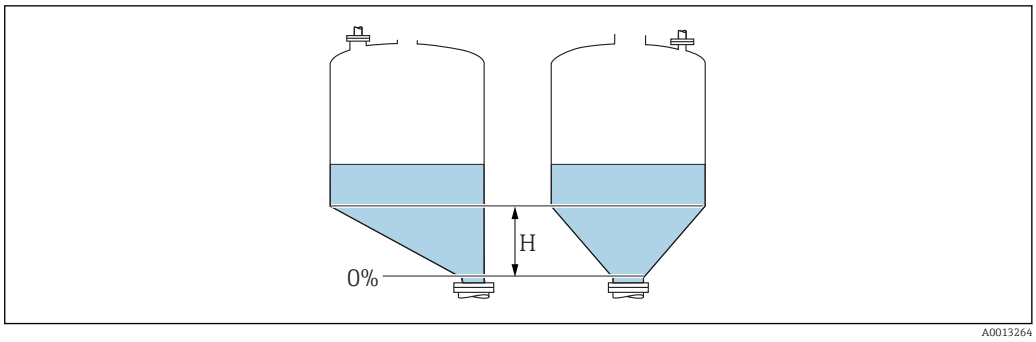
Prerequisite **Linearization type (→ 131)** has one of the following values:
- Pyramid bottom
- Conical bottom
- Angled bottom

Description Specify intermediate height H.

User entry 0 to 200 m

Factory setting 0 m

Additional information



H Intermediate height

The unit is defined in the **Distance unit** parameter (→ 112).

Table mode

Navigation Setup → Advanced setup → Linearization → Table mode

Prerequisite **Linearization type (→ 131) = Table**

Description Select editing mode of the linearization table.

Selection
- Manual
- Semiautomatic
- Clear table
- Sort table

Factory setting Manual

Additional information

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

Conditions the linearization table must meet:
- The table may consist of up to 32 pairs of values "Level - Linearized Value".
- The table must be monotonic (monotonically increasing or decreasing).
- The first linearization point must refer to the minimum level.
- The last linearization point must refer to the maximum level.

Before entering a linearization table, the values for **Empty calibration (→ 114)** and **Full calibration (→ 114)** must be set correctly.

If values of the table need to be changed after the full or empty calibration have been changed, a correct evaluation is only ensured if the existing table is deleted and the complete table is entered again. To do so delete the existing table (**Table mode (→ 135)** = **Clear table**). Then enter a new table.

How to enter the table

- Via FieldCare
  The table points can be entered via the **Table number (→ 136)**, **Level (→ 136)** and **Customer value (→ 137)** parameters. As an alternative, the graphic table editor may be used: Device Operation → Device Functions → Additional Functions → Linearization (Online/Offline)
- Via local display
  Select the **Edit table** submenu to call up the graphic table editor. The table is displayed and can be edited line by line.

The factory setting for the level unit is "%". If you want to enter the linearization table in physical units, you must select the appropriate unit in the **Level unit** parameter (→ 126) beforehand.

If a decreasing table is entered, the values for 20 mA and 4 mA of the current output are interchanged. That means: 20 mA refers to the lowest level, whereas 4 mA refers to the highest level. If required, the current output can be inverted in the **Measuring mode** parameter.

Table number

Navigation Setup → Advanced setup → Linearization → Table number

Prerequisite **Linearization type (→ 131) = Table**

Description Select table point you are going to enter or change.

User entry 1 to 32

Factory setting 1

Level (Manual)

Navigation Setup → Advanced setup → Linearization → Level

Prerequisite

- **Linearization type (→ 131) = Table**
- **Table mode (→ 135) = Manual**

Description Enter level value of the table point (value before linearization).

User entry Signed floating-point number

Factory setting 0 %

Level (Semiautomatic)

Navigation Setup → Advanced setup → Linearization → Level

Prerequisite
- **Linearization type (→ 131)** = **Table**
- **Table mode (→ 135)** = **Semiautomatic**

Description Displays measured level (value before linearization). This value is transmitted to the table.

Customer value

Navigation Setup → Advanced setup → Linearization → Customer value

Prerequisite **Linearization type (→ 131)** = **Table**

Description Enter linearized value for the table point.

User entry Signed floating-point number

Factory setting 0 %

Activate table

Navigation Setup → Advanced setup → Linearization → Activate table

Prerequisite **Linearization type (→ 131)** = **Table**

Description Activate (enable) or deactivate (disable) the linearization table.

Selection
- Disable
- Enable

Factory setting Disable

Additional information

Meaning of the options
- **Disable**
  The measured level is not linearized.
  If **Linearization type (→ 131)** = **Table** at the same time, the device issues error message F435.
- **Enable**
  The measured level is linearized according to the table.

When editing the table, the **Activate table** parameter is automatically reset to **Disable** and must be reset to **Enable** after the table has been entered.

"Safety settings" submenu

Navigation Setup → Advanced setup → Safety sett.

Output echo lost

Navigation Setup → Advanced setup → Safety sett. → Output echo lost

Description Define the behavior of the output signal in case of a lost echo.

Selection
- Last valid value
- Ramp at echo lost
- Value echo lost
- Alarm

Factory setting Last valid value

Additional information

Meaning of the options
- **Last valid value**
  The last valid value is kept in the case of a lost echo.
- **Ramp at echo lost**
  In the case of a lost echo the output value is continously shifted towards 0% or 100%. The slope of the ramp is defined in the **Ramp at echo lost** parameter (→ 139).
- **Value echo lost**
  In the case of a lost echo the output assumes the value defined in the **Value echo lost** parameter (→ 138).
- **Alarm**
  In the case of a lost echo the device generates an alarm; see the **Failure mode** parameter (→ 148)

Value echo lost

Navigation Setup → Advanced setup → Safety sett. → Value echo lost

Prerequisite **Output echo lost (→ 138)** = **Value echo lost**

Description Define output value in case of a lost echo.

User entry 0 to 200 000.0 %

Factory setting 0.0 %

Additional information Use the unit which has been defined for the measured value output:
- without linearization: **Level unit (→ 126)**
- with linearization: **Unit after linearization (→ 132)**

Ramp at echo lost

Navigation Setup → Advanced setup → Safety sett. → Ramp echo lost

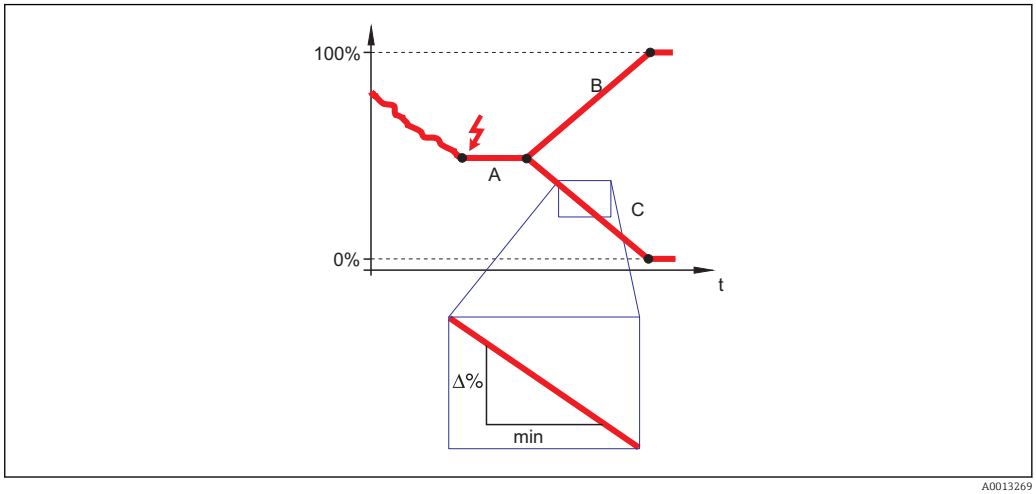
Prerequisite **Output echo lost (→ 138) = Ramp at echo lost**

Description Define the slope of the ramp in the case of a lost echo.

User entry Signed floating-point number

Factory setting 0.0 %/min

Additional information



A Delay time echo lost
B Ramp at echo lost (→ 139) (positive value)
C Ramp at echo lost (→ 139) (negative value)

- The unit for the slope of the ramp is "percentage of the measuring range per minute" (%/min).
- For a negative slope of the ramp: The measured value is continuously decreased until it reaches 0%.
- For a positive slope of the ramp: The measured value is continuosly increased until it reaches 100%.

Blocking distance

Navigation Setup → Advanced setup → Safety sett. → Blocking dist.

Description Specify upper blocking distance UB.

User entry 0 to 200 m

Factory setting For rod and rope probes up to 8 m (26 ft): 200 mm (8 in)

Additional information Signals in the upper blocking distance are only evaluated if they have been outside the blocking distance when the device was switched on and move into the blocking distance

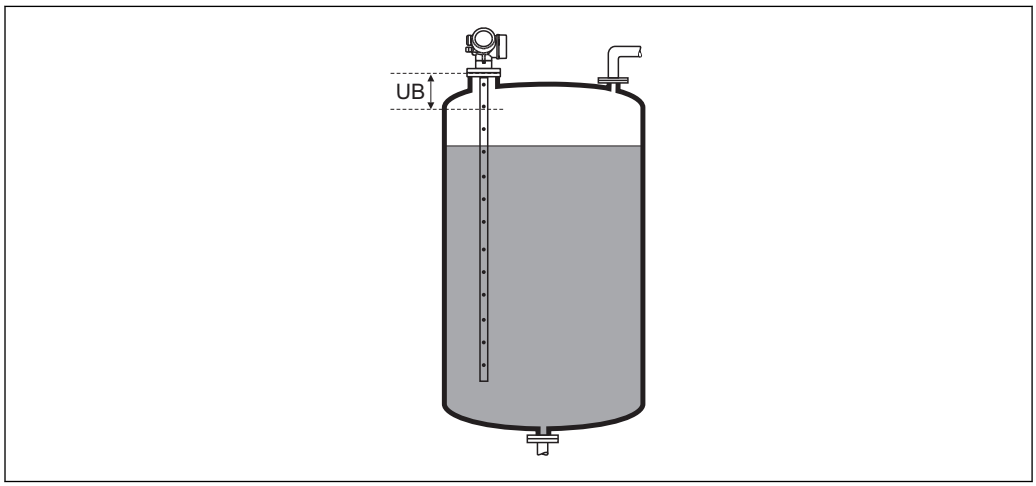
due to a level change during operation. Signals which are already in the blocking distance when the device is switched on, are ignored.

This behavior is only valid if the following two conditions are met:
- Expert → Sensor → Echo tracking → Evaluation mode = **Short time history** or **Long time history**)
- Expert → Sensor → Gas phase comp. → GPC mode= **On**, **Without correction** or **External correction**

If one of these conditions is not met, signals in the blocking distance will always be ignored.

A different behavior for signals in the blocking distance can be defined in the **Blocking distance evaluation mode** parameter.

If required, a different behavior for signals in the blocking distance can be defined by the Endress+Hauser service.



31 Blocking distance (UB) for liquid measurements

"SIL/WHG confirmation" wizard

The **SIL/WHG confirmation** wizard is only available for devices with SIL or WHG approval (Feature 590: "Additional Approval", option LA: "SIL" or LC: "WHG overfill prevention") which are currently **not** in the SIL- or WHG-locked state.

The **SIL/WHG confirmation** wizard is required to lock the device according to SIL or WHG. For details refer to the "Functional Safety Manual" of the respective device, which describes the locking procedure and the parameters of the sequence.

Navigation Setup → Advanced setup → SIL/WHG confirm.

"Deactivate SIL/WHG" wizard

Navigation Setup → Advanced setup → Deactiv. SIL/WHG

Reset write protection

Navigation Setup → Advanced setup → Deactiv. SIL/WHG → Res. write prot.

Description Enter unlocking code.

User entry 0 to 65 535

Factory setting 0

Code incorrect

Navigation Setup → Advanced setup → Deactiv. SIL/WHG → Code incorrect

Description Indicates that a wrong unlocking code has been entered. Select procedure.

Selection
- Reenter code
- Abort sequence

Factory setting Reenter code

"Probe settings" submenu

The **Probe settings** submenu helps to ensure that the end of probe signal within the envelope curve is correctly assigned by the evaluation algorithm. The assignment is correct if the length of probe indicated by the device matches the acutal lenght of the probe. The automatic probe length correction can only be performed if the probe is installed in the vessel and is completely uncovered (no medium). For partially filled vessels and if the probe length is known, select **Confirm probe length (→ 144)** = **Manual input** in order to enter the value manually.

If a mapping (interference echo suppression) has been recorded after shortening the probe, it is no longer possible to perform an automatic probe length correction. In this case there are two options:
- Delete the map using the **Record map** parameter (→ 118) before performing the automatic probe length correction. After the probe length correction, a new map can be recorded using the **Record map** parameter (→ 118).
- Alternative: Select **Confirm probe length (→ 144)** = **Manual input** and enter the probe length manually into the **Present probe length** parameter → 143.

An automatic probe length correction is only possible after the correct option has been selected in the **Probe grounded** parameter (→ 143).

Navigation Setup → Advanced setup → Probe settings

Probe grounded

Navigation Setup → Advanced setup → Probe settings → Probe grounded

Prerequisite **Operating mode** = **Level**

Description Specify whether the probe is grounded.

Selection
- No
- Yes

Factory setting No

Present probe length

Navigation Setup → Advanced setup → Probe settings → Pres. length

Description
- In most cases:
  Displays the length of the probe according to the currently measured end-of-probe signal.
- For **Confirm probe length (→ 144)** = **Manual input**:
  Enter actual length of probe.

User entry 0 to 200 m

Factory setting 4 m

Confirm probe length

Navigation Setup → Advanced setup → Probe settings → Confirm length

Description Select, whether the value displayed in the **Present probe length** parameter → 143 matches the actual length of the probe. Based on this input, the device performs a probe length correction.

Selection
- Probe length OK
- Probe length too small
- Probe length too big
- Probe covered
- Manual input
- Probe length unknown

Factory setting Probe length OK

Additional information

Meaning of the options
- **Probe length OK**
  To be selected if the indicated length is correct. An adjustment is not required. The device quits the sequence.
- **Probe length too small**
  To be selected if the displayed length is smaller than the actual length of the probe. A different end of probe signal is allocated and the newly calculated length is displayed in the **Present probe length** parameter → 143. This procedure has to be repeated until the displayed value matches the actual length of the probe.
- **Probe length too big**
  To be selected if the displayed length is bigger than the actual length of the probe. A different end of probe signal is allocated and the newly calculated length is indicated in the **Present probe length** parameter → 143. This procedure has to be repeated until the displayed value matches the actual length of the probe.
- **Probe covered**
  To be selected if the probe is (partially or completely) covered. A probe length correction is impossible in this case. The device quits the sequence.
- **Manual input**
  To be selected if no automatic probe length correction is to be performed. Instead, the actual length of the probe must be entered manually into the **Present probe length** parameter → 143 [5].
- **Probe length unknown**
  To be selected if the acutal length of the probe is unknown. A probe length correction is impossible in this case and the device quits the sequence.
  .

5) When operated via FieldCare, the **Manual input** option needs not to be selected explicitly. In FieldCare the length of the probe can always be edited.

"Probe length correction" wizard

The **Probe length correction** wizard is only available when operating via the local display. When operating via an operating tool, all parameters concerning the probe length correction are located directly in the **Probe settings** submenu (→ 143).

Navigation Setup → Advanced setup → Probe settings → Prob.length corr

Confirm probe length

Navigation Setup → Advanced setup → Probe settings → Prob.length corr → Confirm length

Description → 144

Present probe length

Navigation Setup → Advanced setup → Probe settings → Prob.length corr → Pres. length

Description → 143

"Current output 1 to 2" submenu

The **Current output 2** submenu (→ 146) is only available for devices with two current outputs.

Navigation Setup → Advanced setup → Curr.output 1 to 2

Assign current output 1 to 2

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Assign curr.

Description Select process variable for current output.

Selection
- Level linearized
- Distance
- Electronic temperature
- Relative echo amplitude
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting

For level measurements
- Current output 1: Level linearized
- Current output 2 [6]: Relative echo amplitude

Additional information *Definition of the current range for the process variables*

Process variable	4 mA value	20 mA value
Level linearized	0 % [1] or the associated linearized value	100 % [2] or the associated linearized value
Distance	0 (i.e. level is at the reference point)	**Empty calibration (→ 114)** (i.e. level is at 0 %)
Electronic temperature	−50 °C (−58 °F)	100 °C (212 °F)
Relative echo amplitude	0 mV	2 000 mV
Analog output adv. diagnostics 1/2	depending on the parametrization of the Advanced Diagnostics	

1) the 0% level is defined by **Empty calibration** parameter (→ 114)
2) The 100% level is defined by **Full calibration** parameter (→ 114)

It may be necessary to adjust the 4mA and 20mA values to the application (especially in the case of the **Analog output adv. diagnostics 1/2** option).

This can be done by the following parameters:
- Expert → Output → Curr.output 1 to 2 → Turn down
- Expert → Output → Curr.output 1 to 2 → 4 mA value
- Expert → Output → Curr.output 1 to 2 → 20 mA value

6) only for devices with two current outputs

Current span

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Current span

Description Select current range for process variable and alarm signal.

Selection
- 4...20 mA
- 4...20 mA NAMUR
- 4...20 mA US
- Fixed current

Factory setting 4...20 mA NAMUR

Additional information *Meaning of the options*

Option	Current range for process variable	Lower alarm signal level	Upper alarm signal level
4...20 mA	4 to 20.5 mA	< 3.6 mA	> 21.95 mA
4...20 mA NAMUR	3.8 to 20.5 mA	< 3.6 mA	> 21.95 mA
4...20 mA US	3.9 to 20.8 mA	< 3.6 mA	> 21.95 mA
Fixed current	Constant current, defined in the **Fixed current** parameter (→ 147).		

- In the case of an error, the output current assumes the value defined in the **Failure mode** parameter (→ 148).
- If the meausred value is out of the measuring range, diagnostic message **Current output** is issued.

In a HART multidrop loop only one device can use the analog current to transmit a signal. For all other devices one must set:
- **Current span** = **Fixed current**
- **Fixed current (→ 147)** = **4 mA**

Fixed current

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Fixed current

Prerequisite **Current span (→ 147)** = **Fixed current**

Description Define constant value of the current.

User entry 4 to 22.5 mA

Factory setting 4 mA

Damping output

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Damping out.

Description Define time constant τ for the damping of the output current.

User entry 0.0 to 999.9 s

Factory setting 0.0 s

Additional information Fluctuations of the measured value affect the output current with an exponential delay, the time constant τ of which is defined in this parameter. With a small time constant the output reacts immediately to changes of the measrued value. With a big time constant the reaction of the output is more delayed. For τ = 0 (factory setting) there is no damping.

Failure mode

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Failure mode

Prerequisite **Current span (→ 147) ≠ Fixed current**

Description Select behavior of the output current in case of an error.

Selection
- Min.
- Max.
- Last valid value
- Actual value
- Defined value

Factory setting Max.

Additional information

Meaning of the options
- **Min.**
  The current output adopts the value of the lower alarm level according to the **Current span** parameter (→ 147).
- **Max.**
  The current output adopts the value of the upper alarm level according to the **Current span** parameter (→ 147).
- **Last valid value**
  The current remains constant at the last value it hat before the error occurred.
- **Actual value**
  The output current follows the actual measured value; the error is ignored.
- **Defined value**
  The output current assumes the value defined in the **Failure current** parameter (→ 149).

The error behavior of other output channels is not influenced by these settings but is defined in separate parameters.

Failure current

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Failure current

Prerequisite **Failure mode (→ 148)** = **Defined value**

Description Enter current output value in alarm condition.

User entry 3.59 to 22.5 mA

Factory setting 22.5 mA

Output current 1 to 2

Navigation Setup → Advanced setup → Curr.output 1 to 2 → Output curr. 1 to 2

Description Displays calculated output current.

"Switch output" submenu

Navigation Setup → Advanced setup → Switch output

Switch output function

Navigation Setup → Advanced setup → Switch output → Switch out funct

Description Select function for switch output.

Selection
- Off
- On
- Diagnostic behavior
- Limit
- Digital Output

Factory setting Off

Additional information

Meaning of the options
- **Off**
  The output is always open (non-conductive).
- **On**
  The output is always closed (conductive).
- **Diagnostic behavior**
  The output is normally closed and is only opened if a diagnostic event is present. The **Assign diagnostic behavior** parameter (→ 151) determines for which type of event the output is opened.
- **Limit**
  The output is normally closed and is only opened if a measured variable exceeds or falls below a defined limit. The limit values are defined by the following parameters:
  – **Assign limit (→ 151)**
  – **Switch-on value (→ 152)**
  – **Switch-off value (→ 153)**
- **Digital Output**
  The switching state of the output tracks the output value of a DI function block. The function block is selected in the **Assign status** parameter (→ 150).

The **Off** and **On** options can be used to simulate the switch output.

Assign status

Navigation Setup → Advanced setup → Switch output → Assign status

Prerequisite **Switch output function (→ 150)** = **Digital Output**

Description Select device status for switch output.

Selection
- Off
- Digital output AD 1
- Digital output AD 2

Factory setting Off

Additional information The **Digital output AD 1** and **Digital output AD 2** options refer to the Advanced Diagnostic Blocks. A switch signal generated in these blocks can be transmitted via the switch output.

Assign limit

Navigation Setup → Advanced setup → Switch output → Assign limit

Prerequisite **Switch output function (→ 150) = Limit**

Description Select process variable for limit monitoring.

Selection
- Off
- Level linearized
- Distance
- Interface linearized *
- Interface distance *
- Thickness upper layer *
- Terminal voltage
- Electronic temperature
- Measured capacitance *
- Relative echo amplitude
- Relative interface amplitude *
- Absolute echo amplitude
- Absolute interface amplitude *

Factory setting Off

Assign diagnostic behavior

Navigation Setup → Advanced setup → Switch output → Assign diag. beh

Prerequisite **Switch output function (→ 150) = Diagnostic behavior**

Description Select diagnostic behavior for switch output.

Selection
- Alarm
- Alarm or warning
- Warning

Factory setting Alarm

* Visibility depends on order options or device settings

Switch-on value

Navigation Setup → Advanced setup → Switch output → Switch-on value

Prerequisite **Switch output function (→ 150) = Limit**

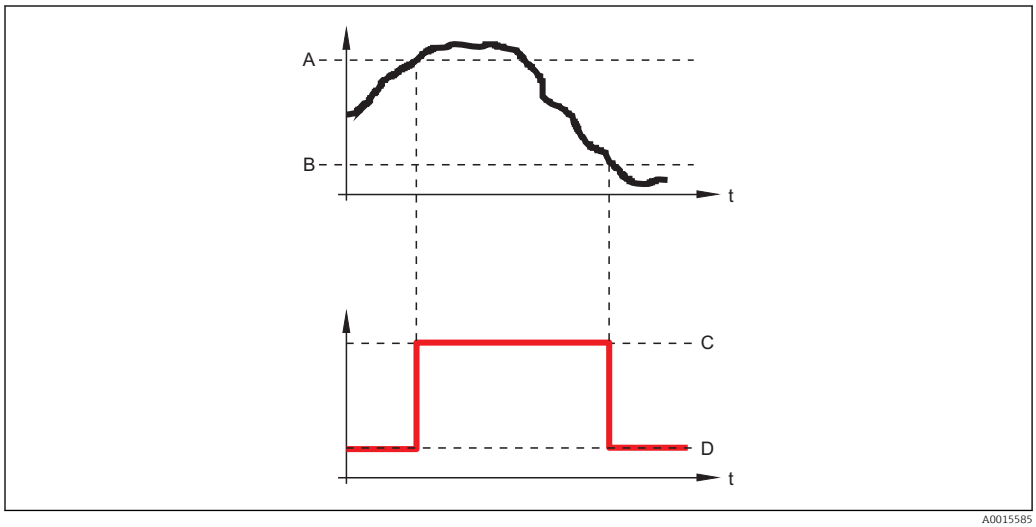
Description Enter measured value for the switch-on point.

User entry Signed floating-point number

Factory setting 0

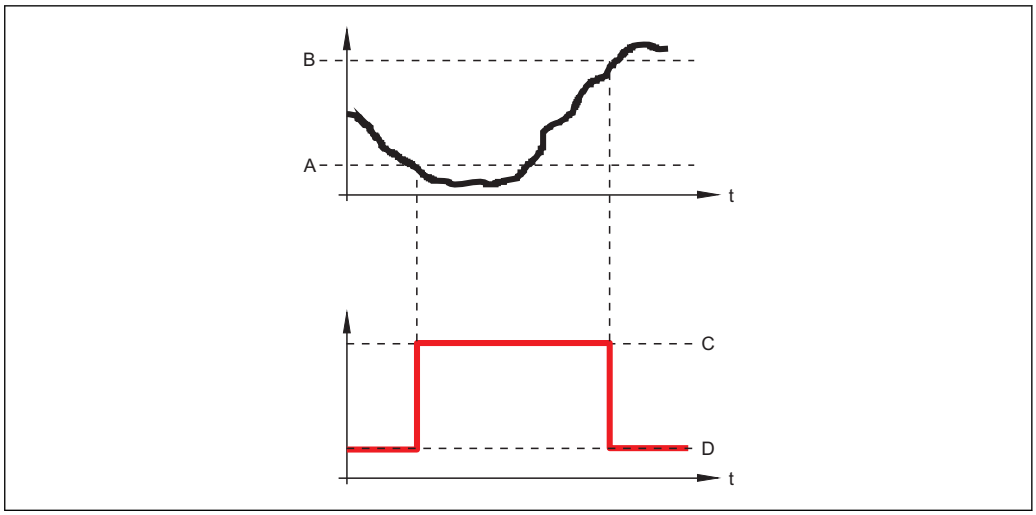
Additional information The switching behavior depends on the relative position of the **Switch-on value** and **Switch-off value** parameters:

Switch-on value > Switch-off value
– The output is closed if the measured value is larger than **Switch-on value**.
– The output is opened if the measured value is smaller than **Switch-off value**.



A Switch-on value
B Switch-off value
C Output closed (conductive)
D Output opened (non-conductive)

Switch-on value < Switch-off value
– The output is closed if the measured value is smaller than **Switch-on value**.
– The output is opened if the measured value is larger than **Switch-off value**.



A Switch-on value
B Switch-off value
C Output closed (conductive)
D Output opened (non-conductive)

Switch-on delay

Navigation Setup → Advanced setup → Switch output → Switch-on delay

Prerequisite
- **Switch output function (→ 150) = Limit**
- **Assign limit (→ 151) ≠ Off**

Description Define switch-on delay.

User entry 0.0 to 100.0 s

Factory setting 0.0 s

Switch-off value

Navigation Setup → Advanced setup → Switch output → Switch-off value

Prerequisite **Switch output function (→ 150) = Limit**

Description Enter measured value for the switch-off point.

User entry Signed floating-point number

Factory setting 0

Additional information The switching behavior depends on the relative position of the **Switch-on value** and **Switch-off value** parameters; description: see the **Switch-on value** parameter (→ 152).

Switch-off delay

Navigation Setup → Advanced setup → Switch output → Switch-off delay

Prerequisite
- **Switch output function (→ 150) = Limit**
- **Assign limit (→ 151) ≠ Off**

Description Define switch-off delay.

User entry 0.0 to 100.0 s

Factory setting 0.0 s

Failure mode

Navigation Setup → Advanced setup → Switch output → Failure mode

Description Define output behavior in alarm condition.

Selection
- Actual status
- Open
- Closed

Factory setting Open

Switch status

Navigation Setup → Advanced setup → Switch output → Switch status

Description Displays the current state of the switch output.

Invert output signal

Navigation Setup → Advanced setup → Switch output → Invert outp.sig.

Description Specify whether the output signal is to be inverted.

Selection
- No
- Yes

Factory setting No

Additional information

Meaning of the options

- **No**
  The behavior of the switch output is as described above.
- **Yes**
  The states **Open** and **Closed** are inverted as compared to the description above.

"Display" submenu

The **Display** submenu is only visible if a display module is connected to the device.

Navigation Setup → Advanced setup → Display

Language

Navigation Setup → Advanced setup → Display → Language

Description Set display language.

Selection
- English
- Deutsch *
- Français *
- Español *
- Italiano *
- Nederlands *
- Portuguesa *
- Polski *
- русский язык (Russian) *
- Svenska *
- Türkçe *
- 中文 (Chinese) *
- 日本語 (Japanese) *
- 한국어 (Korean) *
- Bahasa Indonesia *
- tiếng Việt (Vietnamese) *
- čeština (Czech) *

Factory setting The language selected in feature 500 of the product structure.
If no language has been selected: **English**

Format display

Navigation Setup → Advanced setup → Display → Format display

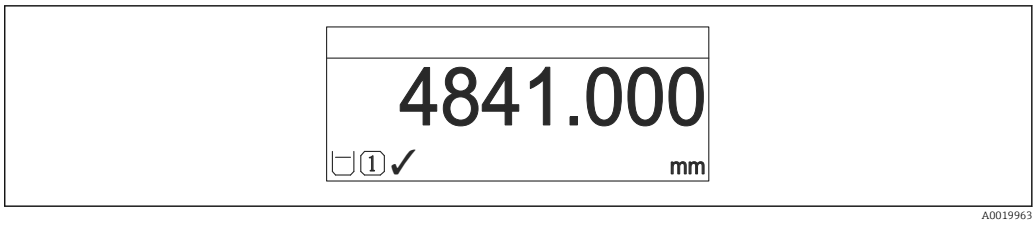
Description Select how measured values are shown on the display.

Selection
- 1 value, max. size
- 1 bargraph + 1 value
- 2 values
- 1 value large + 2 values
- 4 values

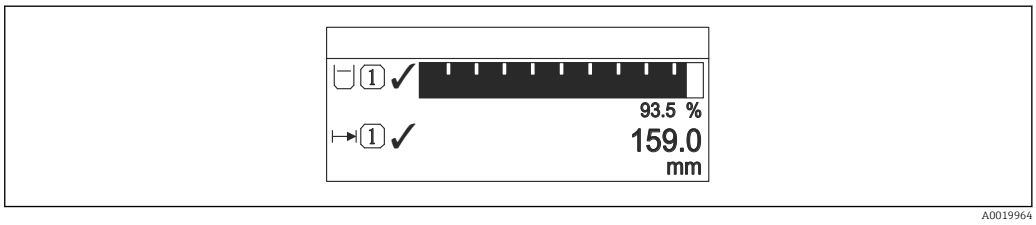
Factory setting 1 value, max. size

* Visibility depends on order options or device settings

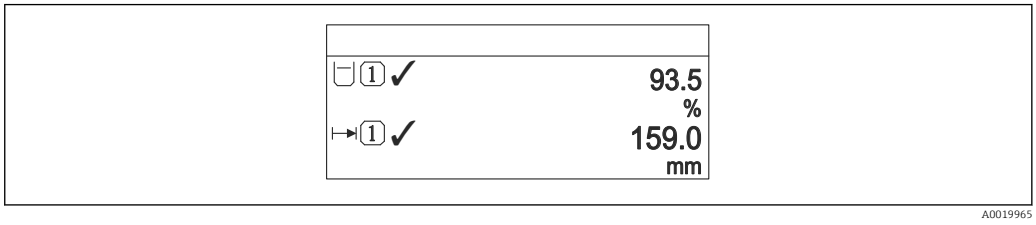
Additional information



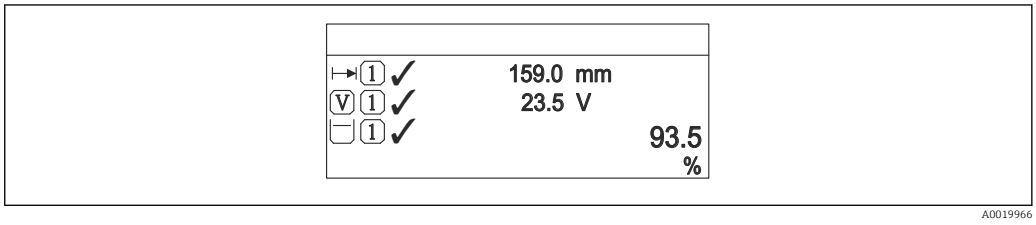
32 *"Format display" = "1 value, max. size"*



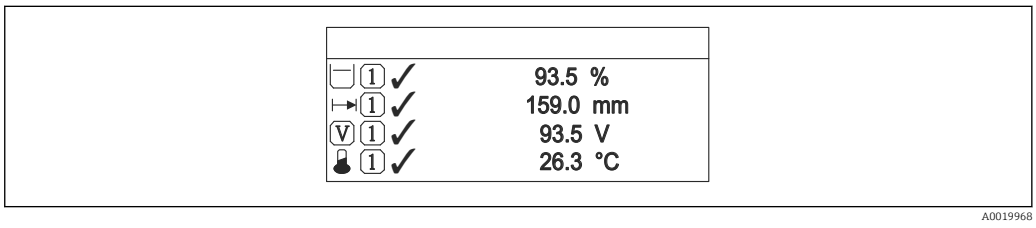
33 *"Format display" = "1 bargraph + 1 value"*



34 *"Format display" = "2 values"*



35 *"Format display" = "1 value large + 2 values"*



36 *"Format display" = "4 values"*

- The **Value 1 to 4 display** → 158 parameters specify which measured values are shown on the display and in which order.
- If more measured values are specified than the current display mode permits, the values alternate on the device display. The display time until the next change is configured in the **Display interval** parameter (→ 158).

Value 1 to 4 display

Navigation Setup → Advanced setup → Display → Value 1 display

Description Select the measured value that is shown on the local display.

Selection
- None [7]
- Level linearized
- Distance
- Current output 1 [8]
- Measured current
- Current output 2
- Terminal voltage
- Electronic temperature
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting

For level measurements
- Value 1 display: Level linearized
- Value 2 display: Distance
- Value 3 display: Current output 1
- Value 4 display: None

Decimal places 1 to 4

Navigation Setup → Advanced setup → Display → Decimal places 1

Description Select the number of decimal places for the display value.

Selection
- x
- x.x
- x.xx
- x.xxx
- x.xxxx

Factory setting x.xx

Additional information The setting does not affect the measuring or computational accuracy of the device.

Display interval

Navigation Setup → Advanced setup → Display → Display interval

Description Set time measured values are shown on display if display alternates between values.

User entry 1 to 10 s

7) can not be selected for the 'Value 1 display" parameter.
8) Visibility depends on order options or device settings

Factory setting 5 s

Additional information This parameter is only relevant if the number of selected measuring values exceeds the number of values the selected display format can display simultaneously.

Display damping

Navigation Setup → Advanced setup → Display → Display damping

Description Define display reaction time to fluctuations in the measured value.

User entry 0.0 to 999.9 s

Factory setting 0.0 s

Header

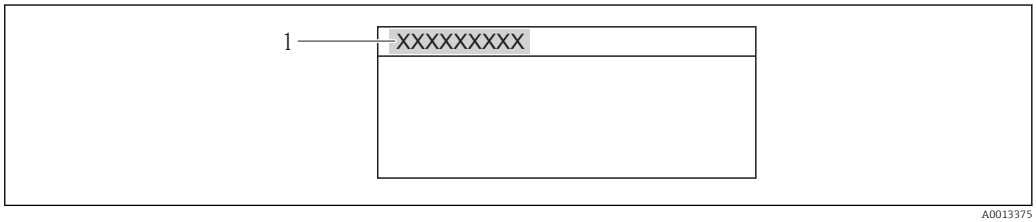
Navigation Setup → Advanced setup → Display → Header

Description Select header contents on local display.

Selection
- Device tag
- Free text

Factory setting Device tag

Additional information



1 Position of the header text on the display

Meaning of the options

- **Device tag**
  Is defined in the **Device tag** parameter (→ 112).
- **Free text**
  Is defined in the **Header text** parameter (→ 159).

Header text

Navigation Setup → Advanced setup → Display → Header text

Prerequisite **Header (→ 159)** = **Free text**

Description Enter display header text.

Factory setting ----------

Additional information The number of characters which can be displayed depends on the characters used.

Separator

Navigation Setup → Advanced setup → Display → Separator

Description Select decimal separator for displaying numerical values.

Selection
- .
- ,

Factory setting .

Number format

Navigation Setup → Advanced setup → Display → Number format

Description Choose number format for the display.

Selection
- Decimal
- ft-in-1/16"

Factory setting Decimal

Additional information The **ft-in-1/16"** option is only valid for distance units.

Decimal places menu

Navigation Setup → Advanced setup → Display → Dec. places menu

Description Select number of decimal places for the representation of numbers within the operating menu.

Selection
- x
- x.x
- x.xx
- x.xxx
- x.xxxx

Factory setting x.xxxx

Additional information

- Is only valid for numbers in the operating menu (e.g. **Empty calibration**, **Full calibration**), but not for the measured value display. The number of decimal places for the measured value display is defined in the **Decimal places 1 to 4** → 158 parameters.
- The setting does not affect the accuracy of the measurement or the calculations.

Backlight

Navigation Setup → Advanced setup → Display → Backlight

Prerequisite The device has the SD03 local display (with optical keys).

Description Switch the local display backlight on and off.

Selection

- Disable
- Enable

Factory setting Disable

Additional information

Meaning of the options

- **Disable**
  Switches the backlight off.
- **Enable**
  Switches the backlight on.

Regardless of the setting in this parameter the backlight may be automatically switched off by the device if the supply voltage is too low.

Contrast display

Navigation Setup → Advanced setup → Display → Contrast display

Description Adjust local display contrast setting to ambient conditions (e.g. lighting or reading angle).

User entry 20 to 80 %

Factory setting Dependent on the display.

Additional information

Setting the contrast via push-buttons:

- Darker: press the ⊖ and Ⓔ buttons simultaneously.
- Brighter: press the ⊕ and Ⓔ buttons simultaneously.

"Configuration backup display" submenu

This submenu is only visible if a display module is connected to the device.

The configuration of the device can be saved to the display module at a certain point of time (backup). The saved configurateion can be restored to the device if required, e.g. in order to bring the device back into a defined state. The configuration can also be transferred to a different device of the same type using the display module.

Navigation Setup → Advanced setup → Conf.backup disp

Operating time

Navigation Setup → Advanced setup → Conf.backup disp → Operating time

Description Indicates how long the device has been in operation.

User interface Days (d), hours (h), minutes (m), seconds (s)

Additional information *Maximum time*
9 999 d (≈ 27 years)

Last backup

Navigation Setup → Advanced setup → Conf.backup disp → Last backup

Description Indicates when the last data backup was saved to the display module.

User interface Days (d), hours (h), minutes (m), seconds (s)

Configuration management

Navigation Setup → Advanced setup → Conf.backup disp → Config. managem.

Description Select action for managing the device data in the display module.

Selection
- Cancel
- Execute backup
- Restore
- Duplicate
- Compare
- Clear backup data

Factory setting Cancel

Additional information

Meaning of the options

- **Cancel**
  No action is executed and the user exits the parameter.
- **Execute backup**
  A backup copy of the current device configuration in the HistoROM (built-in in the device) is saved to the display module of the device.
- **Restore**
  The last backup copy of the device configuration is copied from the display module to the HistoROM of the device.
- **Duplicate**
  The transmitter configuration is duplicated to another device using the transmitter display module. The following parameters, which characterize the individual measuring point are **not** included in the transmitted configuration:
  – HART date code
  – HART short tag
  – HART message
  – HART descriptor
  – HART address
  – Device tag
  – Medium type
- **Compare**
  The device configuration saved in the display module is compared to the current device configuration of the HistoROM. The result of this comparison is displayed in the **Comparison result** parameter (→ 163).
- **Clear backup data**
  The backup copy of the device configuration is deleted from the display module of the device.

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

If an existing backup is restored to a different device using the **Restore** option, it may occur that some device functionalities are no longer available. In some cases even a device reset will not restore the original status.

In order to transmit a configuration to a different device, the **Duplicate** option should always be used.

Backup state

Navigation Setup → Advanced setup → Conf.backup disp → Backup state

Description Displays which backup action is currently in progress.

Comparison result

Navigation Setup → Advanced setup → Conf.backup disp → Compar. result

Description Displays the comparison result between the device and the display.

Additional information

Meaning of the display options

- **Settings identical**
  The current device configuration of the HistoROM is identical to the backup copy in the display module.
- **Settings not identical**
  The current device configuration of the HistoROM is not identical to the backup copy in the display module.
- **No backup available**
  There is no backup copy of the device configuration of the HistoROM in the display module.
- **Backup settings corrupt**
  The current device configuration of the HistoROM is corrupt or not compatible with the backup copy in the display module.
- **Check not done**
  The device configuration of the HistoROM has not yet been compared to the backup copy in the display module.
- **Dataset incompatible**
  The data sets are incompatible and can not be compared.

To start the comparison, set **Configuration management (→ 162)** = **Compare**.

If the transmitter configuration has been duplicated from a different device by **Configuration management (→ 162)** = **Duplicate**, the new device configuration in the HistoROM is only partially identical to the configuration stored in the display module: Sensor specific properties (e.g. the mapping curve) are not duplicated. Thus, the result of the comparison will be **Settings not identical**.

"Administration" submenu

Navigation Setup → Advanced setup → Administration

Define access code

Navigation Setup → Advanced setup → Administration → Def. access code

Description Define release code for write access to parameters.

User entry 0 to 9 999

Factory setting 0

Additional information

If the factory setting is not changed or 0 is defined as the access code, the parameters are not write-protected and the configuration data of the device can then always be modified. The user is logged on in the *Maintenance* role.

The write protection affects all parameters marked with the symbol in this document. On the local display, the symbol in front of a parameter indicates that the parameter is write-protected.

Once the access code has been defined, write-protected parameters can only be modified if the access code is entered in the **Enter access code** parameter (→ 122).

Please contact your Endress+Hauser Sales Center if you lose your access code.

For display operation: The new access code is only valid after it has been confirmed in the **Confirm access code** parameter (→ 167).

Device reset

Navigation Setup → Advanced setup → Administration → Device reset

Description Select to which state the device is to be reset.

Selection

- Cancel
- To factory defaults
- To delivery settings
- Of customer settings
- To transducer defaults
- Restart device

Factory setting Cancel

Additional information

Meaning of the options

- **Cancel**
  No action
- **To factory defaults**
  All parameters are reset to the order-code specific factory setting.
- **To delivery settings**
  All parameters are reset to the delivery setting. The delivery setting may differ from the factory default if customer specific settings have been ordered.
  This option is only visible if customer specific settings have been ordered.
- **Of customer settings**
  All customer parameters are reset to their factory setting. Service parameters, however, remain unchanged.
- **To transducer defaults**
  Every measurment-related parameter is reset to its factory setting. Service parameters and communication-related parameters, however, remain unchanged.
- **Restart device**
  The restart resets every parameter which is stored in the volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.

"Define access code" wizard

The **Define access code** wizard is only available when operating via the local display. When operating via an operating tool, the **Define access code** parameter is located directly in the **Administration** submenu. The **Confirm access code** parameter is not available for operation via operating tool.

Navigation Setup → Advanced setup → Administration → Def. access code

Define access code

Navigation Setup → Advanced setup → Administration → Def. access code → Def. access code

Description → 165

Confirm access code

Navigation Setup → Advanced setup → Administration → Def. access code → Confirm code

Description Confirm the entered access code.

User entry 0 to 9 999

Factory setting 0

16.4 "Diagnostics" menu

Navigation Diagnostics

Actual diagnostics

Navigation Diagnostics → Actual diagnos.

Description Displays current diagnostic message.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

If several messages are active at the same time, the messages with the highest priority is displayed.

Information on what is causing the message, and remedy measures, can be viewed via the ⓘ symbol on the display.

Timestamp

Navigation Diagnostics → Timestamp

Description Displays timestamp for the **Actual diagnostics** parameter (→ 168).

User interface Days (d), hours (h), minutes (m), seconds (s)

Previous diagnostics

Navigation Diagnostics → Prev.diagnostics

Description Displays the last diagnostic message which has been active before the current message.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

The condition displayed may still apply. Information on what is causing the message, and remedy measures, can be viewed via the ⓘ symbol on the display.

Timestamp

Navigation Diagnostics → Timestamp

Description Displays timestamp for the **Previous diagnostics** parameter (→ 168).

User interface Days (d), hours (h), minutes (m), seconds (s)

Operating time from restart

Navigation Diagnostics → Time fr. restart

Description Displays the time the device has been in operation since the last device restart.

User interface Days (d), hours (h), minutes (m), seconds (s)

Operating time

Navigation Diagnostics → Operating time

Description Indicates how long the device has been in operation.

User interface Days (d), hours (h), minutes (m), seconds (s)

Additional information *Maximum time*
9 999 d (≈ 27 years)

16.4.1 "Diagnostic list" submenu

Navigation Diagnostics → Diagnostic list

Diagnostics 1 to 5

Navigation Diagnostics → Diagnostic list → Diagnostics 1 to 5

Description Display the current diagnostics messages with the highest to fifth-highest priority.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

Timestamp 1 to 5

Navigation Diagnostics → Diagnostic list → Timestamp

Description Displays timestamp for the **Diagnostics 1 to 5** parameter (→ 170).

User interface Days (d), hours (h), minutes (m), seconds (s)

16.4.2 "Event logbook" submenu

The **Event logbook** submenu is only available when operating via the local display. When operating via FieldCare, the event list can be displayed in the FieldCare function "Event List / HistoROM".

Navigation Diagnostics → Event logbook

Filter options

Navigation Diagnostics → Event logbook → Filter options

Description Select category (status signal) whose event messages are displayed in the events list.

Selection
- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information (I)

Factory setting All

Additional information
- This parameter is only used for operation via the local display.
- The status signals are categorized according to NAMUR NE 107.

"Event list" submenu

The **Event list** submenu displays the history of past events of the category selected in the **Filter options** parameter (→ 171). A maximum of 100 events are displayed in chronological order.

The following symbols indicate whether an event has occurred or has ended:
- : Event has occurred
- : Event has ended

Information on what is causing the message, and remedy instructions, can be viewed via the ⓘ-button.

Display format
- For event messages in category I: information event, event text, "recording event" symbol and time the event occurred
- For event messages in category F, M, C, S (status signal): diagnostics event, event text, "recording event" symbol and time the event occurred

Navigation Diagnostics → Event logbook → Event list

16.4.3 "Device information" submenu

Navigation Diagnostics → Device info

Device tag

Navigation Diagnostics → Device info → Device tag

Description Enter the name for the measuring point.

Factory setting FMP5x

Serial number

Navigation Diagnostics → Device info → Serial number

Description Displays serial number of the device.

Additional information

Uses of the serial number
- To identify the device quickly, e.g. when contacting Endress+Hauser.
- To obtain specific information on the device using the Device Viewer: www.endress.com/deviceviewer

The serial number is also indicated on the nameplate.

Firmware version

Navigation Diagnostics → Device info → Firmware version

Description Indicates the installed Firmware version.

User interface xx.yy.zz

Additional information For firmware versions differing only in the last two digits ("zz") there is no difference concerning functionality or operation.

Device name

Navigation Diagnostics → Device info → Device name

Description Displays device name.

Order code

Navigation Diagnostics → Device info → Order code

Description Displays order code of the device.

Additional information The order code is generated from the extended roder code, which defines all device features of the product structure. In contrast, the device features can not be read directly from the order code.

Extended order code 1 to 3

Navigation Diagnostics → Device info → Ext. order cd. 1 to 3

Description Displays the three parts of the extended order code.

Additional information The extended order code indicates the version of all the features of the product structure and thus uniquely identifies the device.

Device revision

Navigation Diagnostics → Device info → Device revision

Description Displays the device revision registered for this device at the HART Communication Foundation.

Additional information The device revision is used to allocate the correct Device Description file (DD) to the device.

Device ID

Navigation Diagnostics → Device info → Device ID

Description Displays Device ID.

Additional information In addition to the Device type and Manufacturer ID, the Device ID is part of the unique device identification (Unique ID) which characterizes each HART device unambiguously.

Device type

Navigation Diagnostics → Device info → Device type

Description Displays the device type with which the device is registered with the the HART Communication Foundation.

Additional information The device type is needed to allocate the correct Device Description file (DD) to the device.

Manufacturer ID

Navigation Diagnostics → Device info → Manufacturer ID

Description Displays the manufactured ID with which the device is registered with the HART Communication Foundation.

16.4.4 "Measured values" submenu

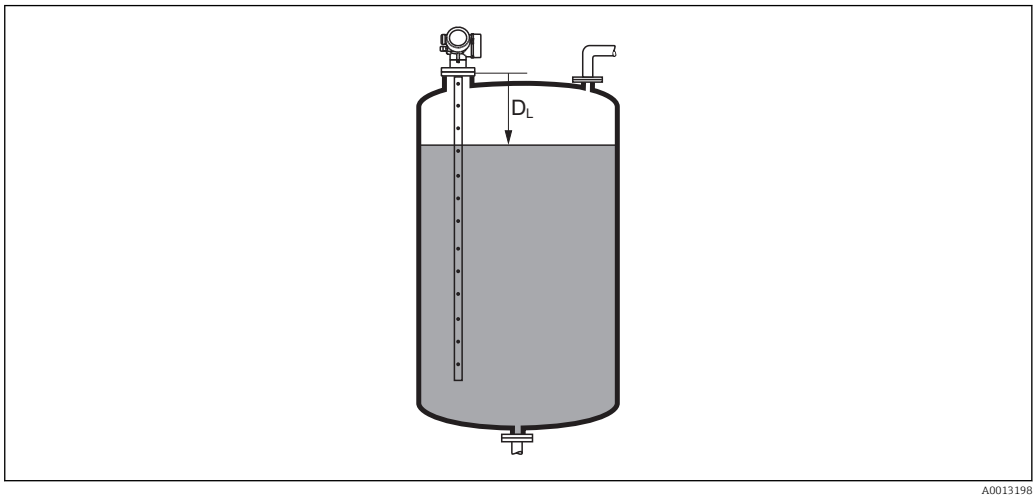
Navigation Diagnostics → Measured val.

Distance

Navigation Diagnostics → Measured val. → Distance

Description Displays the measured distance D_L between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



37 *Distance for liquid measurements*

The unit is defined in the **Distance unit** parameter (→ 112).

Level linearized

Navigation Diagnostics → Measured val. → Level linearized

Description Displays linearized level.

Additional information The unit is defined by the **Unit after linearization** parameter → 132.

Output current 1 to 2

Navigation Diagnostics → Measured val. → Output curr. 1 to 2

Description Displays calculated output current.

Measured current 1

Navigation Diagnostics → Measured val. → Measur. curr. 1

Prerequisite Only available for current output 1

Description Displays the measured value of the output current.

Terminal voltage 1

Navigation Diagnostics → Measured val. → Terminal volt. 1

Description Dipslays terminal voltage at the current output.

16.4.5 "Data logging" submenu

Navigation Diagnostics → Data logging

Assign channel 1 to 4

Navigation Diagnostics → Data logging → Assign chan. 1 to 4

Description Allocate a process variable to the respective data logging channel.

Selection
- Off
- Level linearized
- Distance
- Unfiltered distance
- Interface linearized *
- Interface distance *
- Unfiltered interface distance
- Thickness upper layer *
- Current output 1
- Measured current
- Current output 2 *
- Terminal voltage
- Electronic temperature
- Measured capacitance *
- Absolute echo amplitude
- Relative echo amplitude
- Absolute interface amplitude *
- Relative interface amplitude *
- Absolute EOP amplitude
- EOP shift
- Noise of signal
- Calculated DC value *
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting Off

Additional information A total of 1000 measured values can be logged. This means:
- 1000 data points if 1 logging channel is used
- 500 data points if 2 logging channels are used
- 333 data points if 3 logging channels are used
- 250 data points if 4 logging channels are used

If the maximum number of data points is reached, the oldest data points in the data log are cyclically overwritten in such a way that the last 1000, 500, 333 or 250 measured values are always in the log (ring memory principle).

The logged data are deleted if a new option is selected in this parameter.

* Visibility depends on order options or device settings

Logging interval

Navigation Diagnostics → Data logging → Logging interval

Description Define logging interval t_{log}.

User entry 1.0 to 3 600.0 s

Factory setting 30.0 s

Additional information This parameter defines the interval between the individual data points in the data log, and thus the maximum loggable process time T_{log}:

- If 1 logging channel is used: $T_{log} = 1000 \cdot t_{log}$
- If 2 logging channels are used: $T_{log} = 500 \cdot t_{log}$
- If 3 logging channels are used: $T_{log} = 333 \cdot t_{log}$
- If 4 logging channels are used: $T_{log} = 250 \cdot t_{log}$

Once this time elapses, the oldest data points in the data log are cyclically overwritten such that a time of T_{log} always remains in the memory (ring memory principle).

The logged data are deleted if this parameter is changed.

Example

When using 1 logging channel
- $T_{log} = 1000 \cdot 1$ s = 1 000 s ≈ 16.5 min
- $T_{log} = 1000 \cdot 10$ s = 1 000 s ≈ 2.75 h
- $T_{log} = 1000 \cdot 80$ s = 80 000 s ≈ 22 h
- $T_{log} = 1000 \cdot 3\,600$ s = 3 600 000 s ≈ 41 d

Clear logging data

Navigation Diagnostics → Data logging → Clear logging

Description Initiate a deletion of the complete logging memory.

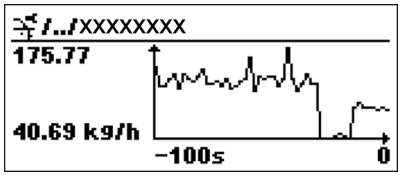
Selection
- Cancel
- Clear data

Factory setting Cancel

"Display channel 1 to 4" submenu

The **Display channel 1 to 4** submenus are only available for operation via the local display. When operating via FieldCare, the logging diagram can be displayed in the FieldCare function "Event List / HistoROM" .

The **Display channel 1 to 4** submenus invoke a diagram of the logging history of the respective channel.



- x-axis: depending on the number of selected channels, 250 to 1000 measured values of a process variable are displayed.
- y-axis: covers the approximate measured value span and constantly adapts this to the measurement.

To return to the operating menu, press ⊞ and ⊟ simultaneaously.

Navigation Diagnostics → Data logging → Displ.channel 1 to 4

16.4.6 "Simulation" submenu

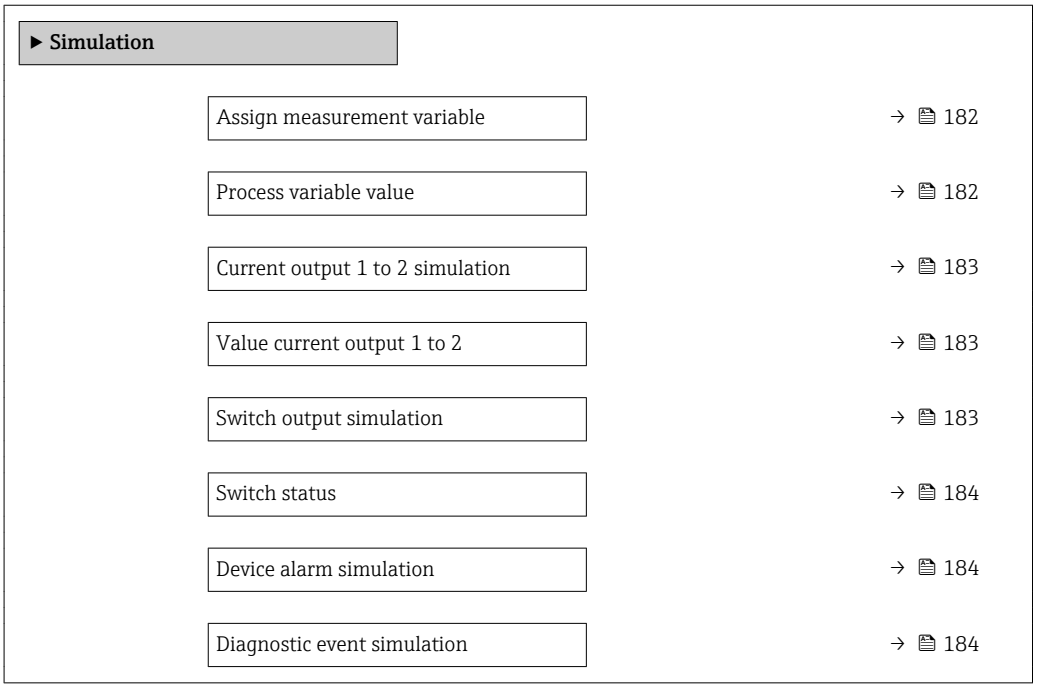
The **Simulation** submenu is used to simulate specific measuring values or other conditions. This helps to check the correct configuration of the device and connected control units.

Conditions which can be simulated

Condition to be simulated	Associated parameters
Specific value of a process variable	▪ Assign measurement variable (→ 182) ▪ Process variable value (→ 182)
Specific value of the output current	▪ Current output simulation (→ 183) ▪ Value current output (→ 183)
Specific state of the switch output	▪ Switch output simulation (→ 183) ▪ Switch status (→ 184)
Existence of an alarm	Device alarm simulation (→ 184)
Existence of a specific diagnostic message	Diagnostic event simulation (→ 184)

Structure of the submenu

Navigation Expert → Diagnostics → Simulation



Description of parameters

Navigation Expert → Diagnostics → Simulation

Assign measurement variable

Navigation Expert → Diagnostics → Simulation → Assign meas.var.

Description Selct process variable to be simulated.

Selection
- Off
- Level
- Interface *
- Thickness upper layer *
- Level linearized
- Interface linearized
- Thickness linearized

Factory setting Off

Additional information
- The value of the variable to be simulated is defined in the **Process variable value** parameter (→ 182).
- If **Assign measurement variable ≠ Off**, a simulation is active. This is indicated by a diagnotic message of the *Function check (C)* category.

Process variable value

Navigation Expert → Diagnostics → Simulation → Proc. var. value

Prerequisite **Assign measurement variable (→ 182) ≠ Off**

Description Specify value of the process value being simulated.

User entry Signed floating-point number

Factory setting 0

Additional information Downstream measured value processing and the signal output use this simulation value. In this way, users can verify whether the measuring device has been configured correctly.

* Visibility depends on order options or device settings

Current output 1 to 2 simulation

Navigation Expert → Diagnostics → Simulation → Curr.out. 1 to 2 sim.

Description Switch the simulation of the current output on or off.

Selection
- Off
- On

Factory setting Off

Additional information An active simulation is indicated by a diagnostic message of the *Function check (C)* category.

Value current output 1 to 2

Navigation Expert → Diagnostics → Simulation → Value curr.out 1 to 2

Prerequisite **Current output simulation (→ 183) = On**

Description Enter current value for the simulation

User entry 3.59 to 22.5 mA

Factory setting 3.59 mA

Additional information The current output assumes the value specified in this parameter. In this way, users can verify the correct adjustment of the current output and the correct function of connected control units.

Switch output simulation

Navigation Expert → Diagnostics → Simulation → Switch sim.

Description Switch the simulation of the switch output on or off.

Selection
- Off
- On

Factory setting Off

Switch status

Navigation Expert → Diagnostics → Simulation → Switch status

Prerequisite **Switch output simulation (→ 183) = On**

Description Define the switch state to be simulated.

Selection
- Open
- Closed

Factory setting Open

Additional information The switch status assumes the value defined in this parameter. This helps to check correct operation of connected control units.

Device alarm simulation

Navigation Expert → Diagnostics → Simulation → Dev. alarm sim.

Description Switch alarm simulation on or off.

Selection
- Off
- On

Factory setting Off

Additional information When selecting the **On** option, the device generates an alarm. This helps to check the correct output behavior of the device in the case of an alarm.

An active simulation is indicated by the diagnostic message **⊗C484 Failure mode simulation**.

Diagnostic event simulation

Navigation Expert → Diagnostics → Simulation → Diag. event sim.

Prerequisite **Access status display (→ 122)/Access status tooling (→ 121) = Service**

Description Select diagnostic event to be simulated.

Factory setting Off

Additional information When operated via the local display, the selection list can be filtered according to the event categories (**Diagnostic event category** parameter).

16.4.7 "Device check" submenu

Navigation Diagnostics → Device check

Start device check

Navigation Diagnostics → Device check → Start dev. check

Description Start a device check.

Selection
- No
- Yes

Factory setting No

Additional information In the case of a lost echo a device check can not be performed.

Result device check

Navigation Diagnostics → Device check → Result dev.check

Description Displays the result of the device check.

Additional information

Meaning of the display options
- **Installation ok**
  Measurement possible without restrictions.
- **Accuracy reduced**
  A measurement is possible. However, the measuring accuracy may be reduced due to the signal amplitudes.
- **Measurement capability reduced**
  A measurement is currently possible. Howerver, there is the risk of an echo loss. Check the mounting position of the device and the dielectric constant of the medium.
- **Check not done**
  No device check has been performed.

Last check time

Navigation Diagnostics → Device check → Last check time

Description Displays the operating time at which the last device check has been performed.

Level signal

Navigation Diagnostics → Device check → Level signal

Prerequisite Device check has been performed.

Description Displays result of the device check for the level signal.

User interface
- Check not done
- Check not OK
- Check OK

Additional information For **Level signal** = **Check not OK**: Check the mounting position of the device and the dielectric constant of the medium.

Launch signal

Navigation Diagnostics → Device check → Launch signal

Prerequisite Device check has been performed.

Description Displays result of the display check for the launch signal.

User interface
- Check not done
- Check not OK
- Check OK

Additional information For **Launch signal** = **Check not OK**: Check the mounting position of the device. In non-metallic vessels use a metal plate or a metal flange.

16.4.8 "Heartbeat" submenu

The **Heartbeat** submenu is only available via **FieldCare** or **DeviceCare**. It contains the wizards which are part of the **Heartbeat Verification** and **Heartbeat Monitoring** application packages.

Detailed description
SD01872F

Navigation Diagnostics → Heartbeat

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