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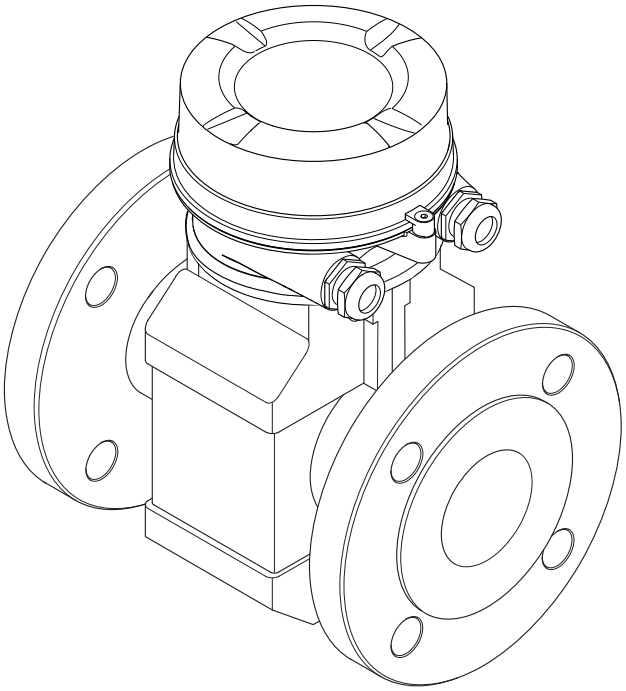
Valid as of version
01.00.zz (Device firmware)

Operating Instructions
Proline Promag P 100 Modbus RS485

Electromagnetic flow measuring system



Endress+Hauser
People for Process Automation

- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser Sales Center will supply you with current information and updates to these Instructions.

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1 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 used

1.2.1 Safety symbols

Symbol	Meaning
A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Electrical symbols

Symbol	Meaning
A0011197	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
A0011198	**Alternating current** A terminal to which alternating voltage is applied or through which alternating current flows.
A0017381	**Direct current and alternating current** ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
A0011201	**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
A0011221	Allen key
A0011222	Open-ended wrench

1.2.4 Symbols for certain types of information

Symbol	Meaning
A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
A0011183	**Preferred** Indicates procedures, processes or actions that are preferred.
A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
A0011193	**Tip** Indicates additional information.
A0011194	**Reference to documentation** Refers to the corresponding device documentation.
A0011195	**Reference to page** Refers to the corresponding page number.
A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
1. , 2. , 3. …	**Series of steps**
✔	**Result of a sequence of actions**
A0013562	**Help in the event of a problem**

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
A0013441	Flow direction
A0011187	**Hazardous area** Indicates a hazardous area.
A0011188	**Safe area (non-hazardous area)** Indicates a non-hazardous area.

1.3 Documentation

The following document types are available:
- On the CD-ROM supplied with the device
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

For a detailed list of the individual documents along with the documentation code (→ 87)

1.3.1 Standard documentation

Document type	Purpose and content of the document
Technical Information	**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	**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.
Modbus RS485 register information	**Reference for Modbus RS485 register information** The document provides Modbus-specific information for each individual parameter in the operating menu.

1.3.2 Supplementary device-dependent documentation

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

1.4 Registered trademarks

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

Applicator®, FieldCare®, Field Xpert™, HistoROM®, Heartbeat Technology™
Registered or registration-pending trademarks of the Endress+Hauser Group

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 beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- Following instructions and basic conditions

The operating personnel must fulfill the following requirements:
- Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- Following the instructions in these Operating Instructions

2.2 Designated use

Application and media
The measuring device described in these Instructions is intended only for flow measurement of liquids with a minimum conductivity of 5 µS/cm.

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

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

To ensure that the measuring device remains in proper condition for the operation time:
- Only use the measuring device in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area (e.g. explosion protection, pressure vessel safety).
- Use the measuring device only for media against which the process-wetted materials are adequately resistant.
- If the measuring device is not operated at atmospheric temperature, compliance with the relevant basic conditions specified in the device documentation provided (on the CD-ROM) is absolutely essential.

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

⚠ WARNING
Danger of breakage of the sensor due to corrosive or abrasive fluids!
- Verify the compatibility of the process fluid with the sensor material.
- Ensure the resistance of all fluid-wetted materials in the process.
- Observe the specified maximum process pressure.

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

warranty or liability as minute changes in the temperature, concentration or level of contamination in the process can alter the corrosion resistance properties.

Residual risks
The external surface temperature of the housing can increase by max. 10 K due to the power consumption of the electronic components. Hot process fluids passing through the measuring device will further increase the surface temperature of the housing. The surface of the sensor, in particular, can reach temperatures which are close to the fluid temperature.

Possible burn hazard due to fluid temperatures!
- ▶ For elevated fluid temperature, ensure protection against contact to prevent burns.

2.3 Workplace safety

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

For welding work on the piping:
- ▶ Do not ground the welding unit via the measuring device.

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 Endress+Hauser.

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 Endress+Hauser only.

2.5 Product safety

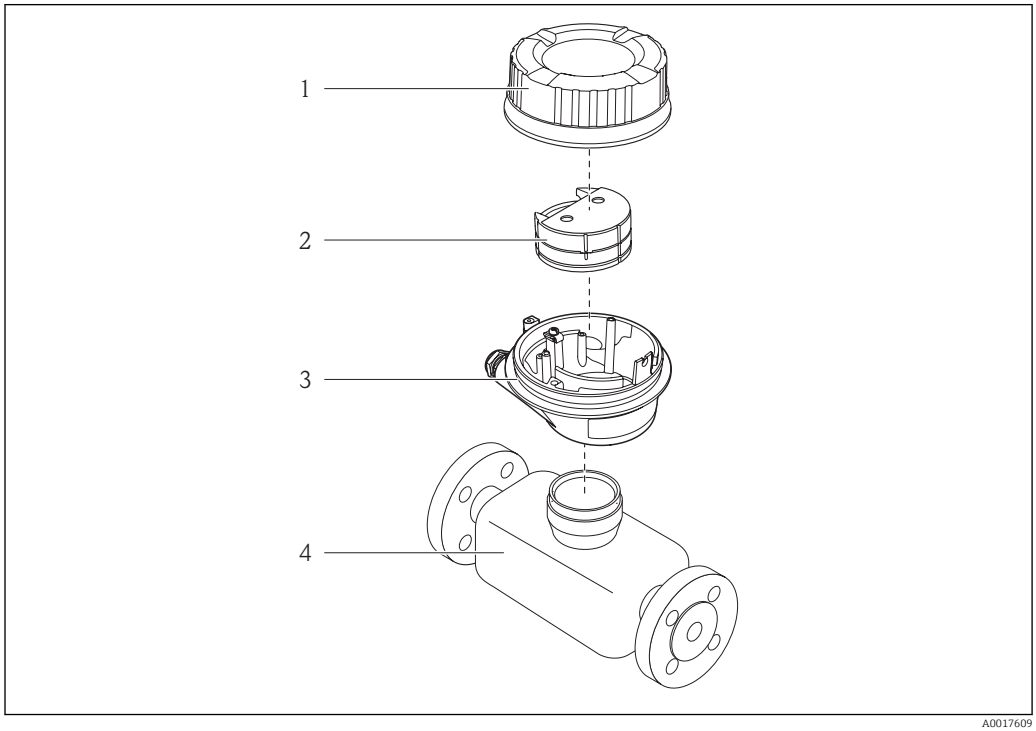
This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate.

It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Product description

3.1 Product design

3.1.1 Device version with Modbus RS485 communication type

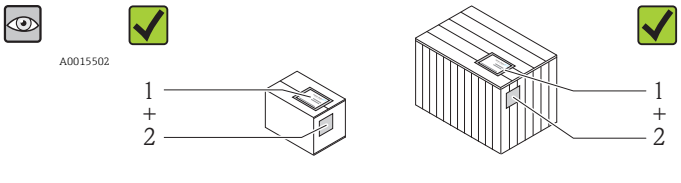


1 Important components of a measuring device

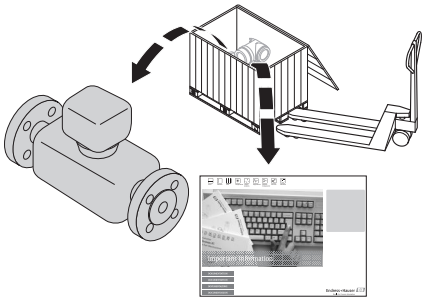
1 Transmitter housing cover
2 Main electronics module for Modbus RS485
3 Transmitter housing
4 Sensor

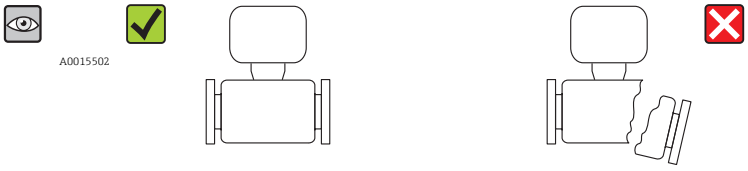
4 Incoming acceptance and product identification

4.1 Incoming acceptance

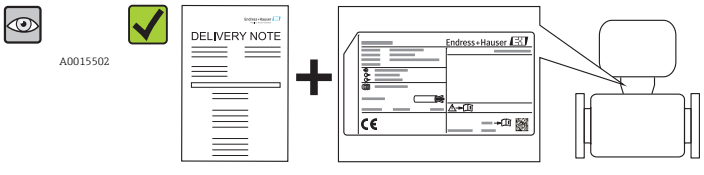


Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?

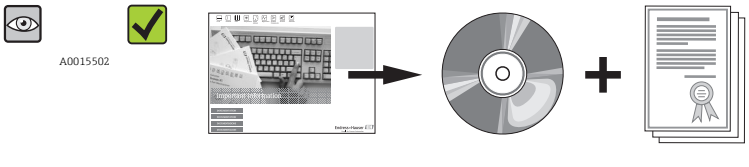




Are the goods undamaged?



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



Is the CD-ROM with the Technical Documentation and documents present?

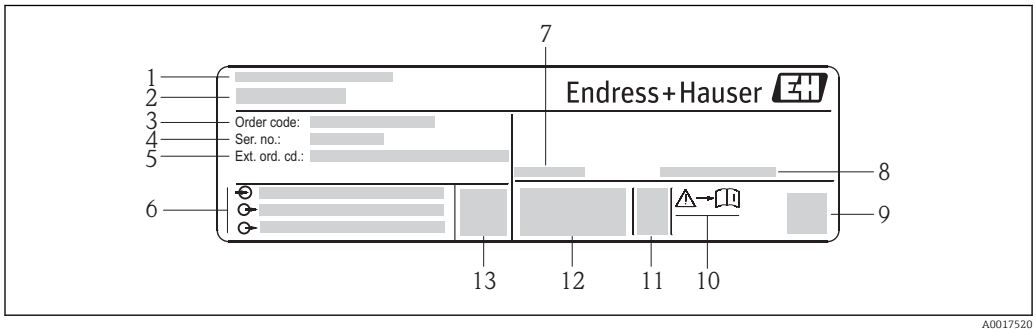
If one of the conditions is not satisfied, contact your Endress+Hauser Sales Center.

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.

For an overview of the scope of the Technical Documentation provided, refer to the following:
- The "Additional standard documentation on the device" (→ 7) and "Supplementary device-dependent documentation" (→ 7) sections
- The *W@M Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)

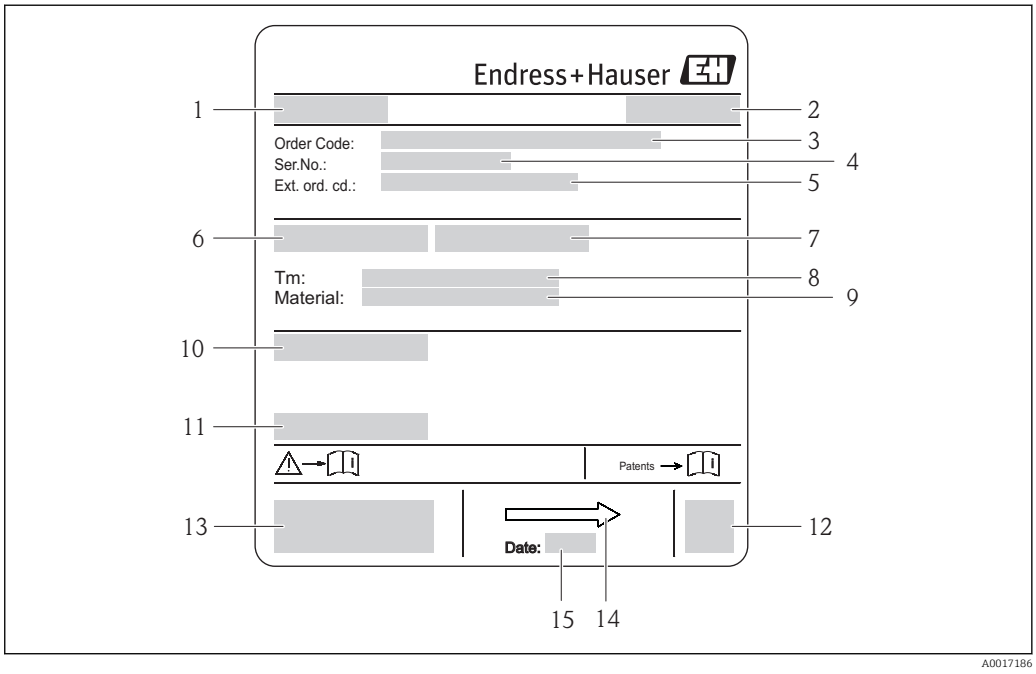
4.2.1 Transmitter nameplate



2 *Example of a transmitter nameplate*

1 *Manufacturing location*
2 *Name of the transmitter*
3 *Order code*
4 *Serial number*
5 *Extended order code*
6 *Electrical connection data, e.g. available inputs and outputs, supply voltage*
7 *Permitted ambient temperature range (T_a)*
8 *Degree of protection*
9 *2-D matrix code*
10 *Document number of safety-related supplementary documentation*
11 *Manufacturing date: year-month*
12 *CE mark, C-Tick*
13 *Firmware version (FW)*

4.2.2 Sensor nameplate



3 *Example of sensor nameplate*

1 *Name of the sensor*
2 *Manufacturing location*
3 *Order code*
4 *Serial number (Ser. no.)*
5 *Extended order code (Ext. ord. cd.)*
6 *Nominal diameter of the sensor*
7 *Test pressure of the sensor*
8 *Medium temperature range*
9 *Material of lining and electrodes*
10 *Degree of protection: e.g. IP, NEMA*
11 *Permitted ambient temperature (T_a)*
12 *2-D matrix code*
13 *CE mark, C-Tick*
14 *Flow direction*
15 *Manufacturing date: year-month*

Order code

The measuring device is reordered using the order code.

Extended order code

- The device type (product root) and basic specifications (mandatory features) are always listed.
- Of the optional specifications (optional features), only the safety and approval-related specifications are listed (e.g. LA). If other optional specifications are also ordered, these are indicated collectively using the # placeholder symbol (e.g. #LA#).
- If the ordered optional specifications do not include any safety and approval-related specifications, they are indicated by the + placeholder symbol (e.g. XXXXXX-ABCDE +).

4.2.3 Symbols on measuring device

Symbol	Meaning
⚠	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.

5 Storage and transport

5.1 Storage conditions

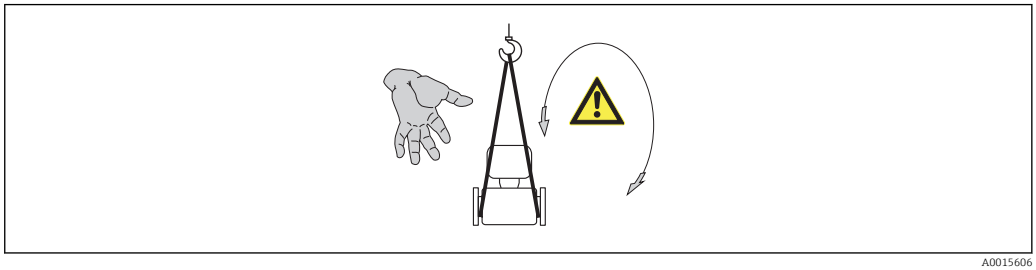
Observe the following notes for storage:
- Store in the original packaging to ensure protection from shock.
- Do not remove protective covers or protective caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.
- Protect from direct sunlight to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device as fungus and bacteria infestation can damage the lining.
- Store in a dry and dust-free place.
- Do not store outdoors.
- Storage temperature(→ 79)

5.2 Transporting the product

WARNING

Center of gravity of the measuring device is higher than the suspension points of the webbing slings.

Risk of injury if the measuring device slips.
- ▶ Secure the measuring device from rotating or slipping.
- ▶ Observe the weight specified on the packaging (stick-on label).
- ▶ Observe the transport instructions on the stick-on label on the electronics compartment cover.



A0015606

Observe the following notes during transport:
- Transport the measuring device to the measuring point in the original packaging.
- Lifting gear
  - Webbing slings: Do not use chains, as they could damage the housing.
  - For wood crates, the floor structure enables these to be loaded lengthwise or broadside using a forklift.
- Use the webbing slings to lift the measuring device at the process connections; do not lift at the transmitter housing.
- Do not remove protective covers or protective caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.

5.3 Packaging disposal

All packaging materials are environmentally friendly and 100% recyclable:
- Measuring device secondary packaging: polymer stretch film that conforms to EC Directive 2002/95/EC (RoHS).
- Packaging:
  - Wood crate, treated in accordance with ISPM 15 standard, which is confirmed by the affixed IPPC logo.
    or
  - Carton in accordance with European Packaging Directive 94/62EC; recyclability is confirmed by the affixed RESY symbol.
- Seaworthy packaging (optional): Wood crate, treated in accordance with ISPM 15 standard, which is confirmed by the affixed IPPC logo.
- Carrying and mounting hardware:
  - Disposable plastic pallet
  - Plastic straps
  - Plastic adhesive strips
- Dunnage: Paper cushion

6 Installation

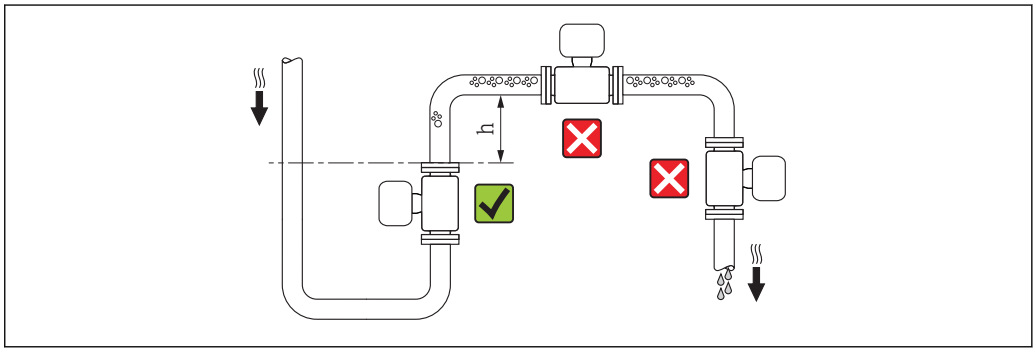
6.1 Installation conditions

No special measures such as supports are necessary. External forces are absorbed by the construction of the device.

6.1.1 Mounting position

Mounting location

Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 2 × DN



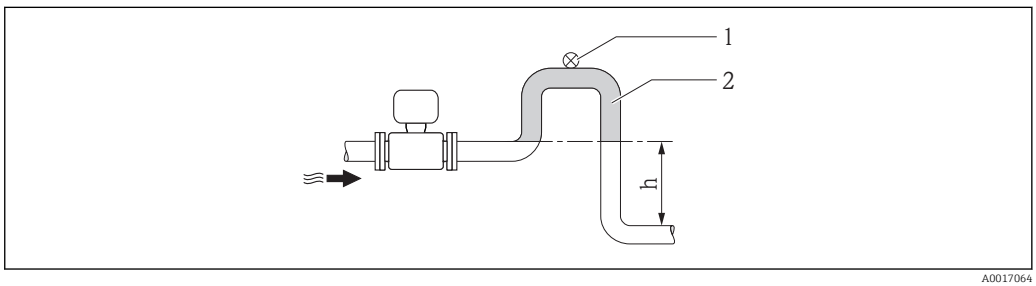
A0017061

To prevent measuring errors arising from accumulation of gas bubbles in the measuring tube, avoid the following mounting locations in the pipe:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Installation in down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the measuring tube. This measure also prevents the system losing prime, which could cause air pockets.

For information on the liner's resistance to partial vacuum (→ 81)



A0017064

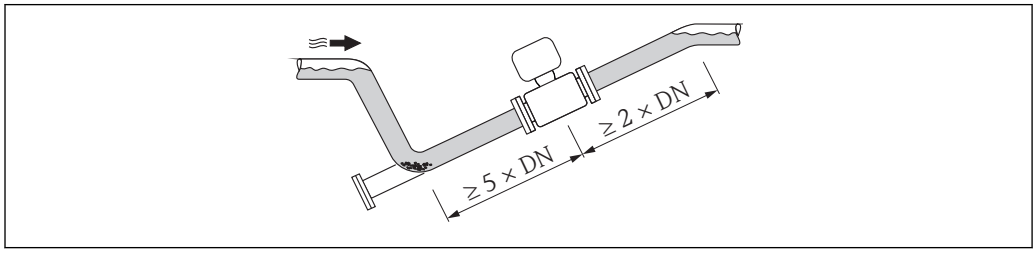
4 *Installation in a down pipe*

1 Vent valve
2 Pipe siphon
h Length of down pipe

Installation in partially filled pipes

A partially filled pipe with a gradient necessitates a drain-type configuration. The empty pipe detection (EPD) function offers additional protection by detecting empty or partially filled pipes.

- Do not install the sensor at the lowest point in the drain: risk of solids accumulating.
- It is advisable to install a cleaning valve.



A0017063

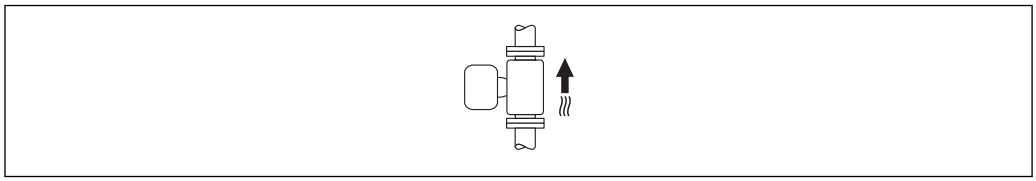
Orientation

The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).
An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube.

The measuring device also offers the empty pipe detection function to detect partially filled measuring pipes in the event of outgassing fluids or variable process pressures.

Vertical

This is the optimum orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.

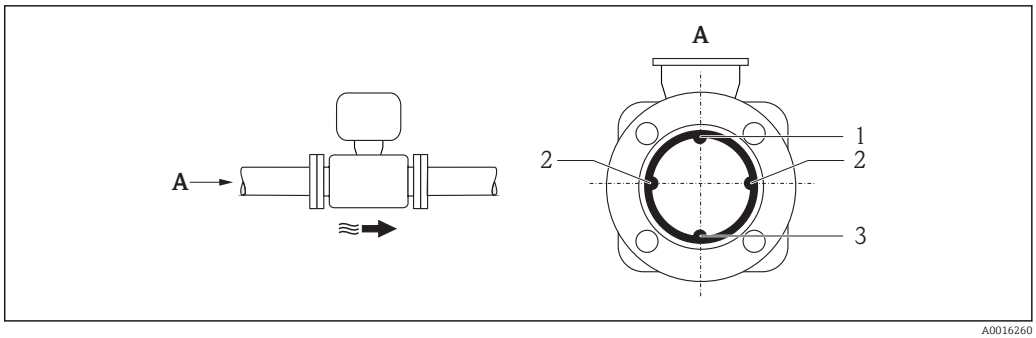


A0015591

Horizontal

The measuring electrode plane must be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

With horizontal orientation, empty pipe detection only works if the transmitter housing is pointing upwards as otherwise there is no guarantee that the empty pipe detection function will actually respond to a partially filled or empty measuring tube.



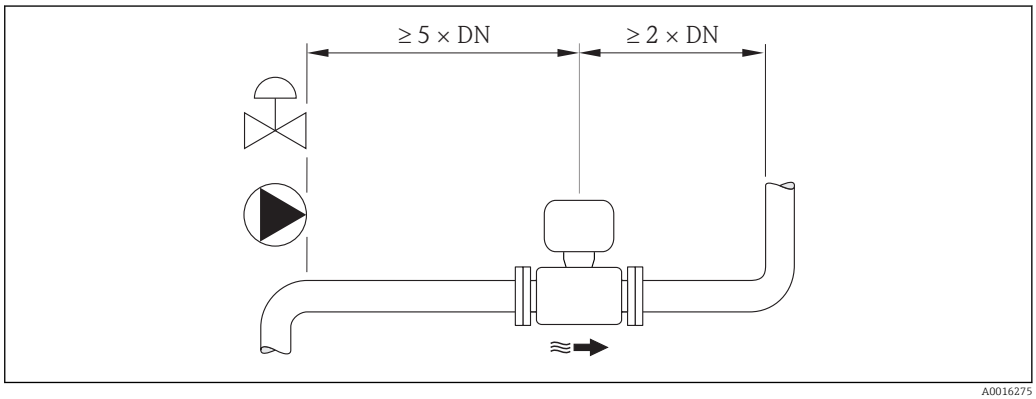
5 *Horizontal orientation*

1 *EPD electrode for empty pipe detection*
2 *Measuring electrodes for signal detection*
3 *Reference electrode for potential equalization*

Inlet and outlet runs

If possible, install the sensor upstream from fittings such as valves, T-pieces or elbows.

Observe the following inlet and outlet runs to comply with accuracy specifications:
- Inlet run ≥ 5 × DN
- Outlet run ≥ 2 × DN



Installation dimensions

For the dimensions and installation lengths of the device, see the "Technical Information" document, "Mechanical construction" section

6.1.2 Requirements from environment and process

Ambient temperature range

Transmitter	−40 to +60 °C (−40 to +140 °F)
Sensor	▪ Flange material carbon steel: −10 to +60 °C (+14 to +140 °F) ▪ Flange material stainless steel: −40 to +60 °C (−40 to +140 °F)
Liner	Do not exceed or fall below the permitted temperature range of the liner (→ 🖹 80).

If operating outdoors:
- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.

Temperature tables

SI units

T_a [°C]	T6 [85 °C]	T5 [100 °C]	T4 [135 °C]	T3 [200 °C]	T2 [300 °C]	T1 [450 °C]
30	50	95	130	150	150	150
50	–	95	130	150	150	150
60	–	95	110	110	110	110

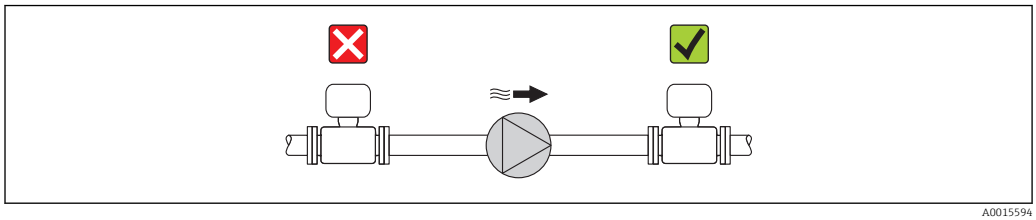
US units

T_a [°F]	T6 [185 °F]	T5 [212 °F]	T4 [275 °F]	T3 [392 °F]	T2 [572 °F]	T1 [842 °F]
86	122	203	266	302	302	302
122	–	203	266	302	302	302
140	–	203	230	230	230	230

System pressure

- Never install the sensor on the pump suction side in order to avoid the risk of low pressure, and thus damage to the liner.
- Furthermore, install pulse dampers if reciprocating, diaphragm or peristaltic pumps are used.

- For information on the liner's resistance to partial vacuum (→ 81)
- For information on the measuring system's resistance to vibration and shock (→ 80), (→ 80)



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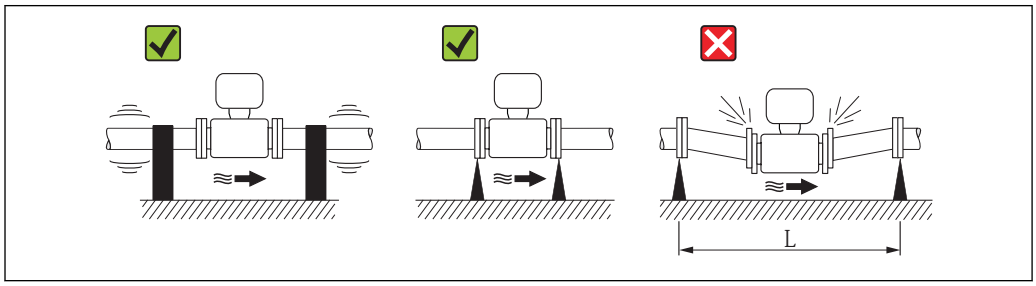
Vibrations

In the event of very strong vibrations, the pipe and sensor must be supported and fixed.

For information on the permitted resistance to vibration and shock (→ 80), (→ 80)



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6 *Measures to prevent vibration of the device*

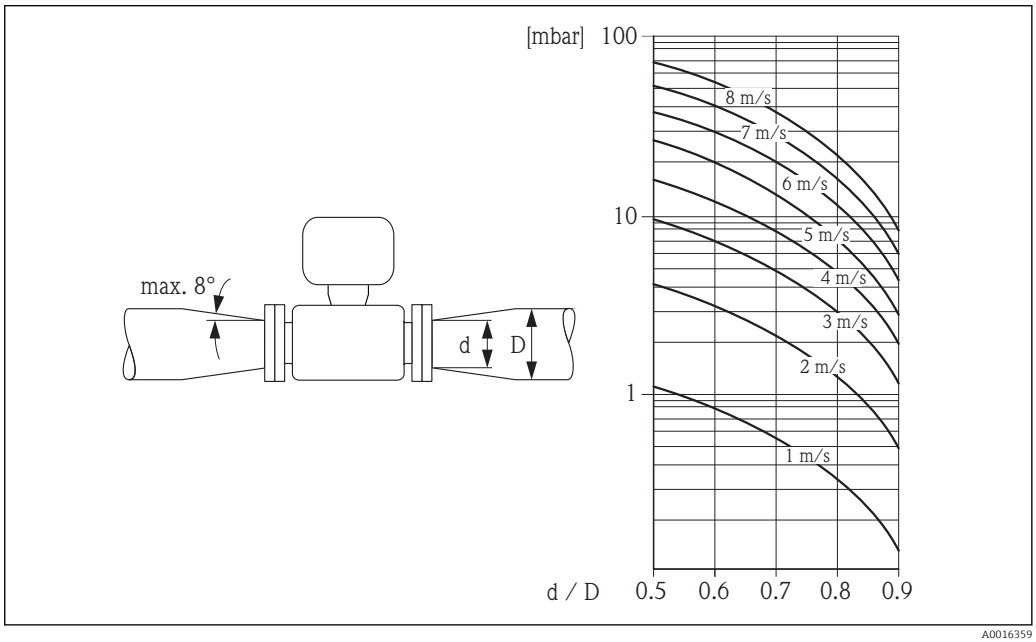
L *> 10 m (33 ft)*

Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

The nomogram only applies to liquids with a viscosity similar to that of water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.



6.1.3 Special mounting instructions

6.2 Mounting the measuring device

6.2.1 Required tools

For sensor

For flanges and other process connections:
- Screws, nuts, seals etc. are not included in the scope of supply and must be provided by the customer.
- Appropriate mounting tools

6.2.2 Preparing the measuring device

1. Remove all remaining transport packaging.
2. Remove any protective covers or protective caps present from the sensor.
3. Remove stick-on label on the electronics compartment cover.

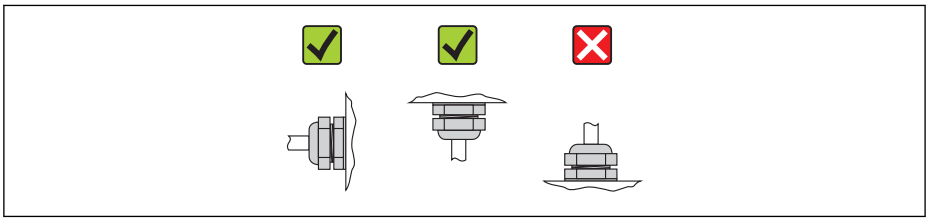
6.2.3 Mounting the sensor

WARNING

Danger due to improper process sealing!

- ▶ Ensure that the inside diameters of the gaskets are greater than or equal to that of the process connections and piping.
- ▶ Ensure that the gaskets are clean and undamaged.
- ▶ Install the gaskets correctly.

1. Ensure that the direction of the arrow on the sensor matches the flow direction of the medium.
2. To ensure compliance with device specifications, install the measuring device between the pipe flanges in a way that it is centered in the measurement section.
3. If using ground disks, comply with the Installation Instructions provided.
4. Observe required screw tightening torques (→ 23).
5. Install the measuring device or turn the transmitter housing so that the cable entries do not point upwards.



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Mounting the seals

CAUTION

An electrically conductive layer could form on the inside of the measuring tube!

Risk of measuring signal short circuit.

- ▶ Do not use electrically conductive sealing compounds such as graphite.

Comply with the following instructions when installing seals:

- When mounting the process connections, make sure that the seals concerned are clean and centered correctly.
- For DIN flanges: only use seals according to DIN EN 1514-1.
- For "PFA" lining: additional seals are **always** required.
- For "PTFE" lining: generally additional seals are **not** required.

Mounting the ground cable/ground disks

Comply with the information on potential equalization and detailed mounting instructions for the use of ground cables/ground disks (→ 32).

Screw tightening torques

Please note the following:
- The screw tightening torques listed below apply only to lubricated threads and to pipes not subjected to tensile stress.
- Tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.

Screw tightening torques for EN 1092-1 (DIN 2501), PN 40/25

Nominal diameter [mm]	Pressure rating [bar]	Threaded fasteners [mm]	Max. screw tightening torque [Nm]	
			PTFE	PFA
15	PN 40	4 × M12	11	–
25	PN 40	4 × M12	26	20
32	PN 40	4 × M16	41	35
40	PN 40	4 × M16	52	47
50	PN 40	4 × M16	65	59
65 [1)]	PN 16	8 × M16	43	40
65	PN 40	8 × M16	43	40
80	PN 16	8 × M16	53	48
80	PN 40	8 × M16	53	48
100	PN 16	8 × M16	57	51
100	PN 40	8 × M20	78	70
125	PN 16	8 × M16	75	67
125	PN 40	8 × M24	111	99
150	PN 16	8 × M20	99	85
150	PN 40	8 × M24	136	120
200	PN 10	8 × M20	141	101
200	PN 16	12 × M20	94	67
200	PN 25	12 × M24	138	105
250	PN 10	12 × M20	110	–
250	PN 16	12 × M24	131	–
250	PN 25	12 × M27	200	–
300	PN 10	12 × M20	125	–
300	PN 16	12 × M24	179	–
300	PN 25	16 × M27	204	–
350	PN 10	16 × M20	188	–
350	PN 16	16 × M24	254	–
350	PN 25	16 × M30	380	–
400	PN 10	16 × M24	260	–
400	PN 16	16 × M27	330	–
400	PN 25	16 × M33	488	–
450	PN 10	20 × M24	235	–
450	PN 16	20 × M27	300	–
450	PN 25	20 × M33	385	–
500	PN 10	20 × M24	265	–
500	PN 16	20 × M30	448	–

Nominal diameter [mm]	Pressure rating [bar]	Threaded fasteners [mm]	Max. screw tightening torque [Nm]	
			PTFE	PFA
500	PN 25	20 × M33	533	–
600	PN 10	20 × M27	345	–
600 [1)]	PN 16	20 × M33	658	–
600	PN 25	20 × M36	731	–

1) Designed acc. to EN 1092-1 (not to DIN 2501)

Screw tightening torques for ASME B16.5, Class 150/300

Nominal diameter		Pressure rating	Threaded fasteners	Max. screw tightening torque [Nm] ([lbf · ft])	
[mm]	[in]	[psi]	[in]	PTFE	PFA
15	½	Class 150	4 × ½	6 (4)	– (–)
15	½	Class 300	4 × ½	6 (4)	– (–)
25	1	Class 150	4 × ½	11 (8)	10 (7)
25	1	Class 300	4 × 5/8	14 (10)	12 (9)
40	1 ½	Class 150	4 × ½	24 (18)	21 (15)
40	1 ½	Class 300	4 × ¾	34 (25)	31 (23)
50	2	Class 150	4 × 5/8	47 (35)	44 (32)
50	2	Class 300	8 × 5/8	23 (17)	22 (16)
80	3	Class 150	4 × 5/8	79 (58)	67 (49)
80	3	Class 300	8 × ¾	47 (35)	42 (31)
100	4	Class 150	8 × 5/8	56 (41)	50 (37)
100	4	Class 300	8 × ¾	67 (49)	59 (44)
150	6	Class 150	8 × ¾	106 (78)	86 (63)
150	6	Class 300	12 × ¾	73 (54)	67 (49)
200	8	Class 150	8 × ¾	143 (105)	109 (80)
250	10	Class 150	12 × 7/8	135 (100)	– (–)
300	12	Class 150	12 × 7/8	178 (131)	– (–)
350	14	Class 150	12 × 1	260 (192)	– (–)
400	16	Class 150	16 × 1	246 (181)	– (–)
450	18	Class 150	16 × 1 1/8	371 (274)	– (–)
500	20	Class 150	20 × 1 1/8	341 (252)	– (–)
600	24	Class 150	20 × 1 ¼	477 (352)	– (–)

Screw tightening torques for JIS B2220, 10/20K

Nominal diameter [mm]	Pressure rating [bar]	Threaded fasteners [mm]	Max. screw tightening torque [Nm]	
			PTFE	PFA
25	10K	4 × M16	32	27
25	20K	4 × M16	32	27
32	10K	4 × M16	38	–
32	20K	4 × M16	38	–
40	10K	4 × M16	41	37

Nominal diameter [mm]	Pressure rating [bar]	Threaded fasteners [mm]	Max. screw tightening torque [Nm]	
			PTFE	PFA
40	20K	4 × M16	41	37
50	10K	4 × M16	54	46
50	20K	8 × M16	27	23
65	10K	4 × M16	74	63
65	20K	8 × M16	37	31
80	10K	8 × M16	38	32
80	20K	8 × M20	57	46
100	10K	8 × M16	47	38
100	20K	8 × M20	75	58
125	10K	8 × M20	80	66
125	20K	8 × M22	121	103
150	10K	8 × M20	99	81
150	20K	12 × M22	108	72
200	10K	12 × M20	82	54
200	20K	12 × M22	121	88
250	10K	12 × M22	133	–
250	20K	12 × M24	212	–
300	10K	16 × M22	99	–
300	20K	16 × M24	183	–

Screw tightening torques for AS 2129, Table E

Nominal diameter [mm]	Threaded fasteners [mm]	Max. screw tightening torque [Nm] PTFE
25	4 × M12	21
50	4 × M16	42

Screw tightening torques for AS 4087, PN 16

Nominal diameter [mm]	Threaded fasteners [mm]	Max. screw tightening torque [Nm] PTFE
50	4 × M16	42

6.3 Post-installation check

Is the device undamaged (visual inspection)?	❑
Does the measuring device conform to the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure (refer to the section on "Pressure-temperature ratings" in the "Technical Information" document) ▪ Ambient temperature ▪ Measuring range	❑

Has the correct orientation for the sensor been selected (→ 🖹 18)? ▪ According to sensor type ▪ According to medium temperature ▪ According to medium properties (outgassing, with entrained solids)	❑
Does the arrow on the sensor nameplate match the direction of flow of the fluid through the piping (→ 🖹 18)?	❑
Are the measuring point identification and labeling correct (visual inspection)?	❑
Is the device adequately protected from precipitation and direct sunlight?	❑
Have the fixing screws been tightened with the correct tightening torque?	❑

7 Electrical connection

7.1 Connection conditions

7.1.1 Required tools

- For cable entries: Use corresponding tools
- For securing clamp (on aluminum housing): Allen screw 3 mm
- For securing screw (for stainless steel housing): open-ended wrench 8 mm
- Wire stripper
- When using stranded cables: Crimping tool for wire end ferrule

7.1.2 Requirements for connecting cable

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

Electrical safety

In accordance with applicable federal/national regulations.

Permitted temperature range

- −40 °C (−40 °F)...≥80 °C (176 °F)
- Minimum requirement: cable temperature range ≥ ambient temperature + 20 K

Power supply cable

Standard installation cable is sufficient.

Signal cable

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ωat a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Cable diameter

- Cable glands supplied:
  M20 × 1.5 with cable Φ6 to 12 mm (0.24 to 0.47 in)
- Spring terminals:
  wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)

7.1.3 Terminal assignment

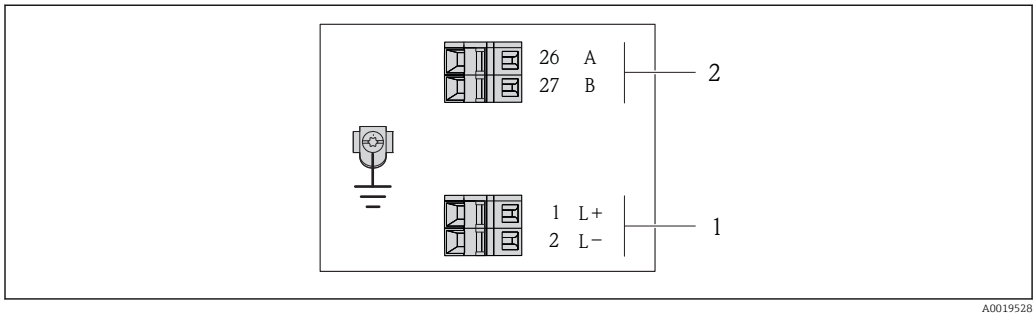
Transmitter

Connection version Modbus RS485, for use in non-hazardous areas and Zone 2/Div. 2

Order code for "Output", option **M**

Depending on the housing version, the transmitters can be ordered with terminals or device plugs.

Order code for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Option **A**	Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Option **A**	Device plug (→ 🖹 28)	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20
Option **A**	Device plug (→ 🖹 28)	Device plug (→ 🖹 28)	Option **Q**: 2 x plug M12x1
Order code for "Housing": Option **A**: compact, coated alu			



7 Modbus RS485 terminal assignment

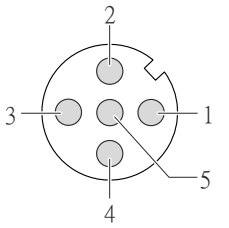
1 Power supply: DC 24 V
2 Output: Modbus RS485

Order code for "Output"	Terminal number			
	Power supply		Output	
	2 (L-)	1 (L+)	27 (B)	26 (A)
Option **M**	24 DC V		Modbus RS485	
Order code for "Output": Option **M**: Modbus RS485, for use in non-hazardous areas and Zone 2/Div. 2				

7.1.4 Pin assignment, device plug

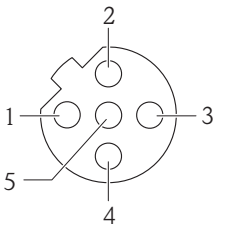
Modbus RS485

Supply voltage for Modbus RS485, non-hazardous area and Zone 2/Div. 2 (on the device side)



Pin	Assignment		Coding	Plug/socket
1	L+	DC24 V	A	Plug
2				
3				
4	L-	DC24 V		
5		Grounding/shielding		

Modbus RS485, non-hazardous areas and zone 2/Div. 2 (on the device side)



Pin	Assignment		Coding	Plug/socket
1			B	Socket
2	A	Modbus RS485		
3				
4	B	Modbus RS485		
5		Grounding/shielding		

7.1.5 Shielding and grounding

The shielding and grounding concept requires compliance with the following:
- Electromagnetic compatibility (EMC)
- Explosion protection
- Personal protection equipment
- National installation regulations and guidelines
- Observe cable specification (→ 27).
- Keep the stripped and twisted lengths of cable shield to the ground terminal as short as possible.
- Seamless cable shielding.

Grounding of the cable shield

To comply with EMC requirements:
- Ensure the cable shield is grounded to the potential matching line at multiple points.
- Connect every local ground terminal to the potential matching line.

NOTICE

In systems without potential matching, the multiple grounding of the cable shield causes mains frequency equalizing currents!

Damage to the bus cable shield.

▶ Only ground the bus cable shield to either the local ground or the protective ground at one end.

7.1.6 Preparing the measuring device

1. Remove dummy plug if present.
2. **NOTICE!** Insufficient sealing of the housing! Operational reliability of the measuring device could be compromised. Use suitable cable glands corresponding to the degree of protection.
   If measuring device is delivered without cable glands:
   Provide suitable cable gland for corresponding connecting cable (→ 27).
3. If measuring device is delivered with cable glands:
   Observe cable specification (→ 27).

7.2 Connecting the measuring device

NOTICE

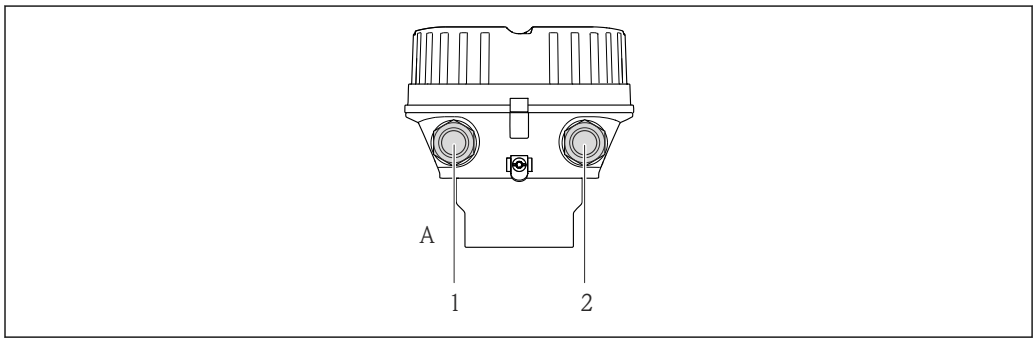
Limitation of electrical safety due to incorrect connection!

- ▶ Have electrical connection work carried out by correspondingly trained specialists only.
- ▶ Observe applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.
- ▶ For use in potentially explosive atmospheres, observe the information in the device-specific Ex documentation.

7.2.1 Connecting the transmitter

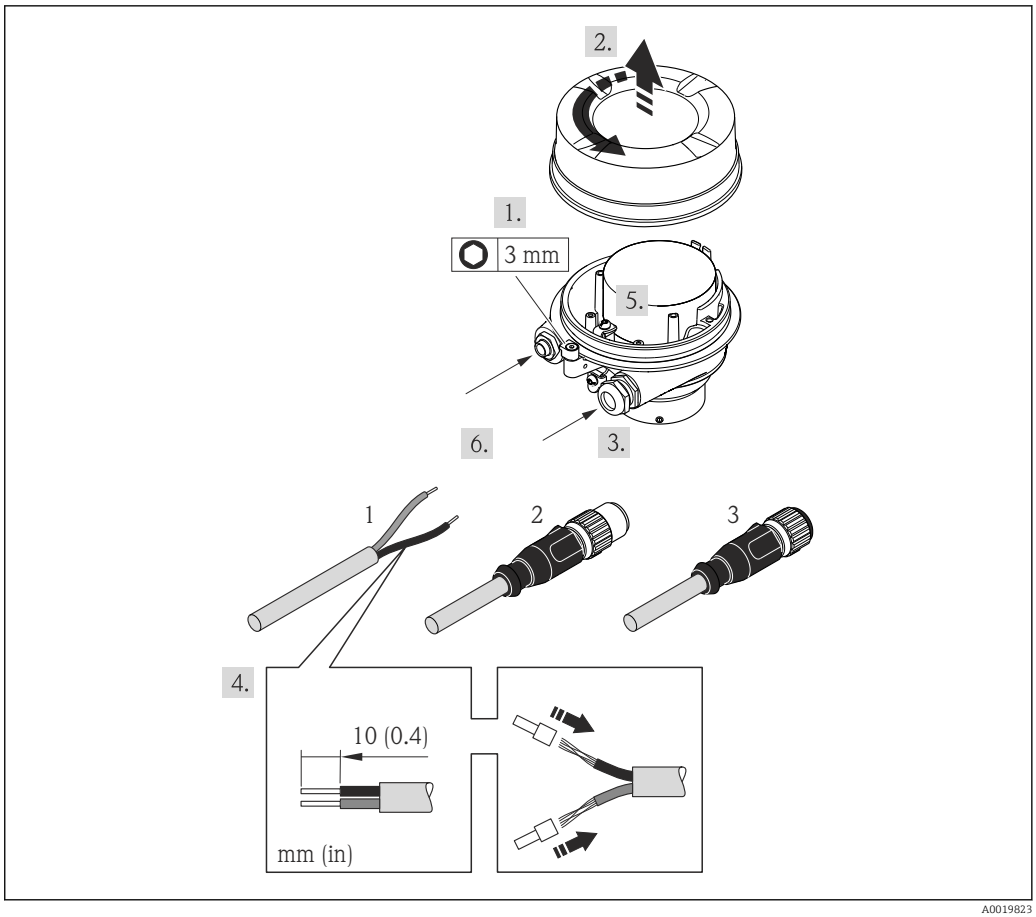
The connection of the transmitter depends on the following order codes:

- Housing version: compact or ultracompact
- Connection version: device plug or terminals



8 Device versions and connection versions

A Housing version: compact, aluminum coated
1 Cable entry or device plug for signal transmission
2 Cable entry or device plug for supply voltage



9 *Device versions with connection examples*

1 Cable
2 Device plug for signal transmission
3 Device plug for supply voltage

For device version with device plug: only pay attention to Step 6.

1. Depending on the housing version, loosen the securing clamp or fixing screw of the housing cover.
2. Depending on the housing version, unscrew or open the housing cover.
3. Push the cable through the cable entry . To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.
5. Connect the cable in accordance with the terminal assignment or the device plug pin assignment (→ 🖹 28).
6. Depending on the device version: tighten the cable glands or plug in the device plug and tighten (→ 🖹 28).
7. Enable the terminating resistor if applicable (→ 🖹 34).
8. **NOTICE!** Housing degree of protection voided due to insufficient sealing of the housing. Screw in the screw without using any lubricant. The threads on the cover are coated with a dry lubricant.
   Reverse the removal procedure to reassemble the transmitter.

7.2.2 Ensuring potential equalization

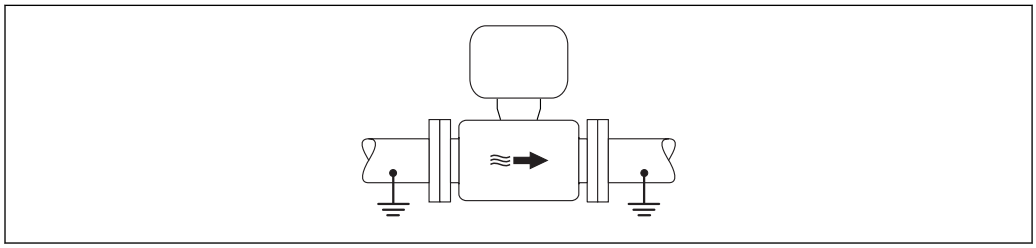
⚠ CAUTION

Electrode damage can result in the complete failure of the device!

- ▶ Make sure that the fluid and sensor have the same electrical potential.
- ▶ Pay attention to internal grounding concepts in the company.
- ▶ Pay attention to the pipe material or grounding.

Connection examples for standard situations

Metal, grounded pipe



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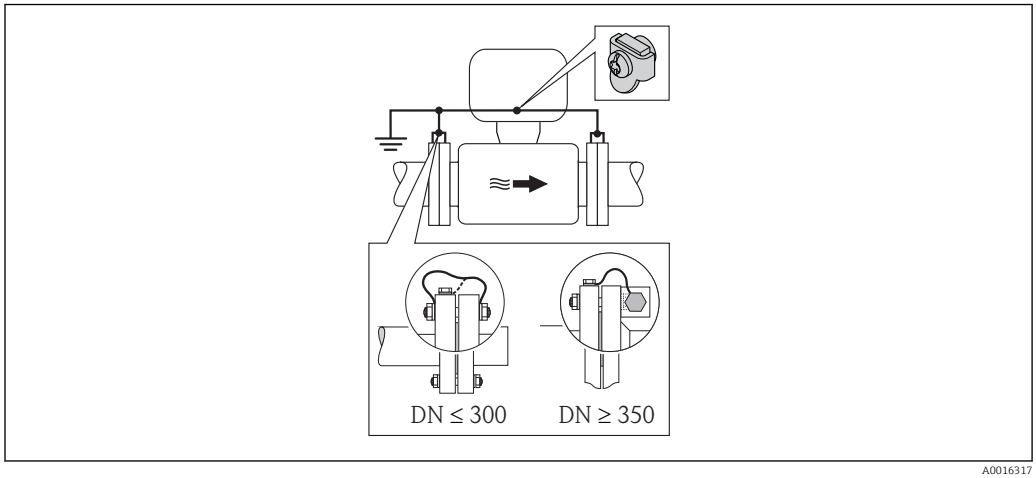
10 *Potential equalization via measuring tube*

Connection example in special situations

Unlined and ungrounded metal pipe

This connection method also applies in situations where:

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



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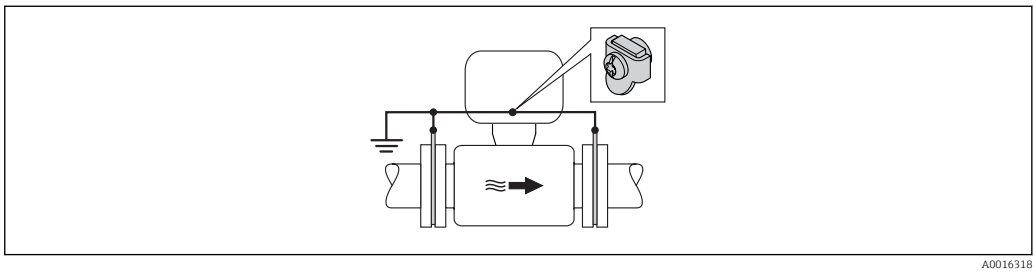
11 *Potential equalization via ground terminal and pipe flanges*

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)

1. Connect both sensor flanges to the pipe flange via a ground cable and ground them.
2. If DN ≤ 300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.If DN ≥ 350 (14"): Mount the ground cable directly on the metal transport bracket.Observe torques (→ 🖹 23).
3. Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for the purpose.

Plastic pipe or pipe with insulating liner

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present



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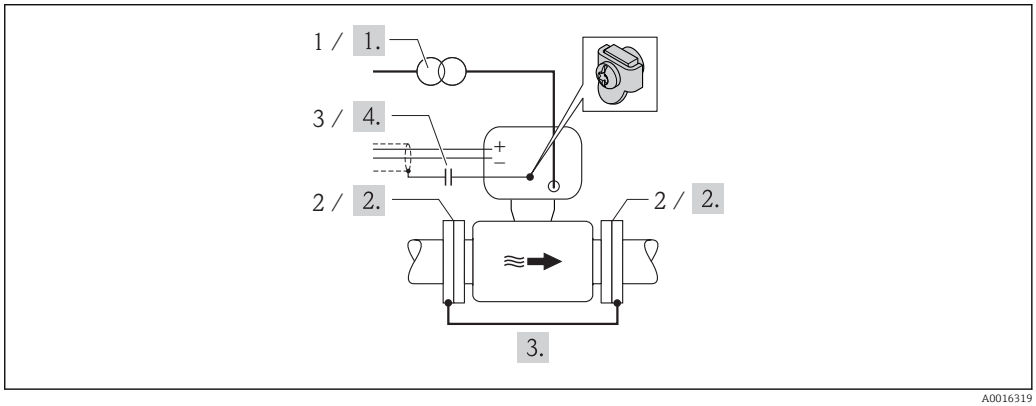
12 *Potential equalization via ground terminal and ground disks*

1. Connect the ground disks to the ground terminal via the ground cable.
2. Connect the ground disks to ground potential.

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)

Pipe with a cathodic protection unit

This connection method is only used if the following two conditions are met:
- Metal pipe without liner or pipe with electrically conductive liner
- Cathodic protection is integrated in the personal protection equipment



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13 *Potential equalization and cathodic protection*

1 Isolation transformer power supply
2 Electrically isolated from the pipe
3 Capacitor

Ground cable	Copper wire, at least 6 mm² (0.0093 in²)

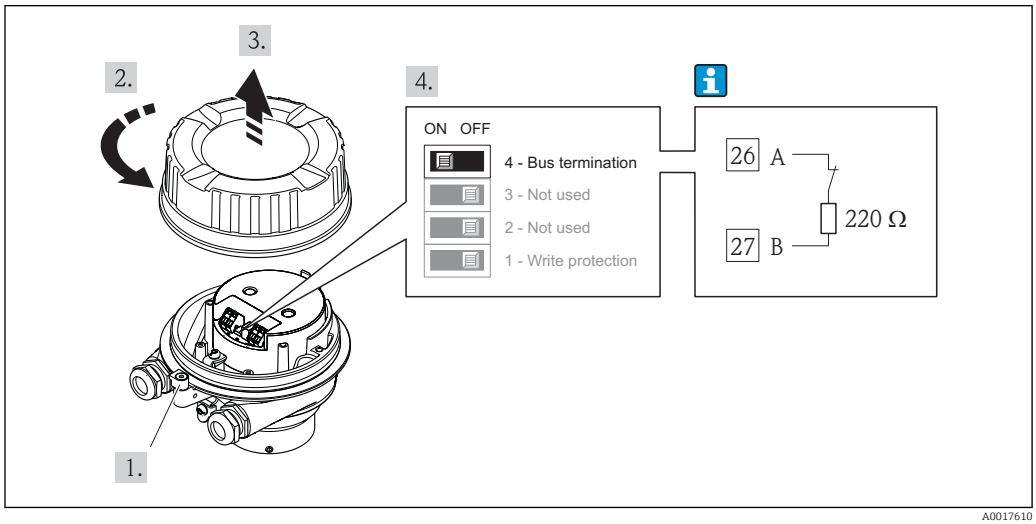
1. Connect the measuring device to the power supply such that it is floating in relation to the protective ground.
2. Install the sensor in the pipe in a way that provides electrical insulation.
3. Connect the two flanges of the pipe to one another via a ground cable.
4. Guide the shield of the signal lines through a capacitor.

7.3 Hardware settings

7.3.1 Enabling the terminating resistor

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

If the transmitter is used in the non-hazardous area or Zone 2/Div. 2



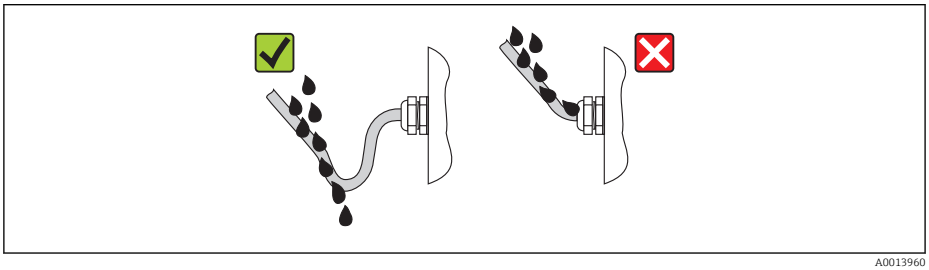
14 *Terminating resistor can be enabled via DIP switch on the main electronics module*

7.4 Ensuring the degree of protection

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

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

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



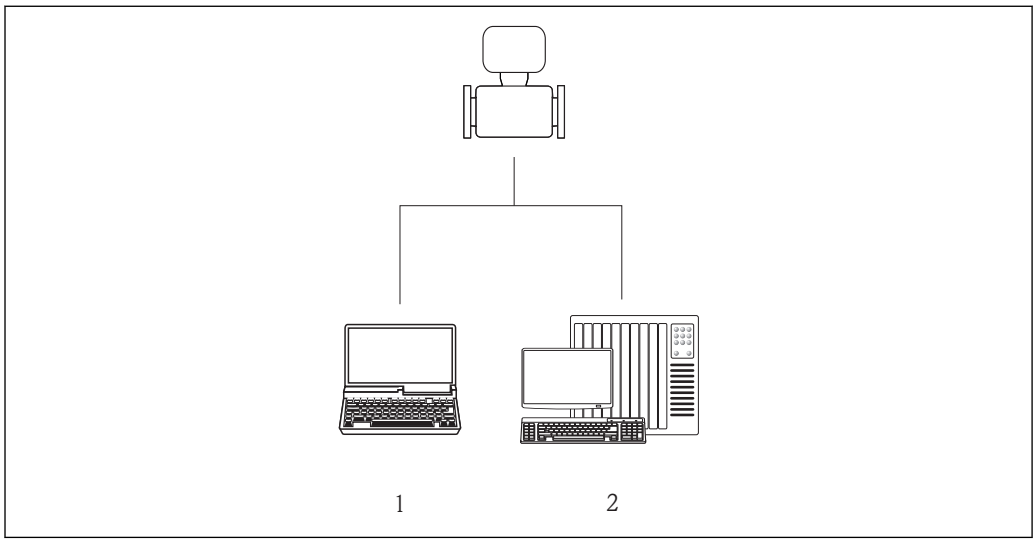
5. Insert dummy plugs into unused cable entries.

7.5 Post-connection check

Are cables or the device undamaged (visual inspection)?	❑
Do the cables comply with the requirements (→ 🖹 27)?	❑
Do the cables have adequate strain relief?	❑
Are all the cable glands installed, firmly tightened and leak-tight? Cable run with "water trap" (→ 🖹 34) ?	❑
Depending on the device version: are all the device plugs firmly tightened (→ 🖹 30)?	❑
▪ Does the supply voltage match the specifications on the transmitter nameplate (→ 🖹 77)? ▪ For device version with Modbus RS485 intrinsically safe: does the supply voltage match the specifications on the nameplate of the Safety Barrier Promass 100 (→ 🖹 77)?	❑
Is the terminal assignment or the pin assignment of the device plug (→ 🖹 28) correct?	❑
▪ If supply voltage is present, is the power LED on the electronics module of the transmitter lit green (→ 🖹 10)? ▪ For device version with Modbus RS485 intrinsically safe, if supply voltage is present, is the power LED on the Safety Barrier Promass 100 lit (→ 🖹 10)?	❑
Is the potential equalization established correctly (→ 🖹 32)?	❑
Depending on the device version, is the securing clamp or fixing screw firmly tightened?	❑

8 Operation options

8.1 Overview of operation options

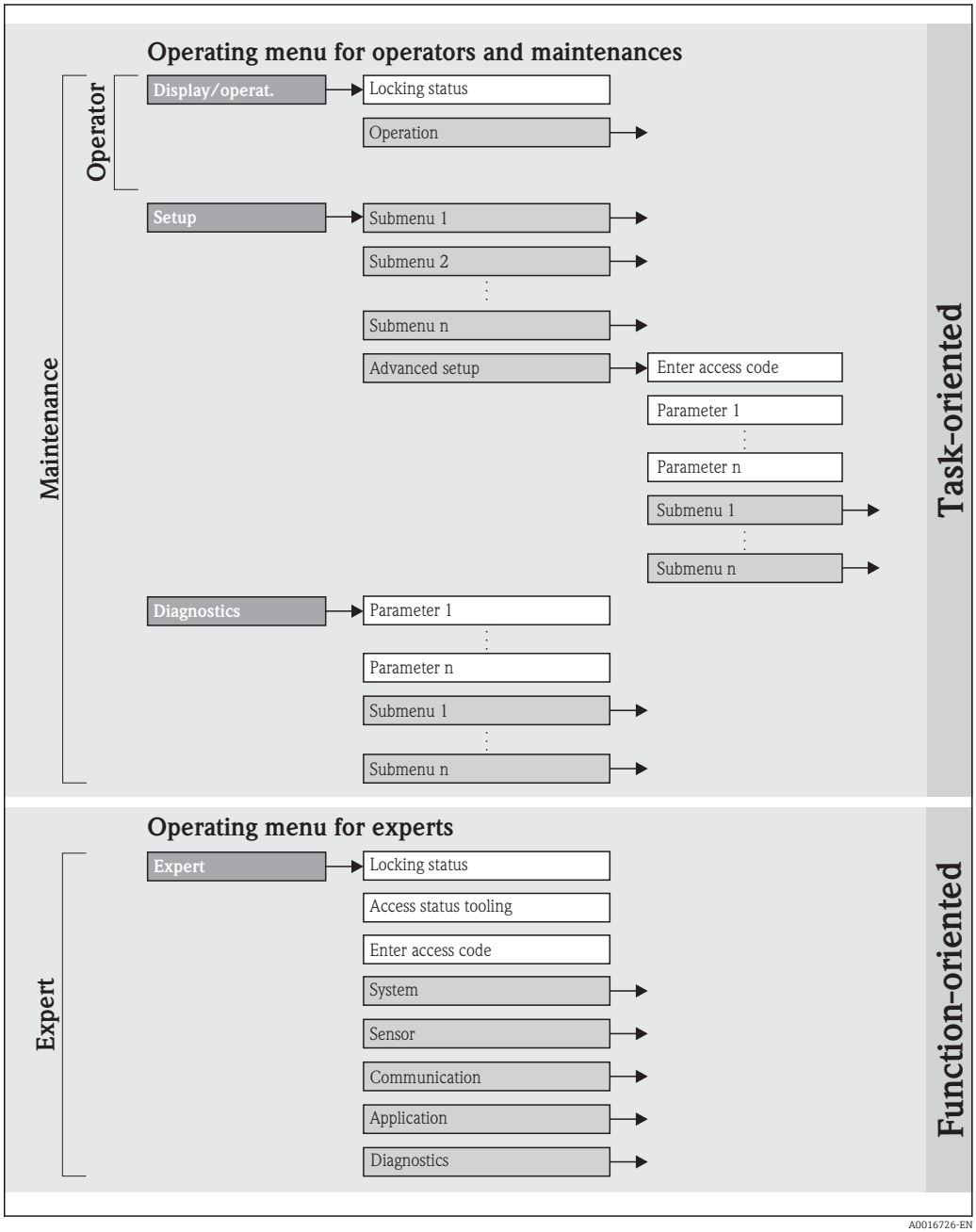


1 Computer with "FieldCare" operating tool via Commubox FXA291 and service interface (CDI)
2 Control system (e.g. PLC)

8.2 Structure and function of the operating menu

8.2.1 Structure of the operating menu

For an overview of the operating menu with menus and parameters



15 *Taking the example of the "FieldCare" operating tool*

8.2.2 Operating philosophy

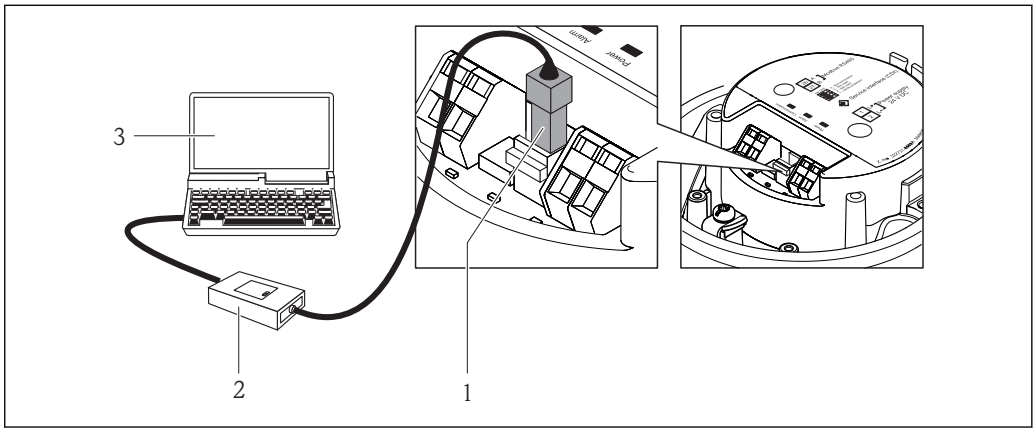
The individual parts of the operating menu are assigned to certain user roles. Each user role corresponds to typical tasks within the device lifecycle.

Menu		User role and tasks	Content/meaning
Display/operat.	task-oriented	**Role "Operator", "Maintenance"** Tasks during operation: Reading measured values	Resetting and controlling totalizers
Setup		**"Maintenance" role** Commissioning: ▪ Configuration of the measurement ▪ Configuration of the communication interface	Submenus for fast commissioning: ▪ Setting the individual system units ▪ Defining the medium ▪ Configuration of the digital communication interface ▪ Configuring the low flow cut off "Advanced setup" submenu: ▪ For more customized configuration of the measurement (adaptation to special measuring conditions) ▪ Configuration of totalizers
Diagnostics		**"Maintenance" role** Fault elimination: ▪ Diagnostics and elimination of process and device errors ▪ Measured value simulation	Contains all parameters for error detection and analyzing process and device errors: ▪ **"Diagnostic list" submenu** Contains up to 5 currently pending diagnostic messages. ▪ **"Event logbook" submenu** Contains 20 event messages that have occurred. ▪ **"Device information" submenu** Contains information for identifying the device. ▪ **"Measured values" submenu** Contains all current measured values. ▪ **"Simulation" submenu** Is used to simulate measured values or output values. ▪ **"Device reset" submenu** Resets the device configuration to certain settings
Expert	function-oriented	Tasks that require detailed knowledge of the function of the device: ▪ Commissioning measurements under difficult conditions ▪ Optimal adaptation of the measurement to difficult conditions ▪ Detailed configuration of the communication interface ▪ Error diagnostics in difficult cases	Contains all the parameters of the device and makes it possible to access these parameters directly using an access code. The structure of this menu is based on the function blocks of the device: ▪ **"System" submenu** Contains all higher-order device parameters that do not pertain either to measurement or the measured value communication. ▪ **"Sensor" submenu** Contains all parameters for configuring the measurement. ▪ **"Communication" submenu** Contains all parameters for configuring the digital communication interface. ▪ **"Application" submenu** Contains all parameters for configuring the functions that go beyond the actual measurement (e.g. totalizer). ▪ **"Diagnostics" submenu** Contains all parameters for error detection and analyzing process and device errors and for device simulation.

8.3 Access to the operating menu via the operating tool

8.3.1 Connecting the operating tool

Via service interface (CDI)



1 Service interface (CDI) of the measuring device
2 Commubox FXA291
3 Computer with "FieldCare" operating tool with COM DTM "CDI Communication FXA291"

8.3.2 FieldCare

Function scope

FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in a system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

Access takes place via:
Service interface CDI (→ 🖹 39)

Typical functions:
- Configuring parameters of transmitters
- Loading and saving device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook

For details, see Operating Instructions BA00027S and BA00059S

Source for device description files

See data (→ 🖹 41)

Establishing a connection

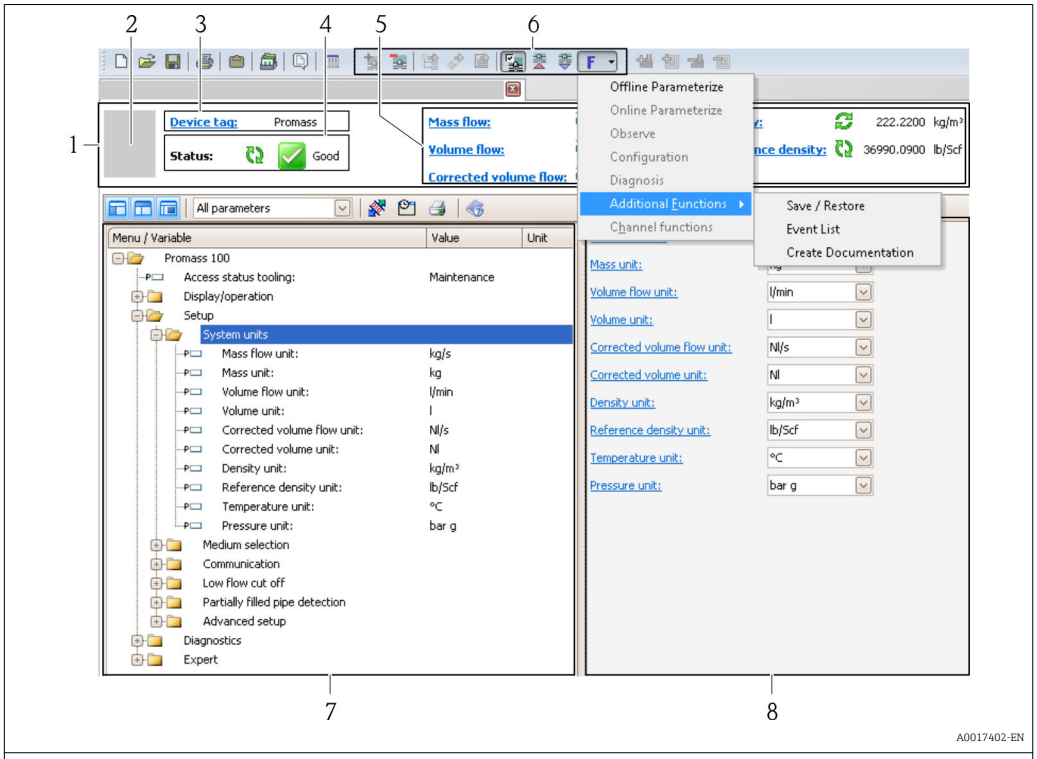
Via service interface (CDI)

1. Start FieldCare and launch the project.
2. In the network: Add a device.
   ↳ The **Add device** window opens.
3. Select the **CDI Communication FXA291** option from the list and press **OK** to confirm.
4. Right-click **CDI Communication FXA291** and select the **Add device** option in the context menu that opens.

5. Select the desired device from the list and press **OK** to confirm.
6. Establish the online connection to the device.

For details, see Operating Instructions BA00027S and BA00059S

User interface



1	*Header*
2	*Picture of device*
3	*Device tag*
4	*Status area with status signal (→ 60)*
5	*Display area for current measured values*
6	*Event list with additional functions such as save/load, events list and document creation*
7	*Navigation area with operating menu structure*
8	*Working area*

9 System integration

9.1 Overview of device description files

9.1.1 Current version data for the device

Firmware version	01.02.00	▪ On the title page of the Operating instructions ▪ On transmitter nameplate(→ 12) ▪ Parameter **firmware version** Diagnostics → Device info→ Firmware version
Release date of firmware version	04.2013	---

9.1.2 Operating tools

The suitable device description file for the operating tool is listed in the table below, along with information on where the file can be acquired.

Operating tool via service interface (CDI)	Sources for obtaining device descriptions
FieldCare	▪ www.endress.com → Download Area ▪ CD–ROM (contact Endress+Hauser) ▪ DVD (contact Endress+Hauser)

9.2 Modbus RS485 information

9.2.1 Function codes

Function codes are used to define which read or write action is carried out via the Modbus protocol. The measuring device supports the following function codes:

Code	Name	Description	Application
03	Read holding register	Master reads one or more Modbus registers from the device. A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes The measuring device does not make a distinction between function codes 03 and 04; these codes therefore yield the same result.	Read device parameters with read and write access Example: Read volume flow
04	Read input register	Master reads one or more Modbus registers from the device. A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes The measuring device does not make a distinction between function codes 03 and 04; these codes therefore yield the same result.	Read device parameters with read access Example: Read totalizer value

Code	Name	Description	Application
06	Write single registers	Master writes a new value to **one** Modbus register of the measuring device. Use function code 16 to write multiple registers with just 1 telegram.	Write only 1 device parameter Example: reset totalizer
08	Diagnostics	Master checks the communication connection to the measuring device. The following "Diagnostics codes" are supported: ▪ Sub-function 00 = Return query data (loopback test) ▪ Sub-function 02 = Return diagnostics register	
16	Write multiple registers	Master writes a new value to multiple Modbus registers of the device. A maximum of 120 consecutive registers can be written with 1 telegram. If the required device parameters are not available as a group, yet must nevertheless be addressed with a single telegram, use Modbus data map (→ 42)	Write multiple device parameters
23	Read/Write multiple registers	Master reads and writes a maximum of 118 Modbus registers of the measuring device simultaneously with 1 telegram. Write access is executed **before** read access.	Write and read multiple device parameters Example: ▪ Read mass flow ▪ Reset totalizer

Broadcast messages are only allowed with function codes 06, 16 and 23.

9.2.2 Register information

For an overview on Modbus-specific information of the individual device parameters, please refer to the additional document on Modbus RS485 register information (→ 87)

9.2.3 Response time

Response time of the measuring device to the request telegram of the Modbus master: typically 3 to 5 ms

9.2.4 Modbus data map

Function of the Modbus data map

The device offers a special memory area, the Modbus data map (for a maximum of 16 device parameters), to allow users to call up multiple device parameters via Modbus RS485 and not only individual device parameters or a group of consecutive device parameters.

Grouping of device parameters is flexible and the Modbus master can read or write to the entire data block simultaneously with a single request telegram.

Structure of the Modbus data map

The Modbus data map consists of two data sets:
- Scan list: Configuration area
  The device parameters to be grouped are defined in a list in that their Modbus RS485 register addresses are entered in the list.
- Data area
  The measuring device reads out the register addresses entered in the scan list cyclically and writes the associated device data (values) to the data area.

For an overview of device parameters with their individual Modbus register address, please refer to the additional document on Modbus RS485 register information

Scan list configuration

For configuration, the Modbus RS485 register addresses of the device parameters to be grouped must be entered in the scan list. Please note the following basic requirements of the scan list:

Max. entries	16 device parameters
Supported device parameters	Only parameters with the following characteristics are supported: ▪ Access type: read or write access ▪ Data type: float or integer

Configuring the scan list via FieldCare

Carried out using the operating menu of the measuring device:
Expert → Communication → Modbus data map → Scan list register 0 -15

Scan list	
No.	**Configuration register**
0	Scan list register 0
...	...
15	Scan list register 15

Configuring the scan list via Modbus RS485

Carried out using register addresses 5001 - 5016

Scan list			
No.	**Modbus RS485 register**	**Data type**	**Configuration register**
0	5001	Integer	Scan list register 0
...	...	Integer	...
15	5016	Integer	Scan list register 15

Reading out data via Modbus RS485

The Modbus master accesses the data area of the Modbus data map to read out the current values of the device parameters defined in the scan list.

Master access to data area	Via register addresses 5051-5081

Data area			
Device parameter value	**Modbus RS485 register**	**Data type***	**Access****
Value of scan list register 0	5051	Integer/float	Read/write
Value of scan list register 1	5053	Integer/float	Read/write
Value of scan list register …	…	…	…
Value of scan list register 15	5081	Integer/float	Read/write

***** Data type depends on the device parameters entered in the scan list.
****** Data access depends on the device parameters entered in the scan list. If the device parameter entered supports read and write access, the parameter can also be accessed via the data area.

10 Commissioning

10.1 Function check

Before commissioning the device, make sure that the post-installation and post-connection checks have been performed.

- "Post-mounting check" checklist (→ 25)
- "Post-connection check" checklist (→ 35)

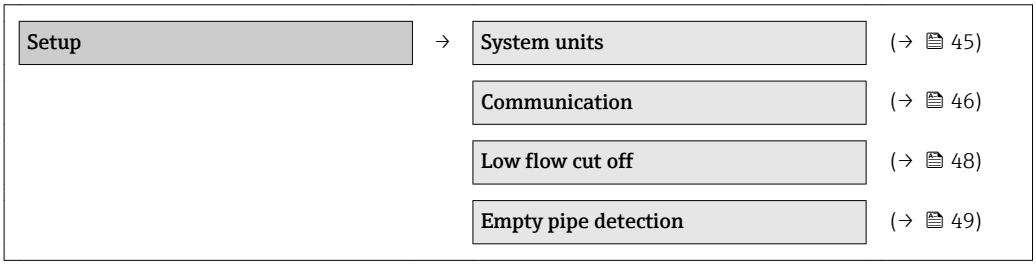
10.2 Establishing a connection via FieldCare

- For FieldCare connection (→ 39)
- For establishing a connection via FieldCare (→ 39)
- For FieldCare user interface (→ 40)

10.3 Configuring the measuring device

The **Setup** menu with its submenus contains all parameters needed for standard operation.

Structure of the "Setup" menu

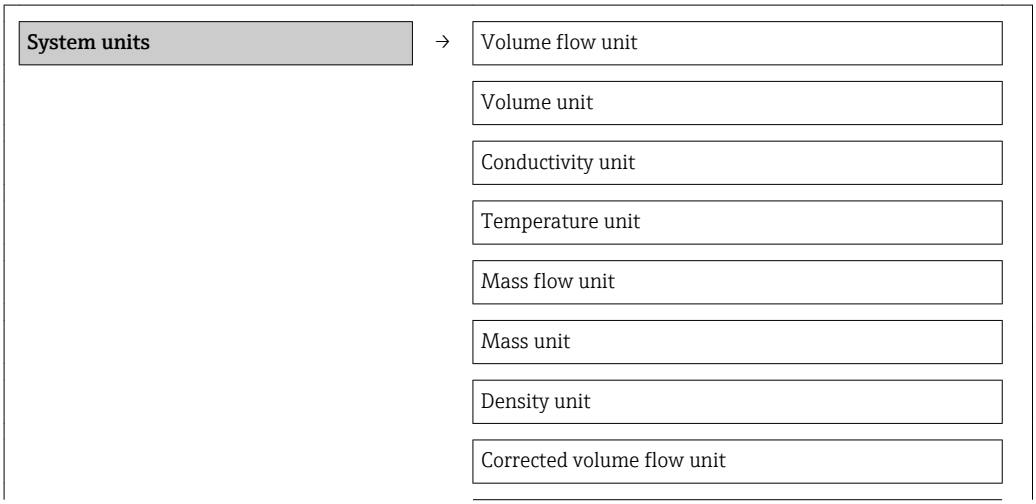


10.3.1 Setting the system units

In the **System units** submenu, you can configure the units of all measured values.

Navigation path
"Setup" menu → Advanced setup → System units

Structure of the submenu



	Corrected volume unit

Parameter overview with brief description

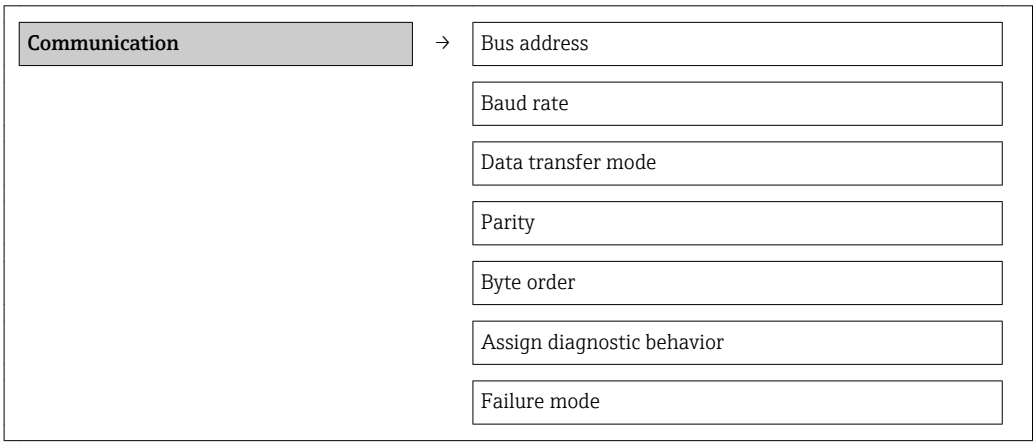
Parameter	Description	Options	Factory setting
Volume flow unit	Select the unit for volume flow. *Result* The selected unit applies for: – Low flow cut off – Simulation process variable	Unit choose list	Country-dependent: ▪ l/h ▪ gal/min
Volume unit	Select the unit for volume. *Result* The selected unit applies for: Value per pulse	Unit choose list	Country-dependent: ▪ m^3 ▪ gal
Conductivity unit	Select the unit for conductivity. *Result* The selected unit applies for: Simulation process variable	Unit choose list	µS/cm
Mass flow unit	Select the unit for mass flow. *Result* The selected unit applies for: – Low flow cut off – Simulation process variable	Unit choose list	Country-dependent: ▪ kg/h ▪ lbs/min
Mass unit	Select the unit for mass. *Result* The selected unit applies for: Value per pulse	Unit choose list	Country-dependent: ▪ kg ▪ lbs
Density unit	Select the unit for density. *Result* The selected unit applies for: Fixed density	Unit choose list	Country-dependent ▪ kg/l ▪ g/cc
Temperature unit	Select the unit for temperature. *Result* The selected unit applies for: Diagnostics: Min/max values	Unit choose list	Country-dependent: ▪ °C (Celsius) ▪ °F (Fahrenheit)
Corrected volume flow unit	Select the unit for corrected volume flow. *Result* The selected unit applies for: – Low flow cut off – Simulation process variable	Unit choose list	Country-dependent: ▪ Nl/h ▪ Sgal/min
Corrected volume unit	Select the unit for standard volume. *Result* The selected unit applies for: – Low flow cut off – Simulation process variable	Unit choose list	Country-dependent: ▪ Nm^3 ▪ Sgal

10.3.2 Configuring communication interface

The **Communication** submenu guides you systematically through all parameters that must be configured for selecting and setting the communication interface.

Navigation path
"Setup" menu → Communication

Structure of the submenu



Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Bus address	Enter device address.	1 to 247	247
Baud rate	Define data transfer speed.	Baud rate list box(→ 🖹 76)	19 200 BAUD
Data transfer mode	Select data transfer mode.	▪ ASCII Transmission of data in the form of readable ASCII characters. Error protection via LRC. ▪ RTU Transmission of data in binary form. Error protection via CRC16.	RTU
Parity	Select parity bits.	**ASCII picklist** ▪ 0 = even ▪ 1 = odd **RTU picklist** ▪ 0 = even ▪ 1 = odd ▪ 2 = no parity bit/1 stop bit ▪ 3 = no parity bit/2 stop bits	Even
Byte order	Select byte transmission sequence.	▪ 0-1-2-3 ▪ 3-2-1-0 ▪ 1-0-3-2 ▪ 2-3-0-1	1-0-3-2

Parameter	Description	Selection/ User entry	Factory setting
Assign diagnostic behavior	Select diagnostic behavior for MODBUS communication.	▪ Off ▪ Alarm or warning ▪ Warning ▪ Alarm	Alarm
Failure mode	Select measured value output behavior when a diagnostic message occurs via Modbus communication. This parameter operates in accordance with the option selected in the **Assign diagnostic behavior** parameter.	▪ NaN value ▪ Last valid value NaN ≡ not a number	NaN value

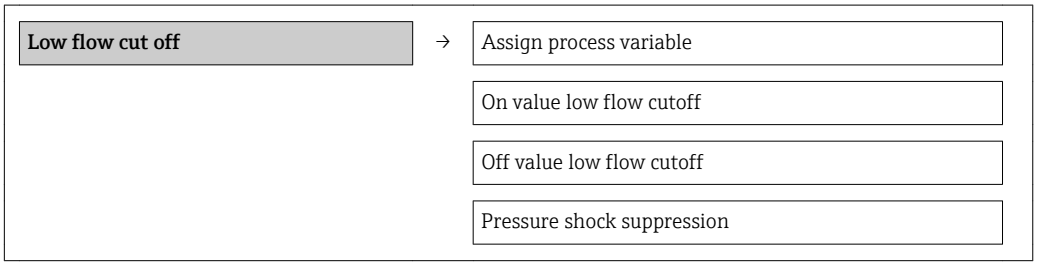
10.3.3 Configuring the low flow cut off

The **Low flow cut off** submenu contains parameters that have to be set for configuring the low flow cut off.

Navigation path

"Setup" menu → Low flow cut off

Structure of the submenu



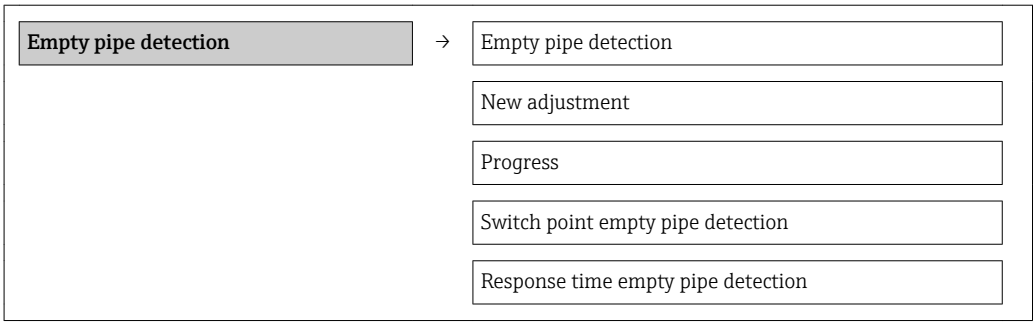
Parameter overview with brief description

Parameter	Description	Selection/input	Factory setting
Assign process variable	Select process variable for low flow cut off.	▪ Off ▪ Volume flow ▪ Mass flow ▪ Corrected volume flow	Volume flow
On value	Enter the on value for low flow cut off.	Positive floating-point number	0
Off value	Enter the off value for low flow cut off.	0 to 100 %	50 %
Pressure shock suppression	Enter time frame for signal suppression (= active pressure shock suppression)	0 to 100 s	0 s

10.3.4 Configuring empty pipe detection

The **Empty pipe detection (EPD)** submenu contains parameters that have to be set for configuring empty pipe detection.

Structure of the submenu



Parameter overview with brief description

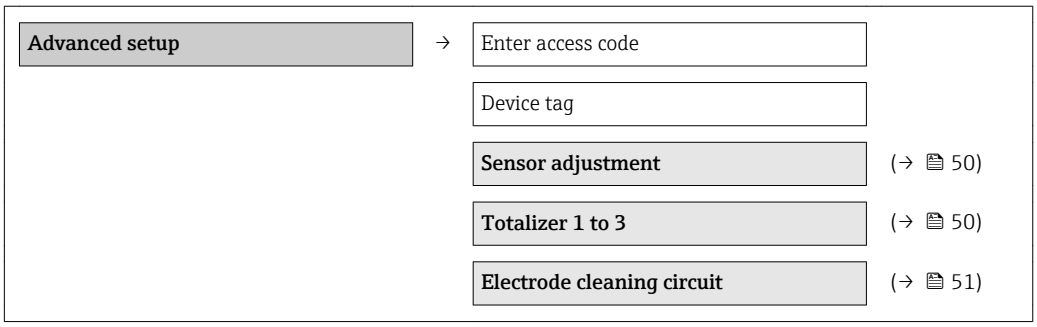
Parameter	Description	Selection/input	Factory setting
Empty pipe detection	Switch empty pipe detection on and off.	▪ Off ▪ On	Off
New adjustment	Select the type of adjustment.	▪ Cancel ▪ Empty pipe adjustment ▪ Full pipe adjustment	Cancel
Progress	The progress is displayed	–	–
Switch point empty pipe detection	Enter the switch point for empty pipe detection.	1 to 99 %	10 %
Response time empty pipe detection	Enter the time interval	0 to 100 s	1 s

10.4 Advanced settings

The **Advanced setup** menu with its submenus contains all parameters needed for specific settings.

Navigation path
"Setup" menu → Advanced setup

Overview of the parameters and submenus in the "Advanced setup" menu



10.4.1 Carrying out a sensor adjustment

The **Sensor adjustment** submenu contains parameters that pertain to the functionality of the sensor.

Navigation path
"Setup" menu → Advanced setup → Sensor adjustment

Structure of the submenu

Parameter overview with brief description

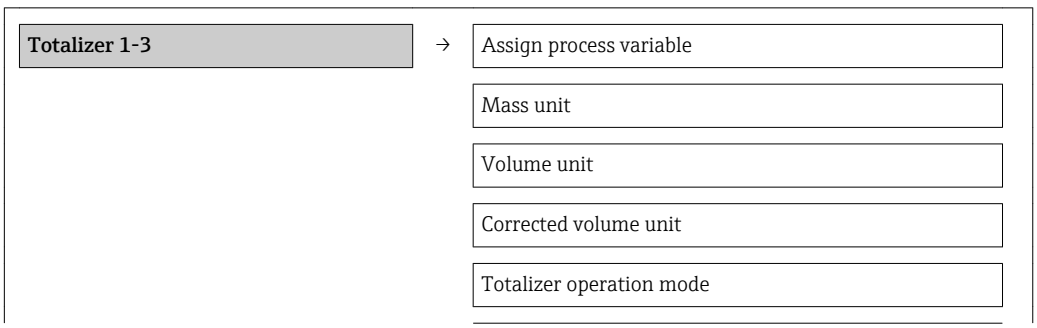
Parameter	Description	Options	Factory setting
Installation direction	Change the sign of the direction of flow of the fluid.	▪ Flow in arrow direction ▪ Flow against arrow direction	Flow in arrow direction

10.4.2 Configuring the totalizer

You can configure each totalizer in the three submenus **Totalizer 1-3**.

Navigation path
"Setup" menu → Advanced setup → Totalizer 1-3

Structure of the submenu



	Failure mode

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection/ User entry	Factory setting
Assign process variable	-	Select process variable for totalizer. *Result* The selection determines the choose list of the **Unit** parameter.	▪ Off ▪ Volume flow ▪ Mass flow ▪ Corrected volume flow	Volume flow
Mass unit		Select the unit for mass. *Result* The selected unit is taken from: Mass flow unit	Unit choose list	
Volume unit		Select the unit for volume. *Result* The selected unit is taken from: Volume flow unit	Unit choose list	
Corrected volume unit		Select the unit for standard volume. *Result* The selected unit is taken from: Corrected volume flow unit	Unit choose list	Country-dependent: ▪ Nl ▪ Scf
Totalizer operation mode	One of the following options is selected in the **Assign process variable** parameter: ▪ Volume flow ▪ Mass flow	Select totalizer calculation mode.	▪ Net flow total ▪ Forward flow total ▪ Reverse flow total	Net flow total
Failure mode	One of the following options is selected in the **Assign process variable** parameter: ▪ Volume flow ▪ Mass flow	Specify the behavior of the totalizer in the event of a device alarm.	▪ Stop ▪ Actual value ▪ Last valid value	Stop

10.4.3 Performing electrode cleaning

The parameters of the electrode cleaning circuit can be configured in the **Electrode cleaning circuit (ECC)** submenu.

Navigation path

"Setup" menu → Advanced setup → Electrode cleaning circuit

The submenu is only available if the device was ordered with electrode cleaning.

Structure of the submenu

Electrode cleaning circuit	→	Electrode cleaning circuit

	ECC duration
	ECC recovery time
	ECC cleaning cycle
	ECC polarity

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection/ input	Factory setting
Electrode cleaning circuit		Enable the cyclic electrode cleaning circuit.	▪ Off ▪ On	Off
ECC duration	The following option is selected in the **Electrode cleaning circuit** parameter: On	Specify the cleaning duration of the electrode cleaning circuit.	1 to 30 s	2 s
ECC recovery time	The following option is selected in the **Electrode cleaning circuit** parameter: On	Specify the recovery time after electrode cleaning to prevent fluctuations in the signal outputs. The last flow value measured before the cleaning is retained.	1 to 600 s	60 s
ECC cleaning cycle	The following option is selected in the **Electrode cleaning circuit** parameter: On	Specify the cleaning cycle of the electrode cleaning circuit.	30 to 10 080 min	30 min
ECC polarity	The following option is selected in the **Electrode cleaning circuit** parameter: On	Select the polarity of the electrode cleaning circuit.	▪ Negative ▪ Positive	Positive

10.5 Simulation

The **Simulation** submenu enables you to simulate, without a real flow situation, various process variables in the process and the device alarm mode and to verify downstream signal chains (switching valves or closed-control loops).

Navigation path

"Diagnostics" menu → Simulation

Simulation	→	Assign simulation process variable
		Value process variable
		Simulation device alarm

10.5.1 Parameter overview with brief description

Parameter	Prerequisite	Description	Selection/ User entry	Factory setting
Assign simulation process variable	-	Select a process variable for the simulation process that is activated.	▪ Off ▪ Volume flow ▪ Mass flow ▪ Corrected volume flow ▪ Conductivity ▪ Corrected conductivity ▪ Temperature	Off
Value process variable	A process variable is selected in the **Assign simulation process variable** parameter.	Enter the simulation value for the selected process variable.	Depends on the process variable selected	-
Simulation device alarm	-	Switch the device alarm on and off.	▪ Off ▪ On	Off

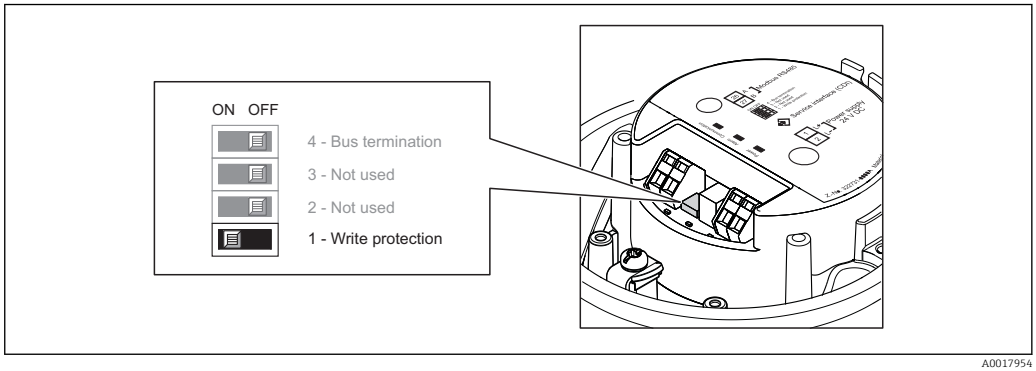
10.6 Protecting settings from unauthorized access

The following option exists for protecting the configuration of the measuring device from unintentional modification after commissioning: Write protection via write protection switch

10.6.1 Write protection via write protection switch

The write protection switch makes it possible to block write access to the entire operating menu with the exception of the following parameters:
- External pressure
- External temperature
- Reference density
- All parameters for configuring the totalizer

The parameter values are now read only and cannot be edited any more:
- Via service interface (CDI)
- Via Modbus RS485



A0017954

1. Depending on the housing version, loosen the securing clamp or fixing screw of the housing cover.
2. Depending on the housing version, unscrew or open the housing cover.
3. Setting the write protection switch on the main electronics module to the ON position enables the hardware write protection. Setting the write protection switch on the main electronics module to the OFF position (factory setting) disables the hardware write protection.

↳ If hardware write protection is enabled, the **Hardware locked** option is displayed in the **Locking status** parameter (→ 55); if disabled, no option is displayed in the **Locking status** parameter (→ 55)

4. Reverse the removal procedure to reassemble the transmitter.

11 Operation

11.1 Read device locking status

The write protection types that are currently active can be determined using the **Locking status** parameter.

Navigation path
"Display/operation" menu → Locking status

Function scope of "Locking status" parameter

Options	Description
Hardware locked	The write protection switch (DIP switch) for hardware locking is activated on the main electronics module. This prevents write access to the parameters (→ 53).
Temporarily locked	Write access to the parameters is temporarily locked on account of internal processes running in the device (e.g. data upload/download, reset etc). Once the internal processing has been completed, the parameters can be changed once again.

11.2 Reading measured values

You can read all measured values using the **Measured values** menu.

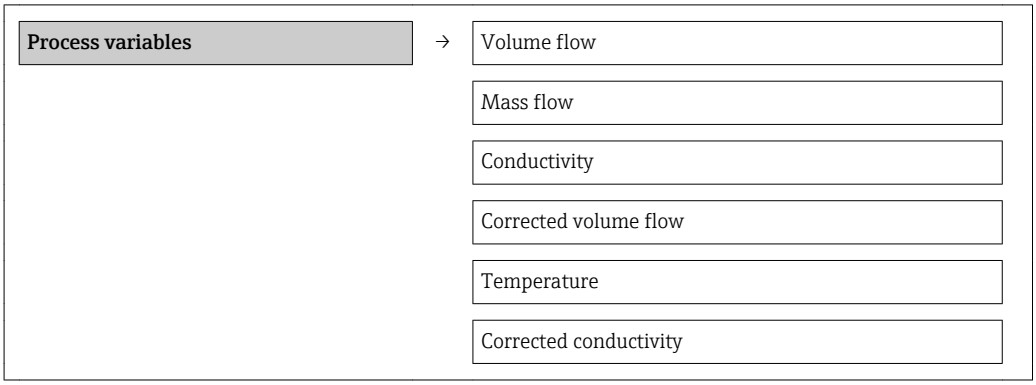
Navigation path
Diagnostics → Measured values

11.2.1 Process variables

The **Process variables** submenu contains all the parameters needed to display the current measured values for every process variable.

Navigation path
"Diagnostics" menu → Measured values → Process variables

Structure of the submenu



Parameter overview with brief description

Parameter	Description	Display
Volume flow	Displays the current volume flow	Floating-point number with sign
Mass flow	Displays the mass flow currently calculated	Floating-point number with sign
Conductivity	Displays the current electrical conductivity	Floating-point number

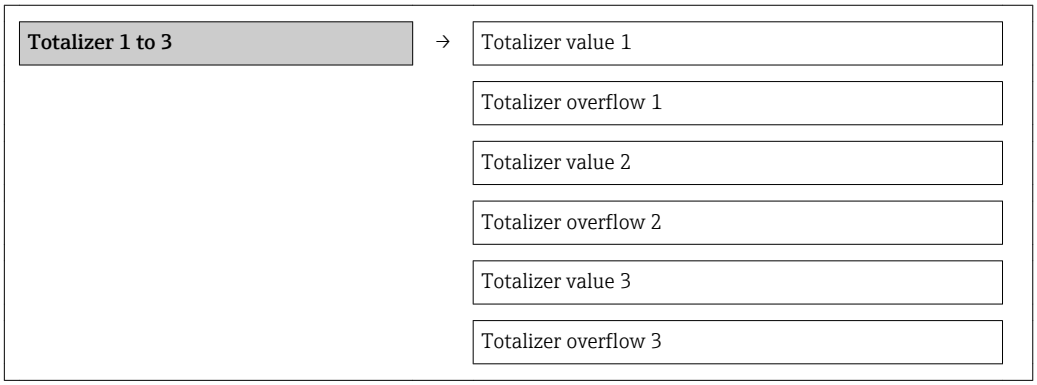
Parameter	Description	Display
Corrected volume flow	Displays the calculated corrected volume flow	Floating-point number with sign
Corrected conductivity	Displays the electrical conductivity currently calculated	Floating-point number

11.2.2 Totalizer

The **Totalizer** submenu contains all the parameters needed to display the current measured values for every totalizer.

Navigation path
"Diagnostics" menu → Measured values → Totalizer

Structure of the submenu



Parameter overview with brief description

Parameter	Prerequisite	Description	Display
Totalizer value 1-3	One of the following options is selected in the **Assign process variable** parameter of the **Totalizer 1-3** submenu: ▪ Volume flow ▪ Mass flow	Displays the current totalizer counter value.	Floating point number with sign
Totalizer overflow 1-3	One of the following options is selected in the **Assign process variable** parameter of the **Totalizer 1-3** submenu: ▪ Volume flow ▪ Mass flow	Displays the current totalizer overflow.	Integer

11.3 Adapting the measuring device to the process conditions

The following are available for this purpose:
- Basic settings using the **Setup** menu (→ 🖹 45)
- Advanced settings using the **Advanced setup** menu (→ 🖹 50)

11.4 Performing a totalizer reset

In the **Operation** submenu, 2 parameters with various options for resetting the three totalizers are available:
- Control totalizer 1-3
- Reset all totalizers

Navigation path
"Display/operat." menu → Operation

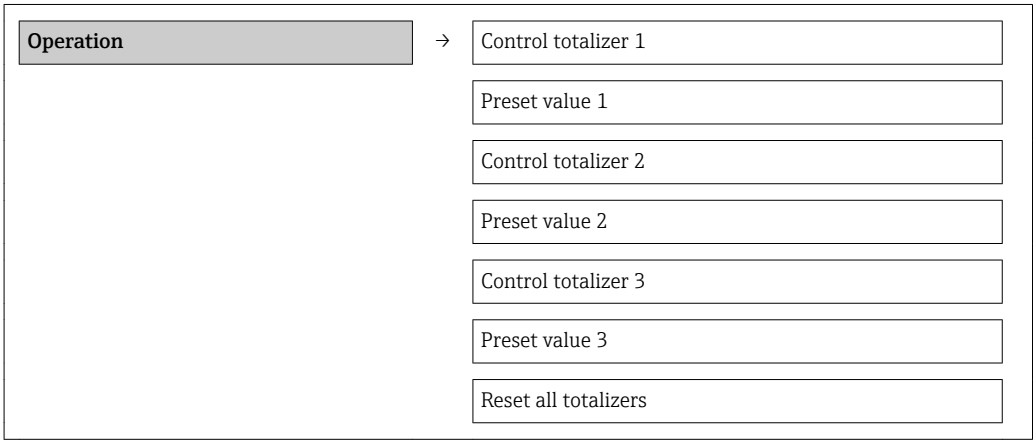
Function scope of the "Control totalizer" parameter

Options	Description
Totalize	The totalizer is started.
Reset + hold	The totaling process is stopped and the totalizer is reset to 0.
Preset + hold	The totaling process is stopped and the totalizer is set to the defined start value in the **Preset** parameter.
Reset + totalize	The totalizer is reset to 0 and the totaling process is restarted.
Preset + totalize	The totalizer is set to the defined start value in the **Preset** parameter and the totaling process is restarted.

Function scope of the "Reset all totalizers" parameter

Options	Description
Reset + totalize	Resets all totalizers to 0 and restarts the totaling process. This deletes all the flow values previously totalized.

"Operation" submenu



Parameter overview with brief description

Parameter	Prerequisite	Description	Selection/ User entry	Factory setting
Control totalizer 1-3	A process variable is selected in the **Assign process variable** parameter of the **Totalizer 1-3** submenu.	Control totalizer value.	▪ Totalize ▪ Reset + hold ▪ Preset + hold ▪ Reset + totalize ▪ Preset + totalize	Totalize
Preset value 1-3	A process variable is selected in the **Assign process variable** parameter of the **Totalizer 1-3** submenu.	Specify start value for totalizer.	Floating-point number with sign	
Reset all totalizers	-	Reset all totalizers to 0 and start.	▪ Cancel ▪ Reset + totalize	Cancel

12 Diagnostics and troubleshooting

12.1 General troubleshooting

For output signals

Problem	Possible causes	Remedy
Green power LED on the main electronics module of the transmitter is dark	Supply voltage does not match that specified on the nameplate.	Apply the correct supply voltage (→ 30).
Green power LED on the main electronics module of the transmitter is dark	Power supply cable connected incorrectly	Check the terminal assignment .
Green power LED on Safety Barrier Promass 100 is dark	Supply voltage does not match that specified on the nameplate.	Apply the correct supply voltage (→ 30).
Green power LED on Safety Barrier Promass 100 is dark	Power supply cable connected incorrectly	Check the terminal assignment .
Device measures incorrectly.	Configuration error or device is operated outside the application.	1. Check and correct parameter configuration. 2. Observe limit values specified in the "Technical Data".

For access

Problem	Possible causes	Remedy
No write access to parameters	Hardware write protection enabled	Set the write protection switch on the main electronics module to the OFF position (→ 53).
No connection via Modbus RS485	Modbus RS485 bus cable connected incorrectly	Check the terminal assignment .
No connection via Modbus RS485	Device plug connected incorrectly	Check the pin assignment of the device plug (→ 28).
No connection via Modbus RS485	Modbus RS485 cable incorrectly terminated	Check terminating resistor (→ 34).
No connection via Modbus RS485	Incorrect settings for the communication interface	Check the Modbus RS485 configuration (→ 46).
No connection via service interface	Incorrect configuration of USB interface on PC or driver not installed correctly.	Observe the documentation for the Commubox. FXA291: Document "Technical Information" TI00405C

12.2 Diagnostic information via light emitting diodes

12.2.1 Transmitter

Various light emitting diodes (LEDs) on the main electronics module of the transmitter provide information on device status.

LED	Color	Meaning
Power	Off	Supply voltage is off or too low.
	Green	Supply voltage is ok.

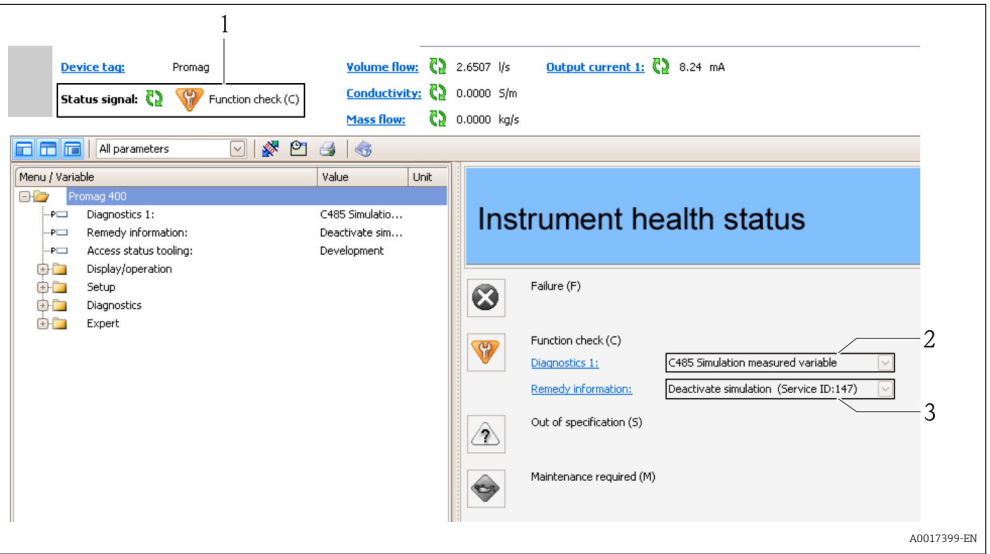
Alarm	Off	Device status is ok.
	Flashing red	A device error of diagnostic behavior "Warning" has occurred.
	Red	▪ A device error of diagnostic behavior "Alarm" has occurred. ▪ Boot loader is active.

Communication	Flashing white	Modbus RS485 communication is active.

12.3 Diagnostic information in FieldCare

12.3.1 Diagnostic options

Any faults detected by the measuring device are displayed on the home page of the operating tool once the connection has been established.



1 *Status area with status signal (→ 60)*
2 *Diagnostic information(→ 61)*
3 *Remedy information with Service ID*

Furthermore, diagnostic events that have occurred can be viewed in the **Diagnostics** menu:
- Via parameters
- Via submenu (→ 64)

Status signals

The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

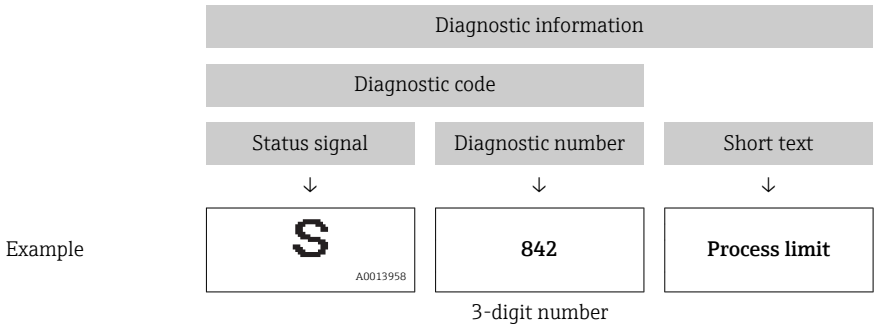
Symbol	Meaning
A0017271	**Failure** A device error has occurred. The measured value is no longer valid.
A0017278	**Function check** The device is in service mode (e.g. during a simulation).

Symbol	Meaning
A0017277	**Out of specification** The device is operated: Outside its technical specification limits (e.g. outside the process temperature range)
A0017276	**Maintenance required** Maintenance is required. The measured value is still valid.

The status signals are categorized in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107.

Diagnostic information

The fault can be identified using the diagnostic information. The short text helps you by providing information about the fault.



12.3.2 Calling up remedy information

Remedy information is provided for every diagnostic event to ensure that problems can be rectified quickly:

- On the home page
  Remedy information is displayed in a separate field below the diagnostics information.
- In the **Diagnostics** menu
  Remedy information can be called up in the working area of the user interface.

The user is in the **Diagnostics** menu.

1. Call up the desired parameter.
2. On the right in the working area, mouse over the parameter.
   ↳ A tool tip with remedy information for the diagnostic event appears.

12.4 Diagnostic information via communication interface

12.4.1 Reading out diagnostic information

Diagnostic information can be read out via Modbus RS485 register addresses.

- Via register address **6821** (data type = string): diagnosis code, e.g. F270
- Via register address **6859** (data type = integer): diagnosis number, e.g. 270

For an overview of diagnostic events with diagnosis number and diagnosis code (→ 63)

12.4.2 Configuring error response mode

Error response mode for Modbus RS485 communication can be configured in the **Communication** submenu using 2 parameters.

Navigation path
"Setup" menu → Communication

Parameter overview with brief description

Parameter	Description	Options	Factory setting
Assign diagnostic behavior	Select diagnostic behavior for MODBUS communication.	▪ Off ▪ Alarm or warning ▪ Warning ▪ Alarm	Alarm
Failure mode	Select measured value output behavior when a diagnostic message occurs via Modbus communication. This parameter operates in accordance with the option selected in the **Assign diagnostic behavior** parameter.	▪ NaN value ▪ Last valid value NaN ≡ not a number	NaN value

12.5 Adapting the diagnostic information

12.5.1 Adapting the diagnostic behavior

Each diagnostic number is assigned a certain diagnostic behavior at the factory. The user can change this assignment for certain diagnostic numbers via the **Diagnostic no. xxx** parameter.

Navigation path
"Expert" menu → System → Diagnostic handling → Diagnostic behavior → Assign behavior of diagnostic no. xxx

You can assign the following options to the diagnostic number as the diagnostic behavior:

Options	Description
Alarm	Measurement is interrupted. Measured value output via Modbus RS485 and totalizers assume the defined alarm condition. A diagnostic message is generated.
Warning	Measurement is resumed. Measured value output via Modbus RS485 and totalizers are not affected. A diagnostic message is generated.
Logbook entry only	The device continues to measure. The diagnostic message is entered in the Event logbook (events list) submenu only and is not displayed in alternation with the measured value display.
Off	The diagnostic event is ignored, and no diagnostic message is generated or entered.

12.6 Overview of diagnostic information

The amount of diagnostic information increases if the measuring device has one or more application packages.

Diagnostics for the sensor

Diagnostic number	Short text	Remedial measures	Status signal from the factory	Diagnostic behavior from the factory
062	Sensor connection	1. Check the sensor connections. 2. Contact service.	F	Alarm
082	Data storage	1. Change main electronic module. 2. Change sensor.	F	Alarm
083	Memory content	1. Restart device. 2. Restore S-DAT data. 3. Change sensor.	F	Alarm
* Diagnostic behavior can be changed: "Adapting the diagnostic behavior" section (→ 62)				

Diagnostics for the electronics

Diagnostic number	Short text	Remedial measures	Status signal from the factory	Diagnostic behavior from the factory
242	Software incompatible	1. Check software. 2. Flash or change main electronic module.	F	Alarm
261	Electronic modules	1. Restart device. 2. Check electronic modules. 3. Change I/O module or main electronics.	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	Replace electronics.	F	Alarm
311	Electronic failure	1. Transfer data or reset device. 2. Contact service.	F	Alarm
* Diagnostic behavior can be changed: "Adapting the diagnostic behavior" section (→ 62)				

Diagnostics for the configuration

Diagnostic number	Short text	Remedial measures	Status signal from the factory	Diagnostic behavior from the factory
410	Data transfer	1. Check connection. 2. Retry data transfer.	F	Alarm
411	Up-/download active	Up-/download active, please wait	C	Warning
438	Dataset	1. Check data set file. 2. Check device configuration. 3. Up- and download new configuration.	M	Warning
453	Flow override	Deactivate flow override.	C	Warning
484	Simulation failsafe mode	Deactivate simulation.	C	Alarm

Diagnostic number	Short text	Remedial measures	Status signal from the factory	Diagnostic behavior from the factory
485	Simulation process variable	Deactivate simulation.	C	Warning
531	Empty pipe detection	Perform empty pipe detection adjustment.	S	Warning*
* Diagnostic behavior can be changed: "Adapting the diagnostic behavior" section (→ 62)				

Diagnostics for the process

Diagnostic number	Short text	Remedial measures	Status signal from the factory	Diagnostic behavior from the factory
832	Ambient temperature	Reduce ambient temperature.	S	Warning*
833	Ambient temperature	Increase ambient temperature.	S	Warning*
843	Process limit	Check process conditions.	S	Warning
861	Process fluid	Check process conditions.	F	Alarm*
862	Empty pipe	1. Check for gas in process. 2. Check detection limits.	S	Warning
* Diagnostic behavior can be changed: "Adapting the diagnostic behavior" section (→ 62)				

12.7 Pending diagnostic events

The **Diagnostics** menu allows the user to view the current diagnostic event and the previous diagnostic event separately.

Navigation path
- "Diagnostics" menu → Actual diagnostics
- "Diagnostics" menu → Previous diagnostics

Parameter overview with brief description

Parameter	Prerequisite	Description	Display
Actual diagnostics	1 diagnostic event has occurred	Displays the current diagnostic event along with the diagnostic information. If two or more messages occur simultaneously, the message with the highest priority is shown on the display.	Diagnostic code, short message
Previous diagnostics	2 diagnostic events have already occurred	Displays the diagnostic event that occurred prior to the current diagnostic event along with the diagnostic information.	Diagnostic code, short message

To call up the measures to rectify a diagnostic event:
Via "FieldCare" operating tool (→ 61)

Other diagnostic events that are pending can be viewed in the **Diagnostic list** submenu (→ 64)

12.8 Diagnostic list

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

Navigation path
"Diagnostics" menu → Diagnostic list

To call up the measures to rectify a diagnostic event:
Via "FieldCare" operating tool (→ 61)

12.9 Event logbook

12.9.1 Event history

A chronological overview of the event messages that have occurred is provided in the events list which contains a maximum of 20 message entries. This list can be displayed via FieldCare if necessary.

Navigation path
Event list: **F**→ Tool box→ Additional functions

For information on the event list, see the FieldCare user interface (→ 40)

This event history includes entries for:
- Diagnostic events (→ 63)
- Information events (→ 66)

In addition to the operation time of its occurrence and possible troubleshooting measures, each event is also assigned a symbol that indicates whether the event has occurred or is ended:
- Diagnostics event
  - : Event has occurred
  - : Event has ended
- Information event
  : Event has occurred

To call up the measures to rectify a diagnostic event:
Via "FieldCare" operating tool (→ 61)

For filtering the displayed event messages (→ 65)

12.9.2 Filtering the event logbook

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

Navigation path
"Diagnostics" menu → Event logbook → Filter options

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

12.9.3 Overview of information events

Unlike a diagnostic event, an information event is displayed in the event logbook only and not in the diagnostic list.

Information event	Event text
I1000	-------- (device ok)
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed
I1110	Write protection switch changed
I1151	History reset
I1351	Empty pipe detection adjustment failure
I1353	Empty pipe detection adjustment Ok

12.10 Resetting the measuring device

Using the **Device reset** parameter it is possible to reset the entire device configuration or some of the configuration to a defined state.

Navigation path
"Diagnostics" menu → Device reset → Device reset

Function scope of the "Device reset" parameter

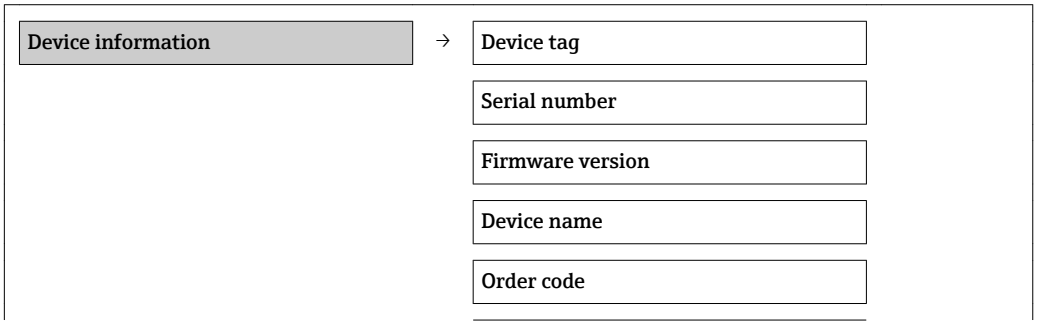
Options	Description
Cancel	The user exists the parameter and no action is performed.
To factory defaults	Every parameter is reset to its factory setting.
To delivery settings	Every parameter for which a customized default setting was ordered is reset to that customized value; all other parameters are reset to their factory setting. This option is not visible if no customized settings were ordered.
Restart device	Restarting the device resets every parameter whose data are saved in the volatile memory (RAM) to the parameter's factory setting (e.g. measured value data). The device configuration remains unchanged.

12.11 Device information

The **Device information** submenu contains all the parameters that display different information for identifying the device.

Navigation path
"Diagnostics" menu → Device information

Structure of the submenu



	Extended order code 1
	Extended order code 2
	Extended order code 3
	ENP version

Parameter overview with brief description

Parameter	Prerequisite	Description	Display
Serial number	-	Displays the serial number of the measuring device. The number can be found on the nameplate of the sensor and transmitter.	Max. 11-digit character string comprising letters and numbers
Firmware version	-	Displays the device firmware version installed.	Character string in the format xx.yy.zz
Device name	-	Displays the name of the transmitter. The name can be found on the nameplate of the transmitter.	
Order code	-	Displays the device order code. The order code can be found on the nameplate of the sensor and transmitter in the "Order code" field.	Character string composed of letters, numbers and certain punctuation marks
Extended order code 1-3	Depending on the length of the extended order code, the code is divided into a maximum of 3 parameters.	Displays the 1st, 2nd or 3rd part of the extended order code. The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string
ENP version	-	Displays the version of the electronic nameplate.	Character string in the format xx.yy.zz

12.12 Firmware history

Release date	Firmware version	Order code for "Firmware version"	Firmware changes	Documentation type	Documentation
04.2013	01.02.00	Option **74**	Update	Operating Instructions	BA01176D/06/DE/01.13 BA01176D/06/EN/01.13
06.2012	01.01.00	–	Original firmware	–	–

Flashing the firmware to the current version or to the previous version is possible via the service interface (CDI) .

For the compatibility of the firmware version with the previous version, the installed device description files and operating tools, observe the information about the device in the "Manufacturer's information" document.

The manufacturer's information is available:
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download
- Specify the following details:
  - Product root: e.g. 5H1B
  - Text search: Manufacturer's information
  - Search range: documentation

13 Maintenance

13.1 Maintenance tasks

No special maintenance work is required.

13.1.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing or the seals.

13.1.2 Interior cleaning

No interior cleaning is planned for the device.

13.1.3 Replacing seals

The sensor's seals (particularly aseptic molded seals) must be replaced periodically.

The interval between changes depends on the frequency of the cleaning cycles, the cleaning temperature and the medium temperature.

Replacement seals (accessory) (→ 87)

13.2 Measuring and test equipment

Endress+Hauser offers a wide variety of measuring and test equipment, such as W@M or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.

For a list of some of the measuring and test equipment, refer to the "Accessories" chapter of the "Technical Information" document for the device.

13.3 Endress+Hauser services

Endress+Hauser offers a wide variety of services for maintenance such as recalibration, maintenance service or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.

14 Repair

14.1 General notes

Repair and conversion concept
The Endress+Hauser repair and conversion concept provides for the following:
- The measuring devices have a modular design.
- Spare parts are grouped into logical kits with the associated Installation Instructions.
- Repairs are carried out by Endress+Hauser Service or by correspondingly trained customers.
- Certified devices can be converted into other certified devices by Endress+Hauser Service or at the factory only.

Notes for repair and conversion
For repair and modification of a measuring device, observe the following notes:
- Use only original Endress+Hauser spare parts.
- Carry out the repair according to the Installation Instructions.
- Observe the applicable standards, federal/national regulations, Ex documentation (XA) and certificates.
- Document every repair and each conversion and enter them into the *W@M* life cycle management database.

14.2 Spare parts

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

Measuring device serial number:
- Is located on the nameplate of the device.
- Can be read out via the **Serial number** parameter in the **Device information** submenu (→ 66).

14.3 Endress+Hauser services

Contact your Endress+Hauser Sales Center for information on services and spare parts.

14.4 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at
www.services.endress.com/return-material

14.5 Disposal

14.5.1 Removing the measuring device

1. Switch off the device.

2. **WARNING!** Danger to persons from process conditions. Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.
   Carry out the mounting and connection steps from the chapters "Mounting the measuring device" and "Connecting the measuring device" in the logically reverse sequence. Observe the safety instructions.

14.5.2 Disposing of the measuring device

⚠ WARNING

Danger to personnel and environment from fluids that are hazardous to health.

- ▶ Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.

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

15 Accessories

Various accessories, which can be ordered with the device or subsequently from Endress +Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

15.1 Device-specific accessories

15.1.1 For the transmitter

Accessories	Description
Ground cable	Set, consisting of two ground cables for potential equalization.

15.1.2 For the sensor

Accessories	Description
Ground disks	Are used to ground the fluid in lined measuring tubes to ensure proper measurement. For details, see Installation Instructions EA00070D

15.2 Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see "Technical Information" TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. For details, see Operating Instructions BA00061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00053S

Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA). For details, see Operating Instructions BA00060S

15.3 Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00059S

15.4 System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic data manager provides information on all the relevant measured 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 a SD card or USB stick. For details, see "Technical Information" TI00133R and Operating Instructions BA00247R

16 Technical data

16.1 Application

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

To ensure that the device remains in proper operating condition for its service life, use the measuring device only for media against which the process-wetted materials are adequately resistant.

16.2 Function and system design

Measuring principle

Electromagnetic flow measurement on the basis of *Faraday's law of magnetic induction*.

Measuring system

One device version is available: compact version, transmitter and sensor form a mechanical unit.
For information on the structure of the device (→ 10)

16.3 Input

Measured variable

Direct measured variables

- Volume flow (proportional to induced voltage)
- Electrical conductivity

Calculated measured variables

- Mass flow
- Corrected volume flow
- Corrected electrical conductivity

Measuring range

Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Flow characteristic values in SI units

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3/10 m/s)	Factory settings Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[dm³/min]	[dm³/min]
15	½	4 to 100	0,5
25	1	9 to 300	1
32	–	15 to 500	2
40	1 ½	25 to 700	3
50	2	35 to 1 100	5
65	–	60 to 2 000	8
80	3	90 to 3 000	12
100	4	145 to 4 700	20
125	–	220 to 7 500	30

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3/10 m/s)	Factory settings Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[dm³/min]	[dm³/min]
150	6	20 to 600 m³/h	2.5 m³/h
200	8	35 to 1 100 m³/h	5 m³/h
250	10	55 to 1 700 m³/h	7.5 m³/h
300	12	80 to 2 400 m³/h	10 m³/h
350	14	110 to 3 300 m³/h	15 m³/h
400	16	140 to 4 200 m³/h	20 m³/h
450	18	180 to 5 400 m³/h	25 m³/h
500	20	220 to 6 600 m³/h	30 m³/h
600	24	310 to 9 600 m³/h	40 m³/h

Flow characteristic values in US units

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3/10 m/s)	Factory settings Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]
½	15	1.0 to 27	0,15
1	25	2.5 to 80	0,25
1 ½	40	7 to 190	0,75
2	50	10 to 300	1,25
3	80	24 to 800	2,5
4	100	40 to 1 250	4
6	150	90 to 2 650	12
8	200	155 to 4 850	15
10	250	250 to 7 500	30
12	300	350 to 10 600	45
14	350	500 to 15 000	60
16	400	600 to 19 000	60
18	450	800 to 24 000	90
20	500	1 000 to 30 000	120
24	600	1 400 to 44 000	180

Recommended measuring range

"Flow limit" section (→ 81)

Operable flow range Over 1000 : 1

Input signal

Fieldbuses

To increase the accuracy of certain measured variables or to calculate the corrected volume flow, the automation system can continuously write different measured values to the measuring device via Modbus RS485, EtherNet/IP or HART input:
- Process pressure or medium temperature to increase accuracy (e.g. external values from Cerabar M, Cerabar S or iTEMP)
- Reference density for calculating the corrected volume flow

16.4 Output

Output signal

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

Signal on alarm

Depending on the interface, failure information is displayed as follows:

Modbus RS485

Failure mode	Choose from: - NaN value instead of current value - Last valid value

Operating tool

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: - Supply voltage active - Data transmission active - Device alarm/error has occurred

Ex connection data

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The following connections are galvanically isolated from each other:
- Outputs
- Power supply

Protocol-specific data

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247

Broadcast address range	0
Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1 200 BAUD ▪ 2 400 BAUD ▪ 4 800 BAUD ▪ 9 600 BAUD ▪ 19 200 BAUD ▪ 38 400 BAUD ▪ 57 600 BAUD ▪ 115 200 BAUD
Data transfer mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information

16.5 Power supply

Terminal assignment (→ 28)

Pin assignment, device plug (→ 28)

Supply voltage

Transmitter

For device version with all communication types: DC 20 to 30 V

The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV).

Power consumption

Transmitter

Order code for "Output"	Maximum Power consumption
Option **M**: Modbus RS485	3.5 W

Current consumption

Transmitter

Order code for "Output"	Maximum Current consumption	Maximum switch-on current
Option **M**: Modbus RS485	90 mA	10 A (<0.8 ms)

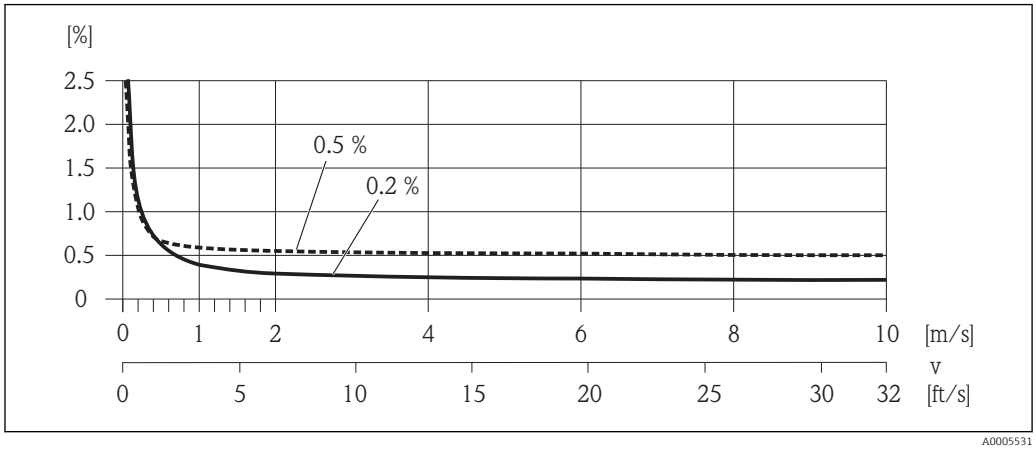
Power supply failure

- Totalizers stop at the last value measured.
- Depending on the device version, the configuration is retained in the device memory or in the plug-in memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Electrical connection	(→ 30)
Potential equalization	(→ 32)
Terminals	**Transmitter** Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)
Cable entries	**Transmitter** ▪ Cable gland: M20 × 1.5 with cable ⌀6 to 12 mm (0.24 to 0.47 in) ▪ Thread for cable entry: – NPT ½" – G ½" – M20
Cable specification	(→ 27)

16.6 Performance characteristics

Reference operating conditions	**To DIN EN 29104** ▪ Fluid temperature: +28±2 °C (+82±4 °F) ▪ Ambient temperature range: +22±2 °C (+72±4 °F) ▪ Warm-up period: 30 min **Installation** ▪ Inlet run > 10 × DN ▪ Outlet run > 5 × DN ▪ Sensor and transmitter grounded. ▪ The sensor is centered in the pipe.
Maximum measured error	**Error limits under reference operating conditions** o.r. = of reading **Pulse output** ▪ ±0.5 % o.r. ± 1 mm/s (0.04 in/s) ▪ Optional: ±0.2 % o.r. ± 2 mm/s (0.08 in/s) Fluctuations in the supply voltage do not have any effect within the specified range.



16 *Maximum measured error in % o.r.*

Electrical conductivity
Max. measured error not specified.

Accuracy of outputs

o.r. = of reading; o.f.s. = of full scale value

The output accuracy must be factored into the measured error if analog outputs are used, but can be ignored for fieldbus outputs (e.g. Modbus RS485, EtherNet/IP).

Current output

Accuracy	Max. ±0.05 % o.f.s. or ±5 µA

Pulse/frequency output

Accuracy	Max. ±50 ppm o.r.

Repeatability

o.r. = of reading

Volume flow
Max. ±0.1 % o.r. ± 0.5 mm/s (0.02 in/s)

Electrical conductivity
Max. ±5 % o.r.

Temperature measurement response time

T_{90} < 15 s

16.7 Installation

"Mounting requirements" (→ 17)

16.8 Environment

Ambient temperature range

(→ 19)

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

- Protect the measuring device against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device as fungus or bacteria infestation can damage the liner.
- If protection caps or protective covers are mounted these should never be removed before installing the measuring device.

Degree of protection

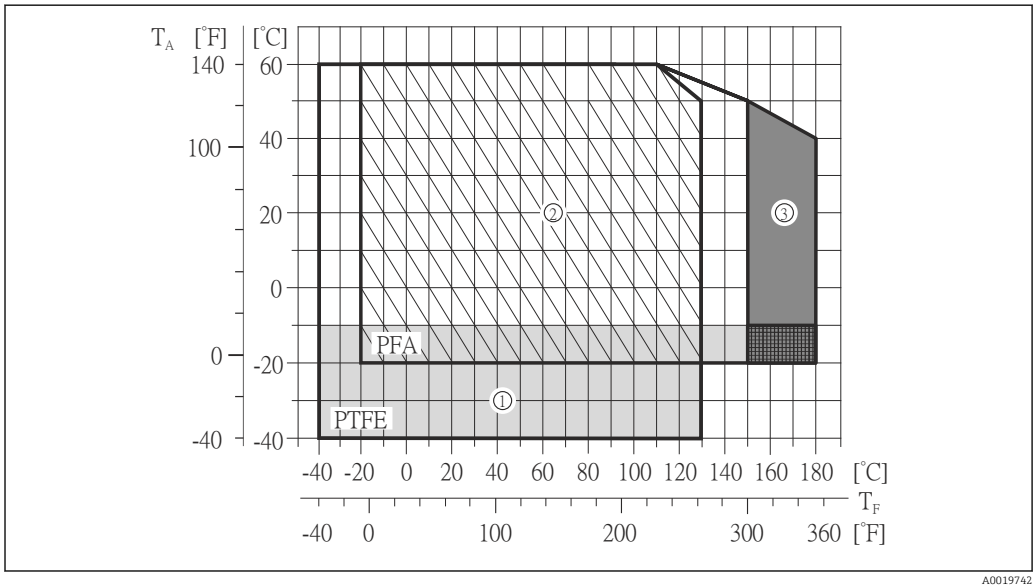
Transmitter and sensor
- As standard: IP66/67, type 4X enclosure
- With the order code for "Sensor options", option **CM**: IP69K can also be ordered
- When housing is open: IP20, type 1 enclosure

Shock resistance	As per IEC/EN 60068-2-31
Vibration resistance	Acceleration up to 2 g following IEC 60068-2-6
Mechanical load	▪ Protect the transmitter housing against mechanical effects, such as shock or impact. ▪ Never use the transmitter housing as a ladder or climbing aid.
Electromagnetic compatibility (EMC)	▪ As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21) ▪ Complies with emission limits for industry as per EN 55011 (Class A) Details are provided in the Declaration of Conformity.

16.9 Process

Medium temperature range

- −20 to +150 °C (−4 to +302 °F) for PFA, DN 25 to 200 (1 to 8")
- −20 to +180 °C (−4 to +356 °F) for PFA high-temperature, DN 25 to 200 (1 to 8")
- −40 to +130 °C (−40 to +266 °F) for PTFE, DN 15 to 600 (½ to 24")



T_A Ambient temperature

T_F Medium temperature

1 Gray area: the ambient temperature range of −10 to −40 °C (−14 to −40 °F) applies to stainless flanges only

2 Hatched area: harsh environment and IP68 only up to +130 °C (+266 °F)

3 Dark-gray area: high-temperature version with insulation

Conductivity	≥ 5 µS/cm for liquids in general
Pressure-temperature ratings	An overview of the material load diagrams (pressure/temperature diagrams) for the process connections is provided in the "Technical Information" document.

Pressure tightness

Liner: PFA

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:		
[mm]	[in]	+25 °C (+77 °F)	+80 °C (+176 °F)	+100 to +180 °C (+212 to +356 °F)
25	1	0 (0)	0 (0)	0 (0)
32	–	0 (0)	0 (0)	0 (0)
40	1 ½	0 (0)	0 (0)	0 (0)
50	2	0 (0)	0 (0)	0 (0)
65	–	0 (0)	– (–)	0 (0)
80	3	0 (0)	– (–)	0 (0)
100	4	0 (0)	– (–)	0 (0)
125	–	0 (0)	– (–)	0 (0)
150	6	0 (0)	– (–)	0 (0)
200	8	0 (0)	– (–)	0 (0)

Liner: PTFE

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:			
[mm]	[in]	+25 °C (+77 °F)	+80 °C (+176 °F)	+100 °C (+212 °F)	+130 °C (+266 °F)
15	½	0 (0)	0 (0)	0 (0)	100 (1.45)
25	1	0 (0)	0 (0)	0 (0)	100 (1.45)
32	–	0 (0)	0 (0)	0 (0)	100 (1.45)
40	1 ½	0 (0)	0 (0)	0 (0)	100 (1.45)
50	2	0 (0)	0 (0)	0 (0)	100 (1.45)
65	–	0 (0)	– (–)	40 (0.58)	130 (1.89)
80	3	0 (0)	– (–)	40 (0.58)	130 (1.89)
100	4	0 (0)	– (–)	135 (1.96)	170 (2.47)
125	–	135 (1.96)	– (–)	240 (3.48)	385 (5.58)
150	6	135 (1.96)	– (–)	240 (3.48)	385 (5.58)
200	8	200 (2.90)	– (–)	290 (4.21)	410 (5.95)
250	10	330 (4.79)	– (–)	400 (5.80)	530 (7.69)
300	12	400 (5.80)	– (–)	500 (7.25)	630 (9.14)
350	14	470 (6.82)	– (–)	600 (8.70)	730 (10.6)
400	16	540 (7.83)	– (–)	670 (9.72)	800 (11.6)
450	18	No negative pressure permitted!			
500	20				
600	24				

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 to 3 m/s (6.56 to 9.84 ft/s). Also match the velocity of flow (v) to the physical properties of the fluid:

- v < 2 m/s (6.56 ft/s): for abrasive fluids (e.g. potter's clay, lime milk, ore slurry)
- v > 2 m/s (6.56 ft/s): for fluids producing buildup (e.g. wastewater sludges)

For an overview of the measuring range full scale values, see the "Measuring range" section (→ 74)

Pressure loss

- No pressure loss occurs if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (→ 21)

System pressure

(→ 20)

Vibrations

(→ 20)

16.10 Mechanical construction

Design, dimensions

For the dimensions and installation lengths of the device, see the "Technical Information" document, "Mechanical construction" section

Weight

Compact version

- Including the transmitter
- High-temperature version + 1.5 kg (3.31 lbs)
- Weight specifications apply to standard pressure ratings and without packaging material.

Weight in SI units

Nominal diameter		EN (DIN), AS [1]		ASME		JIS	
[mm]	[in]	Pressure rating	[kg]	Pressure rating	[kg]	Pressure rating	[kg]
15	½	PN 40	4.5	Class 150	4.5	10K	4.5
25	1	PN 40	5.3	Class 150	5.3	10K	5.3
32	–	PN 40	6	Class 150	–	10K	5.3
40	1 ½	PN 40	7.4	Class 150	7.4	10K	6.3
50	2	PN 40	8.6	Class 150	8.6	10K	7.3
65	–	PN 16	10	Class 150	–	10K	9.1
80	3	PN 16	12	Class 150	12	10K	10.5
100	4	PN 16	14	Class 150	14	10K	12.7
125	–	PN 16	19.5	Class 150	–	10K	19
150	6	PN 16	23.5	Class 150	23.5	10K	22.5
200	8	PN 10	43	Class 150	43	10K	39.9
250	10	PN 10	63	Class 150	73	10K	67.4
300	12	PN 10	68	Class 150	108	10K	70.3
350	14	PN 10	103	Class 150	173		
400	16	PN 10	118	Class 150	203		
450	18	PN 10	159	Class 150	253		
500	20	PN 10	154	Class 150	283		
600	24	PN 10	206	Class 150	403		

1) For flanges to AS, only DN 25 and 50 are available.

Weight in US units

Nominal diameter		ASME	
[mm]	[in]	Pressure rating	[lbs]
15	½	Class 150	9.92
25	1	Class 150	11.7
40	1 ½	Class 150	16.3
50	2	Class 150	19.0
80	3	Class 150	26.5
100	4	Class 150	30.9
150	6	Class 150	51.8
200	8	Class 150	94.8
250	10	Class 150	161.0
300	12	Class 150	238.1
350	14	Class 150	381.5
400	16	Class 150	447.6
450	18	Class 150	557.9
500	20	Class 150	624.0
600	24	Class 150	888.6

Measuring tube specification

Nominal diameter		Pressure rating					Process connection internal diameter			
		EN (DIN)	ASME	AS 2129	AS 4087	JIS	PFA		PTFE	
[mm]	[in]	[bar]	[psi]	[bar]	[bar]	[bar]	[mm]	[in]	[mm]	[in]
15	½	PN 40	Class 150	–	–	20K	–	–	15	0.59
25	1	PN 40	Class 150	Table E	–	20K	23	0.91	26	1.02
32	–	PN 40	–	–	–	20K	32	1.26	35	1.38
40	1 ½	PN 40	Class 150	–	–	20K	36	1.42	41	1.61
50	2	PN 40	Class 150	Table E	PN 16	10K	48	1.89	52	2.05
65	–	PN 16	–	–	–	10K	63	2.48	67	2.64
80	3	PN 16	Class 150	–	–	10K	75	2.95	80	3.15
100	4	PN 16	Class 150	–	–	10K	101	3.98	104	4.09
125	–	PN 16	–	–	–	10K	126	4.96	129	5.08
150	6	PN 16	Class 150	–	–	10K	154	6.06	156	6.14
200	8	PN 10	Class 150	–	–	10K	201	7.91	202	7.95
250	10	PN 10	Class 150	–	–	10K	–	–	256	10.1
300	12	PN 10	Class 150	–	–	10K	–	–	306	12.0
350	14	PN 10	Class 150	–	–	–	–	–	337	13.3
400	16	PN 10	Class 150	–	–	–	–	–	387	15.2
450	18	PN 10	Class 150	–	–	–	–	–	432	17.0
500	20	PN 10	Class 150	–	–	–	–	–	487	19.2
600	24	PN 10	Class 150	–	–	–	–	23	593	23.3

Materials

Transmitter housing

Order code for "Housing", option **A** "Compact, coated alu":
Coated aluminum AlSi10Mg

Cable entries

Order code for "Housing", option A "Compact, coated alu"

The various cable entries are suitable for hazardous and non-hazardous areas.

Electrical connection	Material
Cable gland M20 × 1.5	Nickel-plated brass
Thread G ½", via adapter	
Thread NPT ½", via adapter	

Device plug

Electrical connection	Material
Plug M12x1	▪ Socket: Stainless steel 1.4404 (316L) ▪ Contact housing: Polyamide ▪ Contacts: Gold-plated brass

Sensor housing

- DN 15 to 300 (½ to 12"): coated aluminum AlSi10Mg
- DN 350 to 600 (14 to 24"): carbon steel with protective varnish

Measuring tubes

Stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon with Al/Zn protective coating (DN 15 to 300 (½ to 12")) or protective varnish (DN 350 to 600 (14 to 24"))

Liner

- PFA
- PTFE

Process connections

EN 1092-1 (DIN 2501)
1.4571 (316L), C22, FE 410W B [1], S235JRG2

ASME B16.5
A105, F316L [1]

JIS B2220
1.0425 (316L) [1], HII, S235JRG2

AS 2129 Table E
- DN 25 (1"): A105 or S235JRG2
- DN 40 (1 ½"): A105 or S275JR

AS 4087 PN 16
A105 or S275JR

List of all available process connections (→ 85)

1) DN 15 to 300 (½ to 12") with Al/Zn protective coating; DN 350 to 600 (14 to 24") with protective varnish

Electrodes

1.4435 (316L), Alloy C22, platinum, tantalum, titanium

Seals

In accordance with DIN EN 1514-1

Accessories

Ground disks

1.4435 (316L), Alloy C22, tantalum, titanium

Fitted electrodes

Measuring electrodes, reference electrodes and electrodes for empty pipe detection:
- Standard: 1.4435 (316L), Alloy C22, platinum, tantalum
- Optional: only measuring electrodes made from platinum or tantalum

Process connections

- EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") flat face; dimensions as per DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 only as per EN 1092-1
- ASME B16.5
- JIS B2220
- AS 2129 Table E
- AS 4087 PN 16

For information on the materials of the process connections (→ 84)

Surface roughness

Electrodes with 1.4435 (304L), Alloy C22, platinum, tantalum:
≤ 0.3 to 0.5 µm (11.8 to 19.7 in)
(All data relate to parts in contact with fluid)

Liner with PFA:
≤ 0.4 µm (15.7 µin)
(All data relate to parts in contact with fluid)

16.11 Operability

Remote operation

Service interface (CDI)

Operation of the measuring device with the service interface (CDI) via:
"FieldCare" operating tool with COM DTM "CDI Communication FXA291" via Commubox FXA291

Languages

Can be operated in the following languages:
Via "FieldCare" operating tool:
English, German, French, Spanish, Italian, Chinese, Japanese

16.12 Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

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

C-Tick symbol	The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex approval	The devices are certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.
Modbus RS485 certification	The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.
Pressure Equipment Directive	▪ With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 97/23/EC. ▪ Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.
Other standards and guidelines	▪ EN 60529 Degrees of protection provided by enclosures (IP code) ▪ EN 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use ▪ IEC/EN 61326 Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements) ▪ NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment ▪ NAMUR NE 32 Data retention in the event of a power failure in field and control instruments with microprocessors ▪ NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. ▪ NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics ▪ NAMUR NE 105 Specifications for integrating fieldbus devices in engineering tools for field devices ▪ NAMUR NE 107 Self-monitoring and diagnosis of field devices ▪ NAMUR NE 131 Requirements for field devices for standard applications

16.13 Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered from Endress+Hauser either directly with the device or subsequently. Detailed information on the order code in question is available

from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

16.14 Accessories

Overview of accessories available for order (→ 72)

16.15 Documentation

The following document types are available:
- On the CD-ROM supplied with the device
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

Standard documentation

Communication	Document type	Documentation code
- - - -	Brief Operating Instructions	KA01143D
- - - -	Technical Information	TI01102D

Supplementary device-dependent documentation

Document type	Approval	Documentation code
Safety Instructions	ATEX/IECEx Ex nA	XA01090D
Special documentation	Information on the Pressure Equipment Directive	SD01056D
Special documentation	Modbus RS485 Register Information	SD01148D
Special documentation	Heartbeat Technology	SD01149D
Installation Instructions		Specified for each individual accessory (→ 72) Overview of accessories available for order (→ 72)

17 Appendix

17.1 Overview of the operating menu

The following table provides an overview of the entire operating menu structure with menus and parameters. The page reference indicates where a description of the parameter can be found in the manual.

***** = The submenu only appears if it has been additionally ordered ("Technical Information", Section "Application packages").

- **Device information** → (→ 66)
  - Device name
  - Device tag
  - Status signal
  - Volume flow
  - Conductivity
  - Temperature
  - Mass flow
  - Corrected volume flow
- **Display/operat.** → (→ 55)
  - Access status tooling
  - Locking status (→ 53)
  - **Operation** → (→ 57)
    - Control totalizer 1 to 3
    - Preset value 1 to 3
    - Reset all totalizers
- **Setup** → (→ 45)
  - **System units** → (→ 45)
    - Volume flow unit
    - Volume unit
    - Conductivity unit
    - Temperature unit
    - Mass flow unit
    - Mass unit
    - Density unit

- Corrected volume flow unit
- Corrected volume unit
- **Communication** → (→ 46)
- Bus address
- Baud rate
- Data transfer mode
- Parity
- Byte order
- Assign diagnostic behavior
- Failure mode
- **Low flow cut off** → (→ 48)
- Assign process variable
- On value low flow cut off
- Off value low flow cutoff
- Pressure shock suppression
- **Empty pipe detection** → (→ 49)
- Empty pipe detection
- New adjustment
- Progress
- Switch point empty pipe detection
- Response time empty pipe detection
- **Advanced setup** → (→ 50)
- Enter access code
- Device tag
  - **Sensor adjustment** → (→ 50)
  - Installation direction
  - **Totalizer 1 to 3** → (→ 50)
  - Assign process variable
  - Volume unit

- Mass unit
- Corrected volume unit
- Totalizer operation mode
- Failure mode
- **Electrode cleaning circuit*** → (→ 51)
- Electrode cleaning circuit*
- ECC duration*
- ECC recovery time*
- ECC cleaning cycle*
- ECC polarity*

Diagnostics → (→ 59)

- Actual diagnostics (→ 64)
- Timestamp
- Previous diagnostics (→ 64)
- Timestamp
- Operating time from restart (→ 64)
- Operating time

Diagnostic list → (→ 64)

- Diagnostics 1 to 5
- Timestamp

Event logbook → (→ 65)

- Filter options

Device information → (→ 66)

- Device tag
- Serial number
- Firmware version
- Device name
- Order code
- Extended order code1 to 3
- ENP version

- **Measured values** → (→ 55)
  - **Process variables** → (→ 55)
    - Volume flow
    - Mass flow
    - Conductivity
    - Corrected volume flow
    - Temperature
    - Corrected conductivity
  - **Totalizer** → (→ 56)
    - Totalizer value1 to 3
    - Totalizer overflow1 to 3
  - **Simulation** → (→ 52)
    - Assign simulation process variable
    - Value process variable
    - Simulation device alarm
  - **Heartbeat** → (→ 87)
    - **Performing verification** →
      - Year
      - Month
      - Day
      - Hour
      - AM/PM
      - Minute
      - Start verification
      - Progress
      - Status
    - **Verification results** →
      - Date/time
      - Verification ID
      - Operating time
      - Result

- Sensor
- Sensor electronic module
- **Monitoring results** →
- Noise
- Coil rise time
- Reference electrode potential against PE

Device reset → (→ 66)

- Device reset

Expert → (→ 38)

- Locking status (→ 53)
- Access status tooling
- Enter access code

System →

Diagnostic behavior → (→ 59)

- Alarm delay
- Assign behavior of diagnostic no. 192
- Assign behavior of diagnostic no. 392
- Assign behavior of diagnostic no. 531
- Assign behavior of diagnostic no. 592
- Assign behavior of diagnostic no. 832
- Assign behavior of diagnostic no. 833
- Assign behavior of diagnostic no. 834
- Assign behavior of diagnostic no. 835
- Assign behavior of diagnostic no. 862
- Assign behavior of diagnostic no. 937
- Assign behavior of diagnostic no. 992

- **Management** → (→ 59)
  - Device reset (→ 66)
  - Activate SW option
  - Software option overview
  - Permanent storage
  - Device tag
- **Sensor** →
  - **Measured values** → (→ 55)
    - **Process variables** → (→ 55)
      - Volume flow
      - Mass flow
      - Conductivity
      - Corrected volume flow
      - Temperature
      - Corrected conductivity
    - **Totalizer** → (→ 56)
      - Totalizer value1 to 3
      - Totalizer overflow1 to 3
  - **System units** → (→ 45)
    - Volume flow unit
    - Volume unit
    - Conductivity unit
    - Temperature unit
    - Mass flow unit
    - Mass unit
    - Density unit
    - Corrected volume flow unit
    - Corrected volume unit
    - Date/time format
    - **User-specific units** →
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- User volume factor
- User mass text
- User mass factor
- User corrected volume text
- User corrected volume factor

Process param. → (→ 45)

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- Flow override
- Conductivity damping
- Temperature damping
- Conductivity measurement

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- Pressure shock suppression

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- Response time empty pipe detection
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- Progress
- Empty pipe adjust value
- Full pipe adjust value
- Measured value EPD

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- Electrode cleaning circuit*

- ECC duration*
- ECC recovery time*
- ECC cleaning cycle*
- ECC polarity*
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- External temperature
- Density source
- External value
- Fixed density
- Reference density
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- Mass flow offset
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- Conductivity offset
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Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium / *Medium im Prozess*								
Medium for process cleaning / *Medium zur Prozessreinigung*								
Returned part cleaned with / *Medium zur Endreinigung*								

* explosive; oxidizing; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____

_____

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Company data / *Angaben zum Absender*

Company / *Firma* _____
_____
Address / *Adresse*
_____
_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*
_____
Fax / E-Mail _____
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"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

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