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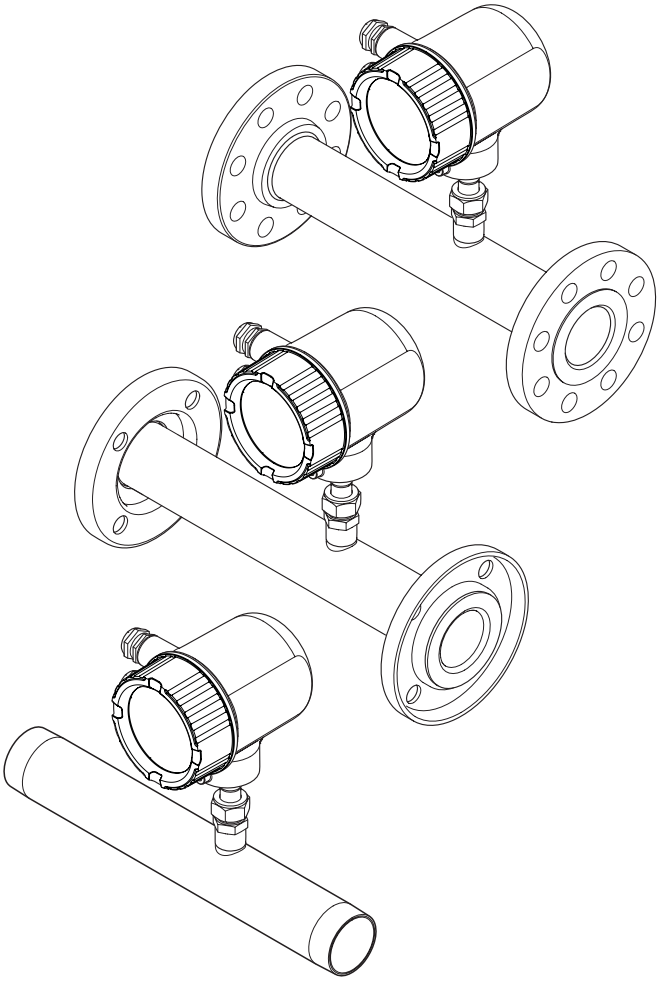
71469730
2020-03-02

Valid as of version
01.00.zz (Device firmware)

Operating Instructions
Proline t-mass A 150 HART

Thermal mass flowmeter



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.

Table of contents

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 Document conventions

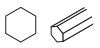
1.2.1 Safety symbols

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 (sine-wave) is applied or through which alternating 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
 A0013442	Torx screwdriver
 A0011220	Flat blade screwdriver
 A0011219	Phillips head screwdriver
 A0011221	Allen key
 A0011222	Hexagon 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

Symbol	Meaning
 A0011187	**Hazardous area** Indicates a hazardous area.
 A0011188	**Safe area (non-hazardous area)** Indicates a non-hazardous location.

1.3 Documentation

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.

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

1.3.2 Supplementary device-dependent documentation

If the device is being used in a hazardous location or in accordance with the Pressure Equipment Directive: Instructions in the relevant supplementary documentation must be consistently observed. The supplementary documentation is an integral part of the device documentation.

Document type	Device particularities and document content
Safety Instructions	**Operation in hazardous areas** The document contains all the necessary information for the safe operation of the device in hazardous areas, and explains how the device can be identified as an Ex system from the device nameplate.
Information on the Pressure Equipment Directive	**Operation in accordance with the Pressure Equipment Directive** The document contains all the necessary information for the safe operation of the device when used in accordance with the Pressure Equipment Directive, and explains how the device can be identified as pressure equipment from the device nameplate.
Installation Instructions	**Ordered accessory** The Installation Instructions contain all the information needed to install the ordered accessory or spare part.

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

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 gases.

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.

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

If the sensor gland is opened, the accuracy specifications of the measuring device no longer apply. In such situations, the measuring device must be removed and returned for recalibration and to the manufacturer.

⚠ WARNING

Risk of injury if the process connection and sensor gland are opened under pressure.
- The process connection should only be opened in an unpressurized state.

NOTICE

Dust and moisture can enter the transmitter when the transmitter housing is opened.
- Only open the transmitter housing briefly, ensuring that no dust or moisture enters the housing.

NOTICE

The accuracy specifications no longer apply if the sensor is opened.
- If the sensor gland is opened, the accuracy specifications of the measuring device no longer apply. In such situations, the measuring device must be removed and returned for recalibration to the manufacturer.

NOTICE

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.

Residual risks

The external surface temperature of the housing can increase by max. 15 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.

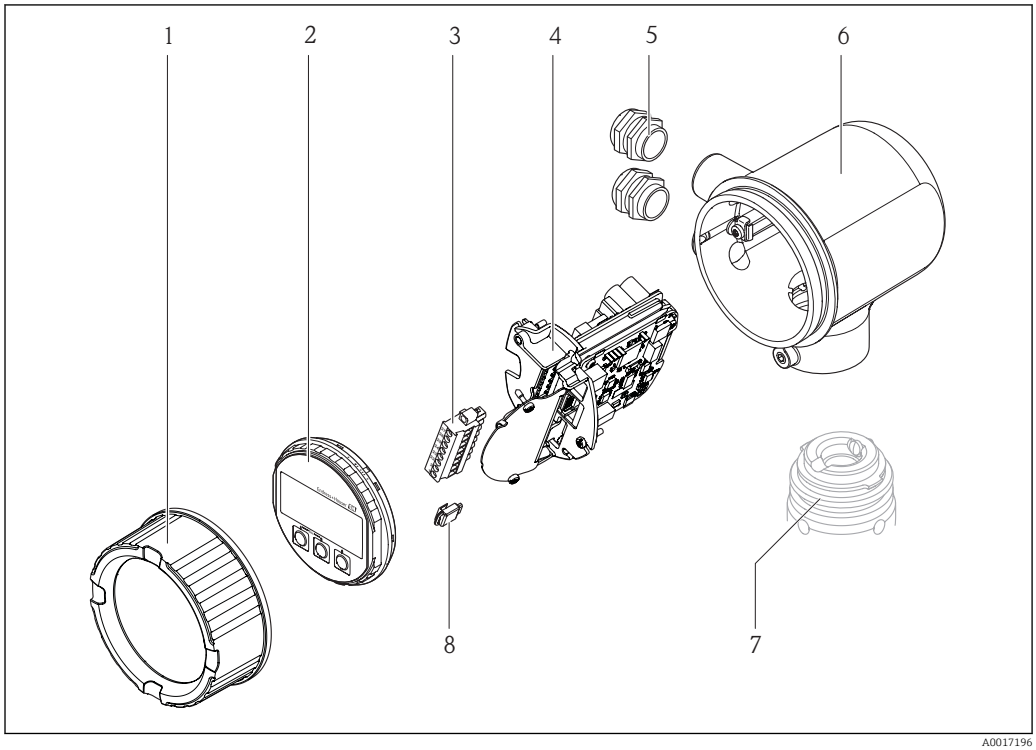
2.5 Product safety

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



1 *Electronics compartment cover*
2 *Display module*
3 *Terminal block*
4 *Electronics module*
5 *Cable gland*
6 *Transmitter housing*
7 *Sensor*
8 *S-DAT*

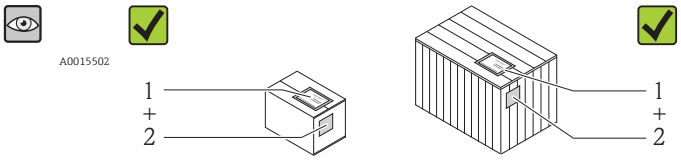
3.2 Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

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

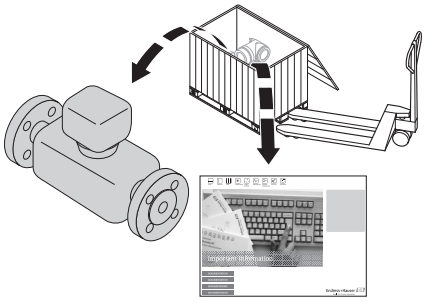
4 Incoming acceptance and product identification

4.1 Incoming acceptance

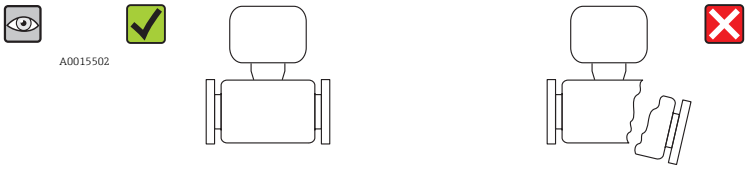


A0013843

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

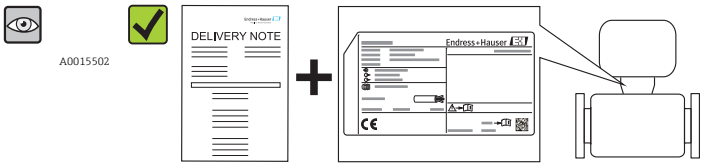


A0013695



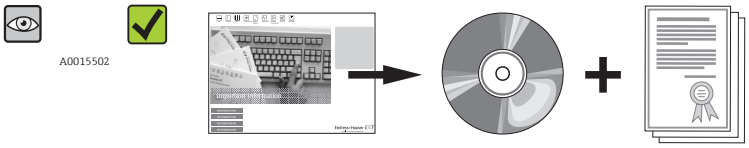
A0013698

Are the goods undamaged?



A0013699

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



A0013697

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

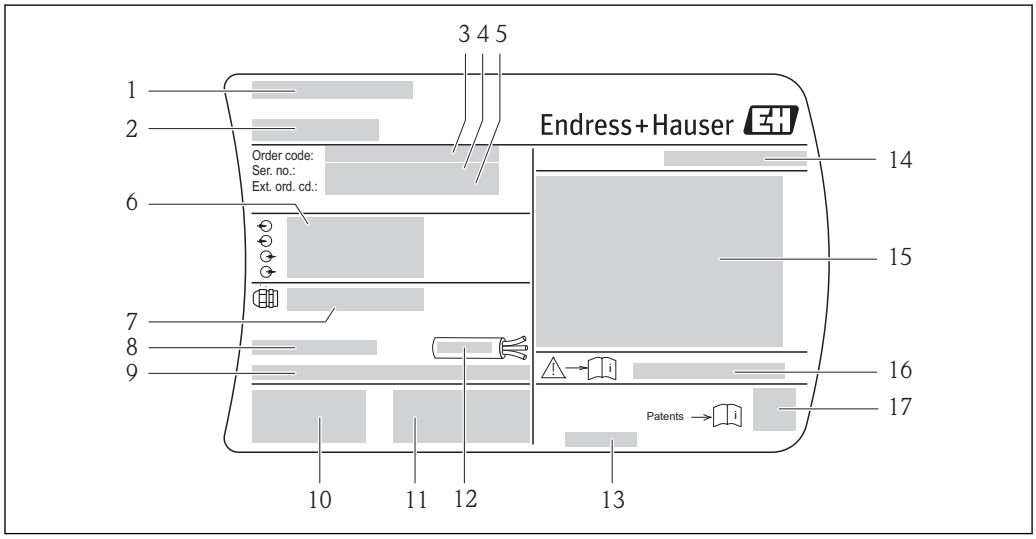
If one of the conditions does not comply, contact your Endress+Hauser distributor.

4.2 Product identification

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

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

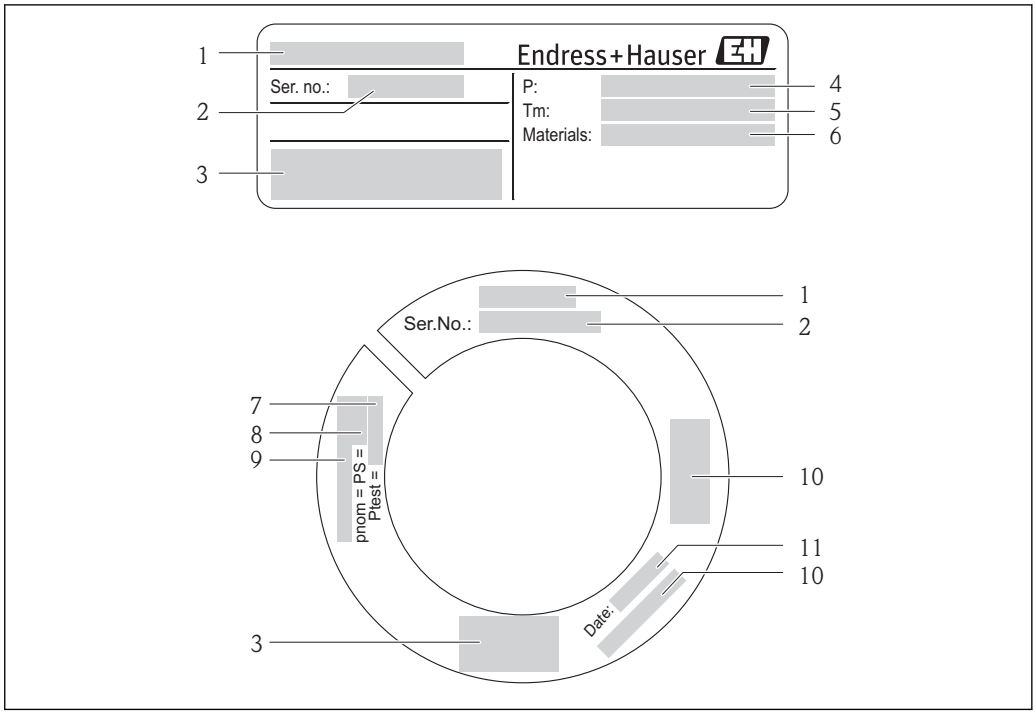
4.2.1 Transmitter nameplate



1 *Example of a transmitter nameplate*

1 *Manufacturing location*
2 *Name of the transmitter*
3 *Order code*
4 *Serial number (Ser. no.)*
5 *Extended order code (Ext. ord. cd.)*
6 *Electrical connection data, e.g. available inputs and outputs, supply voltage*
7 *Type of cable glands*
8 *Permitted ambient temperature (T_a)*
9 *Firmware version (FW) and device revision (Dev.Rev.) from the factory*
10 *CE mark, C-Tick*
11 *Additional information on version: certificates, approvals*
12 *Permitted temperature range for cable*
13 *Manufacturing date: year-month*
14 *Degree of protection*
15 *Approval information for explosion protection*
16 *Document number of safety-related supplementary documentation → 7*
17 *2-D matrix code*

4.2.2 Sensor nameplate



2 *Example of 1st sensor nameplate*

1 *Name of the sensor*
2 *Serial number (Ser. no.)*
3 *CE mark, C-Tick*
4 *Process temperature range*
5 *Medium temperature range*
6 *Material of measuring tube, manifold and seal*
7 *Test pressure of the sensor*
8 *Nominal pressure of the sensor*
9 *Flange nominal diameter/nominal pressure*
10 *Approval information for Pressure Equipment Directive*
11 *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 have also been ordered, they are indicated collectively by 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 +).

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

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.

▶ Webbing slings are usually not required. However if they are used, make sure that the center of gravity of the measuring device is higher than the suspension points of the webbing slings.

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.
- Do not lift the measuring device by 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.

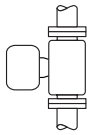
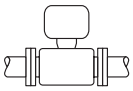
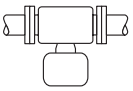
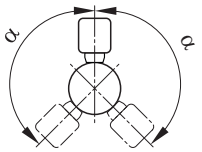
6.1.1 Mounting position

Mounting location

Thermal measuring devices require a fully developed flow profile as a prerequisite for correct flow measurement. For this reason, please pay attention to the following points and document sections when installing the device:
- Avoid flow disturbances, as the thermal measuring principle reacts sensitively to them.
- Take measures to avoid condensation (e.g. condensation trap, thermal insulation etc.).

Orientation

The direction of the arrow on the sensor helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

Vertical orientation	 A0017337	✓✓ 1)
Horizontal orientation, transmitter head up	 A0015589	✓✓
Horizontal orientation, transmitter head down	 A0015590	✓✓ 2)
Inclined mounting position, transmitter head down	 A0015773	✓ 3)

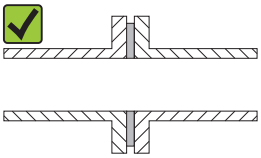
1) In the case of saturated or unclean gases, upward flow in a vertical pipe section is preferred to minimize condensation or contamination.
2) Suitable only for clean and dry gases. If buildup or condensate are always present: Mount the sensor in an inclined position.
3) Select inclined mounting position (α = approx. 135°) if the gas is very wet or saturated with water.

Requirement for pipework

The measuring device must be professionally installed, and the following points must be observed:

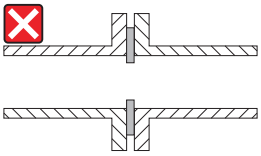
- Piping must be professionally welded.
- Seals must be sized correctly.
- Flanges and seals must be correctly aligned.
- The internal pipe diameter on the inlet side must match the internal diameter of the process connection ordered. The maximum permitted deviation between the internal diameters is:
  1 mm (0.04 in)
- Following installation, the pipe must be free from dirt and particles in order to avoid damage to the sensors.

Further information → ISO standard 14511



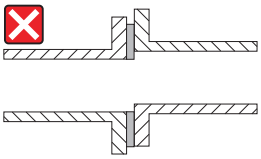
A0005103

Correctly aligned flanges and seals



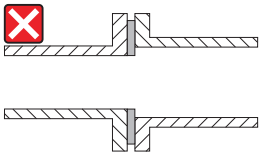
A0005105

Incorrectly sized seal



A0005106

Incorrectly aligned flanges and seals



A0005104

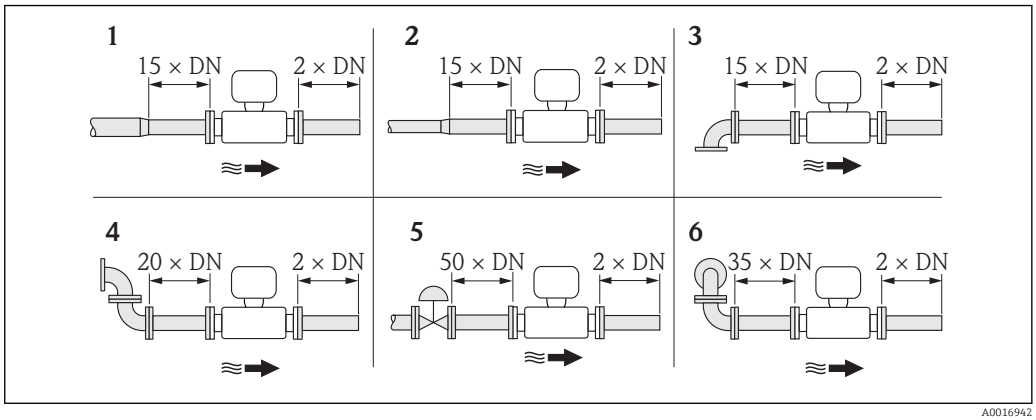
Internal diameter of pipe does not correspond to internal diameter of process connection ordered

Inlet and outlet runs

The thermal measuring principle is sensitive to disturbed flow conditions.

- As a general rule, the measuring device should always be installed as far away as possible from any flow disturbances. For further information, please refer to → ISO 14511.
- If possible, the sensor should be installed upstream from valves, T-pieces, elbows etc. To attain the specified level of accuracy of the measuring device, the below mentioned inlet and outlet runs must be maintained at minimum. If there are several flow disturbances present, the longest specified inlet run must be maintained.

Recommended inlet and outlet runs (without flow conditioner)



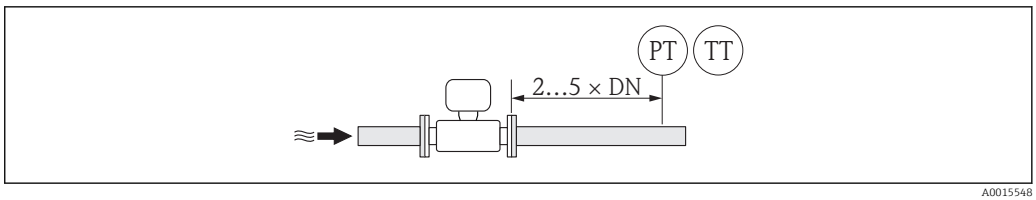
1 reduction
2 expansion
3 90° elbow or T-piece
4 2 × 90° elbow
5 Control valve
6 2 × 90° elbow (3-dimensional)

Installation dimensions

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

Outlet run for pressure or temperature transmitter

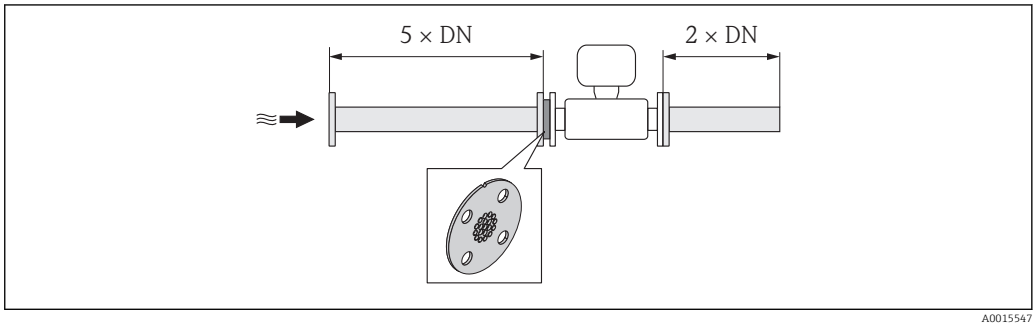
If a pressure or temperature measuring device is installed downstream of the measuring device, make sure there is sufficient distance between the two devices.



PT Pressure measuring device
TT Temperature measuring device

Flow conditioner (19 hole) for use with fixed flanges

If the inlet runs cannot be observed, the use of a flow conditioner is recommended.

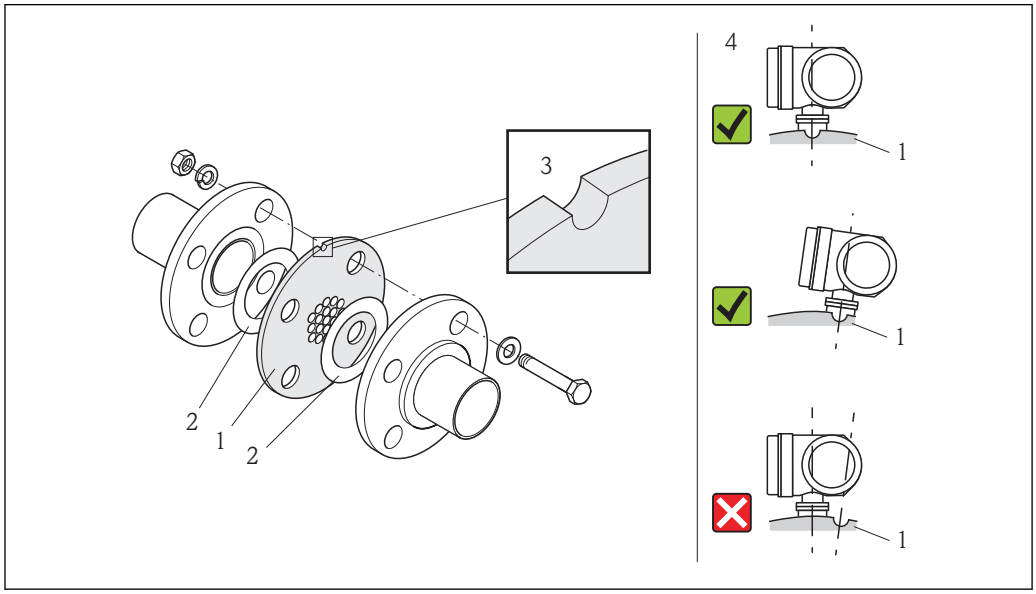


3 Recommended inlet and outlet runs when using a flow conditioner

This is a special Endress+Hauser design which was developed for the sensor t-mass A 150 (DN 40 to 50 / 1 ½ to 2"). The arrangement of the individual screw holes and their diameter means that the flow conditioner can be used for different flange pressure ratings.

The flow conditioner and the seals are installed between the pipe flange and the measuring system. To ensure correct centering of the flow conditioner, use only standard screws which match the screw holes .

Please note that the flow conditioner must be mounted in such a way that the alignment notch is pointing in the direction of the transmitter. Incorrect installation could have a negative effect on the measurement accuracy.



1 *Flow conditioner*
2 *Seal*
3 *Alignment notch*
4 *Correctly align the alignment notch and transmitter.*

- Not suitable for lap joint flange or threaded versions!
- Order the sensor and the flow conditioner together to ensure that they are calibrated together. Joint calibration guarantees optimum performance. Ordering the flow conditioner separately and using it with the device will further increase measurement uncertainty.
- The use of flow conditioners from other suppliers will affect the flow profile and pressure drop and will have an adverse effect on performance.
- Screws, nuts, seals etc. are not included in the scope of supply and must be provided by the customer.

Pressure loss

The pressure loss for flow conditioners is calculated as follows:

$$\Delta p = K \cdot \frac{\dot{m}^2}{\rho} \cdot \frac{1}{D^4}$$

A0005243

Δp = Pressure loss [mbar] ρ = Density [kg/m³] K = Constant 1876 (SI units) or $8.4 \cdot 10^{-7}$ (US units)	$\dot{m}$ = Mass flow [kg/h] D = Diameter [mm]

Calculation example
- $\dot{m}$ = 412 kg/h
- ρ = 8.33 kg/m³ at 7 bar abs. and 20 °C (68 °F)
- D = 42.8 mm for DN 40, PN 40

Calculation in SI units
$\Delta p = 1876 \cdot (412^2 \div 8.33) \cdot (1 \div 42.8^4) = 11.4$ mbar

6.1.2 Environment and process requirements

Ambient temperature range

Transmitter	−40 to +60 °C (−40 to +140 °F)
Sensor	▪ Flange and threaded connection made of stainless steel: −40 to +60 °C (−40 to +140 °F) ▪ Flange connection PN16 made of carbon steel: −10 to +60 °C (−14 to +140 °F) ▪ Flange connection Cl.150 made of carbon steel: −29 to +60 °C (−20.2 to +140 °F)
Local display	−20 to +60 °C (−4 to +140 °F) The readability of the display may be impaired at temperatures outside the temperature range.

▶ If operating outdoors:
Avoid direct sunlight, particularly in warm climatic regions.

System pressure

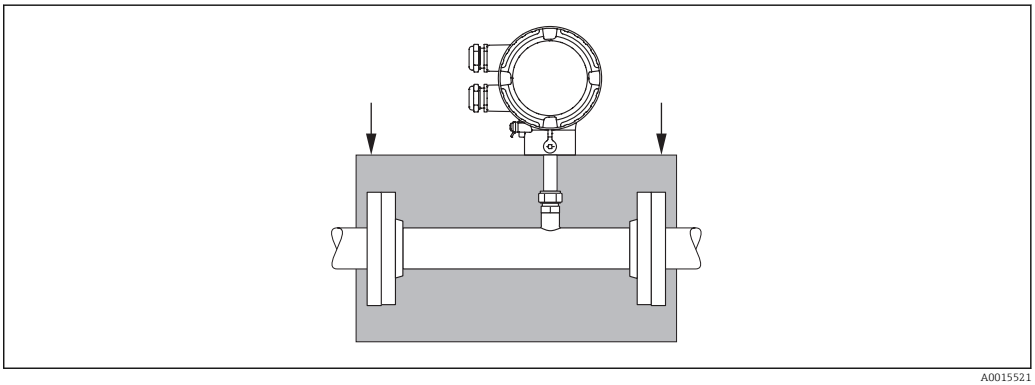
Sensor
Depending on the version, please note the details on the name plate .
Max. 40 bar g (580 psi g)

Thermal insulation

If the gas is very humid or saturated with water, the pipe and the sensor housing should be insulated to prevent water droplets condensing on the transducer.

NOTICE

Electronics overheating on account of thermal insulation!
▶ Observe maximum permitted insulation height of the transmitter neck so that the transmitter head is completely free.



A0015521

6.2 Mounting the measuring device

6.2.1 Required tools

For transmitter

For turning the transmitter housing (in increments of 90°): Allen screw 4 mm (0.15 in)

For sensor

For flanges and other process connections: Corresponding 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.

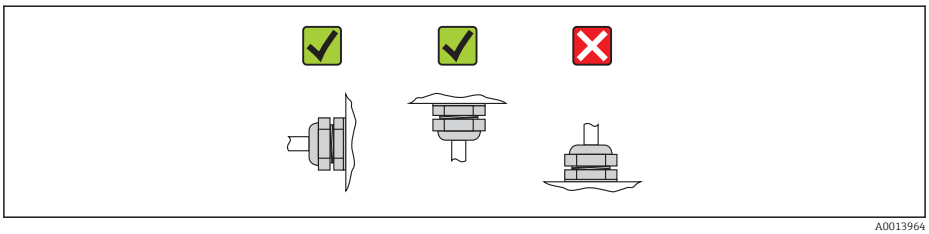
6.2.3 Mounting the measuring device

⚠ WARNING

Danger due to improper process sealing!

- ▶ Ensure that the inside diameters of the gaskets are greater than or equal to that of the measuring tube and piping.
- ▶ Ensure that the gaskets are clean and undamaged.
- ▶ In the case of lap joint flanges the transmitter housing can rotate about he pipe axis if the flanges are not tightened.
- ▶ Install the gaskets correctly.

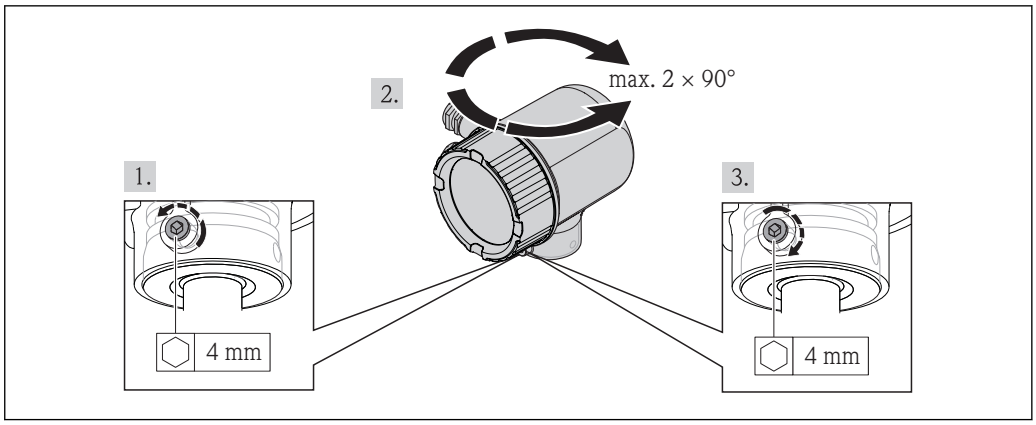
1. Ensure that the direction of the arrow on the sensor matches the flow direction of the medium.
2. Install the measuring device or turn the transmitter housing so that the cable entries do not point upwards.



A0013964

6.2.4 Turning the transmitter housing

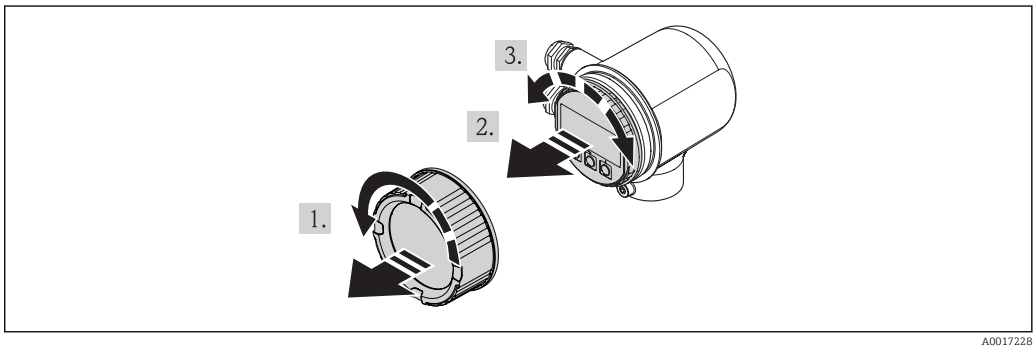
To provide easier access to the connection compartment or display module, the transmitter housing can be turned clockwise or counterclockwise to 4 indexed positions by a maximum of 2 x 90°:



A0017227

1. Unscrew the securing screw using an Allen key.
2. Rotate the housing in the desired direction.
3. Firmly tighten the securing screw.

6.2.5 Turning the display module



A0017228

1. Remove the cover of the electronics compartment.
2. Pull out the display module with a gentle rotational movement.
3. Turn the display module to the desired position: Max. 4×90° in each direction.
4. Feed the ribbon cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment and turn it until it engages.
5. Screw the cover of the electronics compartment back on.

6.3 Post-mounting check

Is the device damaged (visual inspection)?	❑
Does the measuring device conform to the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure (refer to the chapter on "Material load curves" of the "Technical Information" document) ▪ Ambient temperature range ▪ Measuring range → 🖹 95	❑

Has the correct orientation for the sensor been selected → 15? ▪ According to sensor type ▪ According to medium properties ▪ According to medium temperature ▪ According to process pressure	❑
Does the arrow on the sensor match the direction of flow of the medium through the piping → 15?	❑
Have sufficient inlet and outlet runs been provided upstream and downstream of the measuring point?	❑
Correctly aligned in the direction of flow?	❑
Is the device adequately protected from precipitation and direct sunlight?	❑
Is the device protected against overheating?	❑
Is the device protected against excessive vibrations?	❑
Check gas property (e.g. purity, dryness, cleanness).	❑
Are the measuring point identification and labeling correct (visual inspection)?	❑

7 Electrical connection

7.1 Connection conditions

7.1.1 Required tools

- For cable entries: Use corresponding tools
- Wire stripper
- When using stranded cables: Crimping tool for wire end ferrule
- Flat blade screwdriver≤ 3 mm (0.12 in)

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.

Cable specification

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

Current output
For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant.

Pulse/frequency/switching output
Standard installation cable is sufficient

Cable diameter
- Included cable glands: M20 × 1.5 with cable ϕ 6 to 12 mm (0.24 to 0.47 in)
- Core cross-sectional area0.5 to 1.5 mm^2 (21 to 16 AWG)

7.1.3 Requirements for the supply unit

Device supply voltage

DC 24 V (18 to 30 V)

The power supply circuit must comply with ELV (BS 7671) requirements.

Pulse/frequency/status supply voltage

An external power supply is required for each output.

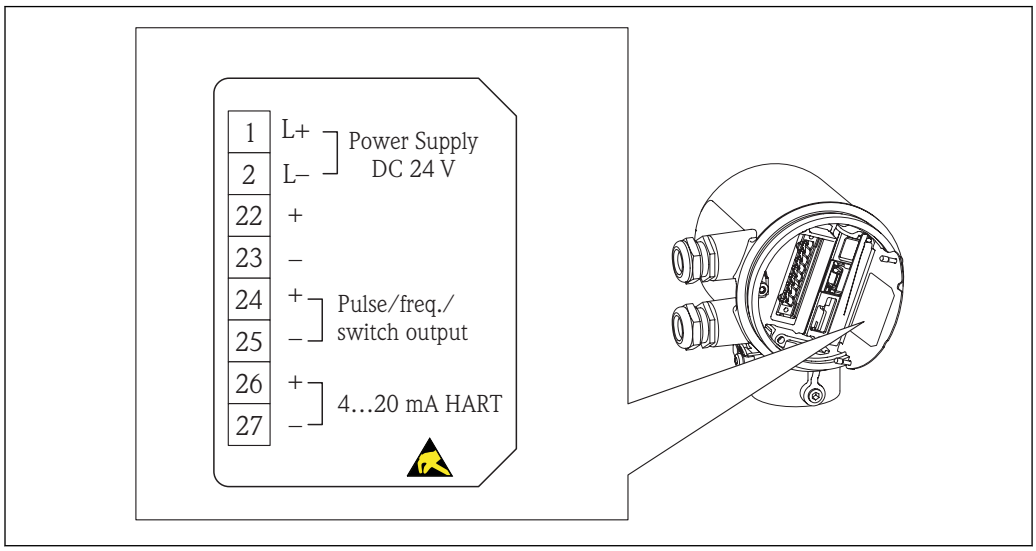
Order characteristic for "Output"	Maximum terminal voltage
Option **B, K**	DC 30 V

Load

0 to 750 Ω, depending on the external supply voltage of the power supply unit

7.1.4 Terminal assignment

The terminal assignment for the electrical connection can be found on the nameplate of the electronics module.



7.1.5 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 defeated.
   ▶ 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 .→ 23
3. If measuring device is delivered with cable glands:
   Observe cable specification → 23.

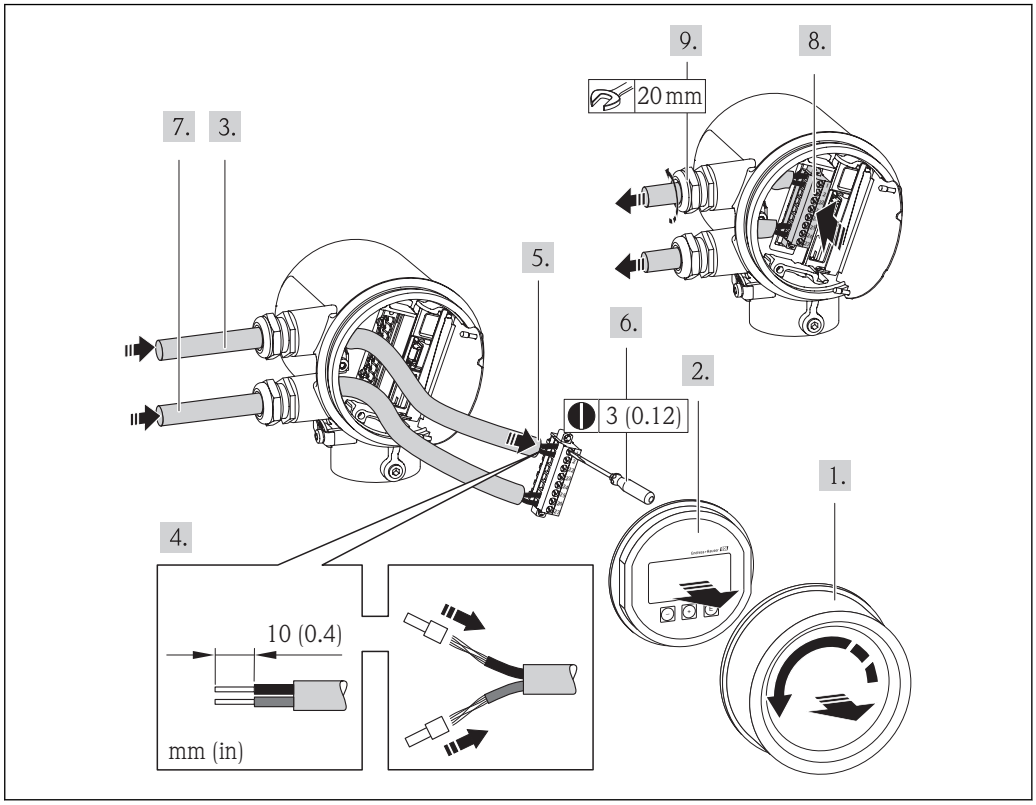
7.2 Connecting the measuring device

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.
- ▶ SELV/PELV-compliant 24 V DC (18 to 30 V) power supply.
- ▶ 4 to 20 mAHART active
- ▶ Maximum output values: DC 24V, 22 mA, load 0 to 750 Ω

7.2.1 Connecting the cables



1. Unscrew the connection compartment cover.
2. Remove the display module.
3. Push the supply 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 wire end ferrules.
5. Connect the cable in accordance with the terminal assignment → 99. For HART communication: When connecting the cable shielding to the ground terminal, observe the grounding concept of the facility.
6. Firmly tighten the screws in the terminal block.
7. Perform the same steps for the signal cable as for the power supply cable.
8. Insert the terminal block into the electronics module.
9. Firmly tighten the cable glands.
10. NOTICE

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

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

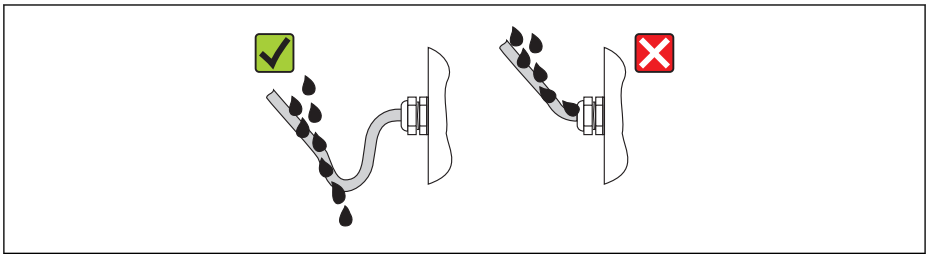
Reverse the removal procedure to reassemble the transmitter.

7.3 Ensuring the degree of protection

The measuring device fulfills all the requirements for the IP66 and IP67 (Type 4X enclosure) degree of protection.

To guarantee IP 66 and IP 67 degree of protection (Type 4X enclosure), carry out the following steps after the electrical connection:

1. Check whether the housing seals of the connection and electronics compartment are clean and inserted 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").



A0013960

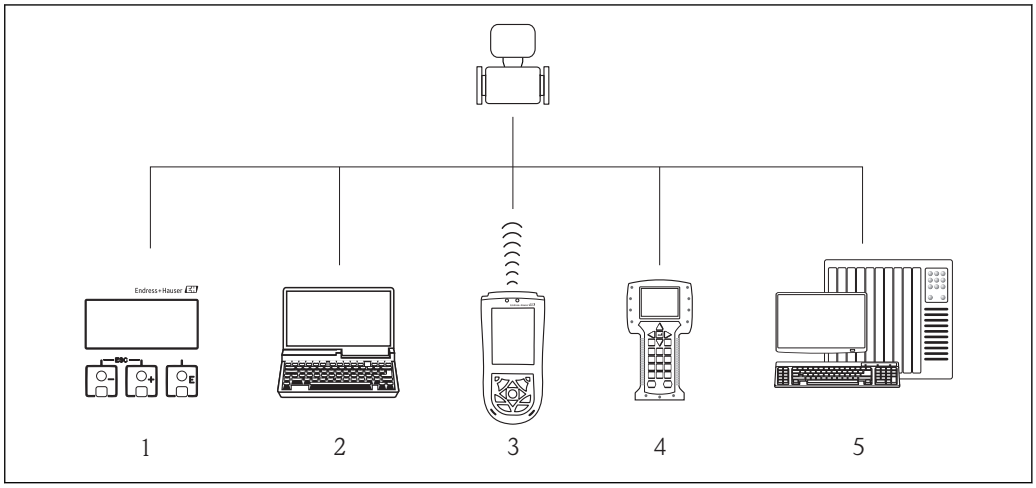
5. Insert dummy plugs into unused cable entries.

7.4 Post-connection check

Are cables or the device undamaged (visual inspection)?	❑
Are the power supply and signal cables correctly connected?	❑
Does the supply voltage correspond to the specifications in the connection diagram?	❑
Do the cables comply with the requirements → 🖹 23?	❑
Do the cables have adequate strain relief? Are they routed securely?	❑
Is the cable route completely isolated? Without loops and cross-overs?	❑
Are all the screw terminals firmly tightened?	❑
Are all the cable glands installed, firmly tightened and leak-tight? Cable run with "water trap" → 🖹 23 ?	❑
Does the supply voltage match the specifications on the transmitter nameplate → 🖹 23?	❑
Is the terminal assignment correct → 🖹 23?	❑
If supply voltage is present, is the device ready for operation and do values appear on the display module?	❑
Are all housing covers installed and firmly tightened?	❑

8 Operation options

8.1 Overview of operation options



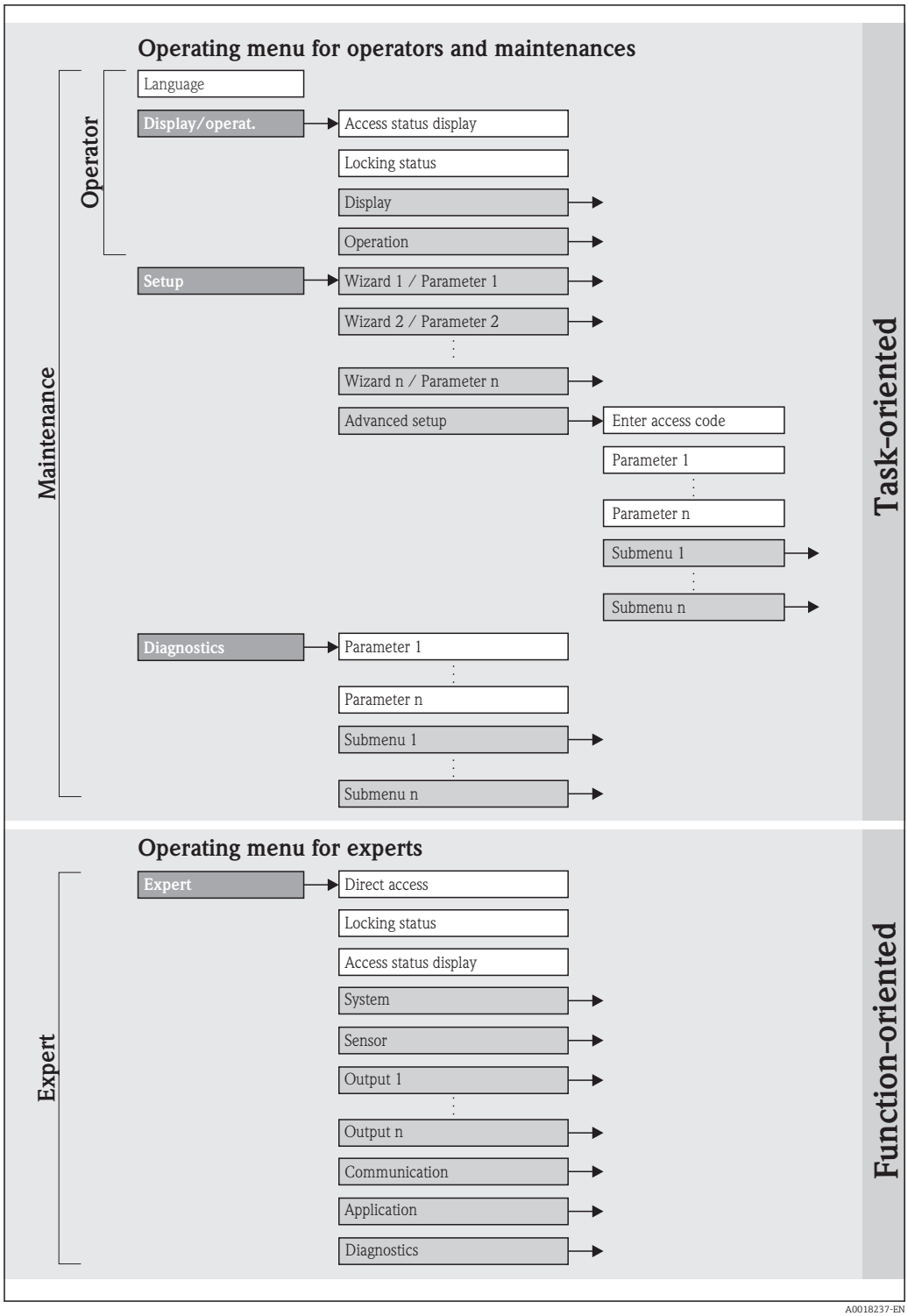
1 *Local operation via display module*
2 *Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)*
3 *Field Xpert SFX100*
4 *Field Communicator 475*
5 *Control system (e.g. PLC)*

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 → 110

For an overview of the operating menu for experts: → 110


Operating menu for operators and maintenances
Operator
Maintenance
Language
Display/operat.
Access status display
Locking status
Display
Operation
Setup
Wizard 1 / Parameter 1
Wizard 2 / Parameter 2
Wizard n / Parameter n
Advanced setup
Enter access code
Parameter 1
Parameter n
Submenu 1
Submenu n
Diagnostics
Parameter 1
Parameter n
Submenu 1
Submenu n
Task-oriented
Operating menu for experts
Expert
Expert
Direct access
Locking status
Access status display
System
Sensor
Output 1
Output n
Communication
Application
Diagnostics
Function-oriented
A0018237-EN

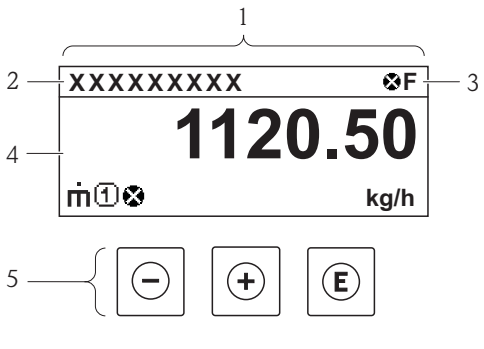
8.2.2 Operating philosophy

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

Menu		User role and tasks	Content/meaning
Language	task-oriented	**Role "Operator", "Maintenance"** Tasks during operation: ▪ Configuring the measured value display ▪ Reading measured values	Defining the operating language
Display/operat.			Configuration of the measured value display (e.g. display format, display contrast) Resetting and controlling totalizers
Setup		**"Maintenance" role** Commissioning: ▪ Configuration of the measurement ▪ Configuration of the outputs	Wizards for quick commissioning: ▪ Defining the medium ▪ Configuring the outputs ▪ Configuring the measured value display ▪ Defining the output conditioning ▪ Configuring the low flow cut off "Advanced setup" submenu: ▪ For more customized configuration of the measurement (adaptation to special measuring conditions) ▪ Configuration of totalizers
Diagnosis		**"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 up to 20 or 100 (order option) event messages that have occurred. ▪ **"Device information" submenu** Contains information for identifying the device. ▪ **"Measured values" submenu** Contains all current measured values. ▪ **"Data logging" submenu (order option)** Storage and visualization of up to 1000 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. ▪ **"Output" submenu** Contains all parameters for configuring the analog current outputs. ▪ **"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 local display

8.3.1 Operational display



1 *Operational display*
2 *Device tag* → 🖹 *53*
3 *Status area*
4 *Display area for measured values (4-line)*
5 *Operating elements* → 🖹 30

Status area

The following symbols appear in the status area of the operational display at the top right:

Status signals

Symbol	Meaning
F A0013956	**Failure** A device error has occurred. The measured value is no longer valid.
C A0013959	**Function check** The device is in service mode (e.g. during a simulation).
S A0013958	**Out of specification** The device is being operated: ▪ Outside its technical specification limits (e.g. outside the process temperature range) ▪ Outside of the configuration carried out by the user (e.g. maximum flow in parameter **20 mA value**)
M A0013957	**Maintenance required** Maintenance is required. The measured value is still valid.

Diagnostic behavior

Symbol	Meaning
A0013961	**Alarm** Measurement is interrupted. The signal outputs and totalizers assume the defined alarm condition. A diagnostics message is generated → 🖹 82.
A0013962	**Warning** Measurement is resumed. The signal outputs and totalizers are not affected. A diagnostics message is generated → 🖹 82.

Locking

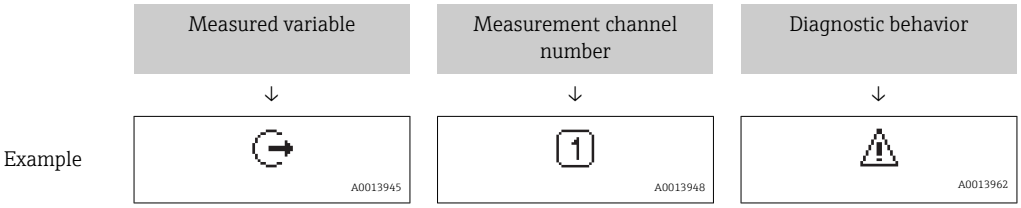
Symbol	Meaning
A0013963	**Device locked** The measuring device is hardware locked → 🖹 71.

Communication

Symbol	Meaning
 A0013965	Communication via remote operation is active.

Display area

In the display area, each measured value is prefaced by certain symbol types for further description:



Measured variables

Symbol	Meaning
 A0013711	Corrected volume flow, FAD
 A0013710	Mass flow
 A0013947	Temperature
 A0013943	Totalizer
 A0013945	Current output

Measurement channel numbers

Symbol	Meaning
 A0016325	Measurement channel 1 to 4
The measurement channel number is displayed only if more than one channel is present for the same measured variable type.	

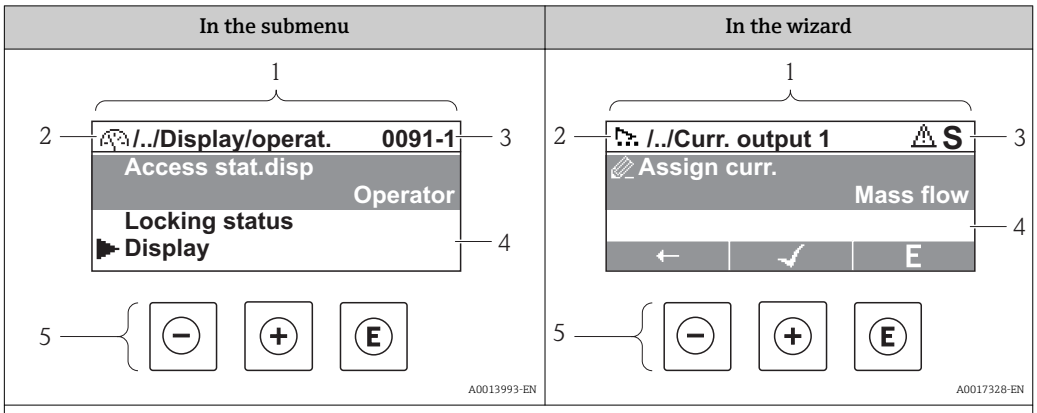
Diagnostic behavior

The diagnostic behavior pertains to a diagnostic event that is relevant to the displayed measured variable. For more information about the symbols, refer to the "Status area" section → 30.

The number and display of the measured values can be configured via the parameter **Format display**.

Navigation path
"Display/operat." menu → Display → Format display

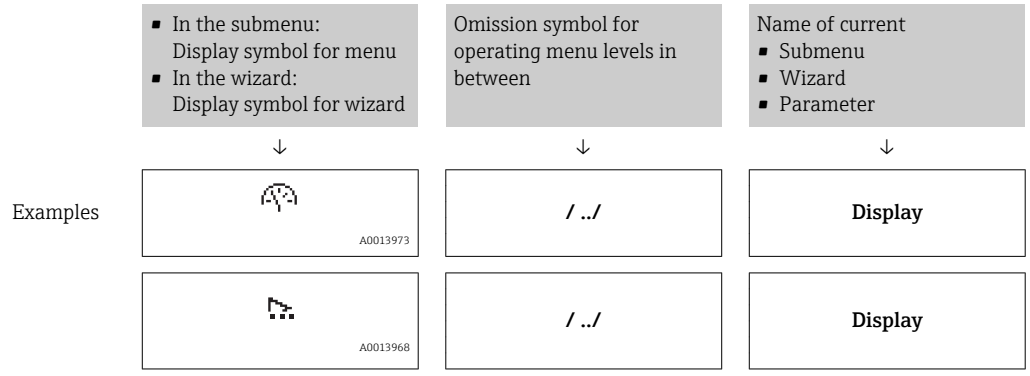
8.3.2 Navigation view



1 *Navigation view*
2 *Navigation path to current position*
3 *Status area*
4 *Display area for navigation*
5 *Operating elements* → 35

Navigation path

The navigation path - displayed at the top left in the navigation view - consists of the following elements:



For more information about the menu icons, refer to the "Display area" section → 33

Status area

The following appears in the status area of the navigation view in the top right corner:
- Of the submenu
  - The direct access code for the parameter you are navigating to (e.g. 0022-1)
  - If a diagnostic event is present, the diagnostic behavior and status signal
- In the wizard
  If a diagnostic event is present, the diagnostic behavior and status signal

For information on the diagnostic behavior and status signal → 82

For information on entering the direct access code and how this function works: → 38

Display area

Menus

Symbol	Meaning
 A0013973	**Display/operat.** Appears: ▪ In the menu next to the "Display/operat." selection ▪ At the left in the navigation path in the "Display/operat." menu
 A0013974	**Setup** Appears: ▪ In the menu next to the "Setup" selection ▪ At the left in the navigation path in the "Setup" menu
 A0013975	**Diagnosis** Appears: ▪ In the menu next to the "Diagnostics" selection ▪ At the left in the navigation path in the "Diagnostics" menu
 A0013966	**Expert** Appears: ▪ In the menu next to the "Expert" selection ▪ At the left in the navigation path in the "Expert" menu

Submenus, wizards, parameters

Symbol	Meaning
A0013967	Submenu
A0013968	Wizard
 A0013972	Parameters within a wizard No display symbol exists for parameters in submenus.

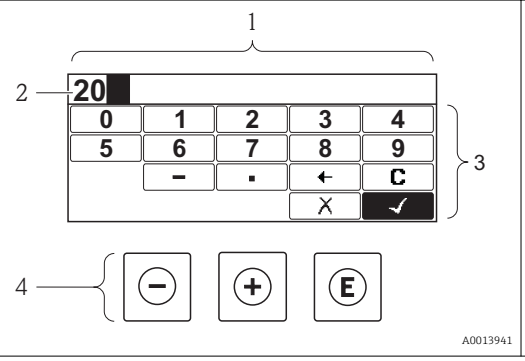
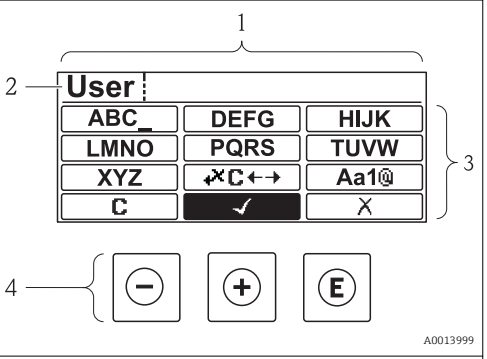
Locking

Symbol	Meaning
 A0013963	**Parameter locked** When displayed in front of a parameter name, indicates that the parameter is locked. ▪ By a user-specific access code → 72 ▪ By the hardware write protection switch → 71

Wizard operation

Symbol	Meaning
 A0013978	Switches to the previous parameter.
 A0013976	Confirms the parameter value and switches to the next parameter.
 A0013977	Opens the editing view of the parameter.

8.3.3 Editing view

Numeric editor	Text editor
	

1 Editing view
2 Display area of the entered values
3 Input mask
4 Operating elements → 35

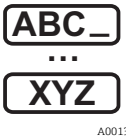
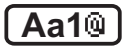
Input mask

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

Numeric editor

Symbol	Meaning
 A0013998	Selection of numbers from 0 to 9.
 A0016619	Inserts decimal separator at the input position.
 A0016620	Inserts minus sign at the input position.
 A0013985	Confirms selection.
 A0016621	Moves the input position one position to the left.
 A0013986	Exits the input without applying the changes.
 A0014040	Clears all entered characters.

Text editor

Symbol	Meaning
 A0013997	Selection of letters from A to Z
 A0013981	Toggle ▪ Between upper-case and lower-case letters ▪ For entering numbers ▪ For entering special characters

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

Correction symbols under 

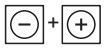
Symbol	Meaning
 A0013989	Clears all entered characters.
 A0013991	Moves the input position one position to the right.
 A0013990	Moves the input position one position to the left.
 A0013988	Deletes one character immediately to the left of the input position.

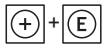
8.3.4 Operating elements

Key	Meaning
 A0013969	**Minus key** *In a menu, submenu* Moves the selection bar upwards in a choose list. *With a Wizard* Confirms the parameter value and goes to the previous parameter. *With a text and numeric editor* In the input mask, moves the selection bar to the left (backwards).
 A0013970	**Plus key** *In a menu, submenu* Moves the selection bar downwards in a choose list. *With a Wizard* Confirms the parameter value and goes to the next parameter. *With a text and numeric editor* Moves the selection bar to the right (forwards) in an input screen.

Key	Meaning

 A0013952	**Enter key**
	For operational display
	▪ Pressing the key briefly opens the operating menu.
	▪ Pressing the key for 2 s opens the context menu.
	In a menu, submenu
	▪ Pressing the key briefly:
	  ▪ Opens the selected menu, submenu or parameter.
	  ▪ Starts the wizard.
	  ▪ If help text is open, closes the help text of the parameter.
	▪ Pressing the key for 2 s for parameter:
	  If present, opens the help text for the function of the parameter.
	With a Wizard
	Opens the editing view of the parameter.
	With a text and numeric editor
	▪ Pressing the key briefly:
	  ▪ Opens the selected group.
	  ▪ Carries out the selected action.
	▪ Pressing the key for 2 s confirms the edited parameter value.

 A0013971	**Escape key combination (press keys simultaneously)**
	In a menu, submenu
	▪ Pressing the key briefly:
	  ▪ Exits the current menu level and takes you to the next higher level.
	  ▪ If help text is open, closes the help text of the parameter.
	▪ Pressing the key for 2 s returns you to the operational display ("home position").
	With a Wizard
	Exits the wizard and takes you to the next higher level.
	With a text and numeric editor
	Closes the text or numeric editor without applying changes.

 A0013953	**Minus/Enter key combination (press the keys simultaneously)** Reduces the contrast (brighter setting).
 A0013954	**Plus/Enter key combination (press and hold down the keys simultaneously)** Increases the contrast (darker setting).
 A0013955	**Minus/Plus/Enter key combination (press the keys simultaneously)** *For operational display* Enables or disables the keypad lock.

8.3.5 Opening the context menu

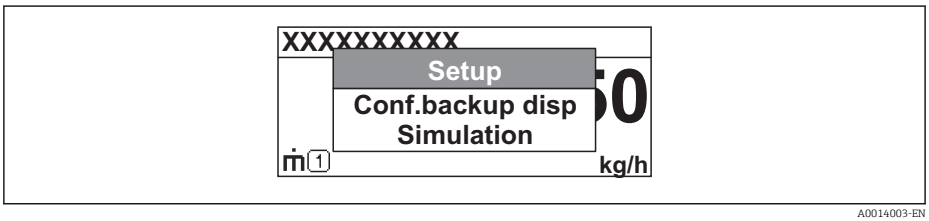
Using the context menu, the user can call up the following three menus quickly and directly from the measured value display:

- Setup
- Conf. backup disp.
- Simulation

Calling up and closing the context menu

The user is in the measured value display.

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



A0014003-EN

2. Press ⊟ + ⊞ simultaneously.
   ↳ The context menu is closed and the measured value display appears.

Calling up the menu via the context menu

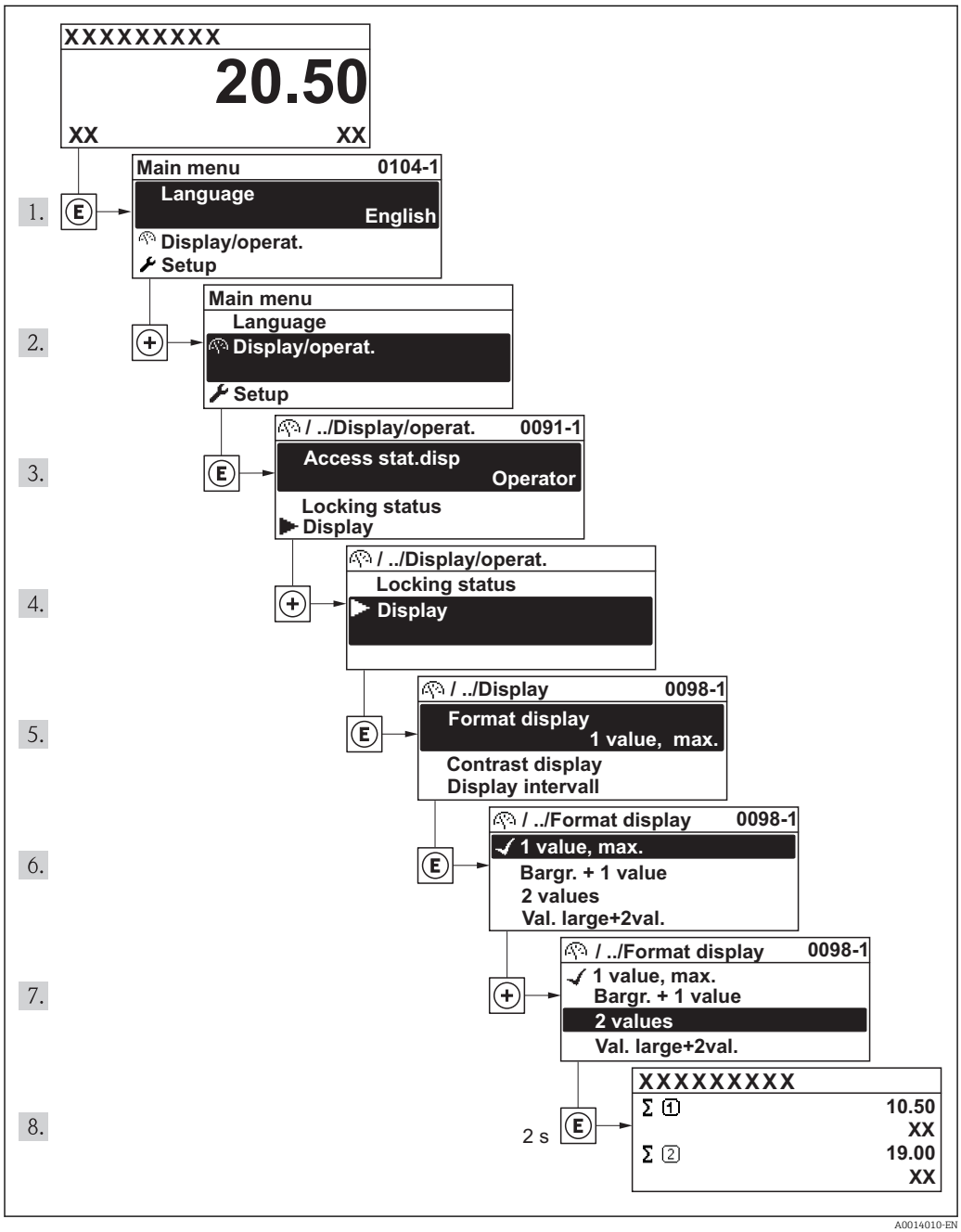
1. Open the context menu.
2. Press ⊞ to navigate to the desired menu.
3. Press Ⓔ to confirm the selection.
   ↳ The selected menu opens.

8.3.6 Navigating and selecting from list

Different operating elements are used to navigate through the operating menu. The navigation path is displayed on the left in the header. Icons are displayed in front of the individual menus. These icons are also shown in the header during navigation.

For an explanation of the navigation view with symbols and operating elements → 32

Example: Setting the number of displayed measured values to "2 values"

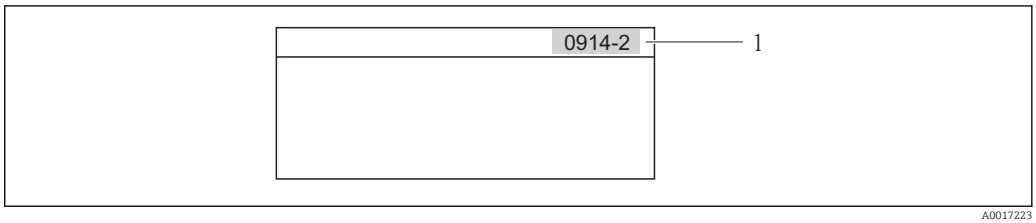


8.3.7 Calling the parameter directly

A parameter number is assigned to every parameter to be able to access a parameter directly via the onsite display. Entering this access code in the **Direct access** parameter calls up the desired parameter directly.

Navigation path
"Expert" menu → Direct access

The direct access code consists of a 4-digit number and the channel number, which identifies the channel of a process variable: e.g. 0914-1. In the navigation view, this appears on the right-hand side in the header of the selected parameter.



1 Direct access code

Note the following when entering the direct access code:
- The leading zeros in the direct access code do not have to be entered.
  Example: Input of "914" instead of "0914"
- If no channel number is entered, channel 1 is jumped to automatically.
  Example: Input of "0914" → Parameter **Totalizer 1**
- If a different channel is jumped to: Enter the direct access code with the corresponding channel number.
  Example: Input of "0914-2" → Parameter **Totalizer 2**

For the direct access codes of the individual parameters → 110→ 110

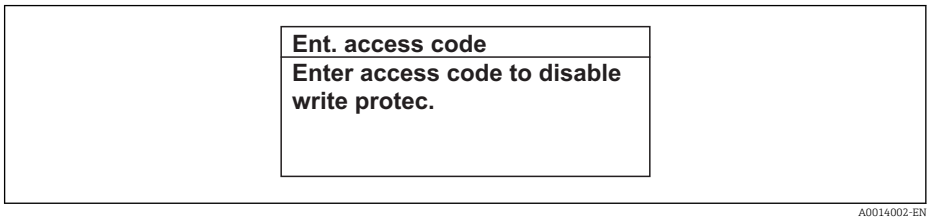
8.3.8 Calling up help text

Help text is available for some parameters and can be called up from the navigation view. The help text provides a brief explanation of the parameter function and thereby supports swift and safe commissioning.

Calling up and closing the help text

The user is in the navigation view and the selection bar is on a parameter.

1. Press E for 2 s.
   ↳ The help text for the selected parameter opens.



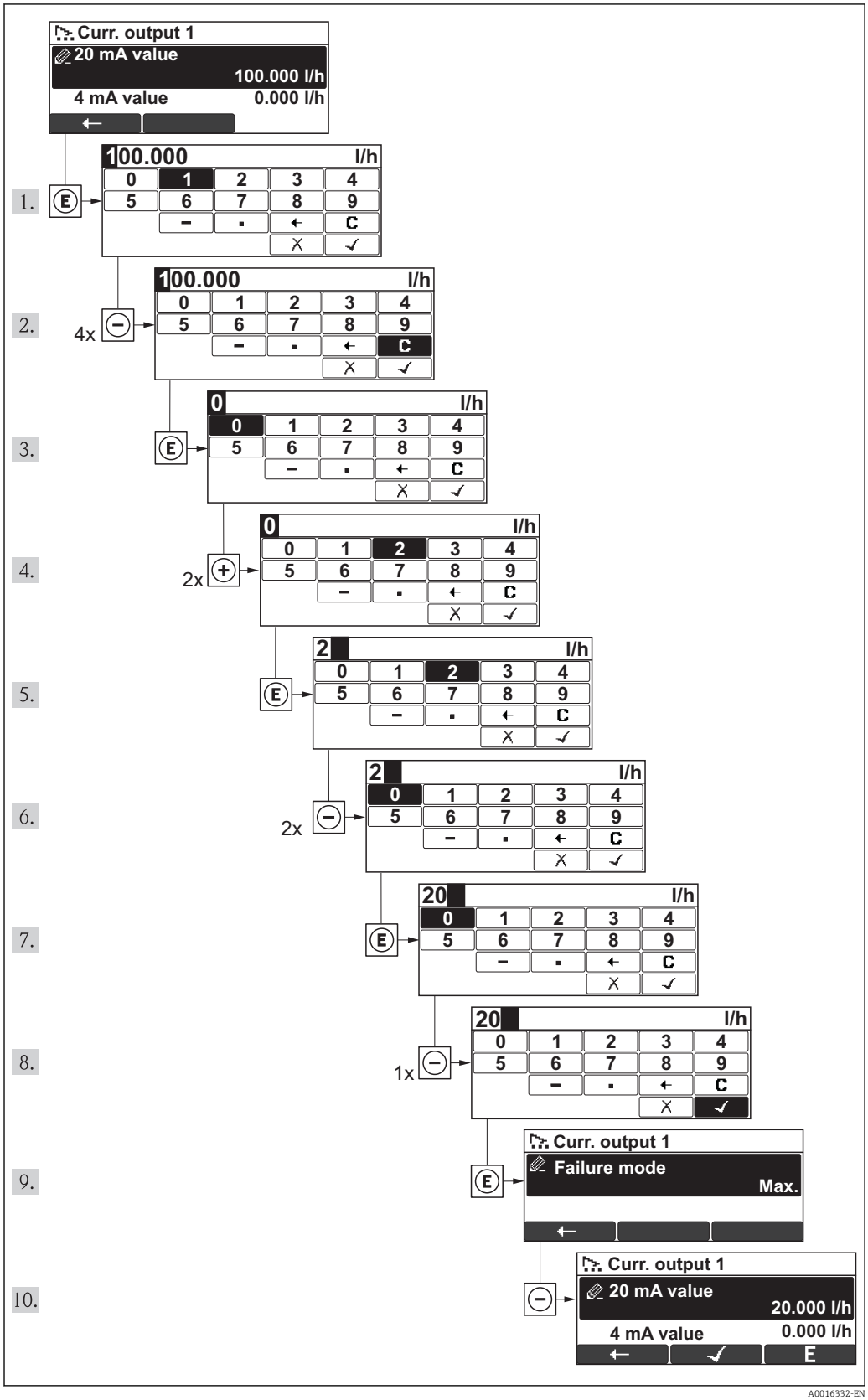
4 Example: Help text for parameter "Enter access code"

2. Press − + + simultaneously.
   ↳ The help text is closed.

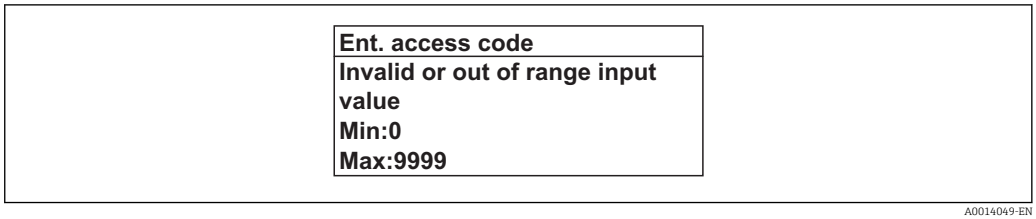
8.3.9 Changing the parameters

For a description of the editing display - consisting of text editor and numeric editor - with symbols → 34, for a description of the operating elements → 30

Example: Changing the parameter "20 mA value" to 20 kg/s



A message is displayed if the value entered is outside the permitted value range.



8.3.10 User roles and related access authorization

The two user roles "Operator" and "Maintenance" have different write access to the parameters if the customer defines a user-specific access code. This protects the device configuration via the local display from unauthorized access → 71.

Access authorization to parameters

User role	Read access		Write access	
	Without access code (from the factory)	With access code	Without access code (from the factory)	With access code
Operator	✔	✔	✔	-- [1]
Maintenance	✔	✔	✔	✔

1) Despite the defined access code, certain parameters can always be modified and thus are excepted from the write protection, as they do not affect the measurement. Refer to the "Write protection via access code" section

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

The user role with which the user is currently logged on is indicated by the **Access status display** parameter. Navigation path: Display/operation → Access status display

8.3.11 Disabling write protection via access code

If the -symbol appears on the local display in front of a parameter, the parameter is write-protected by a user-specific access code and its value cannot be changed at the moment using the local display→ 71.

The locking of the write access via local operation can be disabled by entering the customer-defined access code via the respective access option.

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

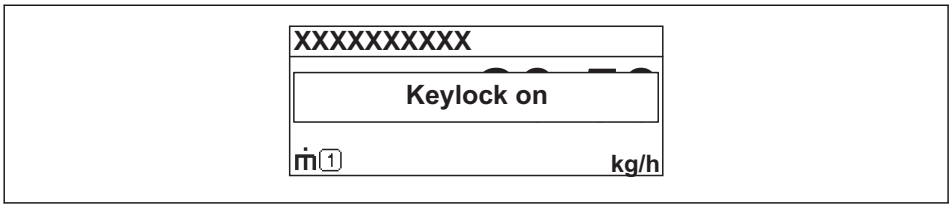
8.3.12 Enabling and disabling the keypad lock

The keypad lock makes it possible to block access to the entire operating menu via local operation. As a result, it is no longer possible to navigate through the operating menu or change the values of individual parameters. Users can only read the measured values on the operational display.

The keypad lock is enabled and disabled in the same way:

The user is in the operational display.

- ▶ By simultaneously pressing the ⊟ + ⊞ + Ⓔ keys.
  - ↳ After enabling the keypad lock:



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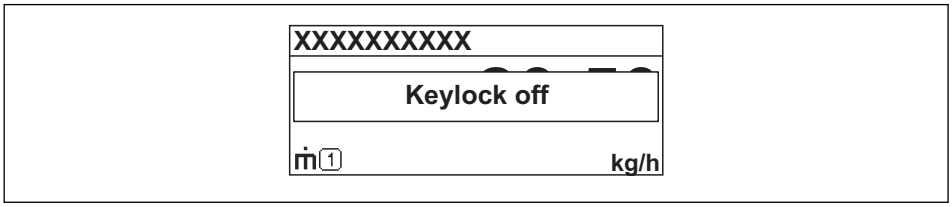
After disabling the keypad lock:



A0014001-EN

If the user attempts to access the operating menu while the keylock is enabled, the message "Keylock on" also appears.

8.4 Access to the operating menu via the operating tool

The structure of the operating menu in the operating tools is the same as for operation via the local display.

8.4.1 Field Xpert SFX100

Function range

Compact, flexible and robust industrial handheld terminal for remote configuration and measured value display via HART protocol.

For details, see Operating Instructions BA00060S

Source for device description files

See data → 46

8.4.2 FieldCare

Function range

FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field devices 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:
- HART protocol
- Service interface

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 → 46

User interface

8.4.3 AMS Device Manager

Function range

Program from Emerson Process Management for operating and configuring measuring devices via HART protocol.

Source for device description files

See data → 46

8.4.4 SIMATIC PDM

Function range

SIMATIC PDM is a standardized, manufacturer-independent program from Siemens for the operation, configuration, maintenance and diagnosis of intelligent field devices via HART protocol.

Source for device description files

See data → 46

8.4.5 Field Communicator 475

Function scope

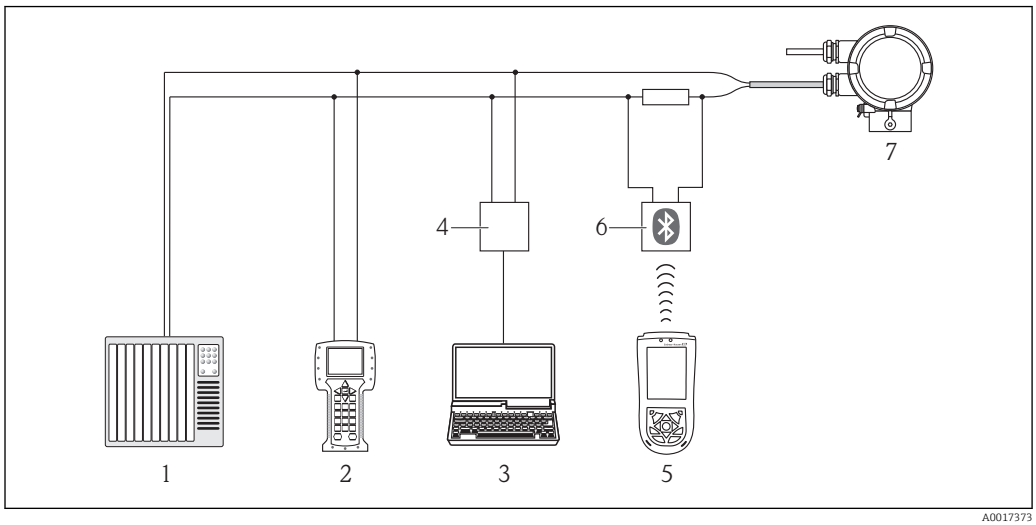
Industrial handheld terminal from Emerson Process Management for remote configuration and measured value display via HART protocol.

Source for device description files

See data → 46

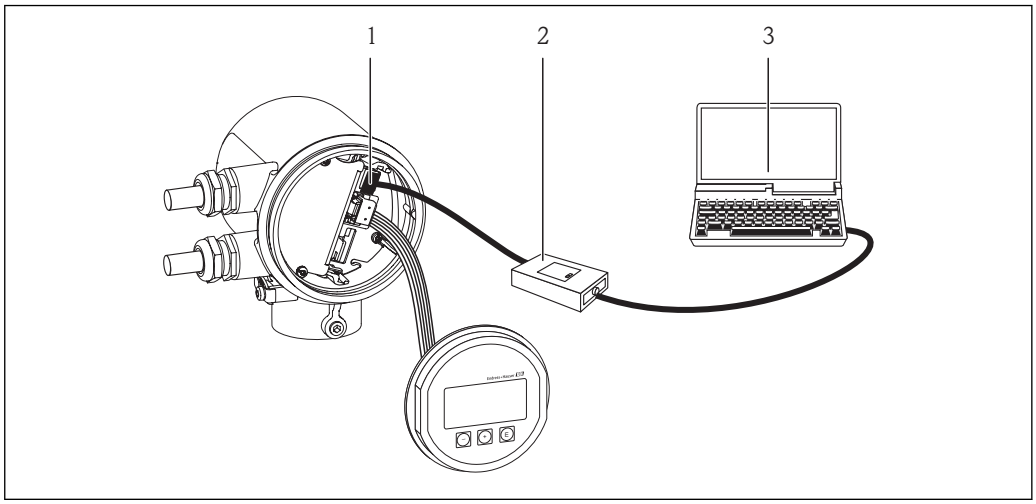
8.4.6 Connecting operating tools

Via HART protocol



1 *Control system (e.g. PLC)*
2 *Field Communicator 475*
3 *Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)*
4 *Commubox FXA195 (USB)*
5 *Field Xpert SFX100*
6 *VIATOR Bluetooth modem with connecting cable*
7 *Transmitter*

Via service interface (CDI)



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

9 System integration

9.1 Overview of device description files

9.1.1 Current version data for the device

Firmware version	01.00.zz	▪ 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	04.2012	---
Manufacturer ID	0x11	**Manufacturer ID** parameter Diagnostics → Device info→ Manufacturer ID
Device type ID	0x66	**Device type** parameter Diagnostics → Device info → Device type
HART protocol revision	6.0	---
Device revision	1	▪ On transmitter nameplate→ 🖹 12 ▪ **Device revision** parameter Diagnostics → Device info → Device revision

9.1.2 Operating tools

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

Operating tool via HART protocol	Sources for obtaining device descriptions
Field Xpert SFX100	Use update function of handheld terminal
FieldCare	▪ www.endress.com → Download Area ▪ CD-ROM (contact Endress+Hauser) ▪ DVD (contact Endress+Hauser)
AMS Device Manager (Emerson Process Management)	www.endress.com → Download Area
SIMATIC PDM (Siemens)	www.endress.com → Download Area
Field Communicator 375, 475 (Emerson Process Management)	Use update function of handheld terminal

9.2 Measured variables via HART protocol

The following measured variables (HART device variables) are assigned to the dynamic variables at the factory:

Dynamic variables	Measured variables (HART device variables)
Primary dynamic variable (PV)	Mass flow
Secondary dynamic variable (SV)	Totalizer
Tertiary dynamic variable (TV)	Temperature
Quaternary dynamic variable (QV)	Totalizer

The assignment of the measured variables to the dynamic variables can be modified and assigned as desired via local operation and the operating tool using the following parameters:

- Expert → Communication → HART output → Output → Assign PV
- Expert → Communication → HART output → Output → Assign SV
- Expert → Communication → HART output → Output → Assign TV
- Expert → Communication → HART output → Output → Assign QV

The following measured variables can be assigned to the dynamic variables:

Measured variables for PV (primary dynamic variable)
- Mass flow
- Corrected volume flow
- FAD volume flow
- Temperature

Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)
- None
- Mass flow
- Corrected volume flow
- FAD volume flow
- Temperature
- Totalizer

9.3 Other settings

In the **Configuration** submenu, you can configure other settings for the HART protocol (e.g. Burst mode)

Navigation path
"Expert" menu → Communication → HART output → Configuration

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 → 21
- "Post-connection check" checklist → 26

10.2 Switching on the measuring device

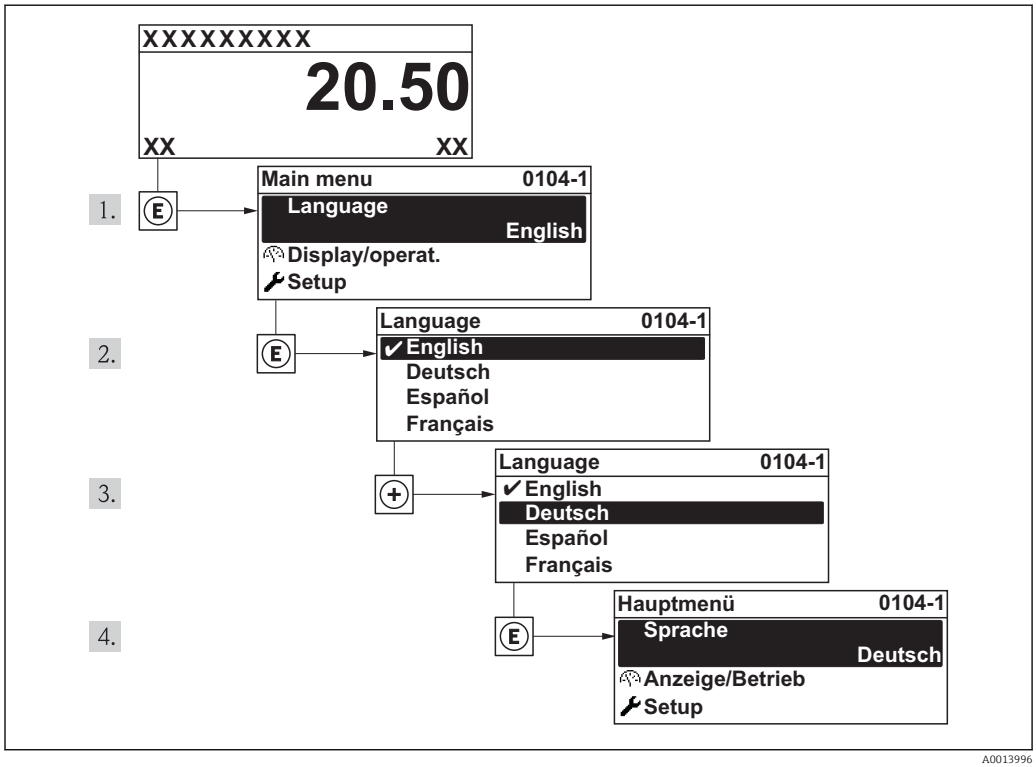
After a successful function check, switch on the measuring device.

After a successful startup, the local display switches automatically from the startup display to the measured value display.

If nothing appears on the local display or a diagnostic message is displayed, refer to the section on "Diagnostics and troubleshooting" → 80.

10.3 Setting the operating language

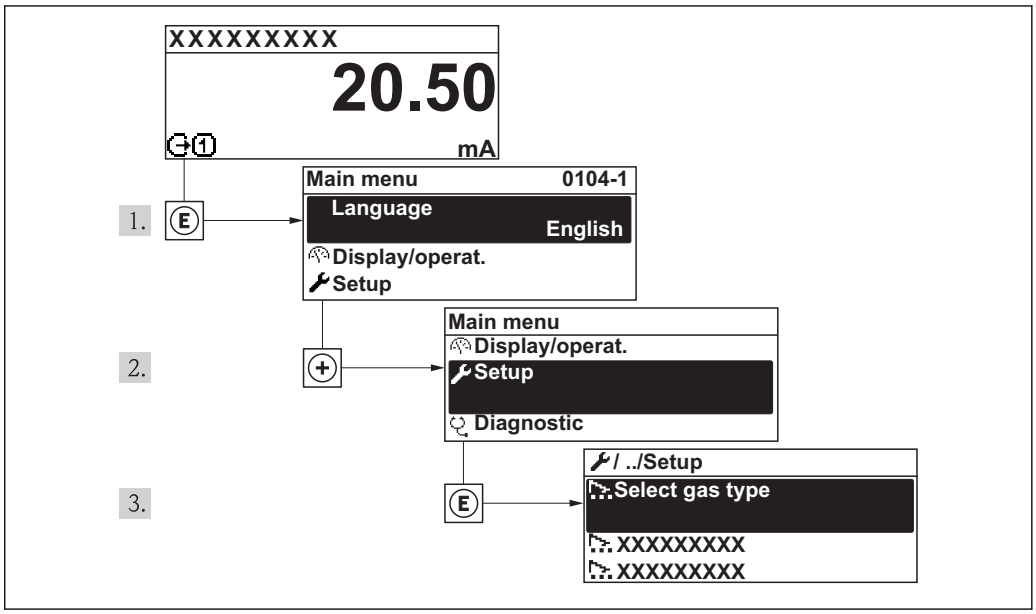
Factory setting: English or ordered local language



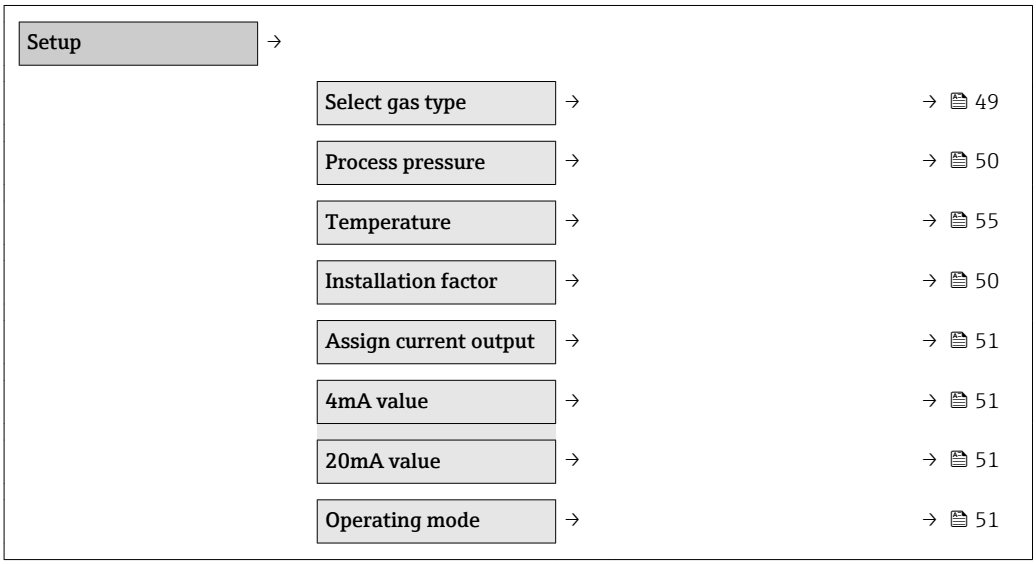
10.4 Configuring the measuring device

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

Navigation to the "Setup" menu



Overview of the "Setup" menu



10.4.1 Selecting the gas type

Navigation path

"Setup" menu → Select gas type

Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Select gas type	Select the gas type for the measurement application.	Gas type choose list ▪ Air ▪ Argon Ar ▪ Carbon dioxide CO2 ▪ Nitrogen N2	Air

10.4.2 Specifying the process pressure

Navigation path

"Setup" menu → Process pressure

Parameter overview with brief description

Parameter/	Description	Selection/ User entry	Factory setting
Process pressure	Process pressure value for calculating pressure-dependent gas properties	0.5 to 41.6 bar a (7.3 to 603 psi a)	Country-dependent: 1.0130 bar a (14.692 psi a)

10.4.3 Determining the installation factor

Navigation path

"Setup" menu → Installation factor

Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Installation factor	The factor is multiplied by the mass flow to correct sub-optimum installations	0 to 9	1

10.4.4 Configuring the current output

Navigation path

"Setup" menu →Assign current output

"Setup" menu →4mA value

"Setup" menu →20mA value

Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Assign current output	Use this function to assign a measured variable or process variable to the current output	Mass flow Corrected volume flow FAD volume flow Temperature	Mass flow
4mA value	Enter the value for the 4 mA current. The value can be larger than or smaller than the 20 mA value assigned. Positive and negative values are permitted depending on the measured variable (e.g. mass flow) assigned.	Number with up to 3 decimal places from - to +. The unit depends on the measured variable assigned.	0
20mA value	Enter the value for the 20 mA current. The value can be larger than or smaller than the 4 mA value assigned. Positive and negative values are permitted depending on the measured variable (e.g. mass flow) assigned.	Number with up to 3 decimal places from - to +. The unit depends on the measured variable assigned.	Maximum calibrated full scale value

10.4.5 Configuring the pulse/frequency/switch output

Navigation path

- "Setup" menu →Operating mode
- "Setup" menu →Assign frequency output
- "Setup" menu →Switch output function
- "Setup" menu →Assign pulse output

Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Operating mode	Specify the output as a pulse, frequency or switch output.	▪ Pulse ▪ Frequency ▪ Switch	Pulse
Assign frequency output	Select the process variable for the frequency output.	▪ Off ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature	Off
Measuring value at minimum frequency	Enter the measured value at the minimum frequency.	Depends on the process variable selected	-

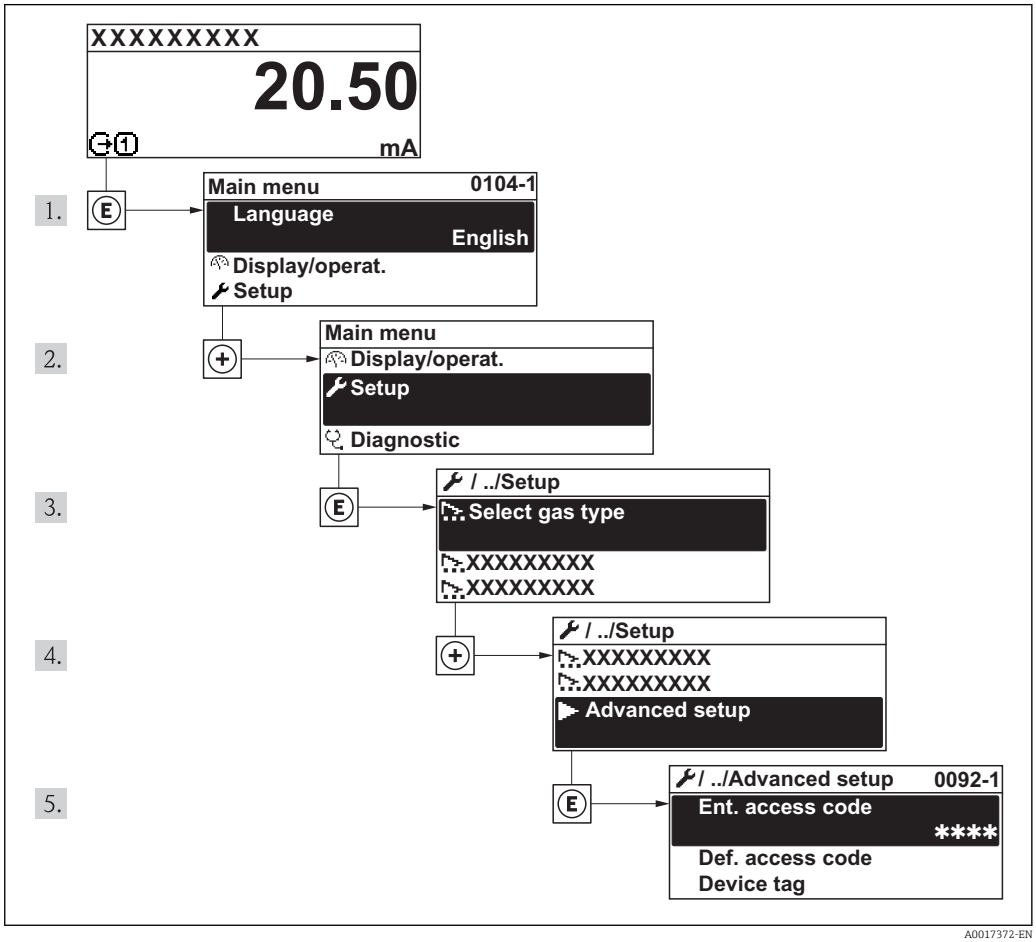
Measuring value at maximum frequency	Specify the measured value at maximum frequency.	Depends on the process variable selected	-
Switch output function	Select the function for the switch output.	▪ Off ▪ On ▪ Diagnostic behavior ▪ Limit value ▪ Status	Off
Assign limit	Select the process variable for the limit function.	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer	Mass flow
Switch-off value	Enter the measured value for the switch-off value.	Depends on the process variable selected	-
Switch-on value	Enter the measured value for the switch-on value.	Depends on the process variable selected	-
Assign diagnostic behavior	Select the diagnostic behavior for the switch output.	▪ Alarm ▪ Alarm or warning ▪ Warning	Alarm
Assign status	Select the device status for the switch output.	Low flow cut off	Low flow cut off
Assign pulse output	Select the process variable for the pulse output.	▪ Off ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Off
Pulse value	Enter the measured value for the pulse output.	Depends on the process variable selected	-

10.5 Advanced settings

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

Navigation path
"Setup" menu → Advanced setup

Navigation to the "Advanced setup" submenu



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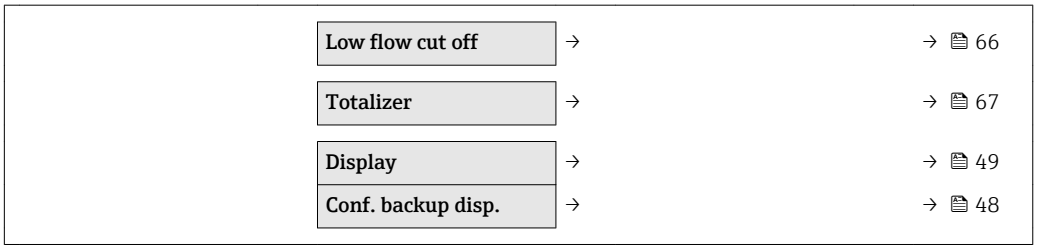
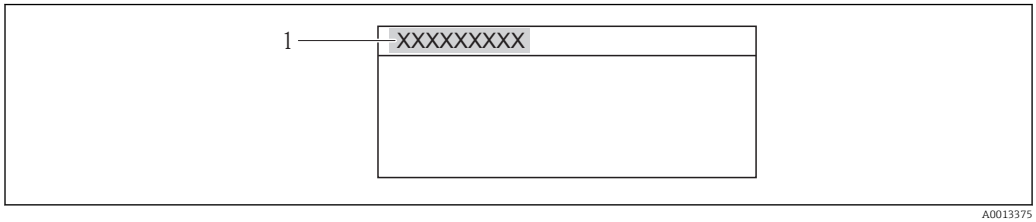
Overview of the parameters and submenus in the "Advanced setup" menu

Advanced setup	→	
Enter access code		→ 30
Define access code		→ 41
Device tag		→ 54
Applications	→	→ 54
System units	→	→ 55
Current output	→	→ 57
PFS output	→	→ 60
Output conduct	→	→ 65



10.5.1 Defining the tag name



1 Device tag

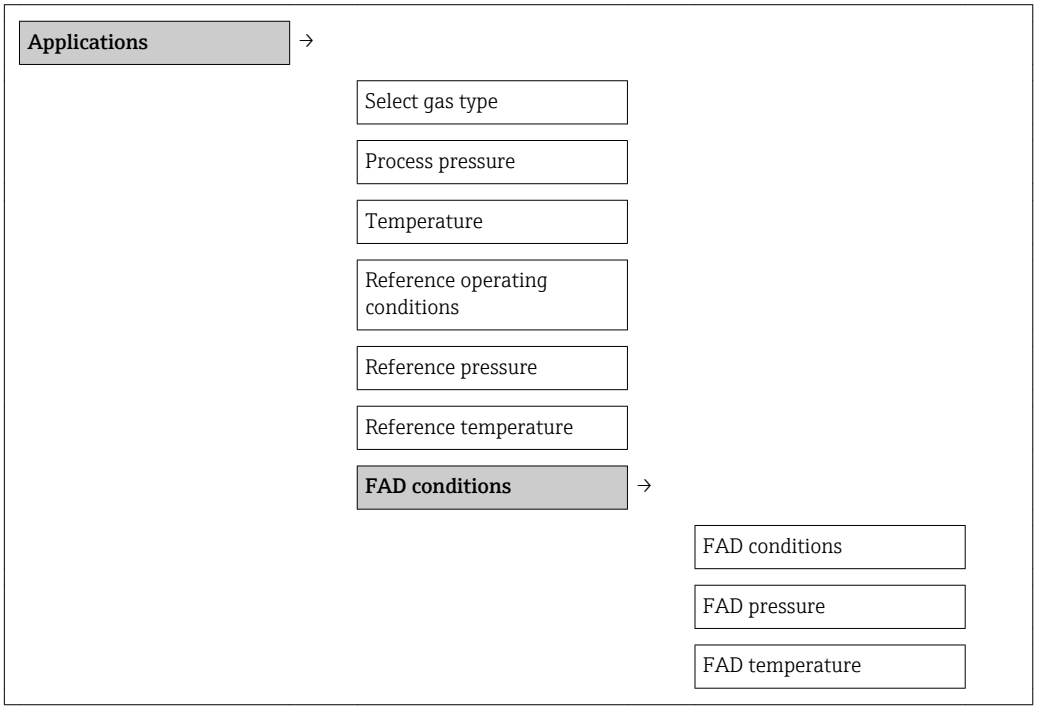
The number of characters displayed depends on the characters used.

10.5.2 Configuring applications

Navigation path

"Setup" menu →"Advanced setup" →Applications

Parameter overview with brief description



Parameter	Description	Selection/ User entry	Factory setting

Select gas type	Select the gas type for the measurement application.	Gas type choose list ▪ Air ▪ Argon Ar ▪ Carbon dioxide CO2 ▪ Nitrogen N2	Air
Process pressure	Process pressure value for calculating pressure-dependent gas properties	0.5 to 41.6 bar a (7.3 to 603 psi a)	Country-dependent: ▪ 1.01325 bar a ▪ 14.696 psi a
Temperature	Use this function to view the process temperature currently measured.	None	-
Reference operating conditions	Select reference operating conditions for calculating the reference density	1013.25 mbar a, 0°C 1013.25 mbar a, 15°C 1013.25 mbar a, 20°C 1013.25 mbar a, 25°C 1000 mbar a, 0°C 1000 mbar a, 15°C 1000 mbar a, 20°C 1000 mbar a, 25°C 14.696 psi a, 59°F 14.696 psi a, 60°F 14.730 psi a, 60°F User-defined	Country-dependent: ▪ 1013.25 mbar a, 0 °C ▪ 14.696 psi a, 59 °F
Reference pressure	Enter the reference pressure for calculating the reference density	0.1 to 99 bar a (1.5 to 1436 psi a)	Country-dependent: 1.0130 bar a (14.696 psi a)
Reference temperature	Enter the reference temperature for calculating the reference density	−50 to 150 °C (−58 to 423 °F)	Country-dependent: ▪ 0.0 °C ▪ 32 °F
FAD conditions	Select reference operating conditions for calculating the FAD density (FAD = free air delivery)	1000 mbar a, 20 °C 14.504 psi a, 68 °F User-defined	Country-dependent: ▪ 1000 mbar a, 20 °C ▪ 14.504 psi a, 68 °F
FAD pressure	Enter the reference pressure for calculating the FAD density	0.1 to 99 bar a (1.5 to 1436 psi a)	Country-dependent: ▪ 1.000 bar a ▪ 14.504 psi a
FAD temperature	Enter the reference temperature for calculating the FAD density	−50 to 150 °C (−58 to 423 °F)	Country-dependent: ▪ 20 °C ▪ 68 °F

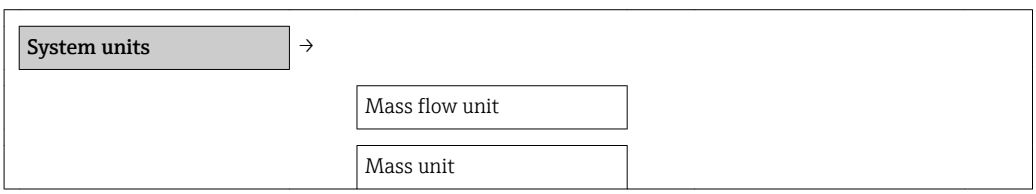
10.5.3 Setting the system units

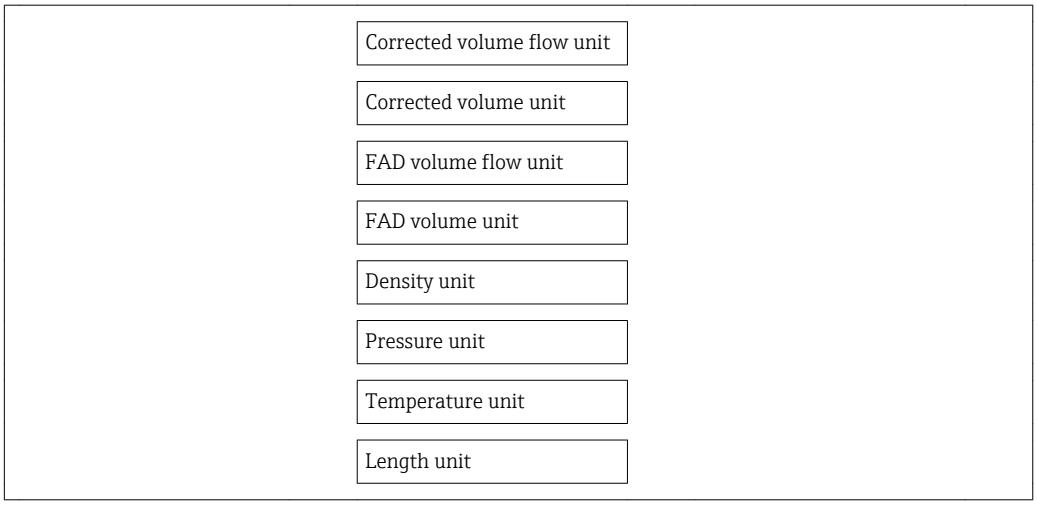
In the **System units** submenu, you can configure the units of all measured values.

Navigation path

"Setup" menu → Advanced setup → System units

Structure of the submenu





Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Mass flow unit	Select the unit for mass flow. *Result* The selected unit applies for all outputs	Metric: Gram: g/s; g/min; g/h; g/day Kilogram: kg/s; kg/min; kg/h; kg/day Metric ton: t/s; t/min; t/h; t/day US: Ounce: oz/s; oz/min; oz/h; oz/day Pound: lb/s; lb/min; lb/h; lb/day ton: LTon/s; LTon/min; LTon/h; LTon/day ton: STon/s; STon/min; STon/h; STon/day Arbitrary unit (see text mass unit function): _ _ _ _/s; _ _ _ _/min; _ _ _ _/h; _ _ _ _/day	Country-dependent: ▪ kg/h ▪ lb/h
Mass unit	Select the unit for mass.	g kg t oz lb STon LTon User-defined	Country-dependent: ▪ kg ▪ lb

Parameter	Description	Selection/ User entry	Factory setting
Corrected volume flow unit	Select the unit for corrected volume flow. *Result* The selected unit applies for all outputs	Nl/s Nl/min Nl/h Nl/d Nm³/s Nm³/min Nm³/h Nm³/d Sl/s Sl/min Sl/h Sl/d Sm³/s Sm³/min Sm³/h Sm³/d Scf/s Scf/min Scf/h Scf/d	Country-dependent: ▪ Nm³/h ▪ Scf/min
Corrected volume unit	Select the unit for volume.	Nl Nm³ Sl Sm³ Scf	Country-dependent ▪ Nm³ ▪ Scf
FAD volume flow unit	Select the unit for the FAD volume flow. *Result* The selected unit applies for all outputs	l FAD/s l FAD/min l FAD/h l FAD/d m³ FAD/s m³ FAD/min m³ FAD/h m³ FAD/d cf FAD/s cf FAD/min cf FAD/h cf FAD/d	Country-dependent ▪ m³ FAD/h ▪ cf FAD/min
FAD volume unit	Select the unit for standard volume.	l FAD m³ FAD cf FAD	Country-dependent: ▪ m³ FAD ▪ cf FAD
Density unit	Select the unit for density. *Result* The selected unit applies for all outputs	g/cm³ kg/dm³ kg/l kg/m³ lb/cf	Country-dependent ▪ kg/m³ ▪ lb/cf
Pressure unit	Select the unit for process pressure.	kPa a MPa a bar a psi a mbar	Country-dependent: ▪ bar a ▪ psi a
Temperature unit	Select the unit for temperature. *Result* The selected unit applies for all outputs	°C °F K °R	Country-dependent: ▪ °C (Celsius) ▪ °F (Fahrenheit)
Length unit	Select the unit of length for the nominal diameter.	mm m in ft	Country-dependent: ▪ mm ▪ in

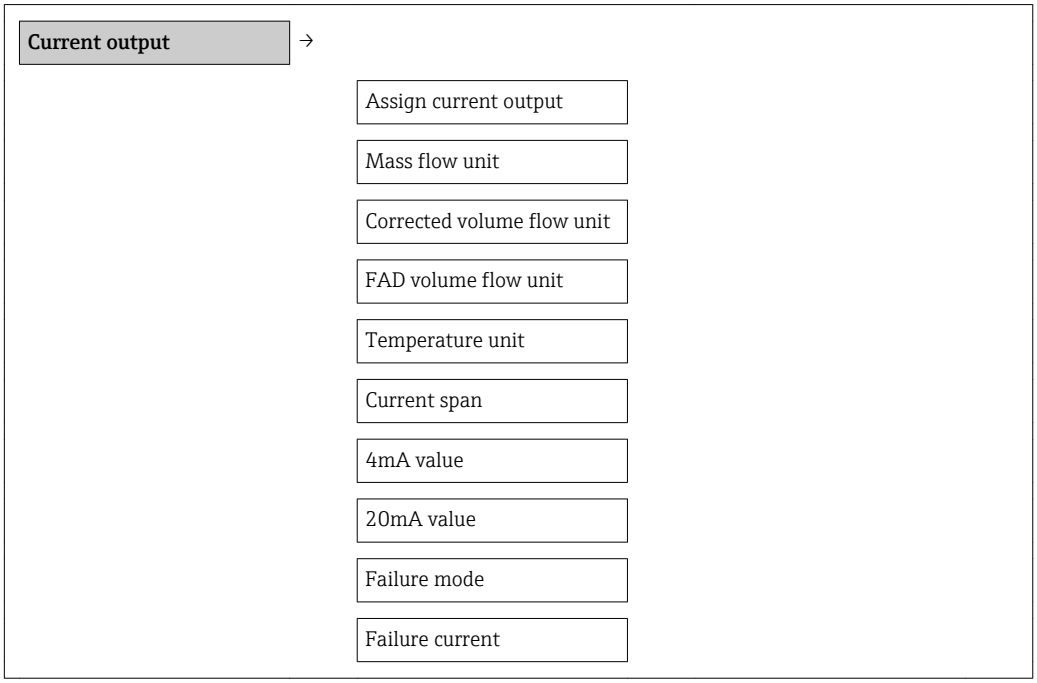
10.5.4 Configuring the current output

In the **Current output** submenu, you can configure the values for the current output.

Navigation path

"Setup" menu → Advanced setup → Current output

Structure of the submenu



Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Assign current output	Use this function to assign a measured variable or process variable to the current output	Mass flow Corrected volume flow FAD volume flow Temperature	Mass flow
Mass flow unit	Select the unit for mass.	Metric: Gram: g/s; g/min; g/h; g/day Kilogram: kg/s; kg/min; kg/h; kg/day Metric ton: t/s; t/min; t/h; t/day US: Ounce: oz/s; oz/min; oz/h; oz/day Pound: lb/s; lb/min; lb/h; lb/day ton: LTon/s; LTon/min; LTon/h; LTon/day ton: STon/s; STon/min; STon/h; STon/day Arbitrary unit (see TEXT mass unit function): _ _ _ _/s; _ _ _ _/min; _ _ _ _/h; _ _ _ _/day	Country-dependent: ▪ kg/h ▪ lb/h

Parameter	Description	Selection/ User entry	Factory setting
Corrected volume flow unit	Select the unit for corrected volume flow. *Result* The selected unit applies for all outputs	Unit choose list Nl/s Nl/min Nl/h Nl/d Nm^3/s Nm^3/min Nm^3/h Nm^3/d Sl/s Sl/min Sl/h Sl/d Sm^3/s Sm^3/min Sm^3/h Sm^3/d Scf/s Scf/min Scf/h Scf/d	Country-dependent: ▪ Nm^3/h ▪ Scf/min
FAD volume flow unit	Select the unit for the FAD volume flow. *Result* The selected unit applies for all outputs	Unit choose list l FAD/s l FAD/min l FAD/h l FAD/d m^3 FAD/s m^3 FAD/min m^3 FAD/h m^3 FAD/d cf FAD/s cf FAD/min cf FAD/h cf FAD/d	Country-dependent: ▪ m^3 FAD/h ▪ cf FAD/min
Temperature unit	Select the unit for temperature. *Result* The selected unit applies for all outputs	°C °F K °R	Country-dependent: ▪ °C (Celsius) ▪ °F (Fahrenheit)
Current span	Select the current range for the process value output and for the upper/ lower level for signal on alarm	Options 4 to 20mA HART NAMUR 4 to 20mA HART US 4 to 20mA FIXED CURRENT	4 to 20mA HART NAMUR
4mA value	Enter the value for the 4 mA current. The value can be larger than or smaller than the 20 mA value assigned. Positive and negative values are permitted depending on the measured variable (e.g. mass flow) assigned.	Number with up to 3 decimal places from - to +. The unit depends on the measured variable assigned.	0
20mA value	Enter the value for the 20 mA current. The value can be larger than or smaller than the 4 mA value assigned. Positive and negative values are permitted depending on the measured variable (e.g. mass flow) assigned.	Number with up to 3 decimal places from - to +. The unit depends on the measured variable assigned.	Nominal size dependent

Parameter	Description	Selection/ User entry	Factory setting
Failure mode	Select the value the current output adopts in an alarm condition. Prerequisite: The "FIXED CURRENT" option was not selected in the CURRENT SPAN function (xxxx).	▪ Min. current ▪ Max. current ▪ Last valid value ▪ Actual value ▪ Defined value	Max. current
Failure current	Select the current value the current output adopts in an alarm condition.	Floating point number with 2 decimal places in the range3.6 to 22.5 mA	22.5 mA

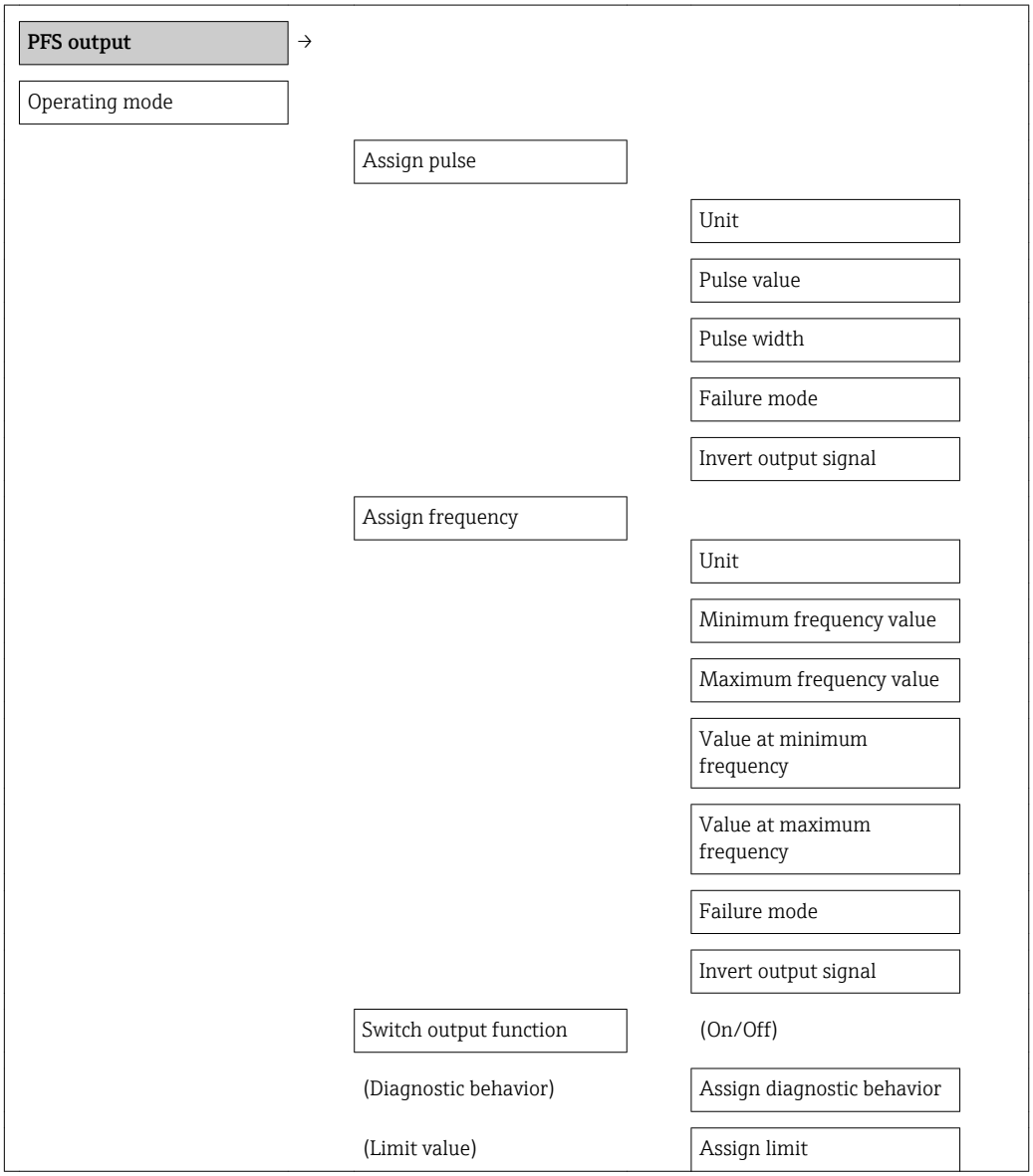
10.5.5 Configuring the PFS output

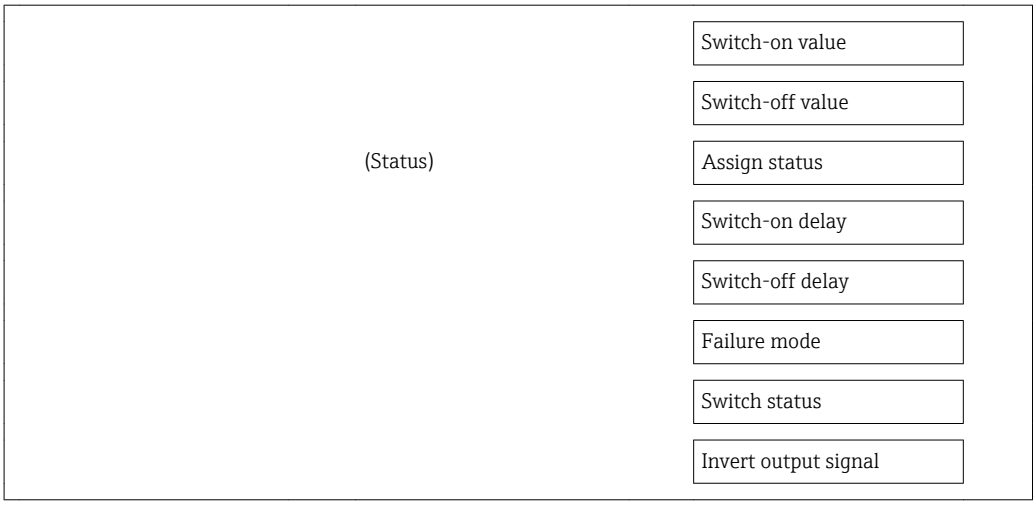
In the **PFS output** submenu, you can configure the values for the current output.

Navigation path

"Setup" menu → Advanced setup →PFS output

Structure of the submenu





Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Operating mode	Specify the output as a pulse, frequency or switch output.	▪ Pulse ▪ Frequency ▪ Switch	Pulse
Assign pulse output	Select the process variable for the pulse output.	▪ Off ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Off
Assign frequency output	Select the process variable for the frequency output.	▪ Off ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature	Off
Assign switch output	Select the function for the switch output.	▪ Off ▪ On ▪ Diagnostic behavior ▪ Limit value ▪ Status	Off
Assign diagnostic behavior	Select the diagnostic behavior for the switch output.	▪ Alarm ▪ Alarm or warning ▪ Warning	Alarm
Assign limit	Select the process variable for the limit function.	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Totalizer	Mass flow
Assign status	Select the device status for the switch output.	Low flow cut off	Low flow cut off

Parameter	Description	Selection/ User entry	Factory setting
Mass flow unit	Select the unit for mass flow. *Result* The selected unit applies for all outputs	Metric: Gram: g/s; g/min; g/h; g/day Kilogram: kg/s; kg/min; kg/h; kg/day Metric ton: t/s; t/min; t/h; t/day US: Ounce: oz/s; oz/min; oz/h; oz/day Pound: lb/s; lb/min; lb/h; lb/day ton: LTon/s; LTon/min; LTon/h; LTon/day ton: STon/s; STon/min; STon/h; STon/day Arbitrary unit (see Text mass unit function: _ _ _ _/s; _ _ _ _/min; _ _ _ _/h; _ _ _ _/day	Country-dependent: ▪ kg/h ▪ lb/h
Mass unit	Select the unit for mass. *Result* The selected unit is taken from: Mass flow unit	g kg t oz lb STon LTon User-defined	Country-dependent: ▪ kg ▪ lb
FAD volume flow unit	Use this function to select the preferred unit that is to be displayed for the FAD volume flow. The following time units can be selected: s = second, m = minute, h = hour, d = day Select the unit for the FAD volume flow. *Result* The selected unit applies for all outputs	l FAD/s l FAD/min l FAD/h l FAD/d m³ FAD/s m³ FAD/min m³ FAD/h m³ FAD/d cf FAD/s cf FAD/min cf FAD/h cf FAD/d	Country-dependent: ▪ m³ FAD/h ▪ cf FAD/min
FAD volume unit	Select the unit for the FAD volume unit.	l FAD m3 FAD cf FAD	Country-dependent: ▪ m³ FAD ▪ cf FAD
Corrected volume flow unit	Select the unit for corrected volume flow. *Result* The selected unit applies for all outputs	Nl/s Nl/min Nl/h Nl/d Nm³/s Nm³/min Nm³/h Nm³/d Sl/s Sl/min Sl/h Sl/d Sm³/s Sm³/min Sm³/h Sm³/d Scf/s Scf/min Scf/h Scf/d	Country-dependent: ▪ Nm³/h ▪ scf/min (us)

Parameter	Description	Selection/ User entry	Factory setting
Corrected volume unit	Select the unit for standard volume. The unit selected here also applies for all outputs	Nl Nm^3 Sl Sm^3 Scf	Country-dependent: ▪ Nm^3 ▪ Scf
Temperature unit	Select the unit for temperature. *Result* The selected unit applies for: ▪ Current outputs ▪ Reference temperature ▪ Simulation process variable	°C °F K °R	Country-dependent: ▪ °C (Celsius) ▪ °F (Fahrenheit)
Pulse value	Enter the measured value for the pulse output.	Depends on the process variable selected	-
Pulse width	Specify the duration of the output pulse.	0.5 to 2 000 msec	20 msec
Failure mode	Select the value the current output adopts in an alarm condition. Prerequisite: The "FIXED CURRENT" option was not selected in the CURRENT SPAN function (xxxx).	▪ Min. current ▪ Max. current ▪ Last valid value ▪ Actual value ▪ Defined value	Max. current
Minimum frequency value	Enter the minimum frequency value.	0 to 1 000 Hertz	0 Hertz
Maximum frequency value	Enter the maximum frequency value.	0 to 1 000 Hertz	1 000 Hertz
Measuring value at minimum frequency	Enter the measured value at the minimum frequency.	Depends on the process variable selected	-
Measuring value at maximum frequency	Specify the measured value at maximum frequency.	Depends on the process variable selected	-
Failure mode	Specify the output behavior in the event of a device alarm	▪ 0 Hertz ▪ Actual value ▪ Defined value	0 Hertz
Failure frequency	Enter the value for the frequency output in the event of a device alarm	0 to 1 250 Hertz	0 Hertz
Switch-on value	Enter the measured value for the switch-on value.	Depends on the process variable selected	-
Switch-off value	Enter the measured value for the switch-off value.	Depends on the process variable selected	-
Switch-on delay	Specify the delay time for switching on the switch output	0.0 to 100.0 sec	0 sec
Switch-off delay	Specify the delay time for switching off the switch output	0.0 to 100.0 sec	0 sec

Parameter	Description	Selection/ User entry	Factory setting
Failure mode	Specify the output behavior in the event of a device alarm Failsafe mode,The failsafe mode defines how the pulse output responds to a status message which is supposed to act on the status output.	Current status Open Closed	Open
Invert output signal	Invert the output signal	Yes No	No

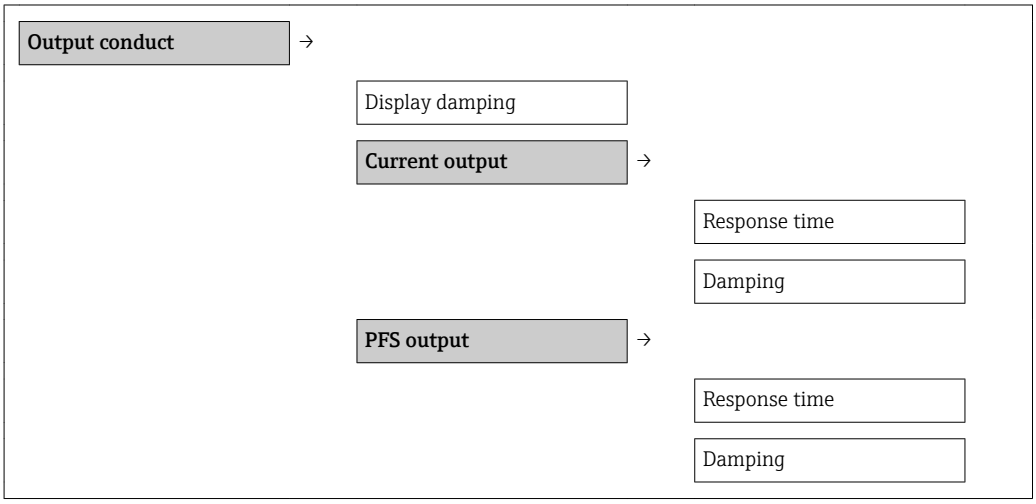
10.5.6 Configuring the output conditioning

The damping and the step response time can be configured in the **Display behavior** submenu.

Navigation path

"Setup" menu → Advanced setup → Output conditioning

Structure of the submenu



Parameter overview with brief description

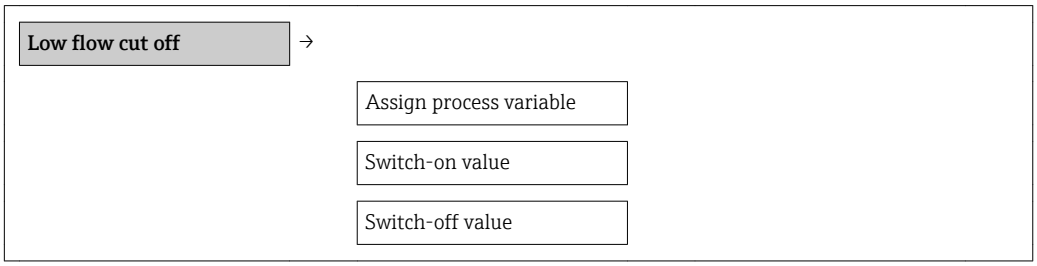
Parameter	Description	Selection/ User entry	Factory setting
Display damping	Set the reaction time of the local display to fluctuations in the measured value.	0.0 to 999.9 sec	0.0
Response time Output	Displays the calculated step response time	-	0
Output damping	Set the reaction time of the output signal to fluctuations in the measured value.	0.0 to 999.9 sec	0.0

10.5.7 Configuring the low flow cut off

Navigation path

"Setup" menu → "Advanced setup" menu →Low flow cut off

Structure of the submenu



Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Assign process variable	Select the process variable for low flow cut off.	▪ Off ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Off
On-value, low flow cut off	Enter the on value for low flow cut off	Max. 15-digit, positive floating-point number	Nominal size dependent 1 % of calibrated full scale value
Off value low flow cutoff	Enter the off value for low flow cut off	0 to 100 %	50 %

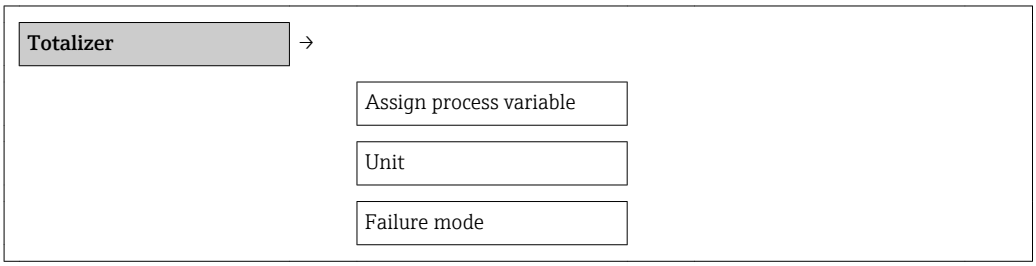
10.5.8 Configuring the totalizer

You can configure the totalizer in the **Totalizer** submenu.

Navigation path

"Setup" menu → Advanced setup → Totalizer

Structure of the submenu



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 ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Mass flow
Unit	One of the following options is selected in the **Assign process variable** parameter: ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Select the unit for the process variable of the totalizer.	Unit choose list	Country-dependent: ▪ kg ▪ lb
Failure mode	One of the following options is selected in the **Assign process variable** parameter: ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Define how the totalizer behaves in an alarm condition.	▪ Stop ▪ Actual value ▪ Last valid value	Stop

10.5.9 Configuring the local display

Navigation path

"Setup" menu → "Advanced setup" menu →"Display" menu

Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Format display	Select how measured values are shown on the display.	▪ 1 value, max. size ▪ 1 bargraph + 1 value ▪ 2 values ▪ 1 value large + 2 values ▪ 4 values	1 value, max. size

Value 1 display	Select the measured value that is shown on the local display.	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer ▪ Current output	Mass flow
0% bargraph value 1	Enter the 0% value to be shown on the bargraph display for the measured value 1.	Floating-point number with sign	0
100% bargraph value 1	Enter the 100% value to be shown on the bargraph display for the measured value 1.	Floating-point number with sign	1
Decimal places 1	Select the number of decimal places for the display value.	x x.x x.xx x.xxx x.xxxx	x.xx
Value 2 display	Select the measured value that is shown on the local display.	▪ None ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer ▪ Current output	None
Decimal places 2	Select the number of decimal places for the display value.	x x.x x.xx x.xxx x.xxxx	x.xx
Value 3 display	Select the measured value that is shown on the local display.	▪ None ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer ▪ Current output	None
0% bargraph value 3	Enter the 0% value to be shown on the bargraph display for the measured value 3.	Floating-point number with sign	0
100% bargraph value 3	Enter the 100% value to be shown on the bargraph display for the measured value 3.	Floating-point number with sign	0
Decimal places 3	Select the number of decimal places for the display value.	x x.x x.xx x.xxx x.xxxx	x.xx
Value 4 display	Select the measured value that is shown on the local display.	▪ None ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer ▪ Current output	None

Decimal places 4	Select the number of decimal places for the display value.	x x.x x.xx x.xxx x.xxxx	x.xx
Display interval	Set time measured values are shown on display if display alternates between values.	1 to 10	5
Display damping	Set the reaction time of the local display to fluctuations in the measured value.	0.0 to 999.9	0
Header	Select header contents on local display.	Device tag Free text	Device tag
Header text	Select text for header on local display.	Free text	–
Separator	Select decimal separator for displaying numerical values.	. ,	.

10.6 Configuration management

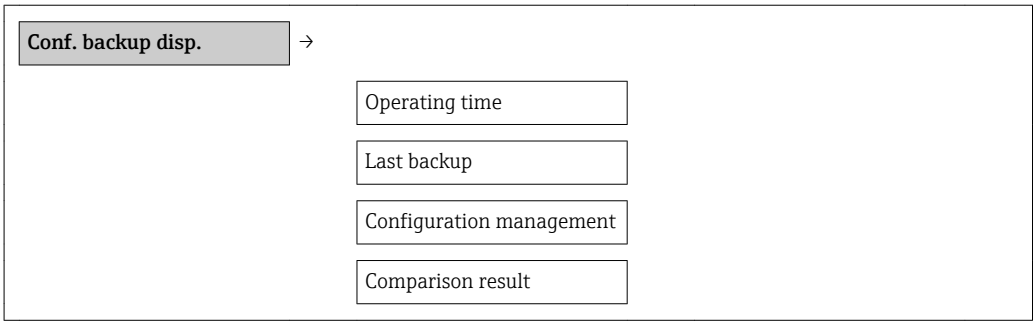
After commissioning, you can save the current device configuration, copy it to another measuring point or restore the previous device configuration.

You can do so using the **Configuration management** parameter and the related options found in the **Conf. backup display** submenu.

Navigation path
"Setup" menu → Advanced setup → Conf. backup disp.

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

Structure of the submenu



Parameter overview with brief description

Parameter	Description	Selection/ Display	Factory setting
Operating time	Indicates how long the device has been in operation up to this point.	Days (d), hours (h), minutes (m), seconds (s)	-
Last backup	Indicates when the last data backup was saved to the display module	Days (d), hours (h), minutes (m), seconds (s)	-

Configuration management	Select action for managing the device data in the display module	▪ Cancel ▪ Execute backup ▪ Restore ▪ Duplicate ▪ Compare ▪ Clear backup data	Cancel

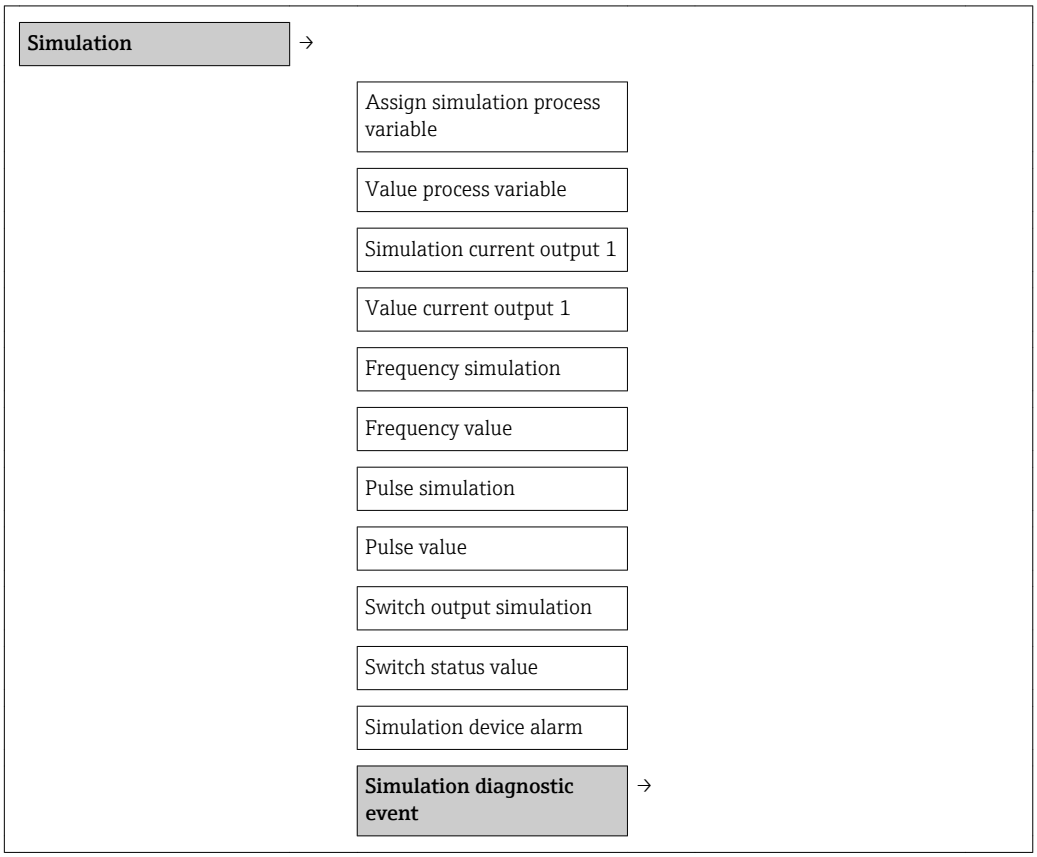
Comparison result	Comparison between present device data and display backup	▪ Settings identical ▪ Settings not identical ▪ No backup available ▪ Backup settings corrupt ▪ Check not done ▪ Dataset incompatible	Check not done

10.7 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

Structure of the submenu



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 ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature	Off
Value process variable	One of the following options must be selected in the **Assign simulation process variable** parameter: ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature	Enter the simulation value for the selected process variable.	Depends on the process variable selected	-
Simulation current output	-	Switch simulation of the current output on and off.	▪ On ▪ Off	Off
Value current output	The **On** option is selected in the **Simulation current output** parameter.	Enter the current value for simulation.	3.6 to 22.5 mA	Current value currently measured
Frequency simulation	**Frequency** must be selected in the **Operating mode** parameter.	Switch simulation of the frequency output on and off.	▪ On ▪ Off	Off
Frequency value	The **On** option is selected in the **Frequency simulation** parameter.	Enter the frequency for simulation.	0.0 to 1 250 Hz	Frequency currently measured
Pulse simulation	**Pulse** must be selected in the **Operating mode** parameter.	Pulse output simulation can be switched on and off in this way.	▪ On ▪ Off	Off
Pulse value	The **On** option is selected in the **Pulse simulation** parameter.	Enter the pulse counter value for the simulation and display the current counter value	▪ Off ▪ Fixed value ▪ Down-count. value	0
Switch output simulation	**Switch** must be selected in the **Operating mode** parameter.	Switch simulation of the switch output on and off.	▪ On ▪ Off	Off
Switch value	The **On** option is selected in the **Switch output simulation** parameter.	Enter the current value for simulation.	Open Closed	Open
Simulation device alarm	-	Switch the device alarm on and off.	▪ On ▪ Off	Off

10.8 Protecting settings from unauthorized access

The following options exist for protecting the configuration of the measuring device from unintentional modification after commissioning:
- Write protection via access code → 71
- Write protection via write protection switch → 71
- Write protection via keypad lock → 30

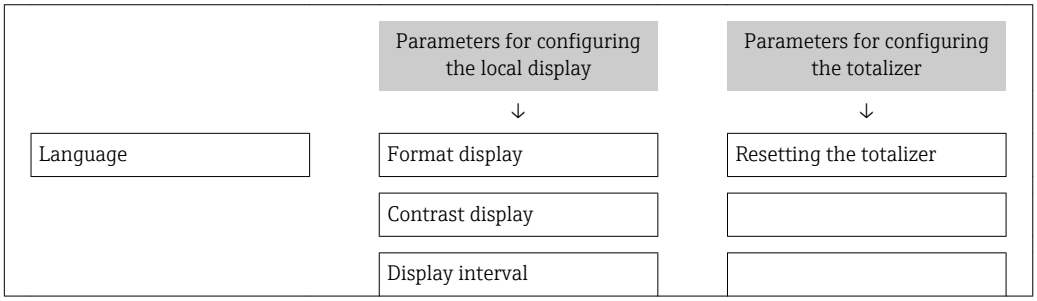
10.8.1 Write protection via access code

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

Define access code

1. Navigating to the "Define access code" parameter: Setup → Advanced setup → Def. access code
2. Define a max. 4-digit numeric code as an access code.
   ↳ The 🔒-symbol appears in front of all write-protected parameters.

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



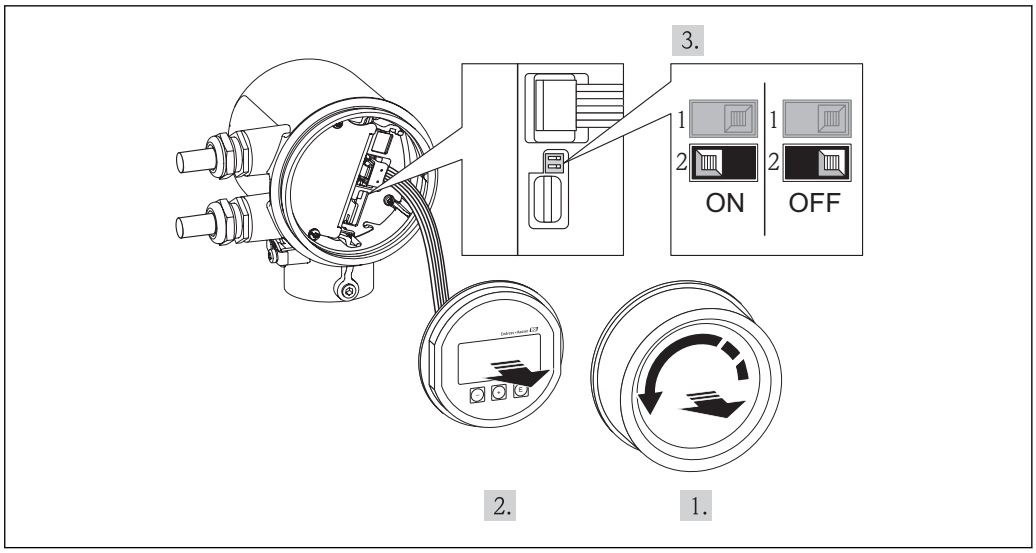
The device automatically locks the write-protected parameters again if a key is not pressed for 10 minutes in the navigation and editing view. The device locks the write-protected parameters automatically after 60 s if the user skips back to the measured value display mode from the navigation and editing view.

- If write access is activated via access code, it can be also be deactivated only via the access code → 📄 41.
- In the "Description of Device Parameters" documents, each write-protected parameter is identified with the 🔒-symbol.

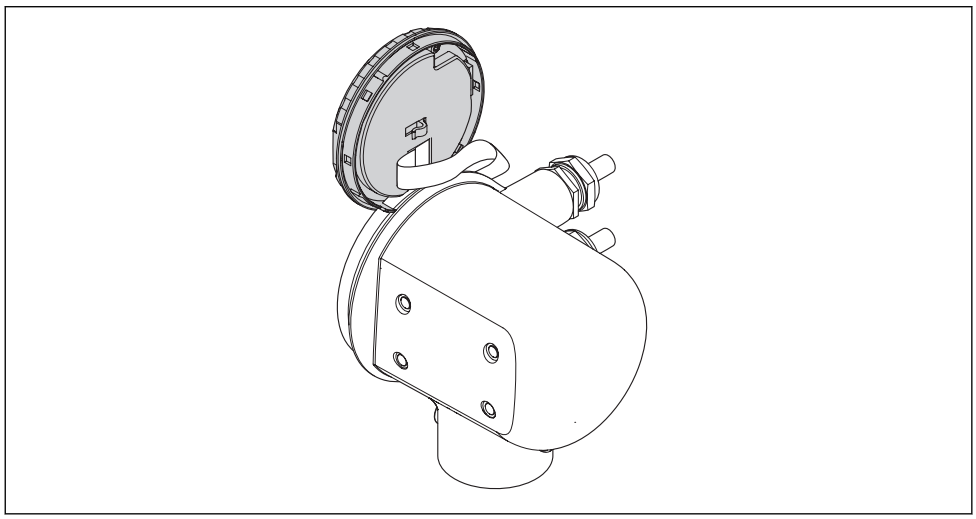
10.8.2 Write protection via write protection switch

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

The values of the parameters are still visible, but can no longer be changed (except for **Contrast display**), either via the local display, the service interface (CDI) or HART protocol.



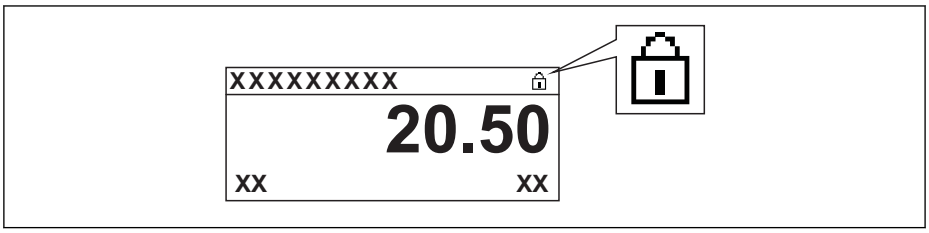
A0017255

1. Unscrew the electronics compartment cover.
2. Pull out the display module with a gentle rotational movement.
3. 

A0017375

To make it easier to access the lock switch, attach the display module to the edge of the electronics compartment.

4. Setting the write protection switch (WP) on the main electronics module to the ON position enables the hardware write protection. Setting the write protection switch (WP) on the main electronics module to the OFF position (factory setting) disables the hardware write protection.
   ↳ If the hardware write protection is enabled, the 🔒 symbol appears before the parameters in the header of the measured value display and in the navigation view.



A0015870

   If the hardware write protection is disabled, the 🔓 symbol does not appear before the parameters in the header of the measured value display and in the navigation view.

5. Feed the ribbon cable into the gap between the housing and electronics module and plug the display module into the electronics compartment in the desired direction until it engages.
6. Screw down the electronics compartment cover

11 Operation

11.1 Adjusting the operating language

See the "Commissioning" section for information on how to set the operating language → 🖹 48.

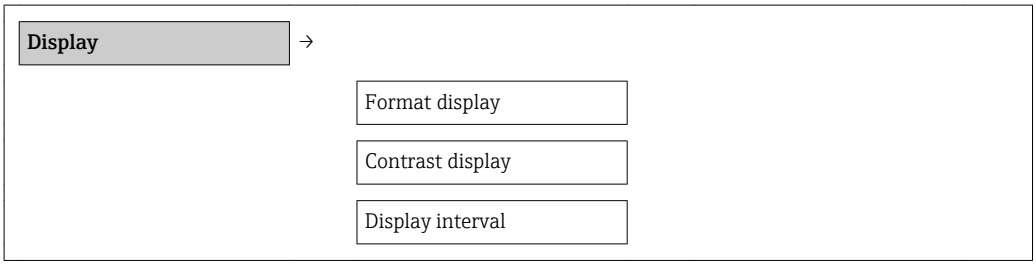
11.2 Configuring the display

- Basic settings for local display
- Advanced settings for local display → 🖹 53

11.2.1 Navigation path

"Display/operat." menu

"Display" submenu



11.2.2 Parameter overview with brief description

Parameter	Description	Selection/ User entry	Factory setting
Format display	Select how measured values are shown on the display.	▪ 1 value, max. size ▪ 1 bargraph + 1 value ▪ 2 values ▪ 1 value large + 2 values ▪ 4 values	1 value, max. size
Contrast display	Adjust the contrast of the local display to ambient conditions (reading angle).	20 to 50 %	30 %
Display interval	Set time measured values are shown on display if display alternates between values.	1 to 10	5

11.3 Reading measured values

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

Navigation path
Diagnostics → Measured values

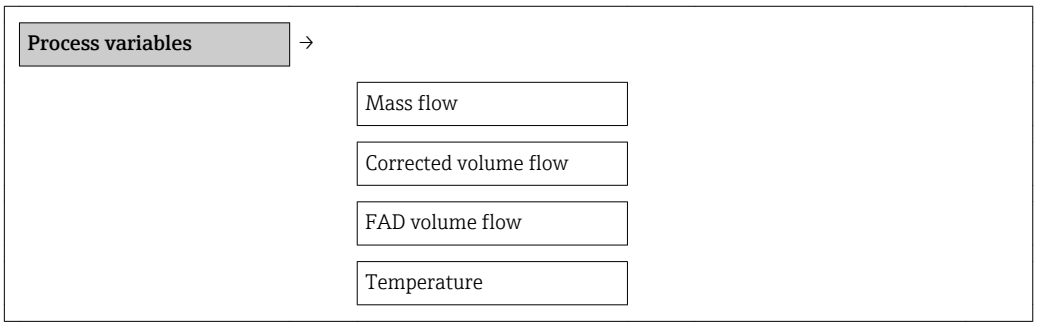
11.3.1 Process variables

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

Temperature display navigation path
The temperature display can also be viewed directly in the Setup menu:
"Setup" menu → Temperature

Structure of the submenu



Parameter overview with brief description

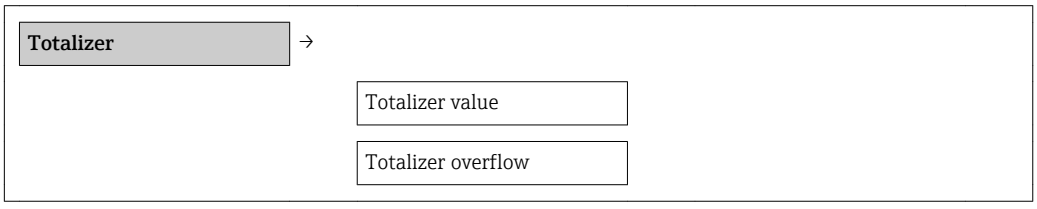
Parameter	Description	Display
Mass flow	Displays the mass flow currently calculated	Floating-point number with sign
Corrected volume flow	Displays the calculated volume flow	Floating-point number with sign
FAD volume flow	Displays the FAD volume flow currently calculated	Floating-point number with sign
Temperature	Displays the current process temperature	Floating-point number with sign

11.3.2 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	One of the following options is selected in the **Assign process variable** parameter of the **Totalizer** submenu: ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Displays the current totalizer counter value.	Floating-point number with sign
Totalizer overflow	One of the following options is selected in the **Assign process variable** parameter of the **Totalizer** submenu: ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow	Displays the number of totalizer overflows. Value range: 0 to 32 000	Integer

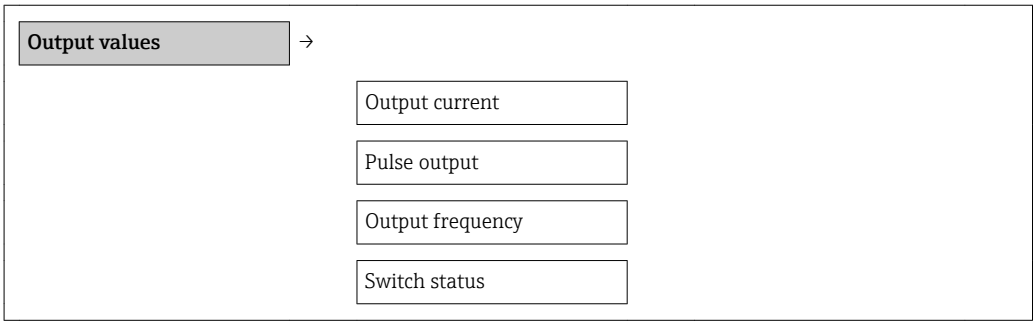
11.3.3 Output values

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

Navigation path

"Diagnostics" menu → Measured values → Output values

Structure of the submenu



Parameter overview with brief description

Parameter	Prerequisite	Description	Display
Output current	-	Displays the current current value of the current output.	3.6 to 22.5 mA
Pulse output	**Pulse** must be selected as the operating mode.	Displays the current value of the pulse output.	Positive floating-point number
Output frequency	**Frequency** must be selected as the operating mode.	Displays the current value of the frequency output.	0.0 to 1 000 Hz (Up to 1 250 Hz in the error mode)
Switch status	**Switch** must be selected as the operating mode.	Displays the current switch output status.	▪ Open ▪ Closed

11.4 Adapting the measuring device to the process conditions

The following are available for this purpose:
- Basic settings using the **Setup** → 📄 49 menu
- Advanced settings using the **Advanced setup** → 📄 53 menu

11.5 Performing a totalizer reset

In the **Operation** submenu, 2 parameters with various options for resetting the totalizers are available:
- Control totalizer
- Preset value
- Resetting the totalizer

Navigation path
"Display/operat." menu → Operation

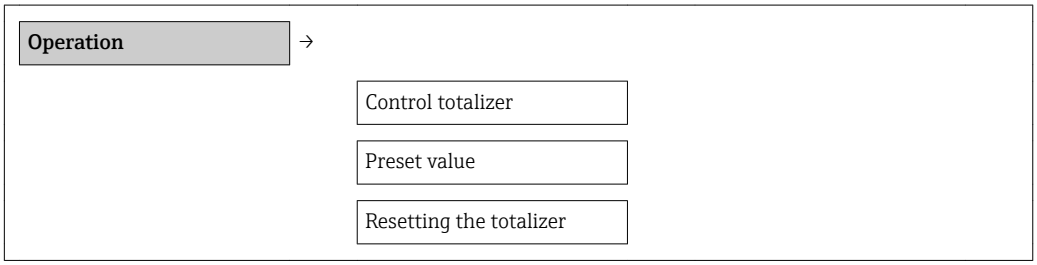
Function scope of the "Control totalizer" parameter

Options	Description
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 totalizer" parameter

Options	Description
Reset + totalize	Resets the totalizer 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		Control totalizer value.	▪ Totalize ▪ Reset + hold ▪ Preset + hold ▪ Reset + totalize ▪ Preset + totalize	Totalize
Preset value		Specify start value for totalizer.	Floating-point number with sign	0

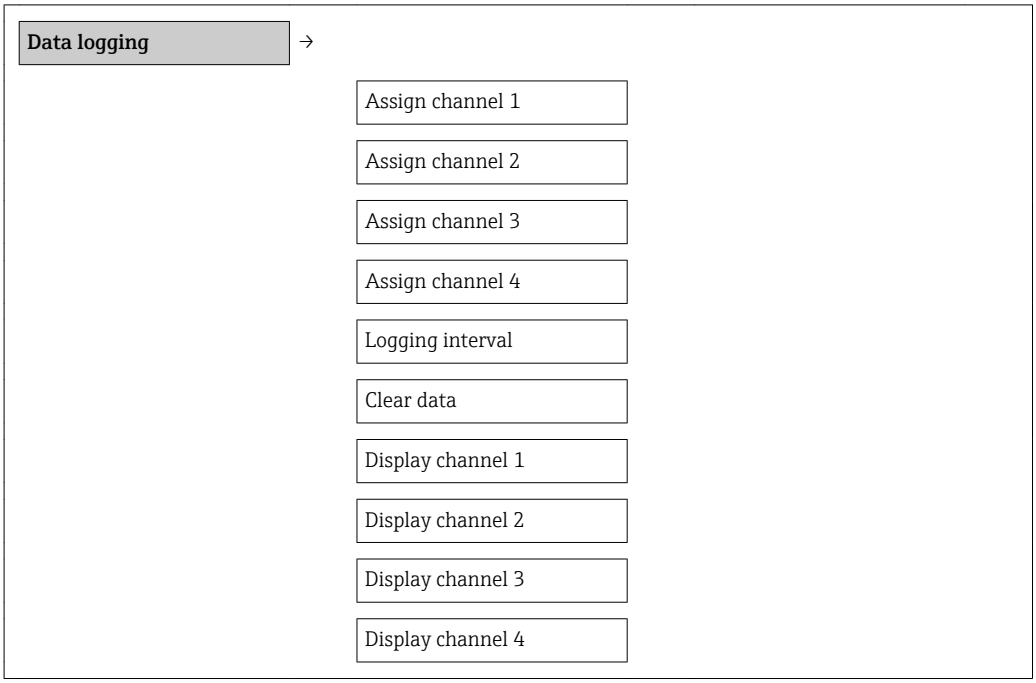
Reset all totalizers	-	Reset the totalizer to 0 and start.	▪ Cancel ▪ Reset + totalize	Cancel

11.6 Showing data logging

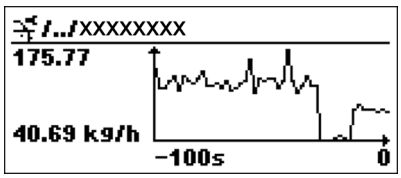
In the device, the extended function of the HistoROM must be enabled (order option) so that the **Data logging** submenu appears. This contains all the parameters for the measured value history.

Navigation path
Diagnostics → Data logging

"Data logging" submenu



Function range
- A total of 1000 measured values can be stored
- 4 logging channels
- Adjustable logging interval for data logging
- Display of the measured value trend for each logging channel in the form of a chart



5 *Chart of a measured value trend*

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

If the length of the logging interval or the assignment of the process variables to the channels is changed, the content of the data logging is deleted.

12 Diagnostics and troubleshooting

12.1 General troubleshooting

Problem	Possible cause	Remedy
Local display dark and no signal output at current output (0 mA)	Supply voltage does not match that specified on the nameplate.	Apply the correct supply voltage → 📄 23.
Local display dark and no signal output at current output (0 mA)	Supply voltage has incorrect polarity.	Reverse polarity of supply voltage.
Local display dark and no signal output at current output (0 mA)	No contact between connecting cables and terminals.	Check the connection of the cables and correct if necessary.
Local display dark and no signal output at current output (0 mA)	Terminals are not plugged into the electronics module correctly.	Check terminals.
Local display dark and no signal output at current output (0 mA)	Electronics module is defective.	Order spare part → 📄 91.
Local display is dark, but signal output is within the valid current range (3.6 to 22 mA)	Display is set too bright or too dark.	▪ Set the display brighter by simultaneously pressing ⊞ + Ⓔ. ▪ Set the display darker by simultaneously pressing ⊟ + Ⓔ.
Local display is dark, but signal output is within the valid current range (3.6 to 22 mA)	Ribbon cable of the display module is not plugged in correctly.	Insert the plug correctly into the main electronics module and display module.
Local display is dark, but signal output is within the valid current range (3.6 to 22 mA)	Display module is defective.	Order spare part → 📄 91.
Signal output outside the valid current range (< 3.6 mA or > 22 mA)	Main electronics module is defective.	Order spare part → 📄 91.
Device shows correct value on local display, but signal output is incorrect, though in the valid current range.	Configuration error	Check and correct parameter configuration.
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".
Text on measured value display and in navigation view appears in a foreign language and cannot be understood.	Incorrect operating language is configured.	1. Press ⊟ + ⊞ for 2 s ("home position"). 2. Press Ⓔ. 3. Set the desired language in the **Language** parameter.
No connection via HART protocol	Missing or incorrectly installed communication resistor.	Install the communication resistor (250 Ω) correctly. Observe the maximum load → 📄 23.

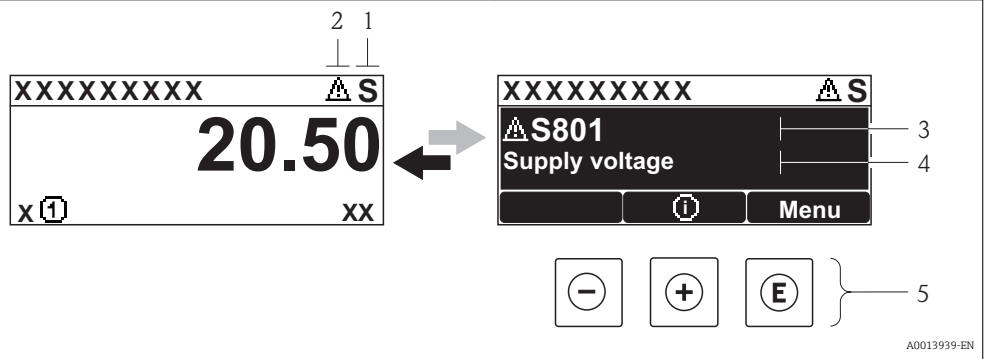
No connection via HART protocol	Commubox ▪ Connected incorrectly ▪ Configured incorrectly ▪ Drivers not installed correctly ▪ USB or COM interface on computer configured incorrectly	Observe the documentation for the Commubox. ▪ FXA 191 HART: Document "Technical Information" TI00237F ▪ FXA 195 HART: Document "Technical Information" TI00404F
No connection via service interface (CDI)	Incorrect configuration of USB interface on PC or driver not installed correctly.	Observe the documentation for the Commubox. FXA 291 HART: Document "Technical Information" TI00405C

12.2 Diagnostic information on local display

12.2.1 Diagnostic message

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

Operational display in alarm condition	Diagnostic message



1 *Status signal*
2 *Diagnostic behavior*
3 *Diagnostic behavior with diagnostic code*
4 *Short text*
5 *Operating elements*

Status signals

Symbol	Meaning
F A0013956	**Failure** A device error has occurred. The measured value is no longer valid.
C A0013959	**Function check** The device is in service mode (e.g. during a simulation).
S A0013958	**Out of specification** The device is being operated: ▪ Outside its technical specification limits (e.g. outside the process temperature range) ▪ Outside of the configuration carried out by the user (e.g. maximum flow in parameter **20 mA value**)
M A0013957	**Maintenance required** Maintenance is required. The measured value is still valid.

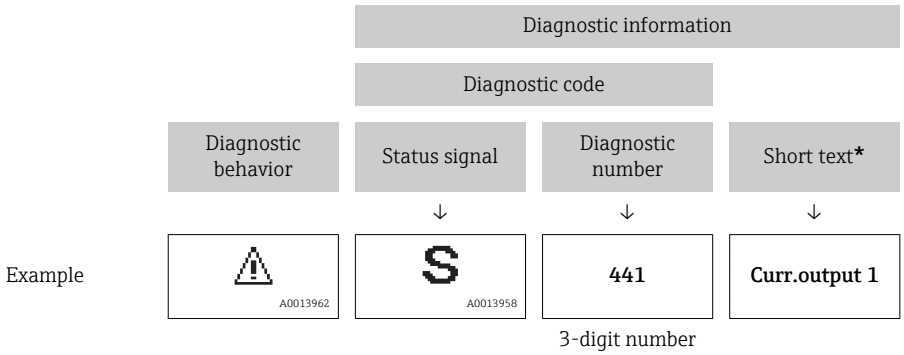
The status signals are categorized according to VDI/VDE 2650 and NAMUR Recommendation NE 107: F = Failure, C = Function Check, S = Out of Specification, M = Maintenance Required

Diagnostic behavior

Symbol	Meaning
A0013961	**Alarm** Measurement is interrupted. The signal outputs and totalizers assume the defined alarm condition. A diagnostic message is generated.
A0013962	**Warning** Measurement is resumed. The signal outputs and totalizers are not affected. A diagnostic message is generated.

Diagnostic information

The fault can be identified using the diagnostic information. The short text helps you by providing information about the fault. In addition, the corresponding symbol for the diagnostic behavior is displayed in front of the diagnostic information.



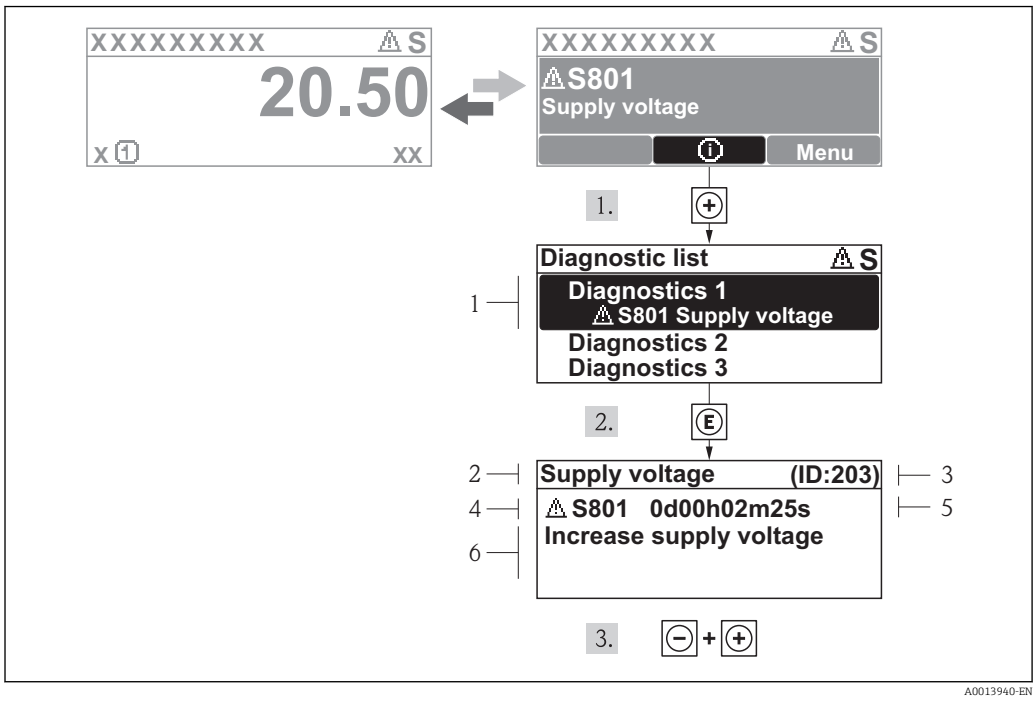
If two or more diagnostic events are pending simultaneously, only the message with the highest priority is shown. Other diagnostic messages that are pending can be viewed in the **Diagnostic list** submenu → 80.

Past diagnostic messages that are no longer pending are shown in the **Event logbook** submenu → 80.

Operating elements

Key	Meaning
A0013970	**Plus key** *In a menu, submenu* Opens the message about the remedy information.
A0013952	**Enter key** *In a menu, submenu* Opens the operating menu.

12.2.2 Calling up remedial measures



6 *Message for remedial measures*

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

The user is in the diagnostic message.

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

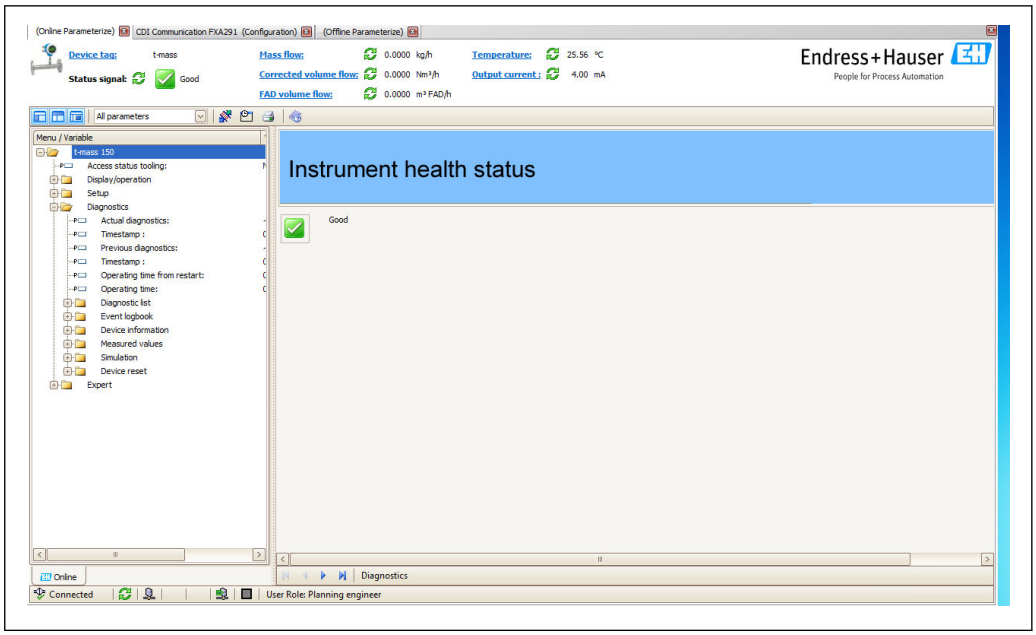
The user is in the **Diagnostics** menu at an entry for a diagnostics event, e.g. in the **Diagnostic list** submenu or the **Previous diagnostics** parameter.

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

12.3 Diagnostic information in the operating tool

If diagnostic information is present in the operating tool, the status signal appears in the top left status area along with the corresponding symbol in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107:

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



A0017300-EN

Calling up remedy information

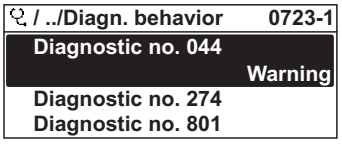
1. Navigate to the "Diagnostics" menu.
   ↳ In the "Actual diagnostics" parameter, the diagnostic code is shown with a short text.
2. On the right in the display range, hover the cursor over the "Actual diagnostics" parameter.
   ↳ A tool tip with remedial measures for the diagnostic number appears.

12.4 Adapting the diagnostic information

12.4.1 Adapting the diagnostic behavior

Each diagnostic number is assigned a specific diagnostic behavior at the factory. The user can change this assignment for specific diagnostic numbers via the **Diagnostics No. xxx** parameter.

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



A0014048-EN

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

Options	Description
Alarm	Measurement is interrupted. The signal outputs assume the defined alarm condition. A diagnostic message is generated.
Warning	The device continues to measure. A diagnostic message is generated.

Options	Description
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.

12.5 Overview of diagnostic information

Diagnostic number	Short text	Remedy information	Status signal from the factory	Diagnostic behavior from the factory
Diagnostics for the sensor				
004	Sensor	Change sensor	F	Alarm*
082	Data storage	1. Change main electronic module. 2. Change sensor.	F	Alarm*
083	Memory content	1. Restart device. 2. Restore data. 3. Change sensor.	F	Alarm*

Diagnostic number	Short text	Remedy information	Status signal from the factory	Diagnostic behavior from the factory
Diagnostics for the electronics				
270	Main electronic failure	Change main electronic module.	F	Alarm
271	Main electronic failure	1. Restart device. 2. Change main electronic module.	F	Alarm
272	Main electronic failure	1. Restart device. 2. Contact service.	F	Alarm*
273	Main electronic failure	1. Emergency operation via display. 2. Change main electronics.	F	Alarm*
282	Data storage	1. Restart device. 2. Contact service.	F	Alarm
283	Memory content	1. Transfer data or reset device. 2. Contact service.	F	Alarm*
311	Electronic failure	1. Transfer data or reset device. 2. Contact service.	F	Alarm*
311	Electronic failure	Maintenance required! 1. Do not perform reset. 2. Contact service.	M	Warning

* Diagnostic behavior can be changed: Section 12.4 "Adapting the diagnostic behavior"

Diagnostic number	Short text	Remedy information	Status signal from the factory	Diagnostic behavior from the factory
Diagnostics for the configuration				

410	Data transfer	1. Check connection. 2. Retry data transfer.	F	Alarm*
411	Upload/download	1. Check connection. 2. Retry data transfer.	F	Alarm*
411	Up-/download active	Up-/download active, please wait	C	Warning*
431	Trim	Carry out trim.	C	Warning*
437	Incompatible configuration	1. Restart device. 2. Contact service.	F	Alarm*
437	Incompatible configuration	1. Transfer data or reset device. 2. Contact service.	C	Alarm
438	Dataset	1. Check data set file. 2. Check device configuration. 3. Up- and download new configuration.	M	Warning*
441	Current output	1. Check process. 2. Check current output settings.	S	Warning*
442	Frequency output	1. Check process. 2. Check frequency output setting.	S	Warning*
443	Pulse output	1. Check process. 2. Check pulse output setting.	S	Warning*
453	Flow override	Deactivate flow override.	C	Warning*
484	Simulation failsafe mode	Deactivate simulation.	C	Alarm
485	Simulation process variable	Deactivate simulation.	C	Warning*
491	Simulation current output	Deactivate simulation.	C	Warning*
492	Frequency simulation	Deactivate simulation.	C	Warning*
493	Simulation pulse output	Deactivate simulation.	C	Warning
494	Switch output simulation	Deactivate simulation.	C	Warning

* Diagnostic behavior can be changed: Section 12.4 "Adapting the diagnostic behavior"

Diagnostic number	**Short text**	**Remedy information**	**Status signal** from the factory	**Diagnostic behavior** from the factory
Diagnostics for the process				
832	Ambient temperature	Reduce ambient temperature.	S	Warning*
833	Ambient temperature	Increase ambient temperature.	S	Warning*
834	Process temperature	Reduce process temperature.	S	Warning*
835	Process temperature	Increase process temperature.	S	Warning*

841	Flow velocity	1. Check process conditions. 2. Increase system pressure	S	Alarm
842	Process limit	Low flow cut off active! Check low flow cut off configuration.	S	Logbook entry only
861	Temperature differential	1. Check process conditions. 2. Check signal path.	S	Alarm

* Diagnostic behavior can be changed: Section 12.4 "Adapting the diagnostic behavior"

12.6 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

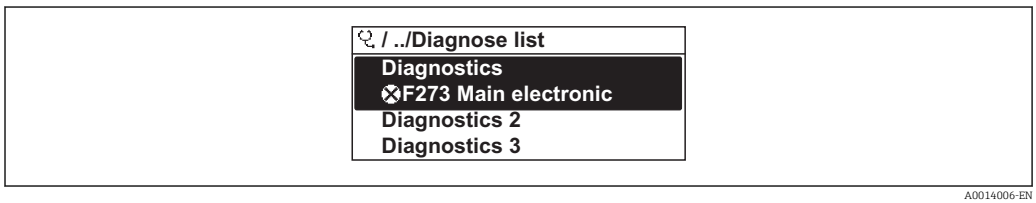
Function scope of the "Device reset" parameter

Options	Description
Cancel	The user can exit the parameter. No action is performed.
To factory defaults	Every parameter is reset to the factory setting.
To delivery settings	Every parameter for which a customer-specific default setting was ordered is reset to this customer-specific value. All other parameters are reset to the factory setting. This option is not visible if no customer-specific settings have been ordered.
Restart device	The restart resets every parameter whose data are in the volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.

12.7 Diagnostics list

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

Navigation path
"Diagnostics" menu → Diagnostic list



A0014006-EN

Calling up and closing remedial measures

1. Press E.
   ↳ The message for the remedial measures for the selected diagnostic number opens.

2. Press ⊟ + ⊞ simultaneously.
   ↳ The message about the remedy information closes.

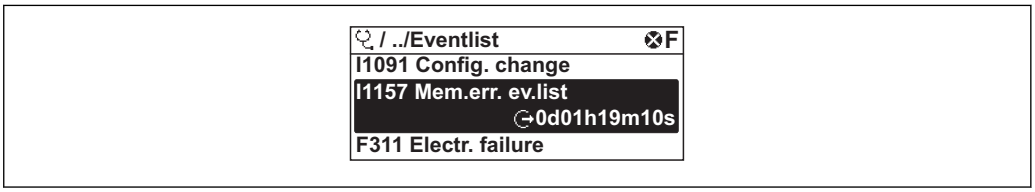
For the structure of the remedial measure message → 82

12.8 Event logbook

12.8.1 Event history

A chronological overview of the event messages that have occurred is provided in the **Events list** submenu.

Navigation path
"Diagnostics" menu → Event logbook → Events list



A0014008-EN

A maximum of 20 event messages can be displayed in chronological order. If the advanced HistoROM function is enabled in the device (order option), up to 1000 entries can be displayed.

The event history includes entries for:
- Diagnostic events → 80
- Information events → 80

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

Calling up and closing remedial measures

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

- For the structure of the remedial measure message → 82
- For filtering the displayed event messages → 89

12.8.2 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)

12.8.3 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
I1092	Trend data deleted
I1110	Write protection switch changed
I1151	History reset
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1185	Display backup done
I1186	Restore via display done
I1187	Settings downloaded with display
I1188	Display data cleared
I1189	Backup compared
I335	Firmware changed

13 Repair

13.1 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 only by Endress+Hauser Service or at the factory.

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.

13.2 Spare parts

- Some interchangeable measuring device components are identified by an overview sign. This contains information about the spare part.
- The spare part overview sign is located in the connection compartment cover of the device and contains the following information:
  - A list of the most important spare parts for the measuring device, including their ordering information.
  - The URL for the *W@M Device Viewer* (www.endress.com/deviceviewer): 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 device nameplate and the spare part overview sign.
- Can be read out via the "Serial number" parameter in the "Device information" submenu.

13.3 Endress+Hauser services

For information about service and spare parts, contact your Endress+Hauser distributor.

14 Maintenance

14.1 Maintenance tasks

No special maintenance work is required.

14.1.1 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.

14.1.2 Interior cleaning

Cleaning the transducer

In applications with dirty gases, it is advisable to inspect and clean the device regularly to minimize measured errors caused by fouling or buildup.

The inspection and cleaning intervals depend on experience and the field of application.

NOTICE

The use of unsuitable equipment or cleaning liquids can damage the transducer.

- ▶ Do not use pigs to clean the pipe.
- ▶ Use an oil-free cleaning agent that does not form a film to clean the sensor. Gently clean the surface using a soft brush.
- ▶ When cleaning make sure that the transducers are not damaged.
- ▶ Never use cleaning agents that can corrode the material and the seal.

Sensor-specific information:

- If the sensor gland is opened, the accuracy specifications of the measuring device no longer apply. In such situations, the measuring device must be removed and returned for recalibration and to the manufacturer.
- Follow the safety instructions when removing the sensor → 8.

14.2 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 representative 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.

14.3 Endress+Hauser services

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

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

15 Return

Observe the following points for returning the device:
- Contact your Endress+Hauser Sales Center to obtain information about the procedure and basic conditions.
- Enclose the completed "Decontamination declaration" form with the device.

The form is available:
As a photocopy master at the end of this manual

16 Disposal

16.1 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.

16.2 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 local site rules and federal/national regulations.
- Ensure proper separation and reuse of the device components.

17 Technical data

17.1 Application

The measuring device is intended only for the flow measurement of gases.

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.

17.2 Function and system design

Measuring principle

Mass flow measurement based on thermal measuring principle

Measuring system

The device consists of a transmitter and a sensor.

One device version is available: compact version - transmitter and sensor form a mechanical unit.

For information on the structure of the device → 10

17.3 Characteristic values

Measured variable

Direct measured variables

- Mass flow
- Gas temperature

Calculated measured variables

- Corrected volume flow
- FAD (free air delivery) volume flow

Measuring range

The available measuring range depends on the choice of gas, the size of the pipe and the use of a flow conditioner. The measuring device is calibrated with air (under ambient conditions) and the value is converted in order to adapt it to the customer's gas if necessary.

To obtain information on other gases and process conditions, please contact your Endress+Hauser sales office.

The following tables list the ranges available for air (without flow conditioner).

Measuring range "Calibration flow", option G and H

Specified measuring range up to 100% → 101

SI units for EN (DIN) flange versions

DN	[kg/h]		[Nm³/h] at 0 °C (1.013 bar a)		[Nm³/h at 15 °C (1.013 bar a)	
[mm]	min.	Max.	min.	Max.	min.	Max.
15	0.5	53	0.38	41	0.4	43
25	2	200	1.5	155	1.6	164

DN	[kg/h]		[Nm³/h] at 0 °C (1.013 bar a)		[Nm³/h at 15 °C (1.013 bar a)	
[mm]	min.	Max.	min.	Max.	min.	Max.
40	6	555	4.6	429	4.9	453
50	10	910	7.7	704	8.2	744

US units for ASME flange versions

DN	[lb/h]		[Scf/min] at 32 °F (14.7 psi a)		[Scf/min] at 59 °F (14.7 psi a)	
[in]	min.	Max.	min.	Max.	min.	Max.
½	1.1	116	0.23	24	0.24	25
1	4.4	440	0.9	91	1.0	96
1½	13.2	1220	2.7	252	2.9	266
2	22.0	2002	4.5	413	4.8	436

Measuring range "Calibration flow" option K

Specified measuring range up to 150% → 🖹 101

SI units for EN (DIN) flange versions

DN	[kg/h]		[Nm³/h] at 0 °C (1.013 bar a)		[Nm³/h at 15 °C (1.013 bar a)	
[mm]	min.	Max.	min.	Max.	min.	Max.
15	0.5	80	0.38	62	0.24	65
25	2	300	1.5	232	1.0	245
40	6	833	4.6	644	2.3	681
50	10	1365	7.7	1056	4.8	1116

US units for ASME flange versions

DN	[lb/h]		[Scf/min] at 32 °F (14.7 psi a)		[Scf/min] at 59 °F (14.7 psi a)	
[in]	min.	Max.	min.	Max.	min.	Max.
½	1.1	174	0.23	36	0.24	38
1	4.4	660	0.9	136	1.0	144
1½	13.2	1830	2.7	378	2.9	399
2	22.0	3003	4.5	620	4.8	656

Operable flow range

Over 100:1 (over 150:1 for calibration option code K).

Even in the extended measuring range (above the specified end value), the flow rate is captured and provided as an output signal. However, the extended range is not subject to the specified measuring uncertainty.

17.4 Output

Output signal

Current output

Current output	4-20 mA HART, active
Maximum output values	▪ DC 24 V (when idle) ▪ 22 mA If the option **Defined value** is selected in the **Failure mode** parameter : 22.5 mA
Load	0 to 750 Ω
Resolution	16 Bitor 0.38 µA
Damping	Adjustable:0 to 999 s
Assignable measured variables	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature

Pulse/frequency/switch output

Function	Can be set to pulse, frequency or switching output
Version	Passive, open collector
Maximum input values	▪ DC30 V ▪ 25 mA
Voltage drop	For 25 mA: ≤ DC2 V
Pulse output	
Pulse width	Adjustable: 0.5 to 2 000 ms → pulse rate:0 to 1 000 Pulse/s
Pulse value	Adjustable
Assignable measured variables	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow
Frequency output	
Maximum frequency	Adjustable:0 to 1 000 Hz
Damping	Adjustable:0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature
Switching output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Adjustable:0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	▪ Off ▪ On ▪ Diagnostic behavior ▪ Limit value ▪ Status

Signal on alarm

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

Current output

Failure mode	Can be selected (as per NAMUR recommendation NE 43)
Minimum alarm	3.6 mA
Maximum alarm	22 mA
Adjustable value	3.6 to 22.5 mA

Pulse/frequency/switch output

Pulse output	
Failure mode	Choose from: ▪ Actual value ▪ No pulses
Frequency output	
Failure mode	Choose from: ▪ Actual value ▪ Defined value: 0 to 1250 Hz ▪ 0 Hz
Switching output	
Failure mode	Choose from: ▪ Current status ▪ Open ▪ Closed

Local display

Plain text display	With information on cause and remedial measures

Status signal as per NAMUR recommendation NE 107

Operating tool

- Via digital communication: HART protocol
- Via service interface

Plain text display	With information on cause and remedial measures

Low flow cut off

The switch point for low flow cut off is programmable.

Galvanic isolation

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

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x66
HART protocol revision	6.0
Device description files (DTM, DD)	Information and files under: www.endress.com

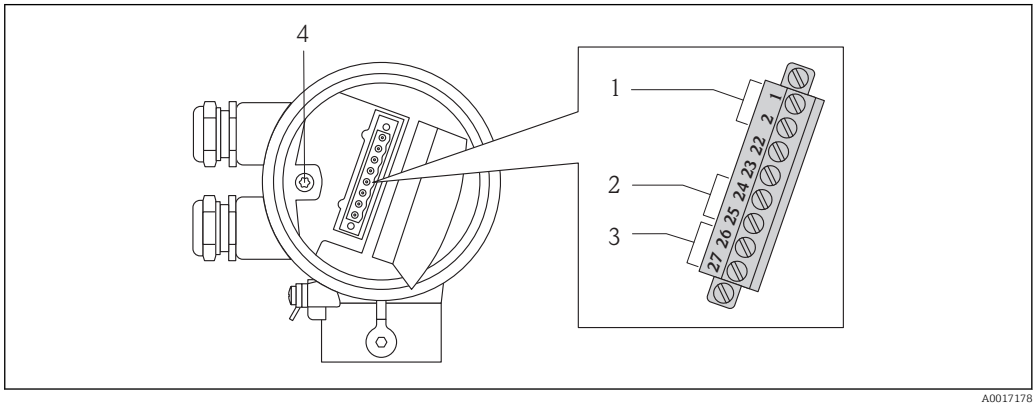
HART load	Min. 250 Ω
Dynamic variables	The measured variables can be freely assigned to the dynamic variables. **Measured variables for PV (primary dynamic variable)** ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Mass flow ▪ Corrected volume flow ▪ FAD volume flow ▪ Temperature ▪ Totalizer

17.5 Power supply

Terminal assignment

Transmitter

Connection version 4-20 mA HART, pulse/frequency/switching output



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1 Supply voltage
2 Signal transmission: Pulse/frequency/switching output
3 Signal transmission: 4-20 mA HART
4 Ground terminal for cable shield

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+)	2 (L-)
Option **D**	DC 24 V (18 to 30 V)	

Signal transmission

Order code for "Output"	Terminal numbers			
	Output 1		Output 2	
	26 (+)	27 (-)	24 (+)	25 (-)
Option **A**	4-20 mA HART active		-	
Option **B**	4-20 mA HART active		Pulse/frequency/switch output	
Option **K**	-		Pulse/frequency/switch output	

Supply voltage

DC 24 V (18 to 30 V)

The power supply circuit must comply with SELV/PELV requirements.

Power consumption

Order code for "Output"	Maximum power consumption
▪ Option **A**: 4-20mA HART ▪ Option **B**: 4-20mA HART, pulse/frequency/ switching output ▪ Option **K**: Pulse/frequency/switching output	3.1 W

Current consumption

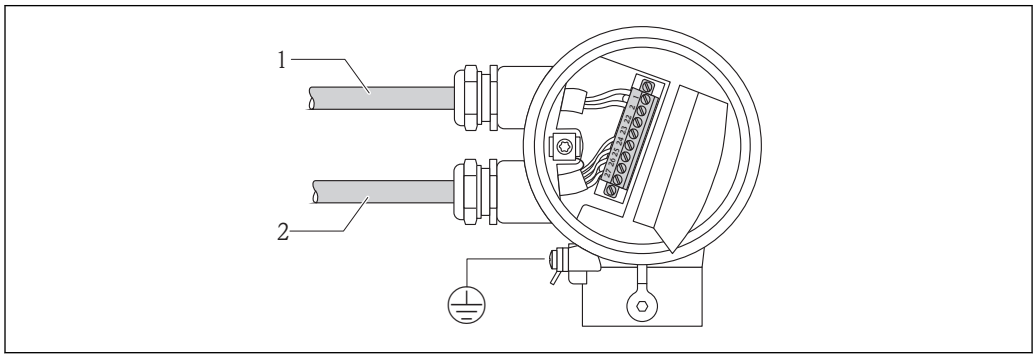
Order code for "Output"	Maximum current consumption	Maximum switch-on current
▪ Option **A**: 4-20mA HART ▪ Option **B**: 4-20mA HART, pulse/frequency/ switching output ▪ Option **K**: Pulse/frequency/switching output	185 mA	< 2.5 A

Power supply failure

- Totalizers stop at the last value measured.
- Configuration is retained in the device memory.
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter



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1 Cable entry for supply voltage
2 Cable entry for signal transmission

Potential equalization

No special measures for potential equalization are required.

Terminals

Plug-in screw terminals for specified wire cross-sections

Cable entries

- Cable gland: M20 × 1.5 with cable ϕ6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - NPT ½"
  - G ½"

Cable specification

Wire cross-sectional area

0.5 to 1.5 mm^2 (21 to 16 AWG)

Permitted temperature range

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

Signal cable

Current output

For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Supply voltage cable

Standard installation cable is sufficient.

17.6 Performance characteristics

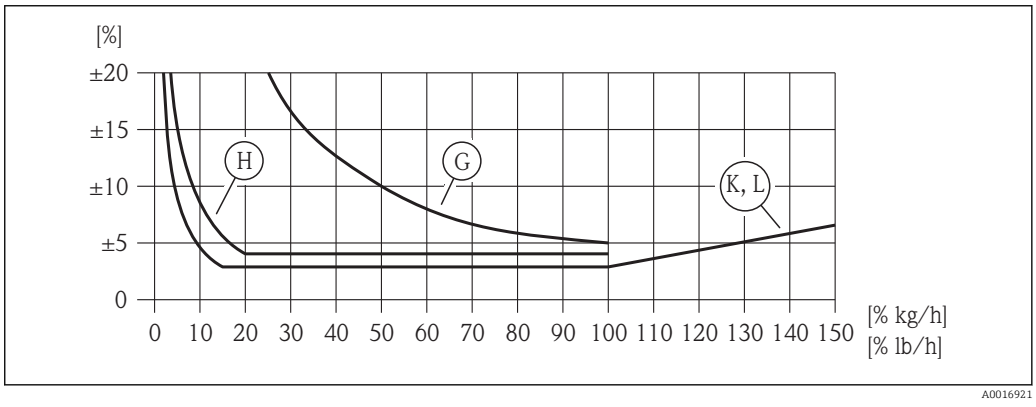
Reference operating conditions

- Calibration systems traceable to national standards
- Accredited in accordance with ISO/IEC 17025
- Air controlled to 24 °C ± 0.5 °C (75.2 °F ± 0.9 °F) at atmospheric pressure
- Humidity controlled < 40 % RH

Maximum measured error

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

- The full scale value depends upon the nominal diameter of the measuring device and the max. flow of the calibration rig.
- Full scale values of the specified measuring range.→ 95



7 *Maximum measured error (% mass flow) as % of measured value/full scale value. G, H, K, L: Order code options for "Calibration flow", see the following table*

Order code option for "Calibration flow"	Accuracy	Description
K L	▪ Q = 100 to 150 %: from ±3 %to ±6.5 % of the current measured value increasing linearly as expressed in the following equation: ±3 ± (X_n -100) × 0.07[% o.r.] (100 %< X_n ≤150 %; X_n = current flow as a % o.f.s.) ▪ Q = 15 to 100 %: ±3 % of current measured value ▪ Q = 1 to 15 % ±0.45 % o.f.s. (all data under reference conditions)	The measuring device is calibrated and adjusted on an accredited and traceable calibration rig . The accuracy is certified with a calibration protocol.
H	▪ Q = 20 to 100 % ±4 % of current measured value ▪ Q = 1 to 20 % ±0.8 % o.f.s. (all data under reference conditions)	The measuring performance of the device is tested, and a verification protocol confirms that the device measures within the specified tolerance.
G	Q = 1 to 100 % ±5 % o.f.s. (under reference conditions)	This version is subject to neither a calibration nor a verification of measuring performance.

Accuracy of outputs

Current output

Accuracy	Max. ±0.05 % o.f.s. or ±10 µA

Repeatability

±0.5 % of value for velocities > 1.0 m/s (3.3 ft/s)

Response time

Typically < 3 s for 63 % of a given step change (in both directions)

Influence of medium pressure

Air: 0.35 % of value per bar (0.02 % per psi) of process pressure change

17.7 Installation

"Mounting requirements"

17.8 Environment

Ambient temperature range

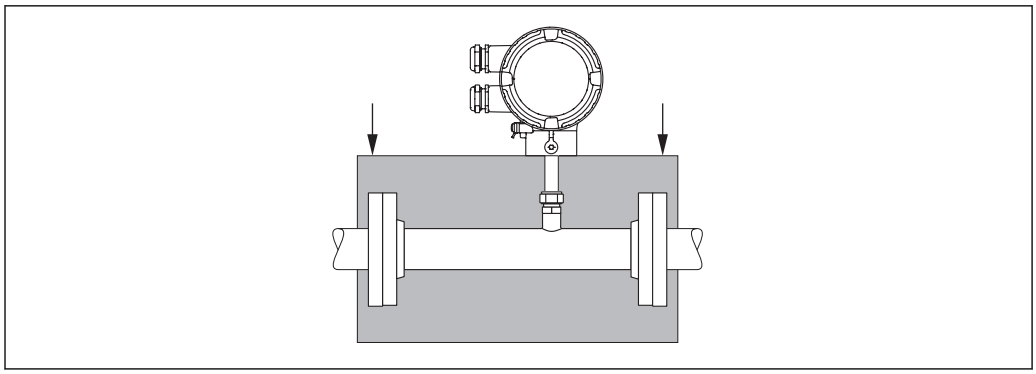
Transmitter	−40 to +60 °C (−40 to +140 °F)
Sensor	▪ Flange and threaded connection made of stainless steel: −40 to +60 °C (−40 to +140 °F) ▪ Flange connection PN16 made of carbon steel: −10 to +60 °C (−14 to +140 °F) ▪ Flange connection Cl.150 made of carbon steel: −29 to +60 °C (−20.2 to +140 °F)
Local display	−20 to +60 °C (−4 to +140 °F) The readability of the display may be impaired at temperatures outside the temperature range.

- If operating outdoors:
  Avoid direct sunlight, particularly in warm climatic regions.

Storage temperature	−40 to +80 °C (−40 to +176 °F), preferably at +20 °C (+68 °F)
Degree of protection	**Transmitter** ▪ As standard: IP66/67, type 4X enclosure ▪ When housing is open: IP20, type 1 enclosure ▪ Display module: IP20, type 1 enclosure **Sensor** IP66/67, type 4X enclosure
Shock resistance	As per IEC/EN 60068-2-31
Vibration resistance	Acceleration up to 2 g, 10 to 150 Hz, as per IEC/EN 60068-2-6
Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21). For details, refer to the Declaration of Conformity.

17.9 Process

Medium temperature range	**Sensor** ▪ Flange and threaded connection made of stainless steel: −40 to +100 °C (−40 to +212 °F) ▪ Flange connection PN16 made of carbon steel: −10 to +100 °C (−14 to +212 °F) ▪ Flange connection Cl.150 made of carbon steel: −29 to +100 °C (−20.2 to +212 °F)
Flow limit	See "Measuring range"→ 95 section The velocity in the measuring tube should not exceed 70 m/s (230 ft/s).
Pressure loss	Negligible (without flow conditioner). For a precise calculation, use the Applicator.
System pressure	**Sensor** Depending on the version, please note the details on the name plate . Max. 40 bar g (580 psi g)
Thermal insulation	If the gas is very humid or saturated with water, the pipe and the sensor housing should be insulated to prevent water droplets condensing on the transducer. **NOTICE** **Electronics overheating on account of thermal insulation!** ▶ Observe maximum permitted insulation height of the transmitter neck so that the transmitter head is completely free.



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17.10 Mechanical construction

Design, dimensions

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

Weight

Weight in SI units

Compact version

DN [mm]	Weight [kg]					
	Fixed flange		Lap joint flange			Threaded version
	CL300	PN40	PN16	PN10	CL150	
15	4.0	3.9	4.1	3.2	3.4	2.6
25	5.5	4.8	5.0	3.5	4.3	2.6
40	7.9	7.0	7.5	4.9	6.1	3.1
50	9.9	9.3	9.4	5.9	8.0	3.8

Weight in US units

Compact version

DN [mm]	Weight [lbs]					
	Fixed flange		Lap joint flange			Threaded version
	CL300	PN40	PN16	PN10	CL150	
15	8.8	8.6	9.0	7.1	7.5	5.7
25	12.1	10.6	11.0	7.7	9.5	5.7
40	17.4	15.4	16.5	10.8	13.5	6.8
50	21.8	20.5	20.7	13.0	17.6	8.4

Materials

Transmitter housing

- Order code for "Housing", option **A**: aluminum coating AlSi10Mg
- Window material: glass

Sensor

Process connections

Fixed flanges: EN 1092-1/ ASME B16.5
- Stainless steel 1.4404 as per EN 10222-5
- Stainless steel F316/F316L as per ASTM A182

Lap joint flanges: EN 1092-1/ ASME B16.5
- Stub end:
  - Stainless steel 1.4404/1.4435 as per EN 10216-5; cold worked
  - Stainless steel 316L as per ASTM A312; cold worked
- Lap-joint flange:
  - Galvanized carbon steel 1.0038 as per EN 10025-2
  - Galvanized carbon steel ASTM A105
  - Stainless steel 1.4301/1.4307 as per EN 10028-7

Threaded version: R external thread as per EN 10226-1, ISO 7/1 and NPT external thread as per ASME B1.20.1
- Stainless steel 1.4404/1.4435 as per EN 10216-5
- Stainless steel 316L as per ASTM A312

Measuring tube

- DN 15(½ in)
  - Stainless steel 1.4404 as per EN 10272/EN10216-5
  - Stainless steel 316/316L as per ASTM A479/ ASTM A312
- DN 25 to 50 (1 to 2 in)
  - Stainless steel 1.4404 as per EN 10216-5
  - Stainless steel 316/316L as per ASTM A312

Sensing element

- Stainless steel 1.4404/1.4435 as per EN 10216-5/ EN10272/ EN 10028-7
- Stainless steel 316L as per ASTM A269/ ASTM A479/ ASTM A240

Cable entries

Order characteristic for "Housing", option A: compact, aluminum coating

Electrical connection	Type of protection	Material
Cable gland M20 × 1.5	For non-hazardous areas	Plastic
Thread G ½" via adapter	For non-Ex and Ex	Nickel-plated brass
Thread NPT ½" via adapter		

Accessories

Flow conditioner as per EN(DIN)/ASME

1.4404 as per EN 10272 and 316L as per A479

1.4404 as per EN 10216-5 and 316L as per A312

Process connections

- Lap joint flanges, fixed flanges
  - as per EN 1092-1
  - as per ASME B16.5
- External thread
  - R external thread as per EN 10226-1
  - NPT external thread as per ASME B1.20.1

For information on the materials of the process connections

17.11 Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Quick and safe commissioning
Menu guidance with brief explanations of the individual parameter functions

Reliable operation
- Operation in different languages: → 108
  - Via local display
  - Via operating tools
- Uniform operating philosophy applied to device and operating tools

Efficient diagnostics increase measurement reliability
- Remedial information is integrated in plain text
- Diverse simulation options and optional line recorder functions

Local operation

"Display; Operation" Order code option C

Display elements

- 4-line display
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: −20 to +60 °C (−4 to +140 °F)
  The readability of the display may be impaired at temperatures outside the temperature range.

Operating elements

Local operation with 3 push buttons (⊕, ⊖, ⓔ)

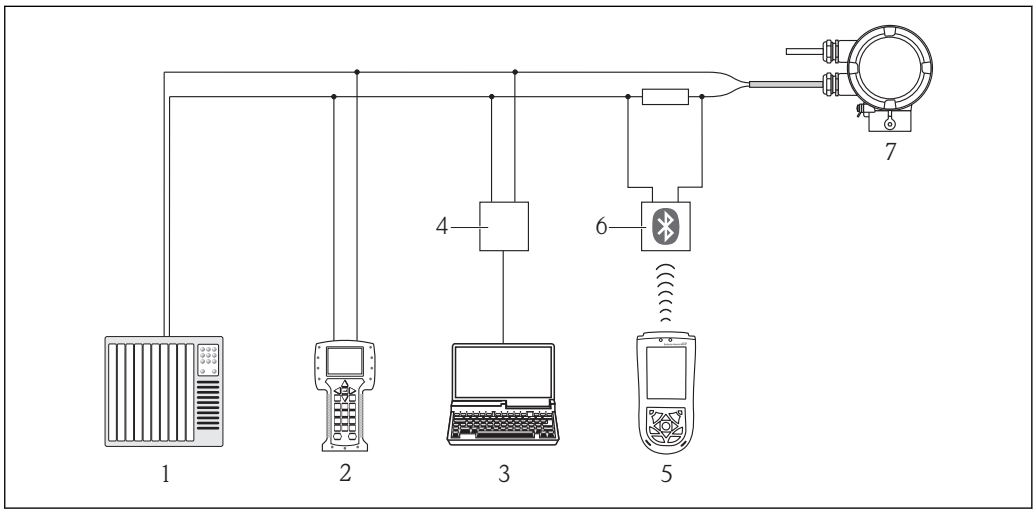
Additional functionality

- Data backup function
  The device configuration can be saved in the display module.
- Data comparison function
  The device configuration saved in the display module can be compared to the current device configuration.
- Data transfer function
  The transmitter configuration can be transmitted to another device using the display module.

Remote operation

Via HART protocol

This communication interface is present in the following device version:
- Order code for "Outlet", option **A**: 4-20 mA HART
- Order code for "Outlet", option **B**: 4-20 mA HART, pulse/frequency/switching output



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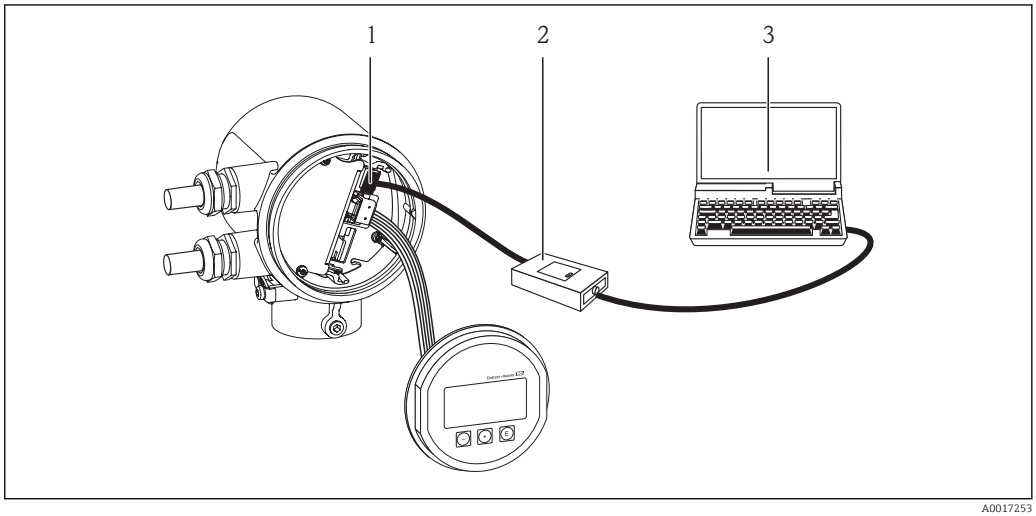
8 Options for remote operation via HART protocol

1 Control system (e.g. PLC)
2 Field Communicator 475
3 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
4 Commubox FXA195 (USB)
5 Field Xpert SFX100
6 VIATOR Bluetooth modem with connecting cable
7 Transmitter

Via service interface (CDI)



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

Languages	Can be operated in the following languages: ▪ Via local display: English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Japanese, Chinese, Korean, Bahasa (Indonesian), Vietnamese, Czech ▪ Via operating tools: English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Japanese, Chinese, Korean, Bahasa (Indonesian), Vietnamese, Czech

17.12 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	$_{C}$CSA$_{US}$ The following hazardous area version is currently available: *NI* Class 1, Division 2, Groups A, B, C and D T4 or Class I
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 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures ▪ 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
  Status classification as per NE107

17.13 Accessories

For an overview of the accessories that can be ordered, see the "Technical Information" document

17.14 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	KA01103D
- - - -	Technical Information	TI01019D

Supplementary device-dependent documentation

Document type	Documentation code
Information on the Pressure Equipment Directive	SD00155D
Installation Instructions	Specified for each individual accessory For an overview of the accessories that can be ordered, see the "Technical Information" document

18 Appendix

18.1 Overview of the Operator/Maintenance operating menu

The following table provides an overview of the operating menu structure with the specific parameters for operators, maintenance staff and experts. The page reference indicates where a description of the parameter can be found in the manual.

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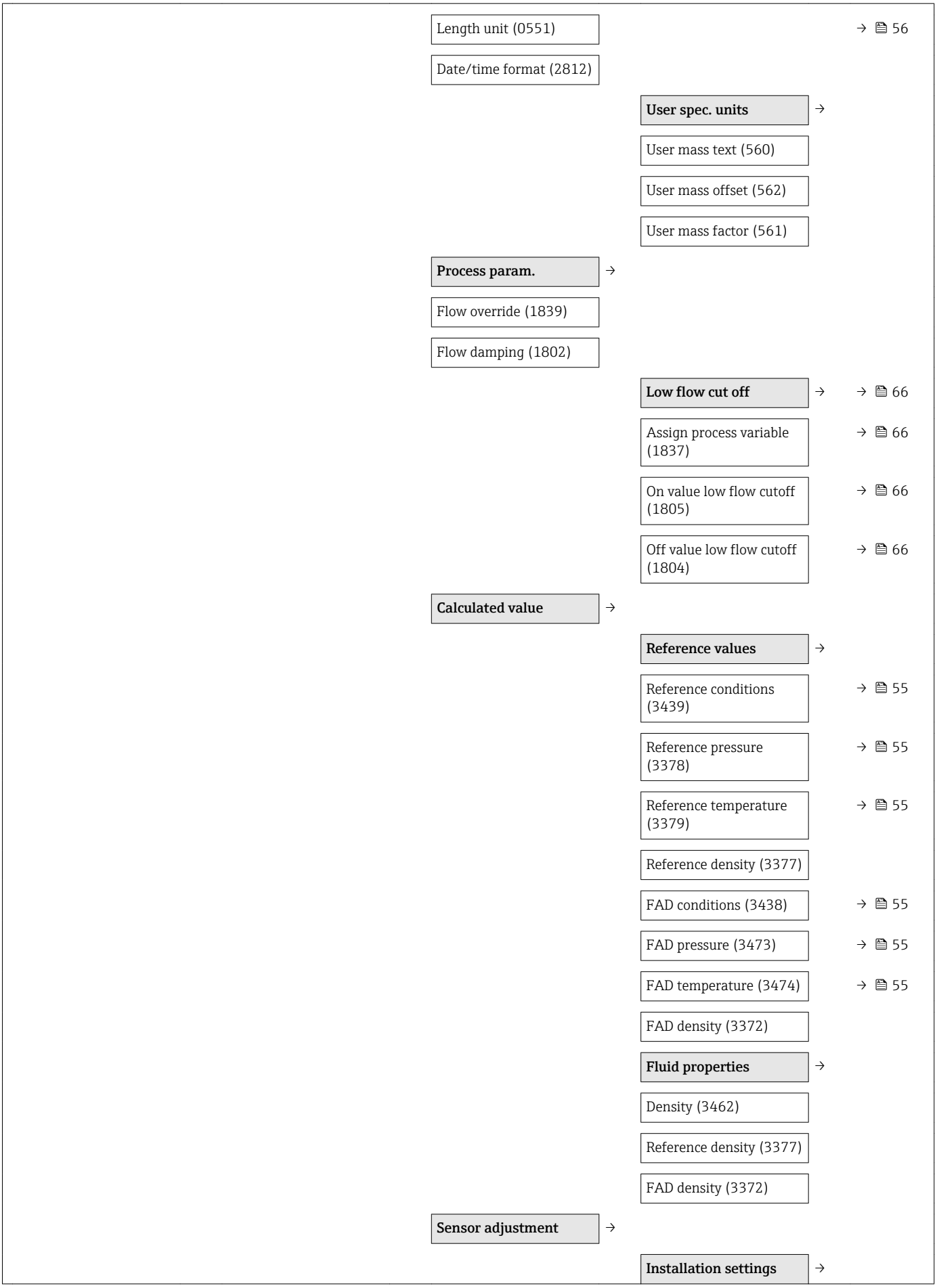
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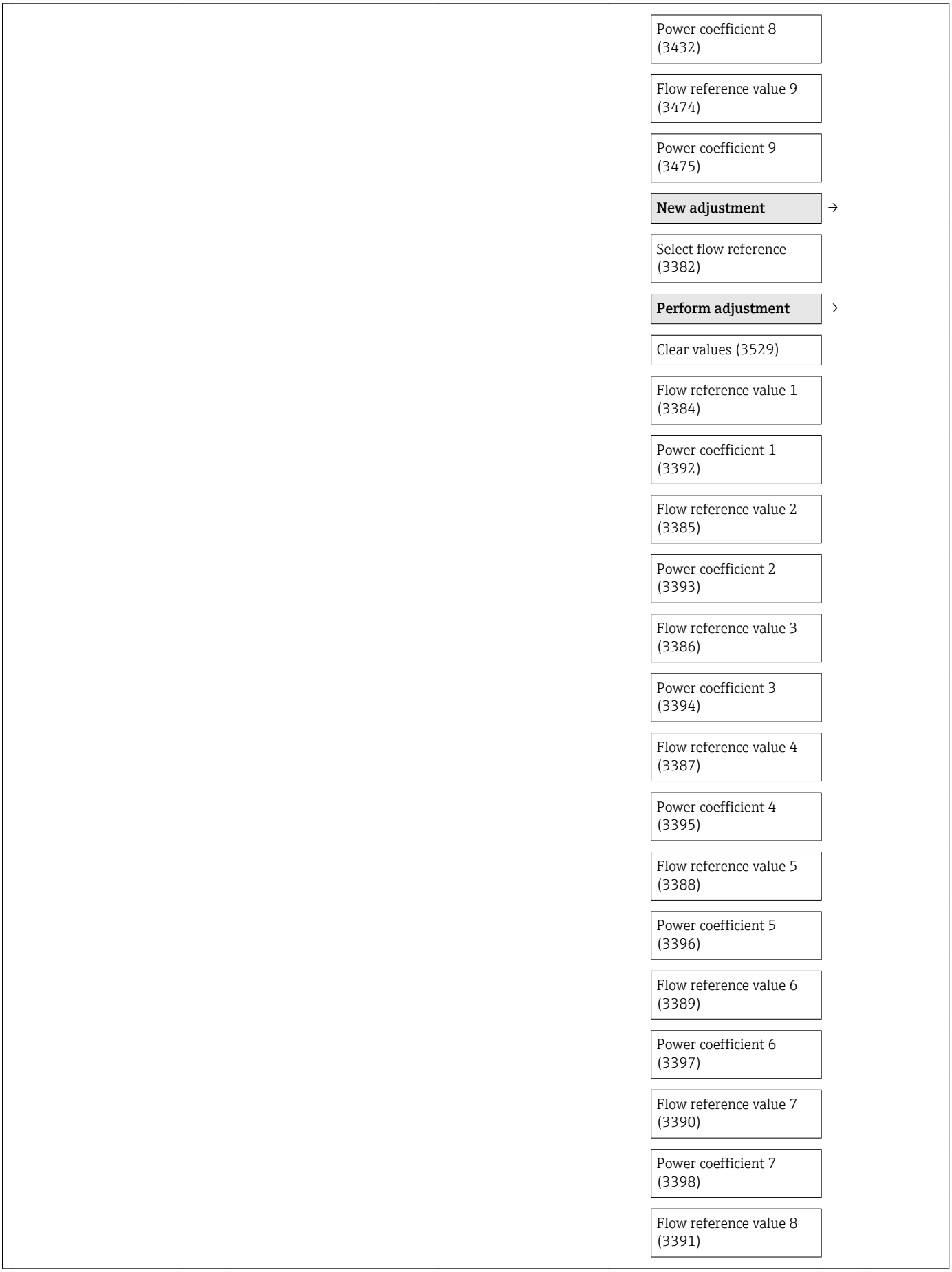
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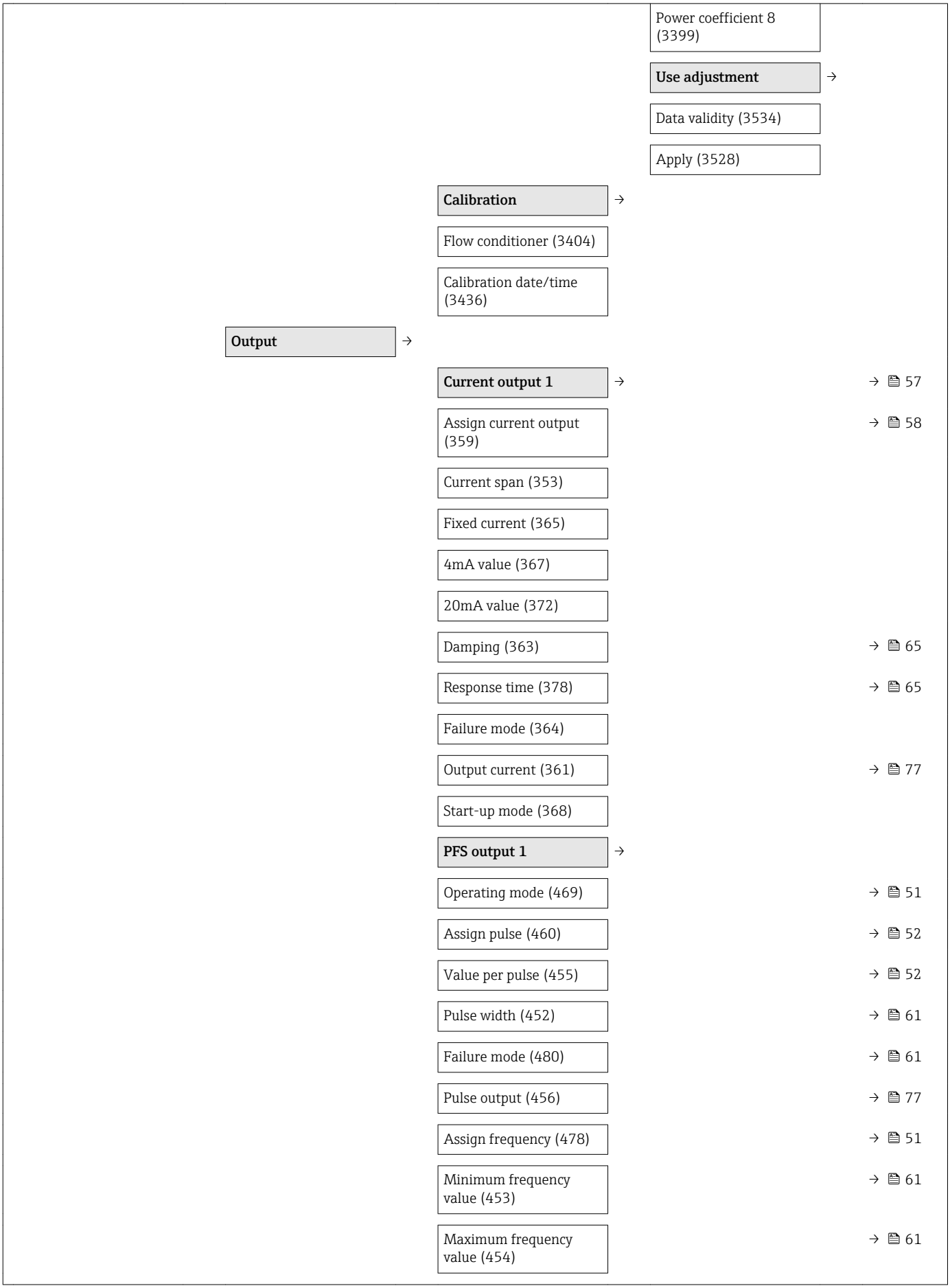
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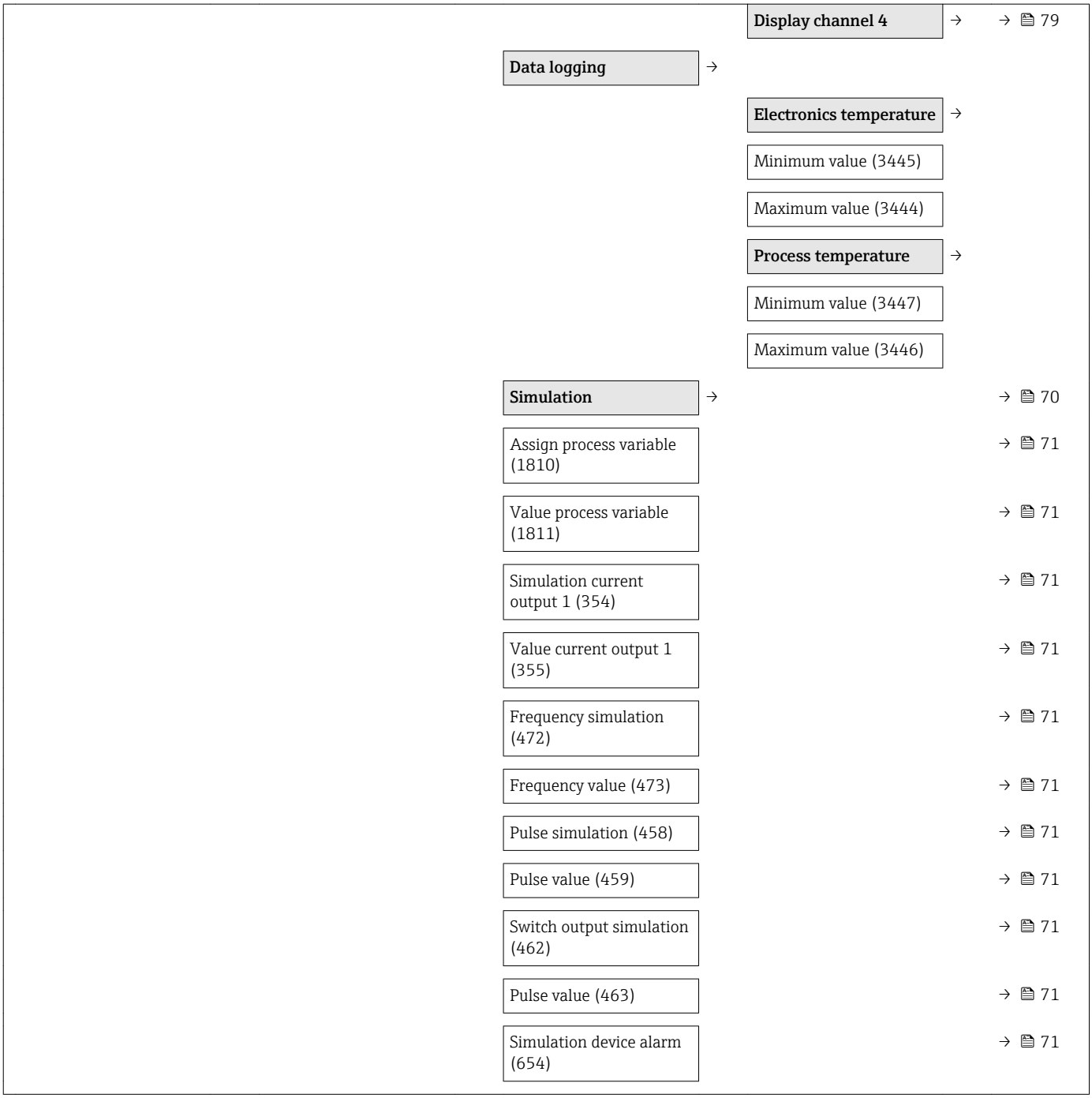
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