

Operating Instructions Proline Prowirl F 200 HART

Vortex flowmeter



- 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 organization will supply you with current information and updates to this manual.

Table of contents

1	About this document	6		
1.1	Document function	6		
1.2	Symbols	6		
1.2.1	Safety symbols	6		
1.2.2	Electrical symbols	6		
1.2.3	Communication-specific symbols	6		
1.2.4	Tool symbols	7		
1.2.5	Symbols for certain types of information	7		
1.2.6	Symbols in graphics	7		
1.3	Documentation	8		
1.4	Registered trademarks	8		
2	Safety instructions	9		
2.1	Requirements for the personnel	9		
2.2	Intended use	9		
2.3	Workplace safety	10		
2.4	Operational safety	10		
2.5	Product safety	10		
2.6	IT security	10		
2.7	Device-specific IT security	11		
2.7.1	Protecting access via hardware write protection	11		
2.7.2	Protecting access via a password	11		
2.7.3	Access via fieldbus	11		
3	Product description	12		
3.1	Product design	12		
4	Incoming acceptance and product identification	14		
4.1	Incoming acceptance	14		
4.2	Product identification	14		
4.2.1	Transmitter nameplate	15		
4.2.2	Sensor nameplate	16		
4.2.3	Pressure measuring cells nameplate	19		
4.2.4	Symbols on the device	19		
5	Storage and transport	20		
5.1	Storage conditions	20		
5.2	Transporting the product	20		
5.2.1	Measuring devices without lifting lugs	20		
5.2.2	Measuring devices with lifting lugs	21		
5.2.3	Transporting with a fork lift	21		
5.3	Packaging disposal	21		
6	Installation	22		
6.1	Installation requirements	22		
6.1.1	Installation position	22		
6.1.2	Environmental and process requirements	27		
6.2	Installing the device	30		
6.2.1	Required tools	30		
6.2.2	Preparing the measuring device	30		
6.2.3	Installing the sensor	30		
6.2.4	Mounting the pressure measuring unit	30		
6.2.5	Installing the transmitter of the remote version	33		
6.2.6	Turning the transmitter housing	34		
6.2.7	Turning the display module	35		
6.3	Post-mounting check	35		
7	Electrical connection	36		
7.1	Electrical safety	36		
7.2	Connecting requirements	36		
7.2.1	Required tools	36		
7.2.2	Requirements for connection cable	36		
7.2.3	Connecting cable for remote version	36		
7.2.4	Terminal assignment	38		
7.2.5	Requirements for the supply unit	41		
7.2.6	Preparing the measuring instrument	43		
7.3	Connecting the device	43		
7.3.1	Connecting the compact version	43		
7.3.2	Connecting the remote version	45		
7.3.3	Connecting the connecting cable for the pressure measuring cell	49		
7.4	Potential equalization	50		
7.4.1	Requirements	50		
7.5	Ensuring the degree of protection	50		
7.6	Post-connection check	50		
8	Operation options	52		
8.1	Overview of operation options	52		
8.2	Structure and function of the operating menu	53		
8.2.1	Structure of the operating menu	53		
8.2.2	Operating philosophy	54		
8.3	Access to operating menu via local display	55		
8.3.1	Operational display	55		
8.3.2	Navigation view	57		
8.3.3	Editing view	58		
8.3.4	Operating elements	60		
8.3.5	Opening the context menu	61		
8.3.6	Navigating and selecting from list	62		
8.3.7	Calling the parameter directly	62		
8.3.8	Calling up help text	63		
8.3.9	Changing the parameters	64		
8.3.10	User roles and related access authorization	65		
8.3.11	Disabling write protection via access code	65		

8.3.12	Enabling and disabling the keypad lock	66	11	Operation	139
8.4	Access to the operating menu via the operating tool	66	11.1	Reading off the device locking status	139
8.4.1	Connecting the operating tool	66	11.2	Adjusting the operating language	139
8.4.2	Field Xpert SFX350, SFX370	67	11.3	Configuring the display	139
8.4.3	FieldCare	68	11.4	Reading off measured values	139
8.4.4	DeviceCare	69	11.4.1	Process variables	140
8.4.5	AMS Device Manager	69	11.4.2	"Totalizer" submenu	143
8.4.6	SIMATIC PDM	70	11.4.3	Input values	143
8.4.7	Field Communicator 475	70	11.4.4	Output variables	144
9	System integration	71	11.5	Adapting the measuring device to the process conditions	145
9.1	Overview of device description files	71	11.6	Performing a totalizer reset	145
9.1.1	Current version data for the device ...	71	11.6.1	Function scope of "Control Totalizer" parameter	145
9.1.2	Operating tools	71	11.6.2	Function range of "Reset all totalizers" parameter	146
9.2	Measured variables via HART protocol	71	11.7	Displaying the measured value history	146
9.3	Other settings	73	12	Diagnostics and troubleshooting ..	149
10	Commissioning	76	12.1	General troubleshooting	149
10.1	Post-mounting and post-connection check ...	76	12.2	Diagnostic information on local display	151
10.2	Switching on the measuring device	76	12.2.1	Diagnostic message	151
10.3	Setting the operating language	76	12.2.2	Calling up remedial measures	153
10.4	Configuring the device	77	12.3	Diagnostic information in FieldCare or DeviceCare	153
10.4.1	Defining the tag name	77	12.3.1	Diagnostic options	153
10.4.2	Setting the system units	78	12.3.2	Calling up remedy information	155
10.4.3	Selecting and setting the medium ...	82	12.4	Adapting the diagnostic information	155
10.4.4	Configuring the current input	85	12.4.1	Adapting the diagnostic behavior ...	155
10.4.5	Configuring the current output	87	12.4.2	Adapting the status signal	156
10.4.6	Configuring the pulse/frequency/switch output	88	12.5	Overview of diagnostic information	156
10.4.7	Configuring the local display	93	12.5.1	Operating conditions for displaying the following diagnostics information	160
10.4.8	Configuring the output conditioning .	95	12.5.2	Emergency mode in the event of pressure compensation	160
10.4.9	Configuring the low flow cut off	95	12.5.3	Emergency mode in event of temperature compensation	160
10.5	Advanced settings	97	12.6	Pending diagnostic events	161
10.5.1	Setting the medium properties	98	12.7	Diagnostics list	161
10.5.2	Performing external compensation .	111	12.8	Event logbook	162
10.5.3	Carrying out a sensor adjustment ...	113	12.8.1	Reading out the event logbook	162
10.5.4	Configuring the totalizer	116	12.8.2	Filtering the event logbook	162
10.5.5	Carrying out additional display configurations	118	12.8.3	Overview of information events	163
10.5.6	Configuration management	121	12.9	Resetting the device	164
10.5.7	Using parameters for device administration	122	12.9.1	Function scope of the "Device reset" parameter	164
10.6	Configuration management	123	12.10	Device information	164
10.6.1	Function range of "Configuration management" parameter	124	12.11	Firmware history	166
10.7	Simulation	124	13	Maintenance	167
10.8	Protecting settings from unauthorized access	127	13.1	Maintenance tasks	167
10.8.1	Write protection via access code ...	127	13.1.1	Exterior cleaning	167
10.8.2	Write protection via write protection switch	128	13.1.2	Interior cleaning	167
10.9	Application-specific commissioning	129	13.1.3	Replacing seals	167
10.9.1	Steam application	129	13.1.4	Adjusting the pressure measuring cell	167
10.9.2	Liquid application	130			
10.9.3	Gas applications	131			
10.9.4	Calculation of the measured variables	134			

13.2	Measuring and test equipment	168
13.3	Endress+Hauser services	168
14	Repair	169
14.1	General notes	169
14.1.1	Repair and conversion concept	169
14.1.2	Notes for repair and conversion	169
14.2	Spare parts	169
14.3	Endress+Hauser services	170
14.4	Return	170
14.5	Disposal	170
14.5.1	Removing the measuring device	170
14.5.2	Disposing of the measuring device ..	171
15	Accessories	172
15.1	Device-specific accessories	172
15.1.1	For the transmitter	172
15.1.2	For the sensor	173
15.2	Communication-specific accessories	173
15.3	Service-specific accessories	174
15.4	System components	175
16	Technical data	176
16.1	Application	176
16.2	Function and system design	176
16.3	Input	176
16.4	Output	184
16.5	Power supply	186
16.6	Performance characteristics	189
16.7	Installation	193
16.8	Environment	193
16.9	Process	195
16.10	Mechanical construction	197
16.11	Operability	206
16.12	Certificates and approvals	207
16.13	Application packages	209
16.14	Accessories	210
16.15	Documentation	211
Index		213

1 About this document

1.1 Document function

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

1.2 Symbols

1.2.1 Safety symbols



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



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



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



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

1.2.2 Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Potential equalization connection (PE: Protective earth) Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: ■ Interior ground terminal: potential equalization connection is connected to the supply network. ■ Exterior ground terminal: device is connected to the plant grounding system.

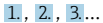
1.2.3 Communication-specific symbols

Symbol	Meaning
	Wireless Local Area Network (WLAN) Communication via a wireless, local network.
	Bluetooth Wireless data transmission between devices over a short distance via radio technology.

1.2.4 Tool symbols

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

1.2.5 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.6 Symbols in graphics

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

1.3 Documentation

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

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	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 (KA)	Guide that takes you quickly to the 1st measured value The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Your reference document The 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.
Description of Device Parameters (GP)	Reference for your parameters The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions.  The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

1.4 Registered trademarks

HART®

Registered trademark of the FieldComm Group, Austin, Texas USA

KALREZ®, VITON®

Registered trademarks of DuPont Performance Elastomers L.L.C., Wilmington, DE USA

GYLON®

Registered trademark of Garlock Sealing Technologies, Palmyra, NY, USA

2 Safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

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

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Intended use

Application and media

The measuring instrument described in this manual is intended only for the flow measurement of liquids, gases and vapors.

Depending on the version ordered, the measuring instrument can also be used to measure potentially explosive ¹⁾, flammable, toxid and oxidizing media.

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

To ensure that the measuring instrument is in perfect condition during operation:

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

Incorrect use

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

WARNING

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

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

1) Not applicable for IO-Link measuring instruments

NOTICE**Verification for borderline cases:**

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

Residual risks**⚠ CAUTION**

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

- ▶ Mount suitable touch protection.

2.3 Workplace safety

When working on and with the device:

- ▶ Wear the required personal protective equipment as per national regulations.

2.4 Operational safety

Damage to the device!

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

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

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

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

2.6 IT security

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

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

2.7 Device-specific IT security

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

2.7.1 Protecting access via hardware write protection

Write access to the parameters of the device via the local display or operating tool (e.g. FieldCare, DeviceCare) can be disabled via a write protection switch (DIP switch on the main electronics module). When hardware write protection is enabled, only read access to the parameters is possible.

2.7.2 Protecting access via a password

A password can be used to protect against write access to the device parameters.

This controls write access to the device parameters via the local display or other operating tools (e.g. FieldCare, DeviceCare) and, in terms of functionality, corresponds to hardware write protection. If the CDI service interface is used, read access is only possible by first entering the password.

User-specific access code

Write access to the device parameters via the local display or operating tool (e.g. FieldCare, DeviceCare) can be protected by the modifiable, user-specific access code (→  127).

When the device is delivered, the device does not have an access code and is equivalent to 0000 (open).

General notes on the use of passwords

- The access code and network key supplied with the device should be changed during commissioning for safety reasons.
- Follow the general rules for generating a secure password when defining and managing the access code and network key.
- The user is responsible for the management and careful handling of the access code and network key.
- For information on configuring the access code or on what to do if you lose the password, for example, see "Write protection via access code" →  127.

2.7.3 Access via fieldbus

When communicating via fieldbus, access to the device parameters can be restricted to "Read only" access. The option can be changed in the **Fieldbus writing access** parameter.

This does not affect cyclic measured value transmission to the higher-order system, which is always guaranteed.

 For detailed information on device parameters, see:
"Description of Device Parameters" document →  211.

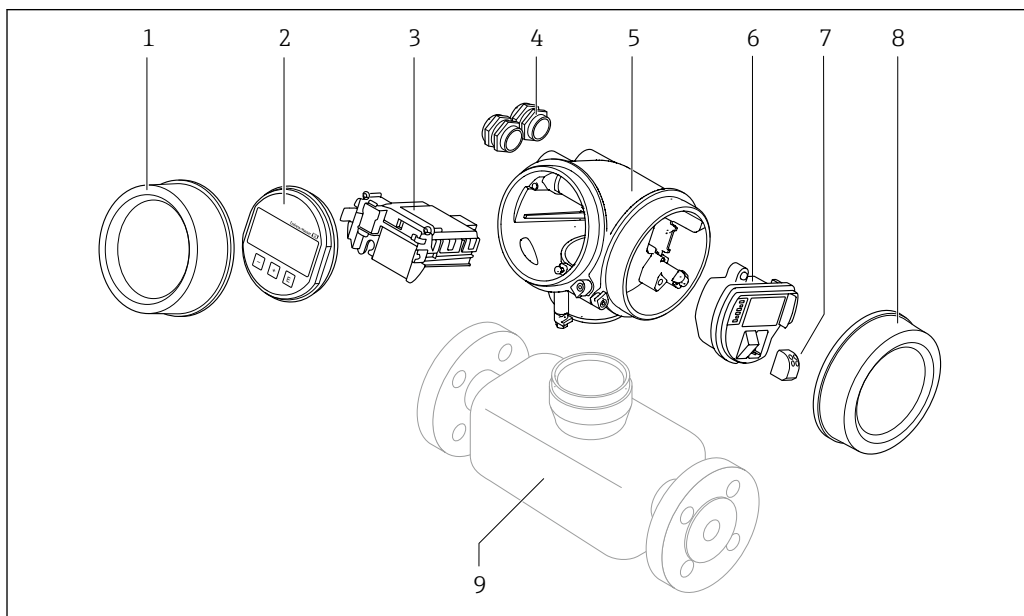
3 Product description

The device consists of a transmitter and a sensor.

Two device versions are available:

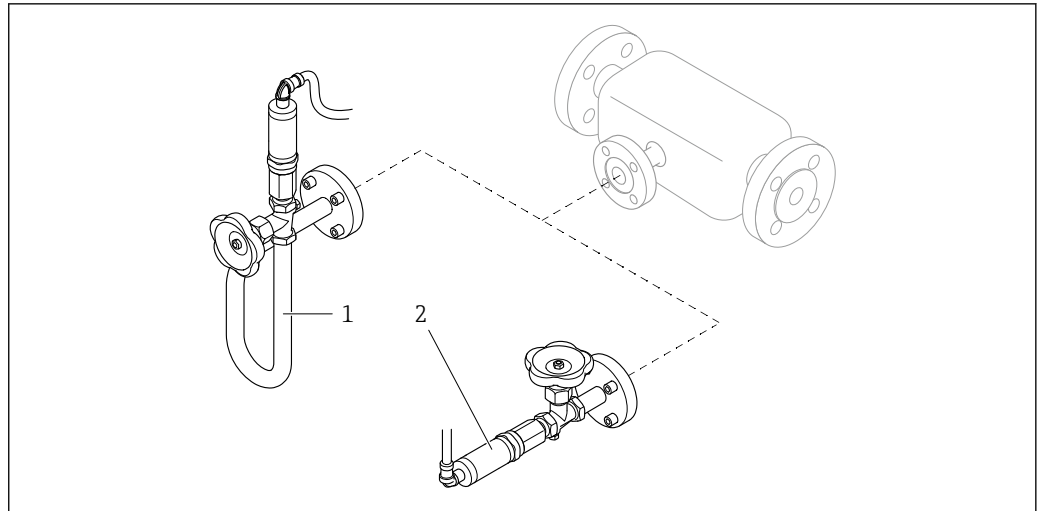
- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

3.1 Product design



A0048824

- 1 Electronics compartment cover
- 2 Display module
- 3 Main electronics module
- 4 Cable glands
- 5 Transmitter housing (incl. HistoROM)
- 6 I/O electronics module
- 7 Terminals (plug-in spring terminals)
- 8 Connection compartment cover
- 9 Sensor



A0034152

 1 Versions of pressure measuring unit

- 1 Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam"
- 2 Order code for "Sensor version; DSC sensor; measuring tube", option DB "Mass gas/liquid"

 For order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid", the following applies:
Oil-free or grease-free cleaning is not possible

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
 - ↳ Report all damage immediately to the manufacturer.
Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

 If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

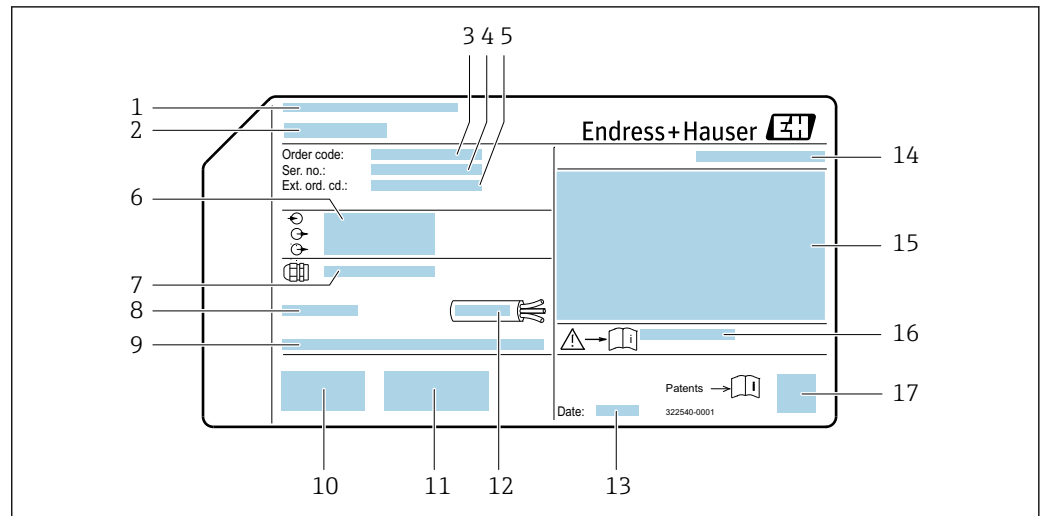
The device can be identified in the following ways:

- Nameplate
- Order code with details of the device features on the delivery note
- Enter the serial numbers from the nameplates in the *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.
- Enter the serial numbers from the nameplates into the *Endress+Hauser Operations app* or scan the DataMatrix code on the nameplate with the *Endress+Hauser Operations app*: all the information about the device is displayed.

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

- The "Additional standard device documentation" and "Supplementary device-dependent documentation" sections
- The *Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations app*: Enter the serial number from the nameplate or scan the DataMatrix code on the nameplate.

4.2.1 Transmitter nameplate



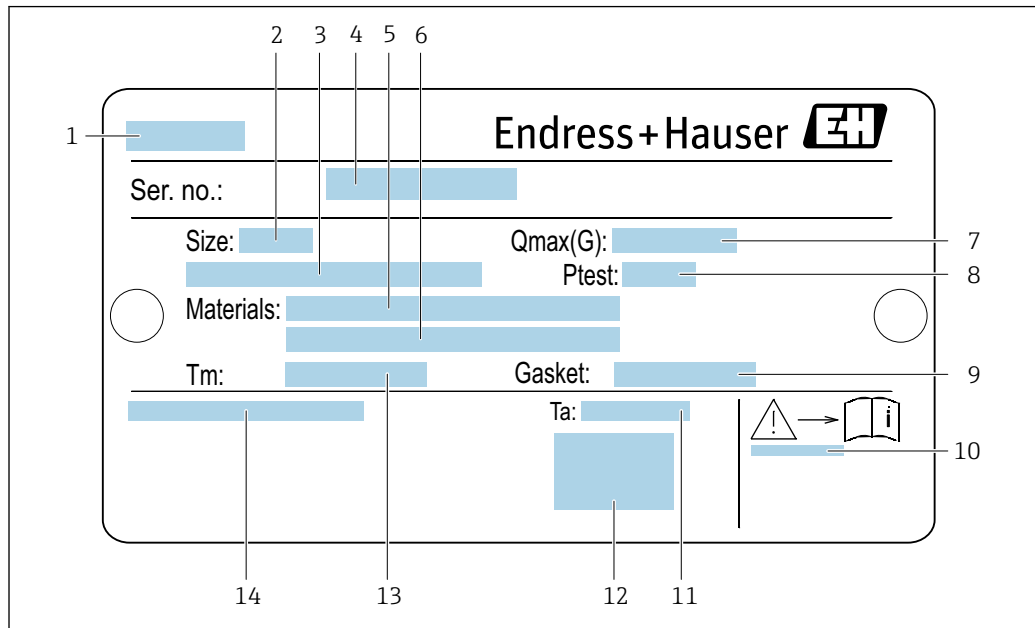
A0032237

2 Example of a transmitter nameplate

- 1 Manufacturer address/certificate holder
- 2 Name of the transmitter
- 3 Order code
- 4 Serial number
- 5 Extended order code
- 6 Electrical connection data, e.g. available inputs and outputs, supply voltage
- 7 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, RCM-Tick mark
- 11 Additional information on version: certificates, approvals
- 12 Permitted temperature range for cable
- 13 Date of manufacture: year-month
- 14 Degree of protection
- 15 Approval information for explosion protection
- 16 Document number of safety-related supplementary documentation
- 17 2-D matrix code

4.2.2 Sensor nameplate

Order code for "Housing" option B "GT18 dual compartment, 316L, compact" and option K "GT18 dual compartment, 316L, remote"



A0034423

3 Example of a sensor nameplate

- 1 Name of sensor
- 2 Nominal diameter of sensor
- 3 Flange nominal diameter/nominal pressure
- 4 Serial number (Ser. no.)
- 5 Measuring tube material
- 6 Measuring tube material
- 7 Maximum permitted volume flow (gas/steam): $Q_{max} \rightarrow$ 177
- 8 Test pressure of the sensor: OPL $\rightarrow$ 196
- 9 Seal material
- 10 Document number of safety-related supplementary documentation $\rightarrow$ 211
- 11 Ambient temperature range
- 12 CE mark
- 13 Medium temperature range
- 14 Degree of protection

Order code for "Housing" option C "GT20 dual compartment, aluminum, coated, compact"

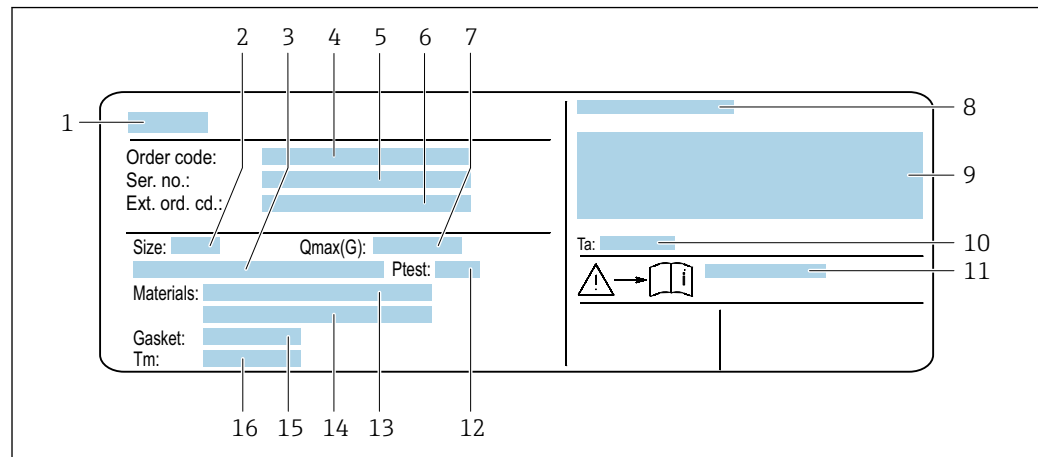
The image shows a rectangular sensor nameplate with various fields. Numbered callouts point to specific fields: 1 points to 'Ser. no.:', 2 to 'Size:', 3 to 'Measuring tube material', 4 to 'Measuring tube material', 5 to 'Serial number (Ser. no.)', 6 to 'Qmax(G):', 7 to 'Ptest:', 8 to 'Degree of protection', 9 to 'Approval information for explosion protection and Pressure Equipment Directive', 10 to 'CE mark', 11 to 'Seal material', 12 to 'Medium temperature range', and 13 to 'Ambient temperature range'. The nameplate also includes labels for 'Materials:', 'Tm:', 'Ta:', and 'Gasket:'.

A0034161

4 Example of a sensor nameplate

- 1 Nominal diameter of sensor
- 2 Flange nominal diameter/nominal pressure
- 3 Measuring tube material
- 4 Measuring tube material
- 5 Serial number (Ser. no.)
- 6 Maximal permitted volume flow (gas/steam)
- 7 Test pressure of the sensor
- 8 Degree of protection
- 9 Approval information for explosion protection and Pressure Equipment Directive → 211
- 10 CE mark
- 11 Seal material
- 12 Medium temperature range
- 13 Ambient temperature range

Order code for "Housing" option J "GT20 dual compartment, aluminum, coated, remote"



A0034162

5 Example of a sensor nameplate

- 1 Name of sensor
- 2 Nominal diameter of sensor
- 3 Flange nominal diameter/nominal pressure
- 4 Order code
- 5 Serial number (Ser. no.)
- 6 Extended order code (ext. ord. cd.)
- 7 Maximal permitted volume flow (gas/steam)
- 8 Degree of protection
- 9 Approval information for explosion protection and Pressure Equipment Directive
- 10 Ambient temperature range
- 11 Document number of safety-related supplementary documentation → 211
- 12 Test pressure of the sensor
- 13 Measuring tube material
- 14 Measuring tube material
- 15 Seal material
- 16 Medium temperature range

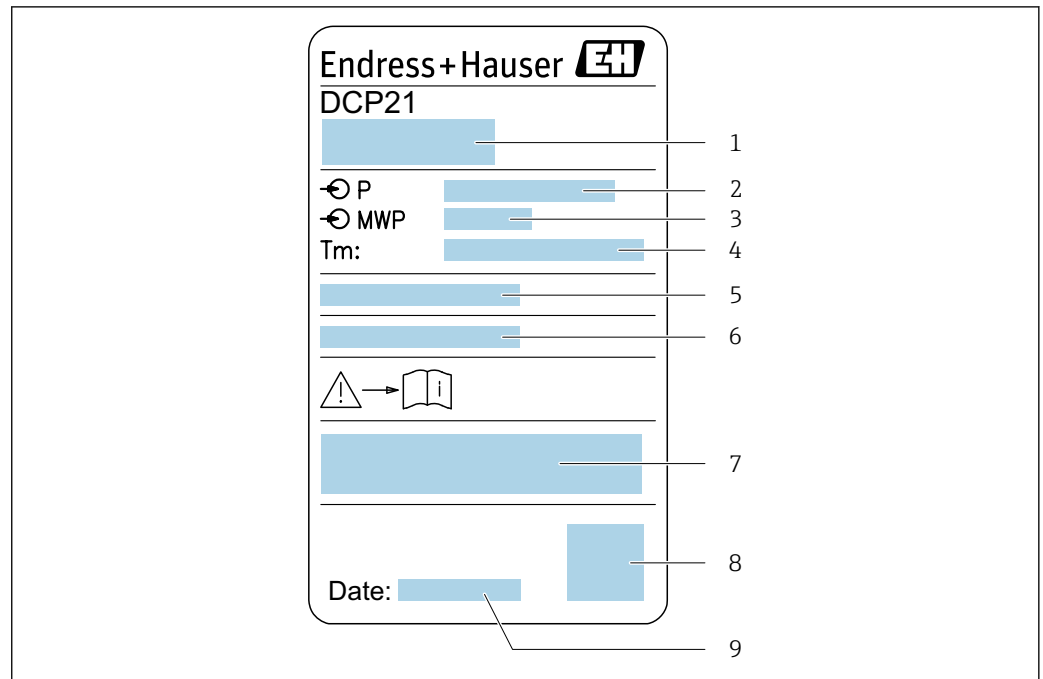
Order code

The measuring device is reordered using the order code.

Extended order code

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

4.2.3 Pressure measuring cells nameplate



A0034354

6 Example of pressure measuring cell nameplate

- 1 Manufacturer address
- 2 Pressure range
- 3 Maximum permitted pressure
- 4 Ambient temperature range
- 5 Serial number or XPD structure
- 6 Degree of protection
- 7 CE mark, C-Tick mark
- 8 QR code
- 9 Manufacturing date

4.2.4 Symbols on the device

Symbol	Meaning
	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury. Please consult the documentation for the measuring instrument to discover the type of potential danger and measures to avoid it.
	Reference to documentation Refers to the corresponding device documentation.
	Protective ground connection A terminal that must be connected to the ground prior to establishing any other connections.

5 Storage and transport

5.1 Storage conditions

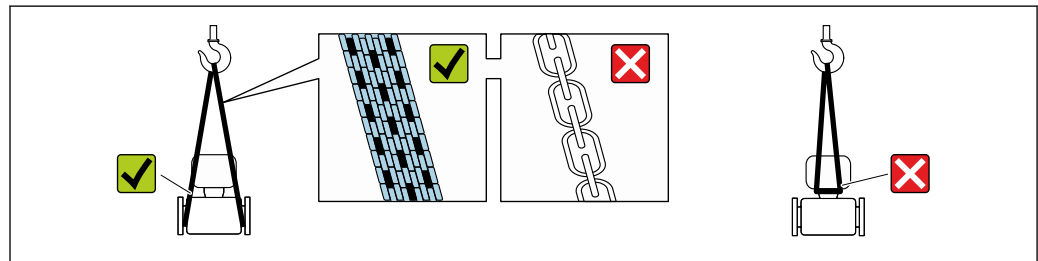
Observe the following notes for storage:

- ▶ Store in the original packaging to ensure protection from shock.
- ▶ Do not remove protective covers or protective caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.
- ▶ Protect from direct sunlight. Avoid unacceptably high surface temperatures.
- ▶ Store in a dry and dust-free place.
- ▶ Do not store outdoors.

Storage temperature: -50 to $+80$ °C (-58 to $+176$ °F)

5.2 Transporting the product

Transport the measuring device to the measuring point in the original packaging.



A0029252

i Do not remove protective covers or caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.

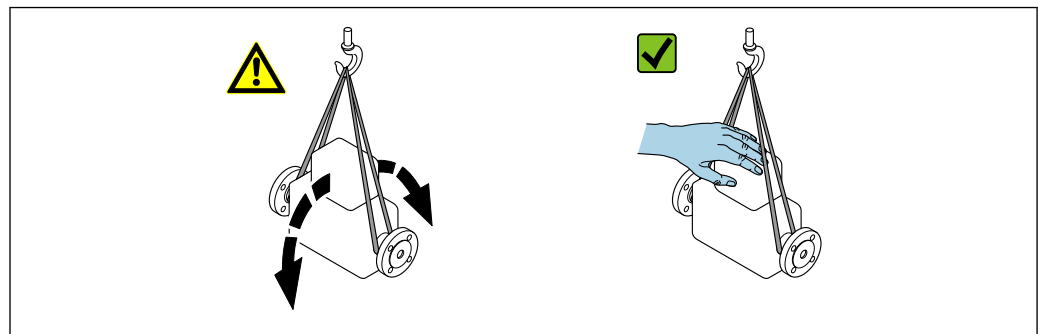
5.2.1 Measuring devices without lifting lugs

⚠ WARNING

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

Risk of injury if the measuring device slips.

- ▶ Secure the measuring device against slipping or turning.
- ▶ Observe the weight specified on the packaging (stick-on label).



A0029214

5.2.2 Measuring devices with lifting lugs

⚠ CAUTION

Special transportation instructions for devices with lifting lugs

- ▶ Only use the lifting lugs fitted on the device or flanges to transport the device.
- ▶ The device must always be secured at two lifting lugs at least.

5.2.3 Transporting with a fork lift

If transporting in wood crates, the floor structure enables the crates to be lifted lengthwise or at both sides using a forklift.

5.3 Packaging disposal

All packaging materials are environmentally friendly and 100% recyclable:

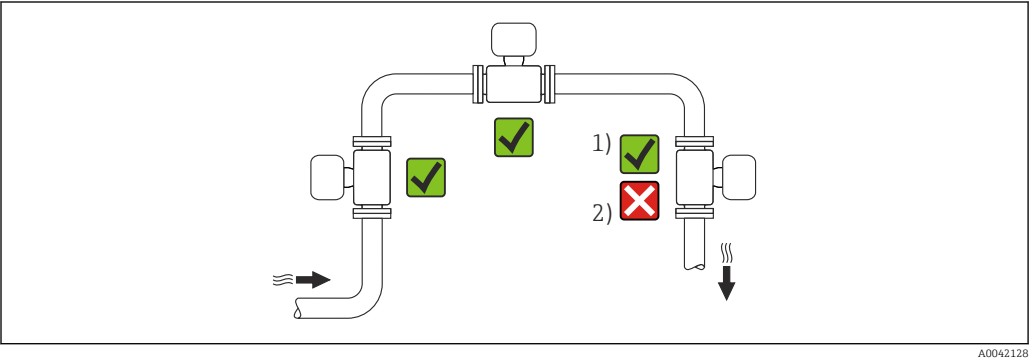
- Outer packaging of device
 - Stretch wrap made of polymer in accordance with EU Directive 2002/95/EC (RoHS)
- Packaging
 - Wood crate treated in accordance with ISPM 15 standard, confirmed by IPPC logo
 - Cardboard box in accordance with European packaging guideline 94/62/EC, recyclability confirmed by Resy symbol
- Transport material and fastening fixtures
 - Disposable plastic pallet
 - Plastic straps
 - Plastic adhesive strips
- Filler material
 - Paper pads

6 Installation

6.1 Installation requirements

6.1.1 Installation position

Mounting location

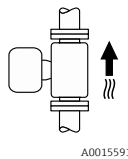
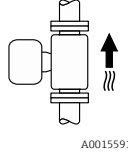
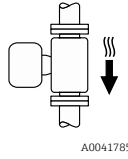
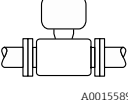


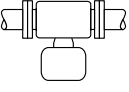
- 1 Installation suitable for gases and steam; the measuring device must be installed upside-down in a horizontal pipe if the order code for "Application package", option ES "Wet steam detection" or EU "Wet steam measurement" is used
- 2 Installation not suitable for liquids

Orientation

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

Vortex meters require a fully developed flow profile as a prerequisite for correct volume flow measurement. Therefore, please note the following:

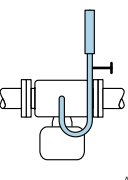
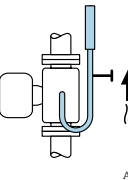
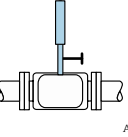
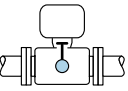
Orientation		Recommendation	
		Compact version	Remote version
A	Vertical orientation (liquids)	 A0015591	
A	Vertical orientation (dry gases)	 A0015591  A0041785	
B	Horizontal orientation, transmitter head up	 A0015589	

Orientation			Recommendation	
			Compact version	Remote version
C	Horizontal orientation, transmitter head down	 A0015590	✓✓ ^{3) 4)}	✓✓
D	Horizontal orientation, transmitter head at side	 A0015592	✓✓ ³⁾	✓✓

- 1) In the case of liquids, there should be upward flow in vertical pipes to avoid partial pipe filling (Fig. A). Disruption in flow measurement!
- 2) In the case of hot media (e.g. steam or medium temperature (TM) $\geq 200^\circ\text{C}$ (392°F): orientation C or D
- 3) In the case of very cold media (e.g. liquid nitrogen): orientation B or D
- 4) For "Wet steam detection/measurement" option: orientation C

 Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.

Pressure measuring cell

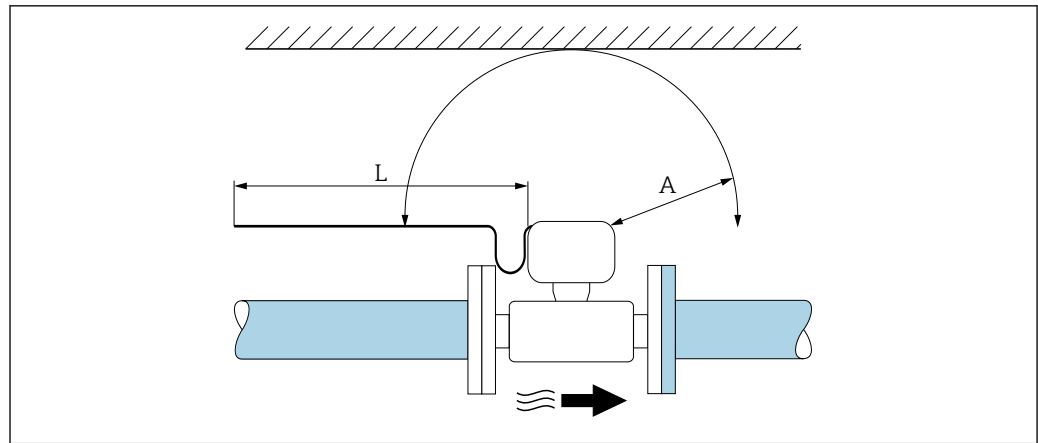
Steam pressure measurement			Option DA
E	- With the transmitter installed at the bottom or at the side - Protection against rising heat	 A0034057	✓✓
F	Reduction in temperature to almost ambient temperature due to siphon¹⁾	 A0034058	✓✓
Gas pressure measurement			Option DB
G	- Pressure measuring cell with shutoff device above tapping point - Discharge of any condensate into the process	 A0034092	✓✓
Liquid pressure measurement			Option DB
H	Device with shutoff device at the same level as tapping point	 A0034091	✓✓

- 1) Note max. permitted ambient temperature of transmitter → 27.

Minimum spacing and cable length

Order code for "Sensor version", option "Mass" DA, DB

 Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.



A0019211

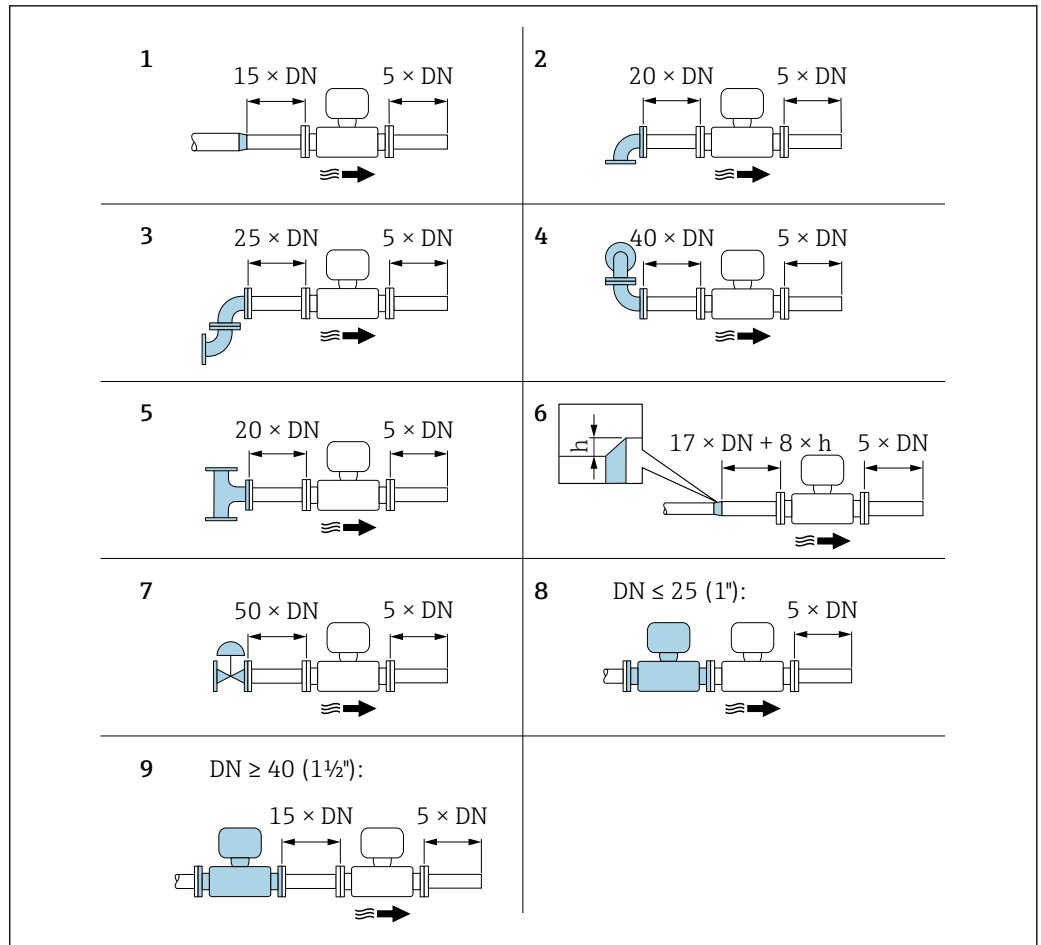
A Minimum spacing in all directions
L Required cable length

The following dimensions must be observed to guarantee problem-free access to the device for service purposes:

- $A = 100 \text{ mm}$ (3.94 in)
- $L = L + 150 \text{ mm}$ (5.91 in)

Inlet and outlet runs

To attain the specified level of accuracy of the measuring instrument, the inlet and outlet runs mentioned below must be maintained at the very minimum.



A0019189

7 Minimum inlet and outlet runs with various flow obstructions

h Difference in expansion

1 Reduction by one nominal diameter size

2 Single elbow (90° elbow)

3 Double elbow (2 × 90° elbows, opposite)

4 Double elbow 3D (2 × 90° elbows, opposite, not on one plane)

5 T-piece

6 Extension

7 Control valve

8 Two measuring instruments in a row where $DN \leq 25$ (1''): directly flange on flange

9 Two measuring instruments in a row where $DN \geq 40$ (1 1/2''): for spacing, see graphic

- If there are several flow disturbances present, the longest specified inlet run must be maintained.
- If the required inlet runs cannot be observed, it is possible to install a specially designed flow conditioner → 25.

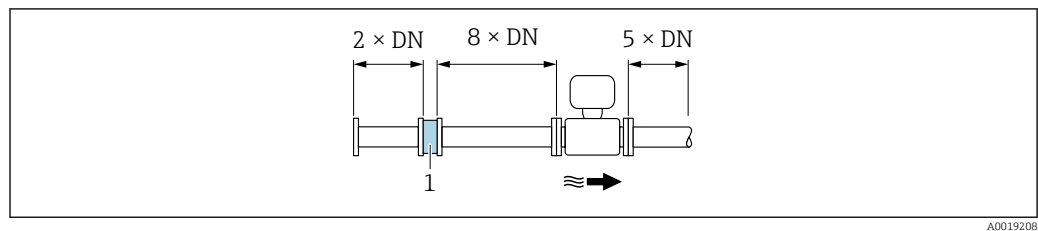
The **inlet run correction** function:

- Makes it possible to shorten the inlet run to a minimum length of $10 \times DN$ in the event of flow obstructions 1 to 4. An additional measurement uncertainty of $\pm 0.5\%$ o.r. occurs here. → 113
- Cannot be combined with the **wet steam detection/measurement** → 210 application package. If wet steam detection/measurement is used, the corresponding inlet runs must be taken into consideration. It is not possible to use a flow conditioner for wet steam.

Flow conditioner

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

The flow conditioner is fitted between two pipe flanges and centered by the mounting bolts. Generally this reduces the inlet run needed to $10 \times \text{DN}$ with full measurement accuracy.



1 Flow conditioner

The pressure loss for flow conditioners is calculated as follows:

$$\Delta p [\text{mbar}] = 0.0085 \cdot \rho [\text{kg/m}^3] \cdot v^2 [\text{m/s}]$$

Example for steam
$p = 10 \text{ bar abs.}$
$t = 240^\circ\text{C} \rightarrow \rho = 4.39 \text{ kg/m}^3$
$v = 40 \text{ m/s}$
$\Delta p = 0.0085 \cdot 4.39 \cdot 40^2 = 59.7 \text{ mbar}$

Example for H ₂ O condensate (80 °C)
$\rho = 965 \text{ kg/m}^3$
$v = 2.5 \text{ m/s}$
$\Delta p = 0.0085 \cdot 965 \cdot 2.5^2 = 51.3 \text{ mbar}$

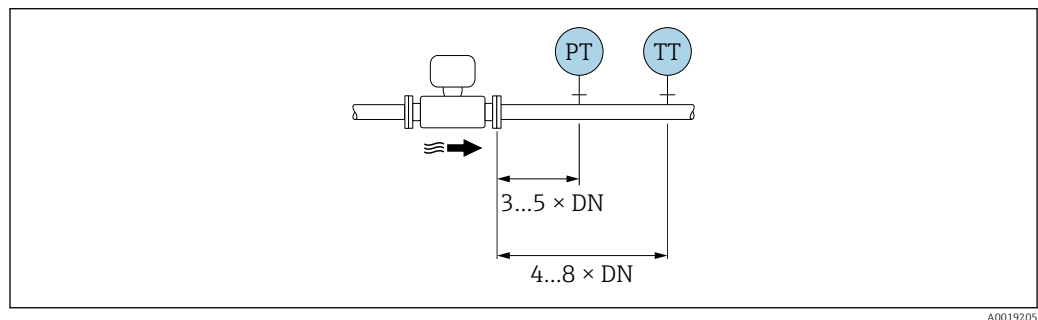
ρ : density of the process medium
 v : average flow velocity
 abs. = absolute



For the dimensions of the flow conditioner, see the "Technical Information" document, "Mechanical construction" section

Outlet runs when installing external devices

If installing an external device, observe the specified distance.



PT Pressure
 TT Temperature device

Installation dimensions



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

6.1.2 Environmental and process requirements

Ambient temperature range

Compact version

Measuring instrument	Non-hazardous area:	-40 to +80 °C (-40 to +176 °F) ¹⁾
	Ex i, Ex nA, Ex ec:	-40 to +70 °C (-40 to +158 °F) ¹⁾
	Ex d, XP:	-40 to +60 °C (-40 to +140 °F) ¹⁾
	Ex d, Ex ia:	-40 to +60 °C (-40 to +140 °F) ¹⁾
Local display		-40 to +70 °C (-40 to +158 °F) ^{2) 1)}

- 1) Additionally available as order code for "Test, certificate", option JN "Transmitter ambient temperature -50 °C (-58 °F)". This option is only available in combination with a "High-temperature sensor -200 to +400 °C (-328 to +750 °F)", see order code 060 for "Sensor version; DSC sensor; measuring tube" with options BA, BB, CA, CB.
- 2) At temperatures below -20 °C (-4 °F), depending on the physical characteristics involved, it may no longer be possible to read the liquid crystal display.

Remote version

Transmitter	Non-hazardous area:	-40 to +80 °C (-40 to +176 °F) ¹⁾
	Ex i, Ex nA, Ex ec:	-40 to +80 °C (-40 to +176 °F) ¹⁾
	Ex d:	-40 to +60 °C (-40 to +140 °F) ¹⁾
	Ex d, Ex ia:	-40 to +60 °C (-40 to +140 °F) ¹⁾
Sensor	Non-hazardous area:	-40 to +85 °C (-40 to +185 °F) ¹⁾
	Ex i, Ex nA, Ex ec:	-40 to +85 °C (-40 to +185 °F) ¹⁾
	Ex d:	-40 to +85 °C (-40 to +185 °F) ¹⁾
	Ex d, Ex ia:	-40 to +85 °C (-40 to +185 °F) ¹⁾
Local display		-40 to +70 °C (-40 to +158 °F) ^{2) 1)}

- 1) Additionally available as order code for "Test, certificate", option JN "Transmitter ambient temperature -50 °C (-58 °F)". This option is only available in combination with a "High-temperature sensor -200 to +400 °C (-328 to +750 °F)", see order code 060 for "Sensor version; DSC sensor; measuring tube" with options BA, BB, CA, CB.
- 2) At temperatures < -20 °C (-4 °F), depending on the physical characteristics involved, it may no longer be possible to read the liquid crystal display.

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

 You can order a weather protection cover from Endress+Hauser. →  172.

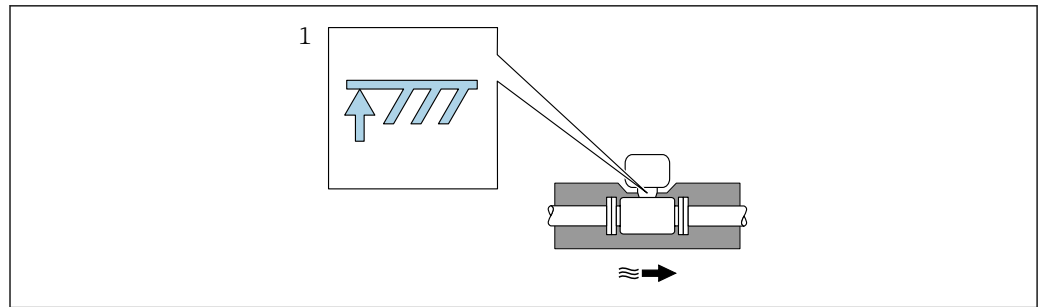
Thermal insulation

For optimum temperature measurement and mass calculation, heat transfer at the sensor must be avoided for some fluids. This can be ensured by installing thermal insulation. A wide range of materials can be used for the required insulation.

This applies for:

- Compact version
- Remote sensor version

The maximum insulation height permitted is illustrated in the diagram:



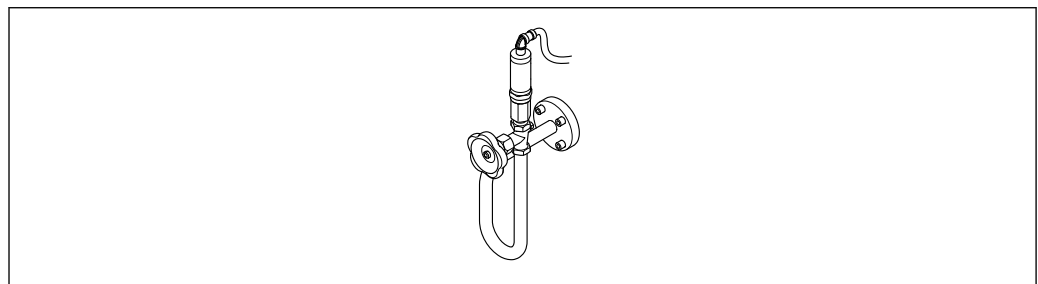
A0019212

1 Maximum insulation height

- When insulating, ensure that a sufficiently large area of the housing support remains exposed.

The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.

i The function of the siphon is to protect the measuring cell from excessively high steam process temperatures through the formation of condensate in the U-tube/ circular pipe. To ensure the steam condenses, the siphon may only be insulated as far as the connection flange on the measuring tube side.



A0047532

8 Siphon

NOTICE

Electronics overheating on account of thermal insulation!

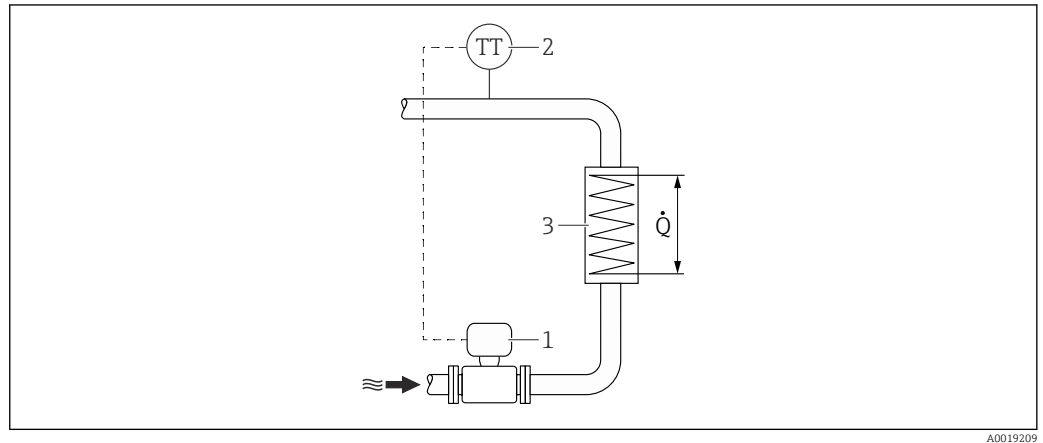
- Observe the maximum permitted insulation height of the transmitter neck so that the transmitter head and/or the connection housing of the remote version is completely free.
- Observe information on the permissible temperature ranges .
- Note that a certain orientation might be required, depending on the fluid temperature .

Installation for delta heat measurements

- Order code for "Sensor version", option CA "Mass; 316L; 316L (integrated temperature measurement), -200 to +400 °C (-328 to +750 °F)"
- Order code for "Sensor version", option CB "Mass; Alloy C22; 316L (integrated temperature measurement), -200 to +400 °C (-328 to +750 °F)"
- Order code for "Sensor version", option CC "Mass; Alloy C22; Alloy C22 (integrated temperature measurement), -40 to +260 °C (-40 to +500 °F)"
- Order code for "Sensor version", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement), -200 to +400 °C (-328 to +750 °F)"
- Order code for "Sensor version", option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement), -40 to +100 °C (-40 to +212 °F)"

The second temperature measurement is taken using a separate temperature sensor. The measuring instrument reads in this value via a communication interface.

- In the case of saturated steam delta heat measurements, the measuring instrument must be installed on the steam side.
- In the case of water delta heat measurements, the device can be installed on the cold or warm side.



9 Layout for delta heat measurement of saturated steam and water

- 1 Measuring instrument
- 2 Temperature sensor
- 3 Heat exchanger
- Q Heat flow

Installation in steam systems

The device has been tested for dynamic pressure surges of up to 300 bar (4350 psi) by condensation-induced water hammer (CIWH). Despite the robust and reinforced design, the following best practice recommendations for steam applications apply to prevent damage from condensation-induced water hammer.

1. Ensure sufficient and constant condensate drainage from the pipes by using correctly dimensioned and well-maintained steam traps. These are generally installed every 30 to 50 m (100 to 165 in) in horizontal pipes or at ground points.
2. The steam lines must have an adequate gradient of at least 1% in the direction of the steam flow to ensure that the condensate is directed to the steam traps at the drain points.
3. If the system is shut down, they must be drained completely.
4. Avoid pipe configurations that cause accumulations of standing water.
5. Slowly increase the static pressure and steam flow rate when starting up the system.
6. Make sure steam does not come into contact with significantly cooler condensate.

Protective cover

A protective cover is available as an accessory for the device. It is used to protect against direct sunlight, precipitation and ice.

When installing the protective cover, a minimum upward clearance must be maintained: 222 mm (8.74 in)

The protective cover can be ordered via the product structure together with the device: Order code for "Accessories enclosed" option PB "Protective cover"

 Ordered separately as an accessory →  172

6.2 Installing the device

6.2.1 Required tools

For transmitter

- For turning the transmitter housing: Open-ended wrench 8 mm
- For opening the securing clamps: Allen key 3 mm

For sensor

For flanges and other process connections: Use a suitable mounting tool.

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.

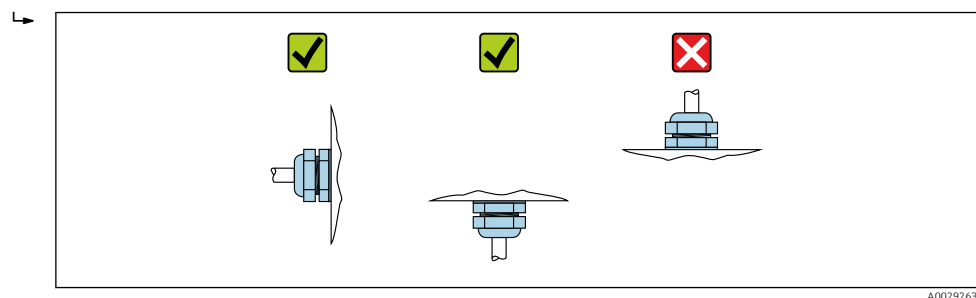
6.2.3 Installing the sensor

⚠ WARNING

Danger due to improper process sealing!

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

1. Ensure that the direction of the arrow on the sensor matches the flow direction of the medium.
2. To ensure compliance with device specifications, install the measuring instrument between the pipe flanges in a way that it is centered in the measurement section.
3. Install the measuring instrument or turn the transmitter housing so that the cable entries do not point upwards.



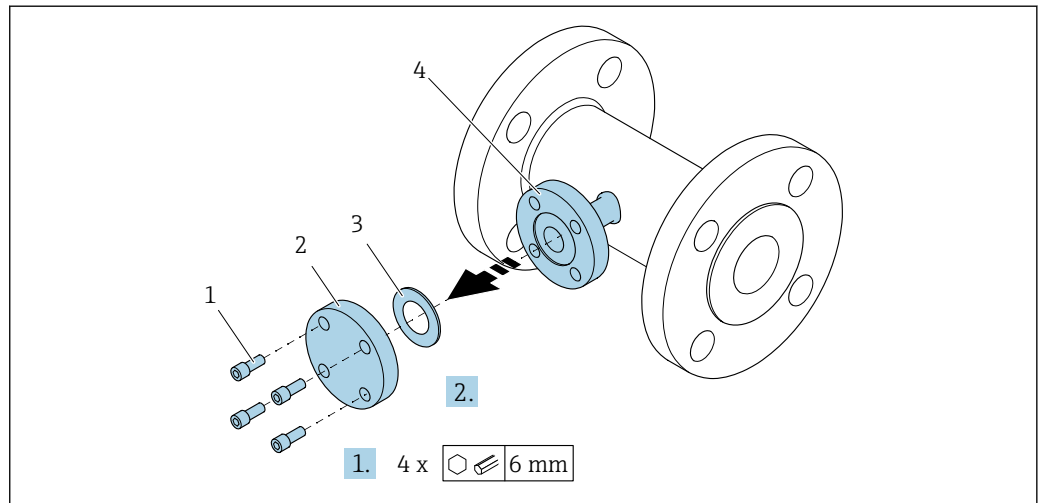
A0029263

6.2.4 Mounting the pressure measuring unit

Preparation

1. Prior to mounting the pressure measuring unit, install the measuring device in the pipe.
2. When mounting the pressure measuring unit, use only the seal provided. The use of a different sealing material is not permitted.

Removing the blind flange



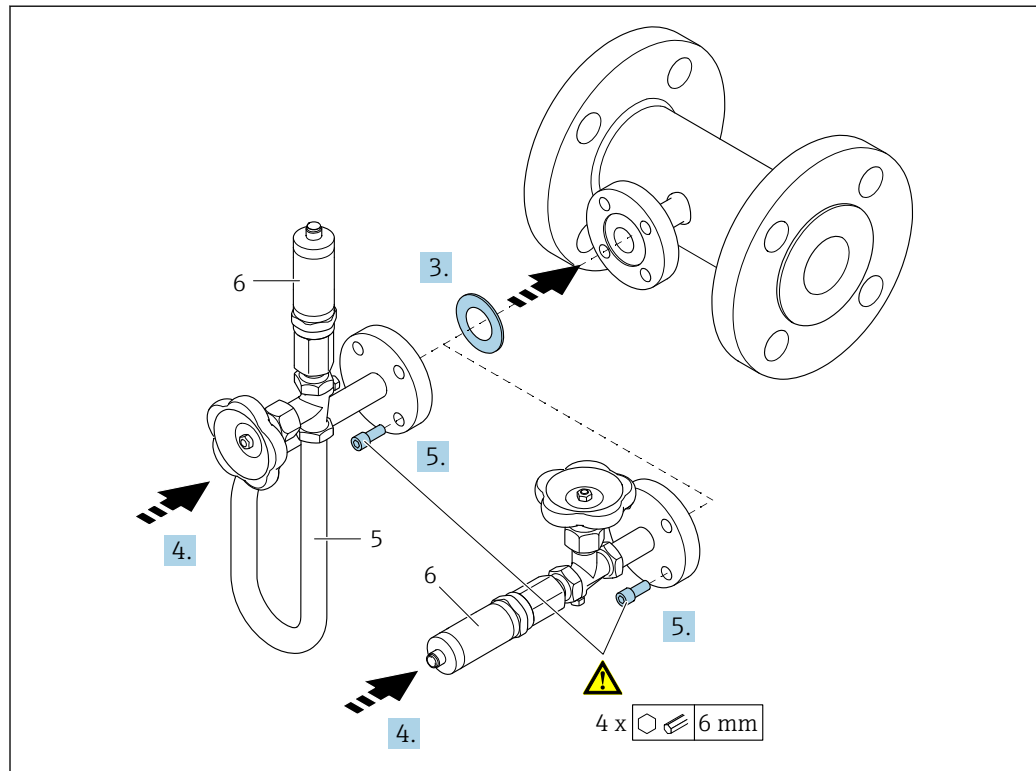
- 1 Mounting screws
- 2 Blind flange
- 3 Seal
- 4 Flange connection on sensor side

NOTICE

When replacing the seal following commissioning, fluid may escape when the flange connection is opened!

- Ensure that the measuring device is not under pressure.
 - Ensure that there is no fluid in the measuring device.
1. Release the mounting screws on the blind flange.
 - ↳ The screws are needed again to mount the pressure measuring unit.
 2. Remove the internal seal.

Mounting the pressure measuring unit



A0035442

- 5 Siphon
6 Pressure measuring cell

3. NOTICE

Damage to seal!

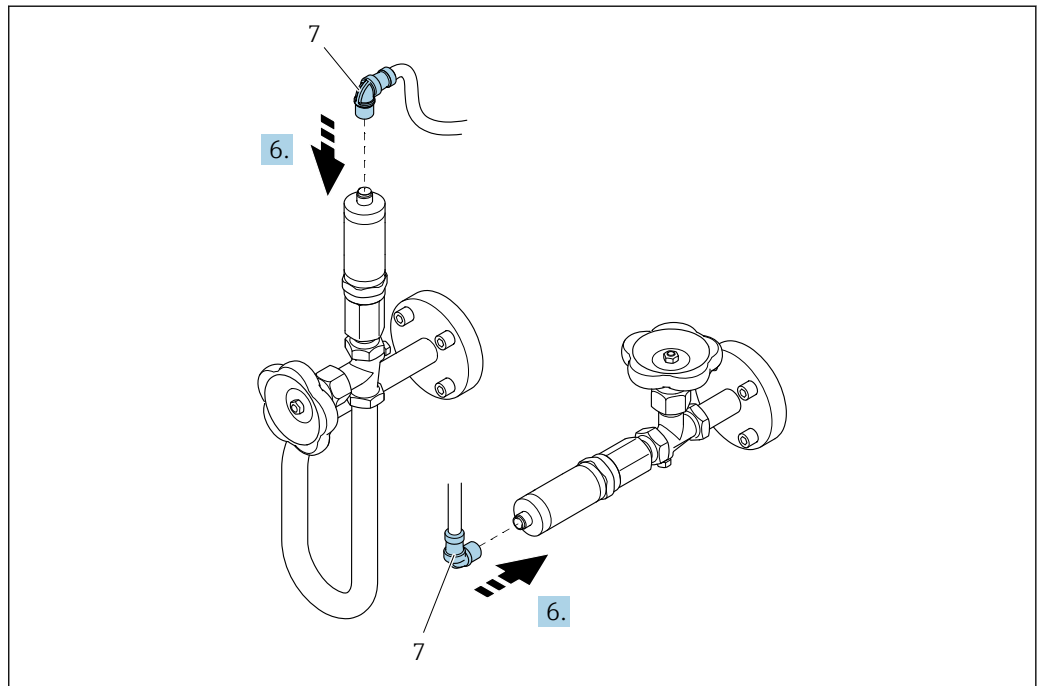
The seal is made of expanded graphite. It can therefore be used only once. If a coupling is released, a new seal must be installed.

- Use the additional seals provided. If necessary, these can be ordered as separate spare parts at a later stage.

Insert the enclosed seal into the groove of the flange connection on the sensor side.

4. Align the flange connection on the pressure measuring unit and tighten the screws by hand.
5. Tighten the screws with a torque wrench in three steps.
 - ↳ 1. 10 Nm in criss-cross sequence
 - 2. 15 Nm in criss-cross sequence
 - 3. 15 Nm in circular sequence

Connecting the pressure measuring unit



A0035443

7 Device plug

6. Insert the plug for electrical connection of the pressure measuring cell and screw into place.

6.2.5 Installing the transmitter of the remote version

⚠ CAUTION

Ambient temperature too high!

Danger of electronics overheating and housing deformation.

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

⚠ CAUTION

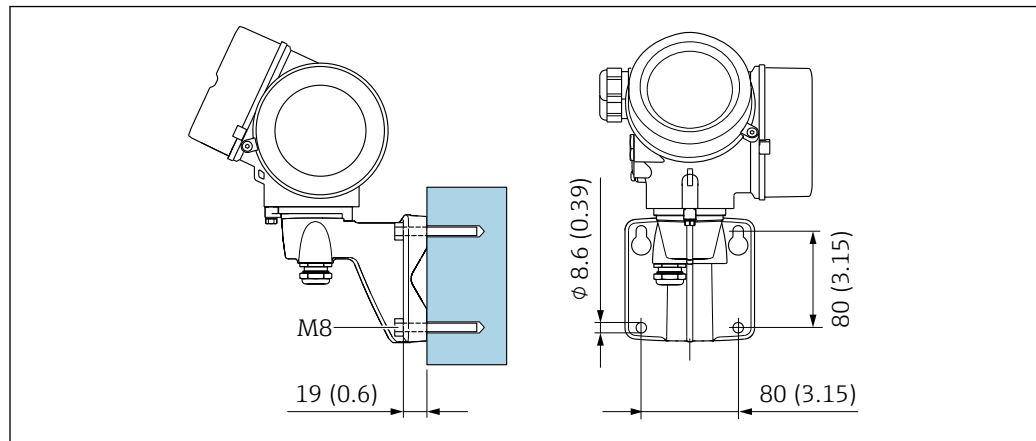
Excessive force can damage the housing!

- ▶ Avoid excessive mechanical stress.

The transmitter of the remote version can be mounted in the following ways:

- Wall mounting
- Pipe mounting

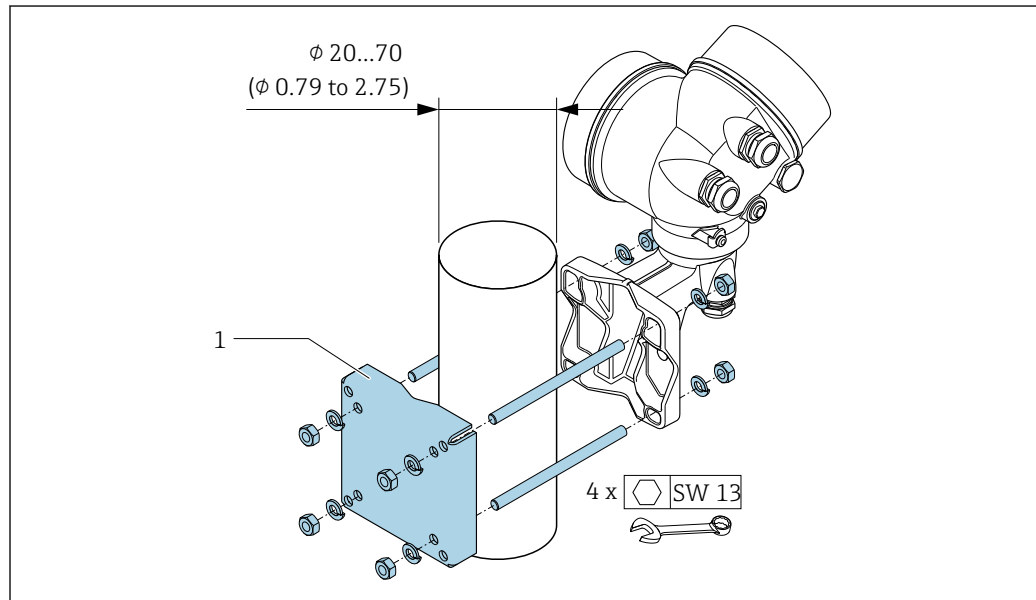
Wall mounting



A0033484

10 mm (in)

Pipe mounting

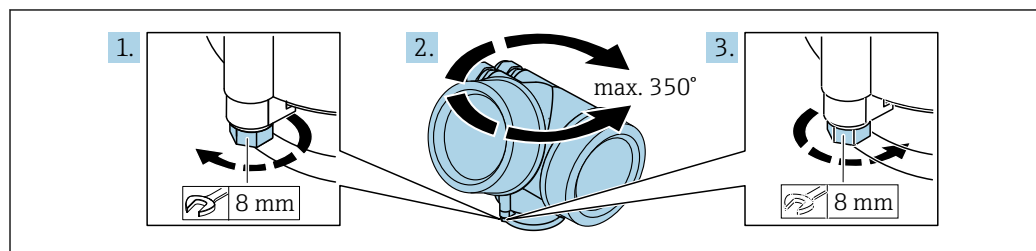


A0033486

11 mm (in)

6.2.6 Turning the transmitter housing

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



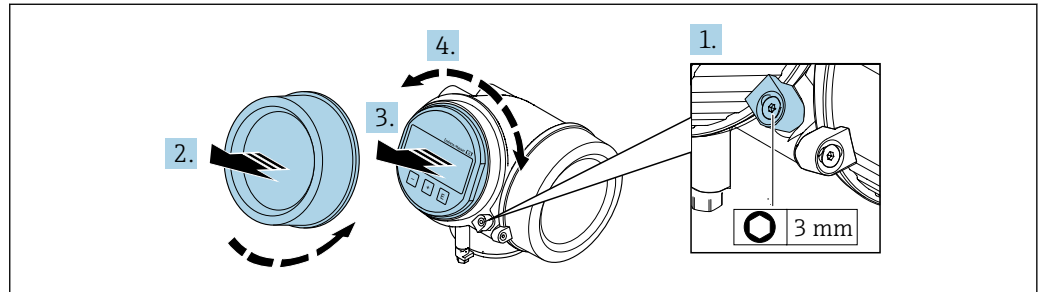
A0032242

1. Loosen the securing screw.
2. Turn the housing to the desired position.

3. Firmly tighten the securing screw.

6.2.7 Turning the display module

The display module can be turned to optimize display readability and operability.



A0032238

1. Loosen the securing clamp of the electronics compartment cover using an Allen key.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Optional: pull out the display module with a gentle rotational movement.
4. Turn the display module to the desired position: Max. $8 \times 45^\circ$ in each direction.
5. Without display module pulled out:
Allow display module to engage at desired position.
6. With display module pulled out:
Feed the cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment until it engages.
7. Reassemble the transmitter in the reverse order.

6.3 Post-mounting check

Is the device undamaged (visual inspection)?	☐
Does the measuring instrument correspond to the measuring point specifications? For example: ■ Process temperature → 195 ■ Process pressure (refer to the section on "Pressure/temperature ratings" in the "Technical Information" document) ■ Ambient temperature ■ Measuring range → 177	☐
Has the correct orientation been selected for the sensor → 22? ■ According to sensor type ■ As per medium temperature ■ As per medium properties (outgassing, with entrained solids)	☐
Does the arrow on the sensor match the direction of flow of the medium → 22?	☐
Is the tag name and labeling correct (visual inspection)?	☐
Is the device sufficiently protected from precipitation and direct sunlight?	☐
Are the securing screw and securing clamp tightened securely?	☐
Has the maximum permitted insulation height been observed?	☐
Has the pressure range been observed → 196?	☐
Has the correct orientation been selected for the sensor → 23?	☐
Is the pressure unit mounted correctly → 30?	☐
Are the manometer valve and the siphon with pressure measuring cell mounted using the prescribed seal and the specified tightening torque → 30?	☐

7 Electrical connection

7.1 Electrical safety

In accordance with applicable national regulations.

7.2 Connecting requirements

7.2.1 Required tools

- For cable entries: Use corresponding tools
- For securing clamp: Allen key 3 mm
- Wire stripper
- When using stranded cables: Crimper for wire end ferrule
- For removing cables from terminal: Flat blade screwdriver ≤ 3 mm (0.12 in)

7.2.2 Requirements for connection cable

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

Permitted temperature range

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

Signal cable

4 to 20 mA current output (without HART)

Standard installation cable is sufficient.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Current output 4 to 20 mA HART

Shielded twisted-pair cable.



See <https://www.fieldcommgroup.org> "HART PROTOCOL SPECIFICATIONS".

Cable diameter

- Cable glands supplied:
M20 $\times$ 1.5 with cable ϕ 6 to 12 mm (0.24 to 0.47 in)
- Plug-in spring terminals for device version without integrated overvoltage protection:
wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)

7.2.3 Connecting cable for remote version

Connecting cable (standard)

Standard cable	2 $\times$ 2 $\times$ 0.5 mm ² (22 AWG) PVC cable with common shield (2 pairs, pair-stranded) ¹⁾
Flame resistance	According to DIN EN 60332-1-2
Oil resistance	According to DIN EN 60811-2-1

Shielding	Galvanized copper-braid, opt. density approx. 85 %
Cable length	5 m (15 ft), 10 m (30 ft), 20 m (60 ft), 30 m (90 ft)
Continuous operating temperature	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

Connecting cable (armored)

Cable, armored	2 × 2 × 0.34 mm ² (22 AWG) PVC cable with common shield (2 pairs, pair-stranded) and additional steel-wire braided sheath ¹⁾
Flame resistance	According to DIN EN 60332-1-2
Oil resistance	According to DIN EN 60811-2-1
Shielding	Galvanized copper-braid, opt. density approx. 85%
Strain relief and reinforcement	Steel-wire braid, galvanized
Cable length	10 m (30 ft), 20 m (60 ft), 30 m (90 ft)
Continuous operating temperature	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

Connecting cable (option "mass pressure-/temperature-compensated")

Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB

Standard cable	$[(3 \times 2) + 1] \times 0.34 \text{ mm}^2$ (22 AWG) PVC cable with common shield (3 pairs, pair-stranded) ¹⁾
Flame resistance	According to DIN EN 60332-1-2
Oil resistance	According to DIN EN 60811-2-1
Shielding	Galvanized copper-braid, opt. density approx. 85%
Cable length	10 m (30 ft), 30 m (90 ft)
Continuous operating temperature	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)

- 1) UV radiation may cause damage to the outer jacket of the cable. Protect the cable from exposure to sun as much as possible.

7.2.4 Terminal assignment

Transmitter

4-20 mA HART connection version with additional inputs and outputs

Maximum number of terminals Terminals 1 to 6: Without integrated overvoltage protection	Maximum number of terminals for order code for "Accessory mounted", option NA "Overvoltage protection" - Terminals 1 to 4: With integrated overvoltage protection - Terminals 5 to 6: Without integrated overvoltage protection
1 Output 1 (passive): supply voltage and signal transmission 2 Output 2 (passive): supply voltage and signal transmission 3 Input (passive): supply voltage and signal transmission 4 Ground terminal for cable shield	

Order code for "Output"	Output 1		Output 2		Input	
	1 (+)	2 (-)	3 (+)	4 (-)	5 (+)	6 (-)
Option A	4-20 mA HART (passive)		-		-	
Option B ¹⁾	4-20 mA HART (passive)		Pulse/frequency/switch output (passive)		-	
Option C ¹⁾	4-20 mA HART (passive)		4-20 mA analog (passive)		-	
Option D ^{1) 2)}	4-20 mA HART (passive)		Pulse/frequency/switch output (passive)		4-20 mA current input (passive)	

1) Output 1 must always be used; output 2 is optional.

2) The integrated overvoltage protection is not used with option D: Terminals 5 and 6 (current input) are not protected against overvoltage.

Connecting cable for remote version

Transmitter and sensor connection housing

In the case of the remote version, the sensor and transmitter are mounted separately from one another and connected by a connecting cable. Connection is performed via the sensor connection housing and the transmitter housing.

i How the connecting cable is connected in the transmitter housing depends on the measuring instrument approval and the version of the connecting cable used.

In the following versions, only terminals can be used for connection in the transmitter housing:

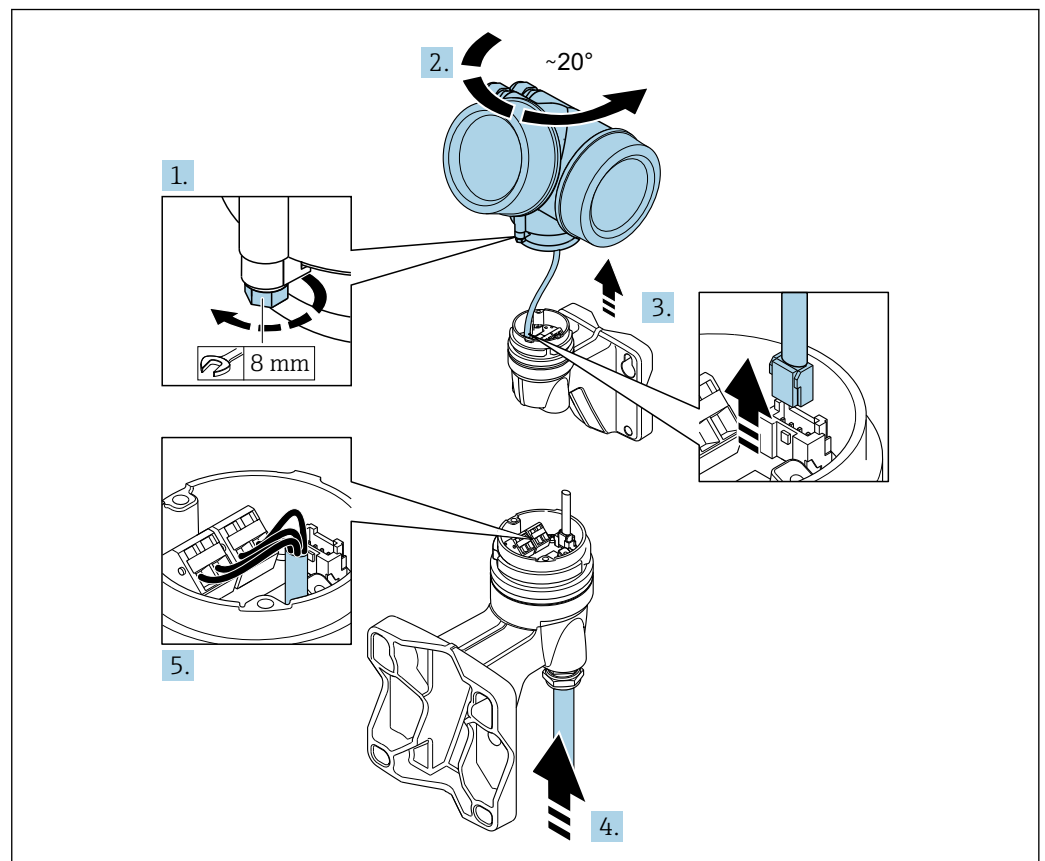
- Order code for "Electrical connection", option B, C, D, 6
- Certain approvals: Ex nA, Ex ec, Ex tb and Division 1
- Use of reinforced connecting cable
- Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB

In the following versions, an M12 device connector is used for connection in the transmitter housing:

- All other approvals
- Use of connecting cable (standard)

Terminals are always used to connect the connecting cable in the sensor connection housing (tightening torques for screws for cable strain relief: 1.2 to 1.7 Nm).

Connection via terminals



A0041608

1. Loosen the securing clamp of the transmitter housing.
2. Turn the transmitter housing clockwise by approx. 20°.

3. NOTICE

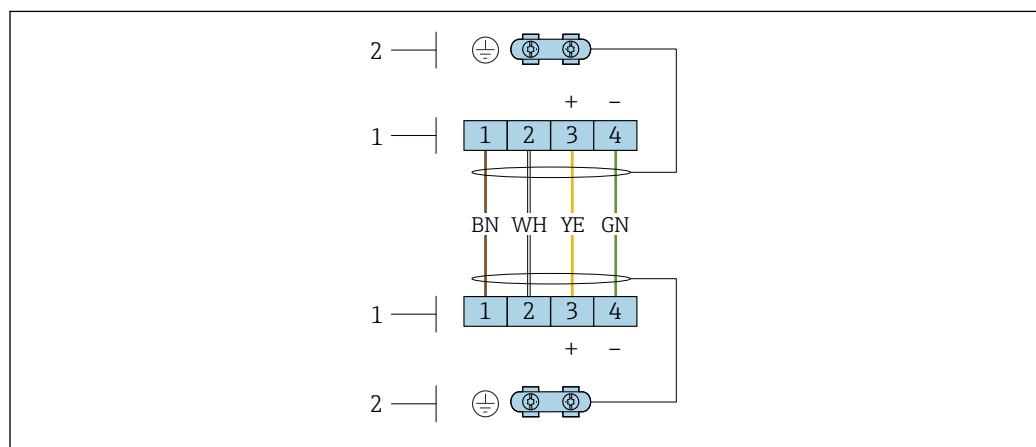
The connection board of the wall housing is connected to the electronics board of the transmitter via a signal cable!

- Pay attention to the signal cable when lifting the transmitter housing!

Lift the transmitter housing, plug the signal cable out of the connection board of the wall holder and remove the transmitter housing.

4. Release the cable gland and insert the connecting cable (use the shorter stripped end of the connecting cable).
5. Wire the connecting cable →  12,  40 →  13,  41.
6. Reverse the removal procedure to reassemble the transmitter housing.
7. Firmly tighten the cable gland.

Connecting cable (standard, reinforced)



A0033476

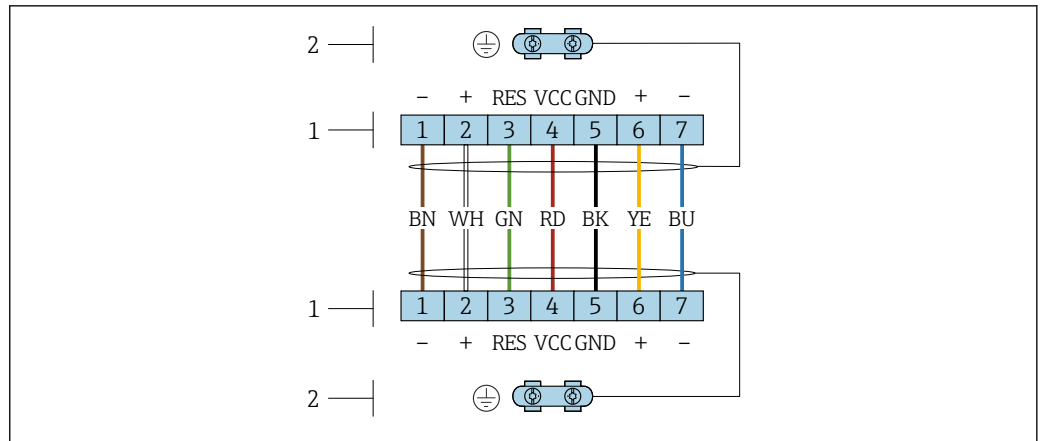
 12 Terminals for connection compartment in the transmitter wall holder and the sensor connection housing

- 1 Terminals for connecting cable
2 Grounding via the cable strain relief

Terminal number	Assignment	Cable color Connecting cable
1	Supply voltage	Brown
2	Grounding	White
3	RS485 (+)	Yellow
4	RS485 (-)	Green

Connecting cable (option "mass pressure-/temperature-compensated")

Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB



A0034571

13 Terminals for connection compartment in the transmitter wall holder and the sensor connection housing

- 1 Terminals for connecting cable
2 Grounding via the cable strain relief

Terminal number	Assignment	Cable color Connecting cable
1	RS485 (-) DPC	Brown
2	RS485 (+) DPC	White
3	Reset	Green
4	Supply voltage	Red
5	Grounding	Black
6	RS485 (+)	Yellow
7	RS485 (-)	Blue

7.2.5 Requirements for the supply unit

Supply voltage

Transmitter

An external power supply is required for each output.

The following supply voltage values apply for the outputs available:

Supply voltage for a compact version without a local display ¹⁾

Order code for "Output; input"	Minimum terminal voltage ²⁾	Maximum Terminal voltage
Option A: 4-20 mA HART	≥ DC 12 V	DC 35 V
Option B: 4-20 mA HART, pulse/ frequency/switch output	≥ DC 12 V	DC 35 V
Option C: 4-20 mA HART + 4-20 mA analog	≥ DC 12 V	DC 30 V
Option D: 4-20 mA HART, pulse/ frequency/switch output, 4-20 mA current input ³⁾	≥ DC 12 V	DC 35 V

- 1) In event of external supply voltage of the power supply unit with load
2) The minimum terminal voltage increases if local operation is used: see the following table
3) Voltage drop 2.2 to 3 V for 3.59 to 22 mA

Increase of minimum terminal voltage with local operation

Order code for "Display; operation"	Increase in minimum Terminal voltage
Option C: Local operation SD02	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting not used)	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting used)	+ DC 3 V

Order code for "Sensor version; DSC sensor; measuring tube"	Increase in minimum Terminal voltage
Option DA: Mass steam; 316L; 316L (integrated pressure/temperature measurement)	+ DC 1 V
Option DB: Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement)	+ DC 1 V

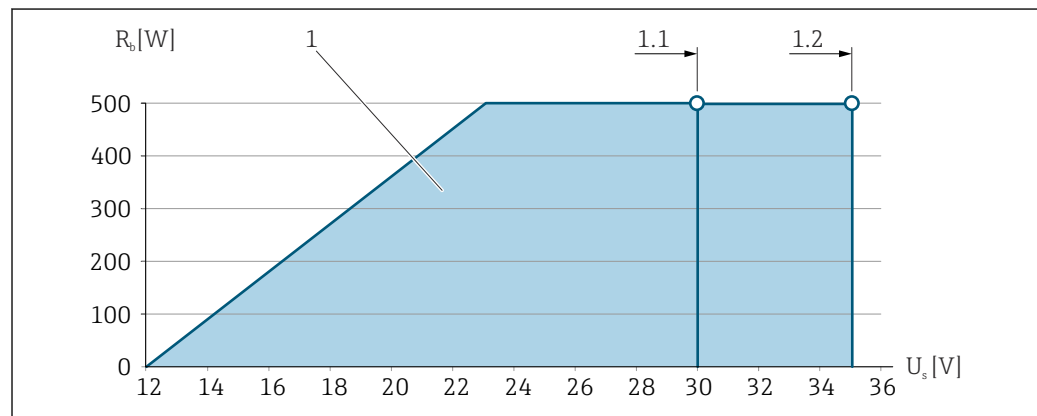
Load

Load for current output: 0 to 500 Ω , depending on the external supply voltage of the power supply unit

Calculation of the maximum load

Depending on the supply voltage of the power supply unit (U_S), the maximum load (R_B) including line resistance must be observed to ensure adequate terminal voltage at the device. In doing so, observe the minimum terminal voltage

- $R_B \leq (U_S - U_{\text{term. min}}) : 0.022 \text{ A}$
- $R_B \leq 500 \Omega$



A0033472

 14 Load for a compact version without local operation

1 Operating range

1.1 For order code for "Output", option A "4-20 mA HART"/option B "4-20 mA HART, pulse/frequency/switch output" with Ex i and option C "4-20 mA HART + 4-20 mA analog"

1.2 For order code for "Output", option A "4-20 mA HART"/option B "4-20 mA HART, pulse/frequency/switch output" for non-hazardous area and Ex d

Sample calculation

Supply voltage of power supply unit:

- $U_S = 19 \text{ V}$
- $U_{\text{term. min}} = 12 \text{ V (measuring device)} + 1 \text{ V (local operation without lighting)} = 13 \text{ V}$

Maximum load: $R_B \leq (19 \text{ V} - 13 \text{ V}) : 0.022 \text{ A} = 273 \Omega$

 The minimum terminal voltage ($U_{Kl \min}$) increases if local operation is used. →  41.

7.2.6 Preparing the measuring instrument

Carry out the steps in the following order:

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

NOTICE

Insufficient sealing of the housing!

Operational reliability of the measuring device could be compromised.

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

1. Remove dummy plug if present.
2. If the measuring device is supplied without cable glands:
Provide suitable cable gland for corresponding connecting cable.
3. If the measuring device is supplied with cable glands:
Observe requirements for connecting cables →  36.

7.3 Connecting the device

NOTICE

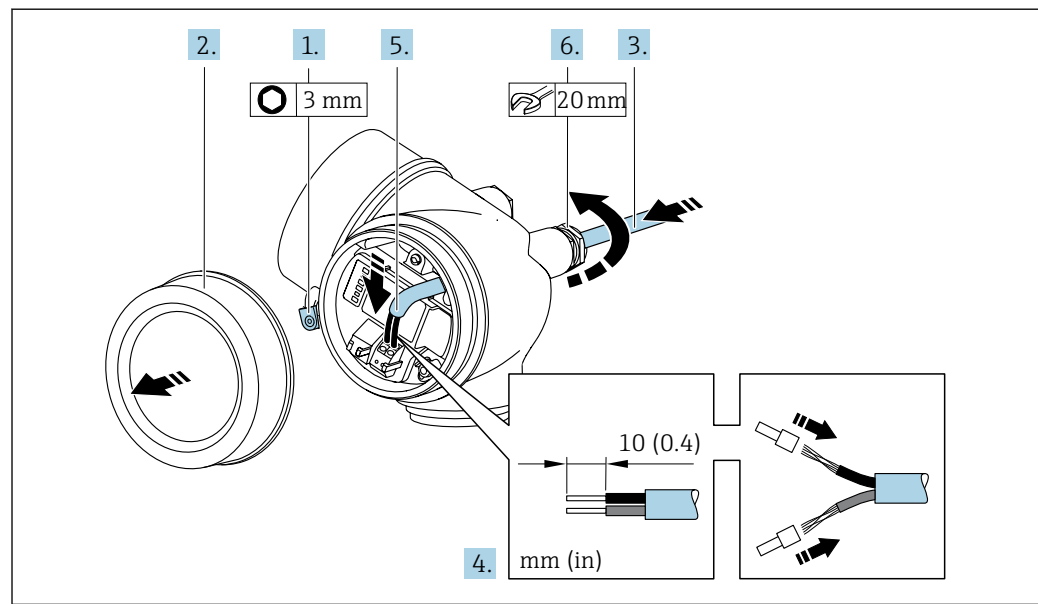
An incorrect connection compromises electrical safety!

- Only properly trained specialist staff may perform electrical connection work.
- Observe applicable federal/national installation codes and regulations.
- Comply with local workplace safety regulations.
- Always connect the protective ground cable  before connecting additional cables.
- When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation.
- The power unit must be safety-approved (e.g. SELV/PELV protection class II limited power).

7.3.1 Connecting the compact version

Connecting the transmitter

Connection via terminals



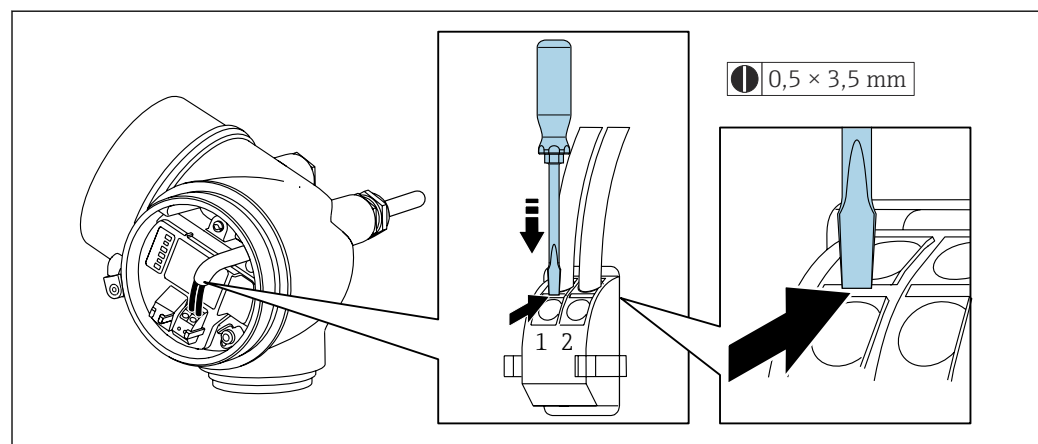
A0048825

1. Loosen the securing clamp of the connection compartment cover.
2. Unscrew the connection compartment cover.
3. Push the cable through the cable entry . To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.
5. Connect cable in accordance with terminal assignment → 38. For HART communication: when connecting the cable shield to the ground terminal, observe the grounding concept of the facility.
6. **⚠ WARNING**
Housing degree of protection may be voided due to insufficient sealing of the housing.
 - Screw in the screw without using any lubricant. The threads on the cover are coated with a dry lubricant.

Firmly tighten the cable glands.

7. Reassemble the transmitter in the reverse order.

Removing a cable



A0048822

- To remove a cable from the terminal, use a flat-blade screwdriver to push the slot between the two terminal holes while simultaneously pulling the cable end out of the terminal.

7.3.2 Connecting the remote version

⚠ WARNING

Risk of damaging electronic components!

- Connect the sensor and transmitter to the same potential equalization.
- Only connect the sensor to a transmitter with the same serial number.

The following sequence of steps is recommended :

1. Mount the sensor and transmitter.
2. Connect the .
3. Connect the transmitter.

i How the connecting cable is connected in the transmitter housing depends on the measuring instrument approval and the version of the connecting cable used.

In the following versions, only terminals can be used for connection in the transmitter housing:

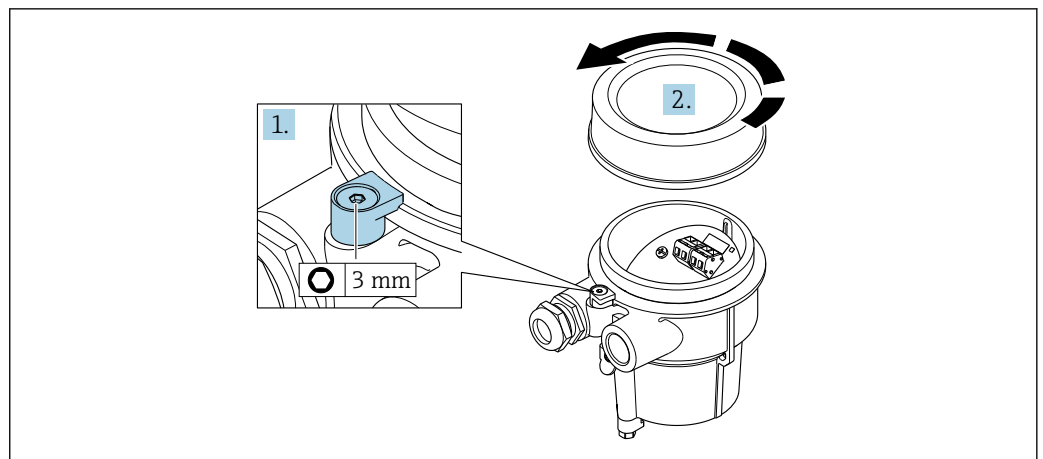
- Order code for "Electrical connection", option B, C, D, 6
- Certain approvals: Ex nA, Ex ec, Ex tb and Division 1
- Use of reinforced connecting cable
- Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB

In the following versions, an M12 device connector is used for connection in the transmitter housing:

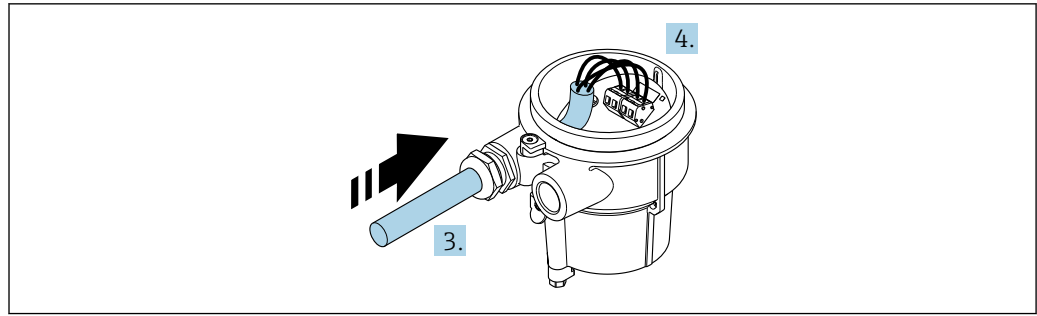
- All other approvals
- Use of connecting cable (standard)

Terminals are always used to connect the connecting cable in the sensor connection housing (tightening torques for screws for cable strain relief: 1.2 to 1.7 Nm).

Connecting the sensor connection housing



1. Loosen the securing clamp.
2. Unscrew the housing cover.



A0034171

15 Sample graphic

Connecting cable (standard, reinforced)

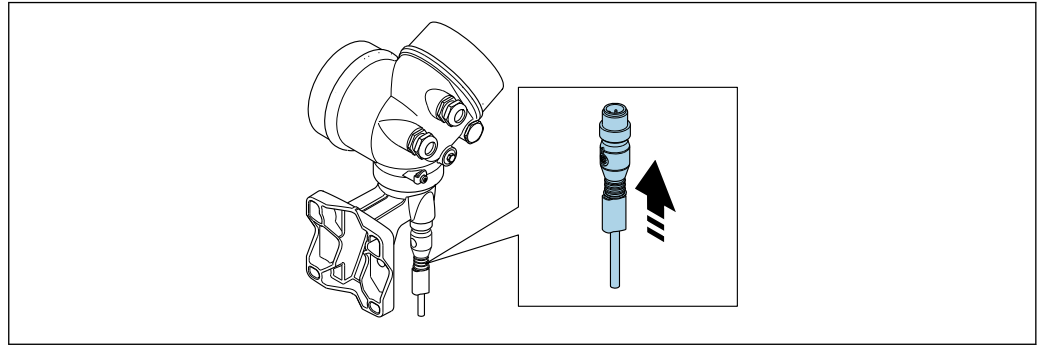
3. Guide the connecting cable through the cable entry and into the connection housing (if using a connecting cable without an M12 device plug, use the shorter stripped end of the connecting cable).
4. Wire the connecting cable:
 - ↳ Terminal 1 = brown cable
 - Terminal 2 = white cable
 - Terminal 3 = yellow cable
 - Terminal 4 = green cable
5. Connect the cable shield via the cable strain relief.
6. Tighten the screws for the cable strain relief using a torque in the range of 1.2 to 1.7 Nm.
7. Reverse the removal procedure to reassemble the connection housing.

Connecting cable (option "mass pressure-/temperature-compensated")

3. Guide the connecting cable through the cable entry and into the connection housing (if using a connecting cable without an M12 device plug, use the shorter stripped end of the connecting cable).
4. Wire the connecting cable:
 - ↳ Terminal 1 = brown cable
 - Terminal 2 = white cable
 - Terminal 3 = green cable
 - Terminal 4 = red cable
 - Terminal 5 = black cable
 - Terminal 6 = yellow cable
 - Terminal 7 = blue cable
5. Connect the cable shield via the cable strain relief.
6. Tighten the screws for the cable strain relief using a torque in the range of 1.2 to 1.7 Nm.
7. Reverse the removal procedure to reassemble the connection housing.

Connecting the transmitter

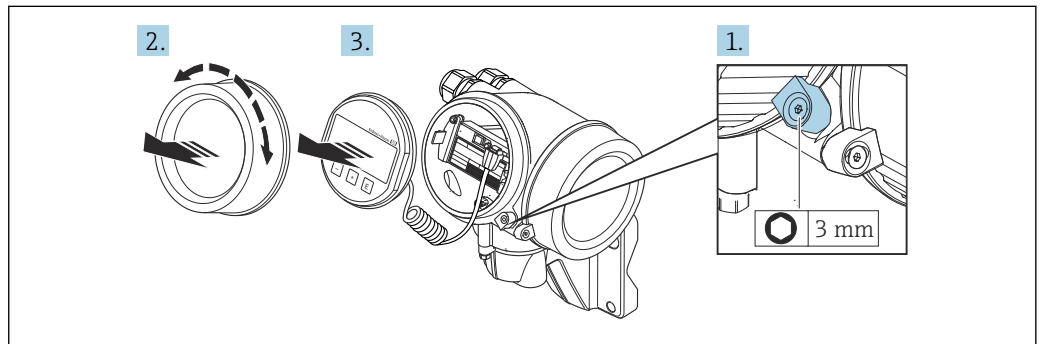
Connecting transmitter via plug



A0034172

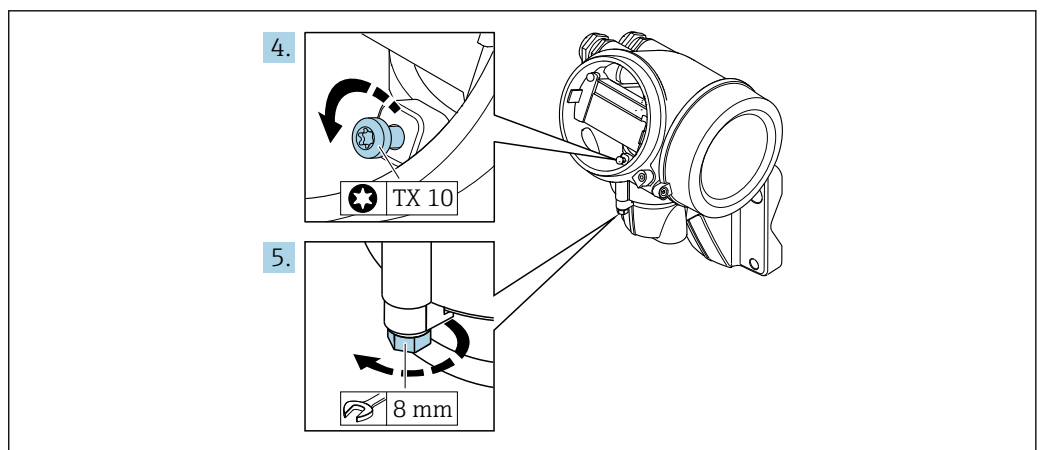
- Connect the plug.

Connecting transmitter via terminals



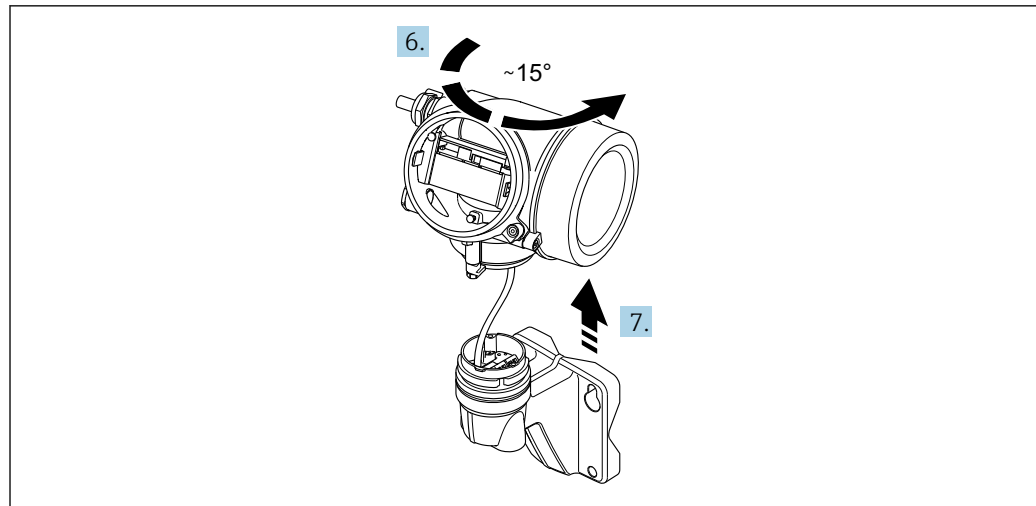
A0034173

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



A0034174

4. Loosen the locking screw of the transmitter housing.
5. Loosen the securing clamp of the transmitter housing.



A0034175

16 Sample graphic

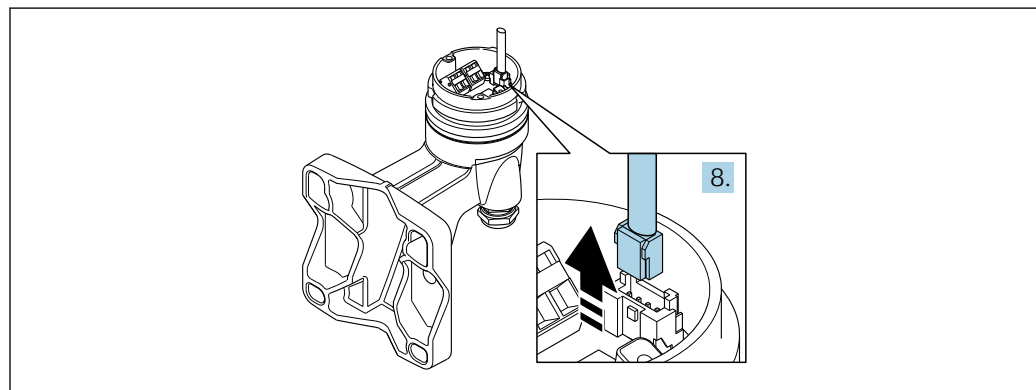
6. Turn the transmitter housing to the right until it reaches the marking.

7. **NOTICE**

The connection board of the wall housing is connected to the electronics board of the transmitter via a signal cable!

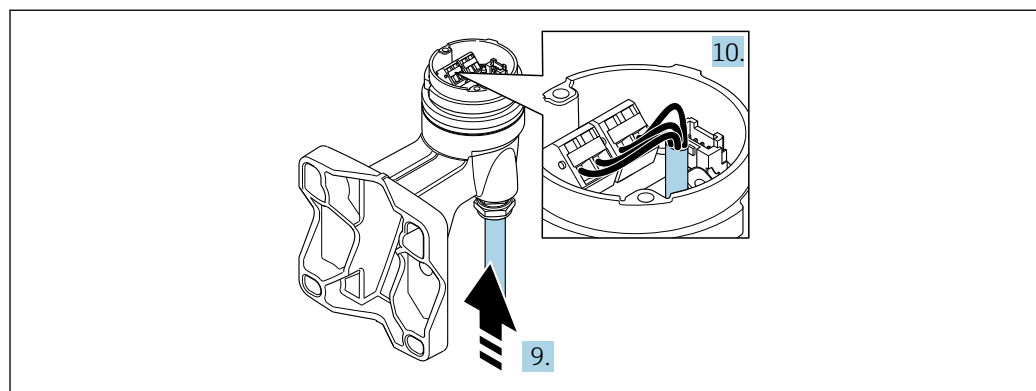
- Pay attention to the signal cable when lifting the transmitter housing!

Lift the transmitter housing.



A0034176

17 Sample graphic



A0034177

18 Sample graphic

Connecting cable (standard, reinforced)

8. Disconnect the signal cable from the connection board of the wall housing . by pressing in the locking clip on the connector. Remove the transmitter housing.
9. Guide the connecting cable through the cable entry and into the connection housing (if using a connecting cable without an M12 device plug, use the shorter stripped end of the connecting cable).
10. Wire the connecting cable:
 - ↳ Terminal 1 = brown cable
 - Terminal 2 = white cable
 - Terminal 3 = yellow cable
 - Terminal 4 = green cable
11. Connect the cable shield via the cable strain relief.
12. Tighten the screws for the cable strain relief using a torque in the range of 1.2 to 1.7 Nm.
13. Reverse the removal procedure to reassemble the transmitter housing.

Connecting cable (option "mass pressure-/temperature-compensated")

8. Disconnect both signal cables from the connection board of the wall housing. by pressing in the locking clip on the connector. Remove the transmitter housing.
9. Guide the connecting cable through the cable entry and into the connection housing (if using a connecting cable without an M12 device plug, use the shorter stripped end of the connecting cable).
10. Wire the connecting cable:
 - ↳ Terminal 1 = brown cable
 - Terminal 2 = white cable
 - Terminal 3 = green cable
 - Terminal 4 = red cable
 - Terminal 5 = black cable
 - Terminal 6 = yellow cable
 - Terminal 7 = blue cable
11. Connect the cable shield via the cable strain relief.
12. Tighten the screws for the cable strain relief using a torque in the range of 1.2 to 1.7 Nm.
13. Reverse the removal procedure to reassemble the transmitter housing.

7.3.3 Connecting the connecting cable for the pressure measuring cell

When delivered to the customer, the connecting cable is connected as follows:

- Compact version: to transmitter housing
- Remote version: to sensor connection housing

For connection to sensor and pressure measuring cell:

- ▶ Insert M12 plug of connecting cable into pressure measuring cell and screw into place.

7.4 Potential equalization

7.4.1 Requirements

For potential equalization:

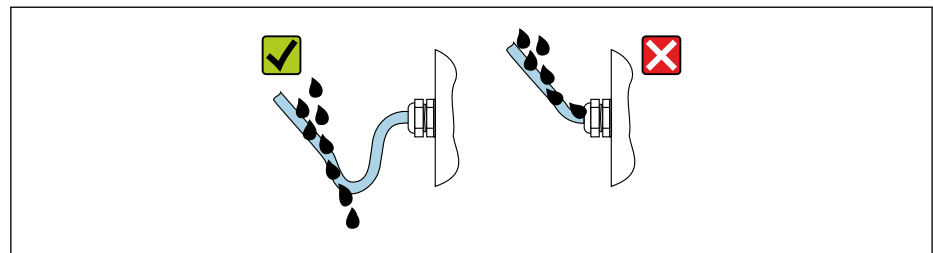
- Pay attention to in-house grounding concepts
- Take account of operating conditions, such as the pipe material and grounding
- Connect the medium, sensor and transmitter to the same electric potential
- Use a ground cable with a minimum cross-section of 6 mm² (10 AWG) and a cable lug for potential equalization connections

7.5 Ensuring the degree of protection

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

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

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



A0029278

6. The cable glands supplied do not ensure housing protection when not in use. They must therefore be replaced by dummy plugs corresponding to the housing protection.

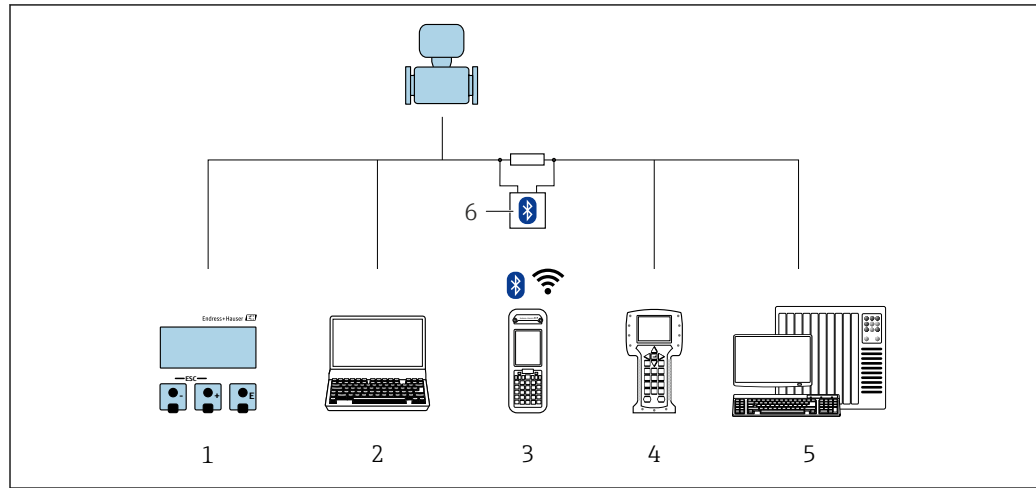
7.6 Post-connection check

Are the device and cable undamaged (visual inspection)?	☐
Do the cables used comply with the requirements → 36?	☐
Are the mounted cables strain relieved?	☐
Are all cable glands installed, securely tightened and leak-tight? Cable run with "water trap" → 50?	☐
Depending on the device version: are all the device plugs firmly tightened → 43?	☐
Only for remote version: ■ Is the sensor connected to the right transmitter? ■ Check the serial number on the nameplate of the sensor and transmitter.	☐
Does the supply voltage match the specifications on the transmitter nameplate ?	☐
Is the terminal assignment correct ?	☐
If supply voltage is present, do values appear on the display module?	☐
Are all housing covers installed and firmly tightened?	☐

Is the securing clamp securely tightened?	☐
Have the screws for the cable strain relief been tightened using the correct tightening torque→ 45?	☐
Is the M12 plug of the connecting cable correctly connected to the pressure measuring cell→ 49?	☐

8 Operation options

8.1 Overview of operation options



A0032226

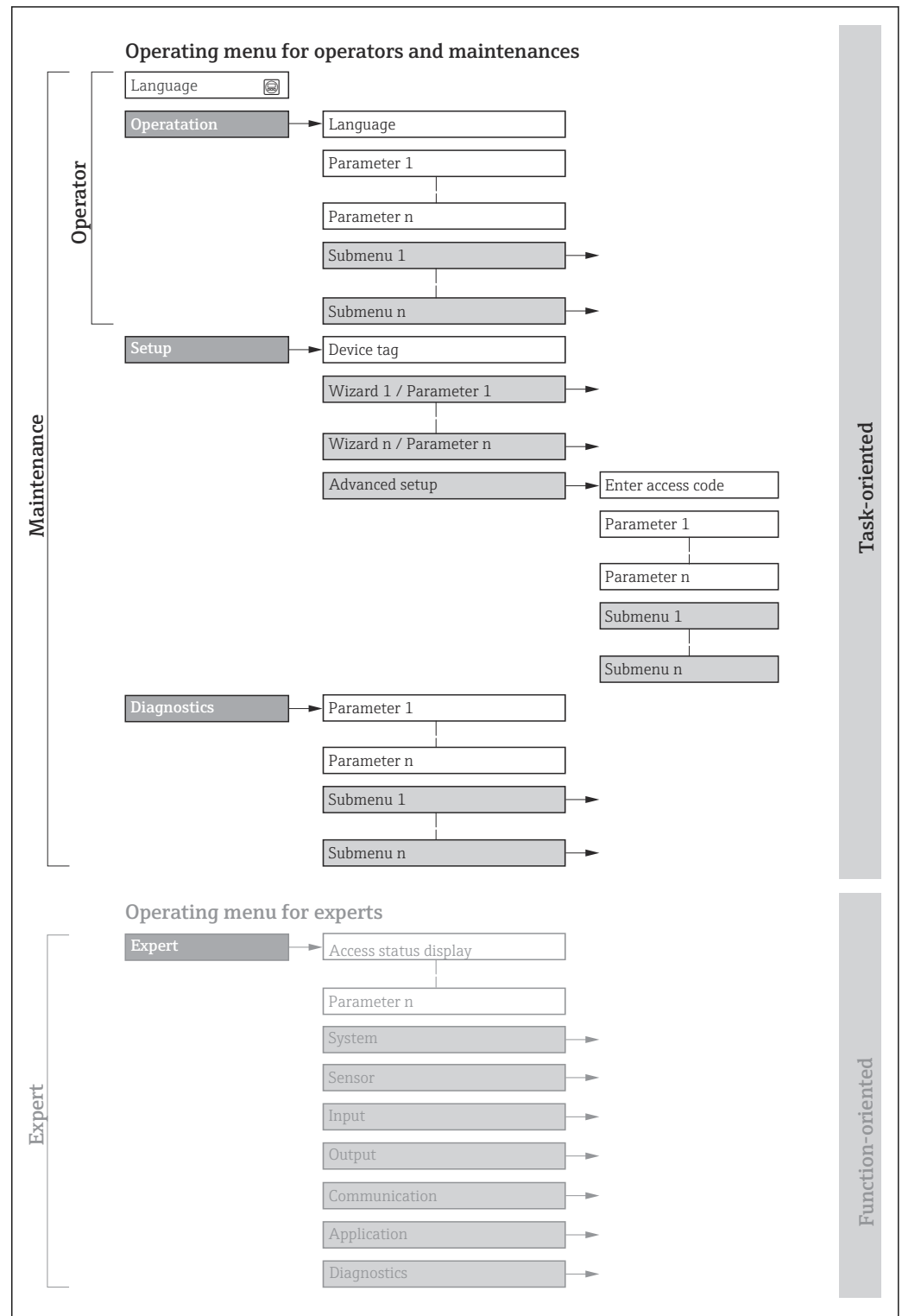
- 1 Local operation via display module
- 2 Computer with operating tool (e.g., FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM)
- 3 Field Xpert SFX350 or SFX370
- 4 Field Communicator 475
- 5 Automation system (e.g. PLC)
- 6 VIATOR Bluetooth modem with connecting cable

8.2 Structure and function of the operating menu

8.2.1 Structure of the operating menu



For an overview of the operating menu for experts: see the "Description of Device Parameters" document supplied with the device



19 Schematic structure of the operating menu

A0018237-EN

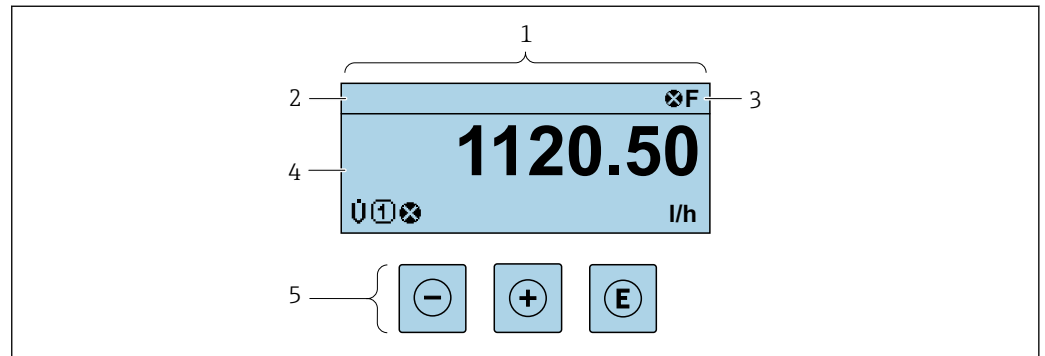
8.2.2 Operating philosophy

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

Menu/parameter		User role and tasks	Content/meaning
Language	Task-oriented	Role "Operator", "Maintenance" Tasks during operation: - Configuration of the operational display - Reading measured values	- Defining the operating language - Resetting and controlling totalizers
Operation			- Configuration of the operational display (e.g. display format, display contrast) - Resetting and controlling totalizers
Setup		"Maintenance" role Commissioning: - Configuration of the measurement - Configuration of the inputs and outputs	Wizards for fast commissioning: - Configuring the system units - Definition of the medium - Configuration of the current input - Configuring the outputs - Configuration of the operational display - Definition of output conditioning - Configuring the low flow cut off Advanced setup - For more customized configuration of the measurement (adaptation to special measuring conditions) - Configuration of totalizers - Administration (define access code, reset measuring device)
Diagnostics		"Maintenance" role Troubleshooting: - 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 Contains up to 5 currently pending diagnostic messages. - Event logbook Contains event messages that have occurred. - Device information Contains information for identifying the device - Measured values Contains all current measured values. Data logging submenu with the "Extended HistoROM" order option Storage and visualization of measured values - Heartbeat Technology Verification of device functionality on request and documentation of verification results - Simulation Used to simulate measured values or output values.
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 of the device parameters and allows direct access to these by means of an access code. The structure of this menu is based on the function blocks of the device: - System Contains all higher-level device parameters that do not affect measurement or measured value communication - Sensor Configuration of the measurement. - Input Configuration of the input - Output Configuration of the outputs - Communication Configuration of the digital communication interface - Application Configuration of the functions that go beyond the actual measurement (e.g. totalizer) - Diagnostics Error detection and analysis of process and device errors and for device simulation and Heartbeat Technology.

8.3 Access to operating menu via local display

8.3.1 Operational display



A0029346

- 1 Operational display
- 2 Tag name → 77
- 3 Status area
- 4 Display area for measured values (up to 4 lines)
- 5 Operating elements → 60

Status area

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

- Status signals → 151
 - **F**: Failure
 - **C**: Function check
 - **S**: Out of specification
 - **M**: Maintenance required
- Diagnostic behavior → 152
 - **X**: Alarm
 - **A**: Warning
- **L**: Locking (the device is locked via the hardware)
- **R**: Communication (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 variable	Measurement channel number	Diagnostic behavior
	↓	↓	↓
Example			
			Appears only if a diagnostics event is present for this measured variable.

Measured variables

Symbol	Meaning
	Volume flow

i The number and display format of the measured variables can be configured via the **Format display** parameter (→ 94).

Totalizer

Symbol	Meaning
	Totalizer  The measurement channel number indicates which of the three totalizers is displayed.

Output

Symbol	Meaning
	Output  The measurement channel number indicates which of the two current outputs is displayed.

Measurement channel numbers

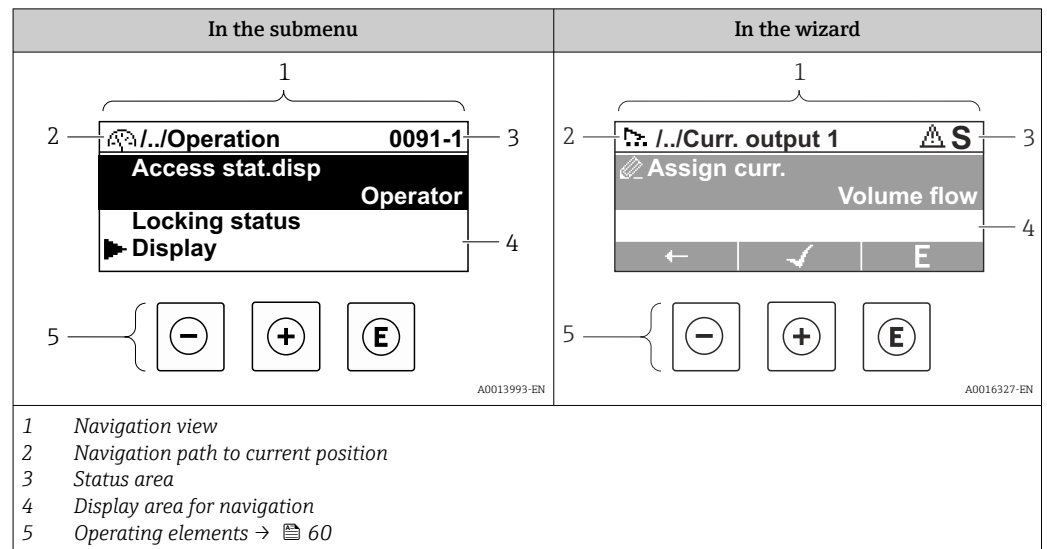
Symbol	Meaning
	Measurement channel 1 to 4  The measurement channel number is displayed only if more than one channel is present for the same measured variable type (e.g. Totalizer 1 to 3).

Diagnostic behavior

Symbol	Meaning
	Alarm - Measurement is interrupted. - Signal outputs and totalizers assume the defined alarm condition. - A diagnostic message is generated. - For local display with touch control: the background lighting changes to red.
	Warning - Measurement is resumed. - The signal outputs and totalizers are not affected. - A diagnostic message is generated.

 The diagnostic behavior pertains to a diagnostic event that is relevant to the displayed measured variable.

8.3.2 Navigation view



Navigation path

The navigation path to the current position is displayed at the top left in the navigation view and consists of the following elements:

- The display symbol for the menu/submenu (▶) or the wizard (⚙).
- An omission symbol (/ ../) for operating menu levels in between.
- Name of the current submenu, wizard or parameter

	Display symbol	Omission symbol	Parameter
	↓	↓	↓
Example	▶	/ ../	Indication

For more information about the icons in the menu, refer to the "Display area" section → 57

Status area

The following appears in the status area of the navigation view in the top right corner:

- In the submenu
 - The direct access code to the parameter (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 → 151
- For information on the function and entry of the direct access code → 62

Display area

Menus

Symbol	Meaning
	Operation Is displayed: ■ In the menu next to the "Operation" selection ■ At the left in the navigation path in the Operation menu

	Setup Is displayed: ■ In the menu next to the "Setup" selection ■ At the left in the navigation path in the Setup menu
	Diagnosis Is displayed: ■ In the menu next to the "Diagnostics" selection ■ At the left in the navigation path in the Diagnostics menu
	Expert Is displayed: ■ In the menu next to the "Expert" selection ■ At the left in the navigation path in the Expert menu

Submenus, wizards, parameters

Symbol	Meaning
	Submenu
	Wizards
	Parameters within a wizard  No display symbol exists for parameters in submenus.

Locking procedure

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

Wizards

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

8.3.3 Editing view

Numeric editor

1

20

2

01234

56789

- . ← C

X ✓

3

4

-

+

E

A0013941

Text editor

1

User

2

ABC DEFG HIJK

LMNO PQRS TUVW

XYZ ↵ C ↔ Aa1@

C X ✓

3

4

-

+

E

A0013999

1 Editing view

2 Display area of the entered values

3 Input mask

4 Operating elements → 60

Input screen

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

Numeric editor

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

Text editor

Symbol	Meaning
Aa1@	Toggle - Between upper-case and lower-case letters - For entering numbers - For entering special characters
ABC _ ... XYZ	Selection of letters from A to Z.
abc _ ... xyz	Selection of letters from a to z.
""^ _ ... ~& _	Selection of special characters.
✓	Confirms the selection.
✗ C ↔	Switches to the selection of the correction tools.
✗	Exits the input without applying the changes.
C	Clears all entered characters.

Text correction under ✗ C ↔

Symbol	Meaning
C	Clears all entered characters.

	Moves the input position one position to the right.
	Moves the input position one position to the left.
	Deletes one character immediately to the left of the input position.

8.3.4 Operating elements

Operating key	Meaning
	Minus key <i>In menu, submenu</i> Moves the selection bar upwards in a picklist <i>In wizards</i> Goes to previous parameter <i>In the text and numeric editor</i> In the input screen, moves the selection bar to the left (backwards)
	Plus key <i>In menu, submenu</i> Moves the selection bar downwards in a picklist <i>In wizards</i> Goes to the next parameter <i>In the text and numeric editor</i> In the input screen, moves the selection bar to the right (forwards)
	Enter key <i>In the operational display</i> Pressing the key for 2 s opens the context menu. <i>In menu, submenu</i> - Pressing the key briefly: - Opens the selected menu, submenu or parameter. - Starts the wizard. - If help text is open, closes the help text of the parameter. - Pressing the key for 2 s in a parameter: - If present, opens the help text for the function of the parameter. <i>In wizards</i> Opens the editing view of the parameter and confirms the parameter value <i>In the text and numeric editor</i> - Pressing the key briefly: - Opens the selected group. - Carries out the selected action. - Pressing the key for 2 s confirms the edited parameter value.
	Escape key combination (press keys simultaneously) <i>In menu, submenu</i> - Pressing the key briefly: - Exits the current menu level and takes you to the next higher level. - If help text is open, closes the help text of the parameter. - Pressing the key for 2 s returns you to the operational display ("home position"). <i>In wizards</i> Exits the wizard and takes you to the next higher level <i>In the text and numeric editor</i> Closes the text or numeric editor without applying changes.
	Plus/Enter key combination (press and hold down the keys simultaneously) Increases the contrast (darker setting).
	Minus/Plus/Enter key combination (press the keys simultaneously) <i>In the operational display</i> Enables or disables the keypad lock (only SD02 display module).

8.3.5 Opening the context menu

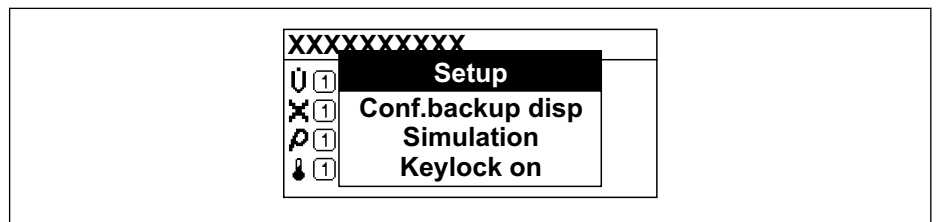
Using the context menu, the user can call up the following menus quickly and directly from the operational display:

- Setup
- Configuration backup display
- Simulation

Calling up and closing the context menu

The user is in the operational display.

1. Press the  and  keys for longer than 3 seconds.
 - ↳ The context menu opens.



A0034284-EN

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

Calling up the menu via the context menu

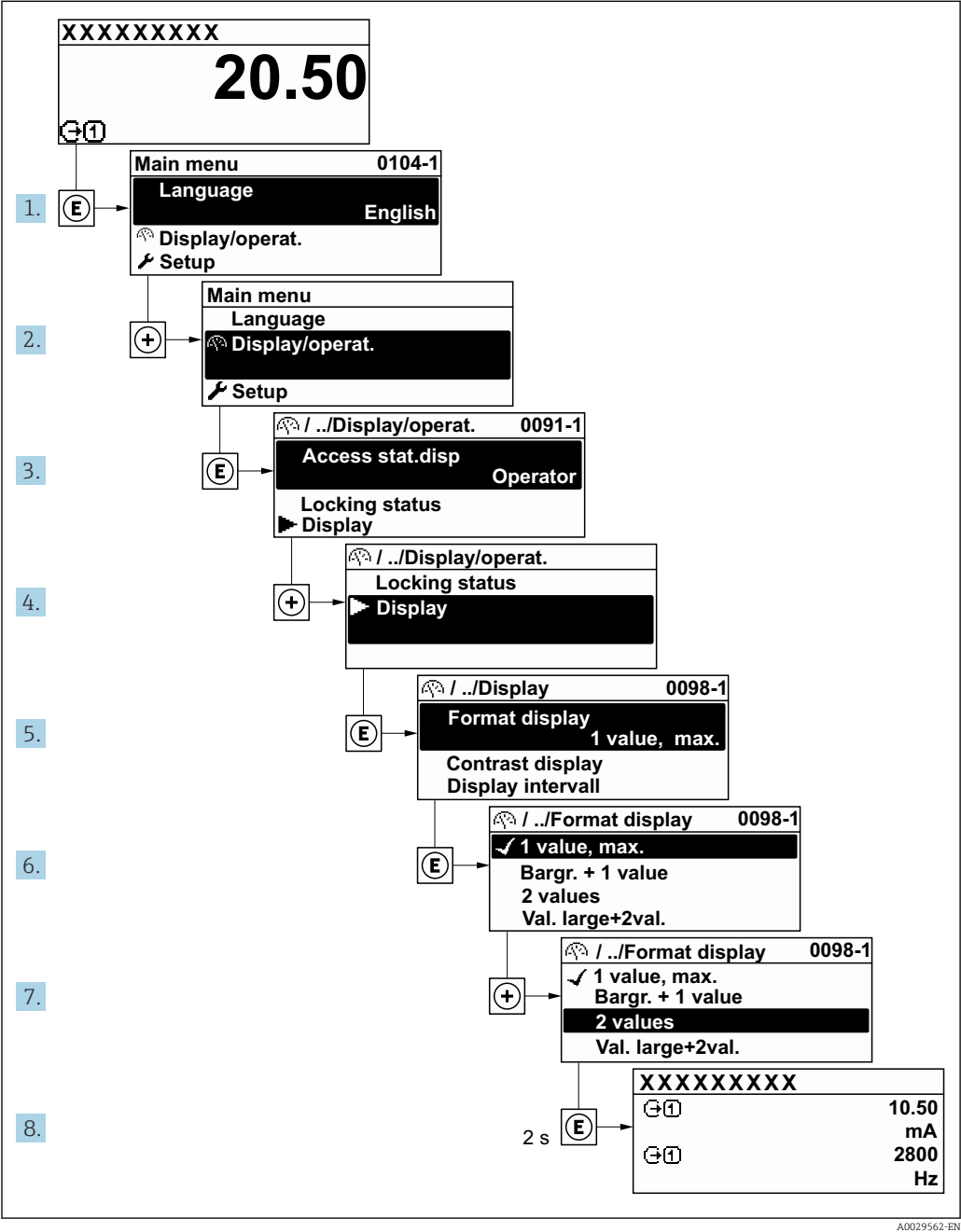
1. Open the context menu.
2. Press  to navigate to the desired menu.
3. Press  to confirm the selection.
 - ↳ The selected menu opens.

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
→  57

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



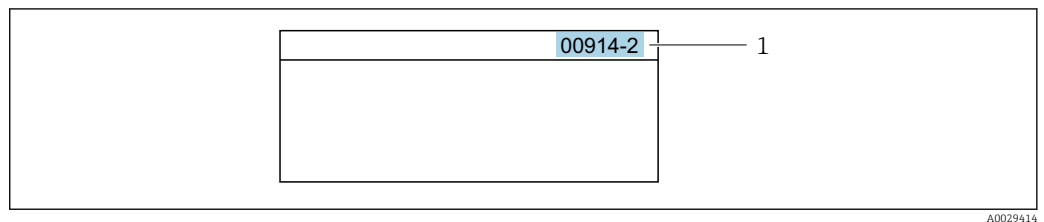
A0029562-EN

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 → Direct access

The direct access code consists of a 5-digit number (at maximum) and the channel number, which identifies the channel of a process variable: e.g. 00914-2. 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: Enter "914" instead of "00914"
- If no channel number is entered, channel 1 is opened automatically.
Example: Enter 00914 → **Assign process variable** parameter
- If a different channel is opened: Enter the direct access code with the corresponding channel number.
Example: Enter 00914-2 → **Assign process variable** parameter



For the direct access codes of the individual parameters, see the "Description of Device Parameters" document for the device

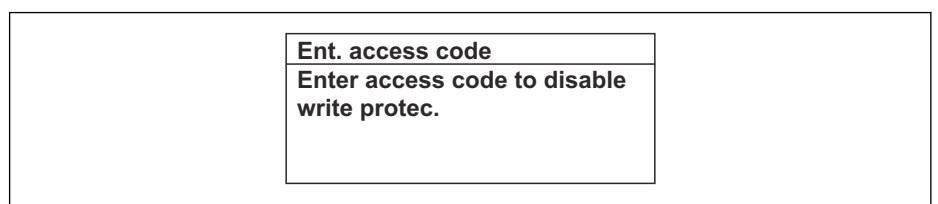
8.3.8 Calling up help text

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



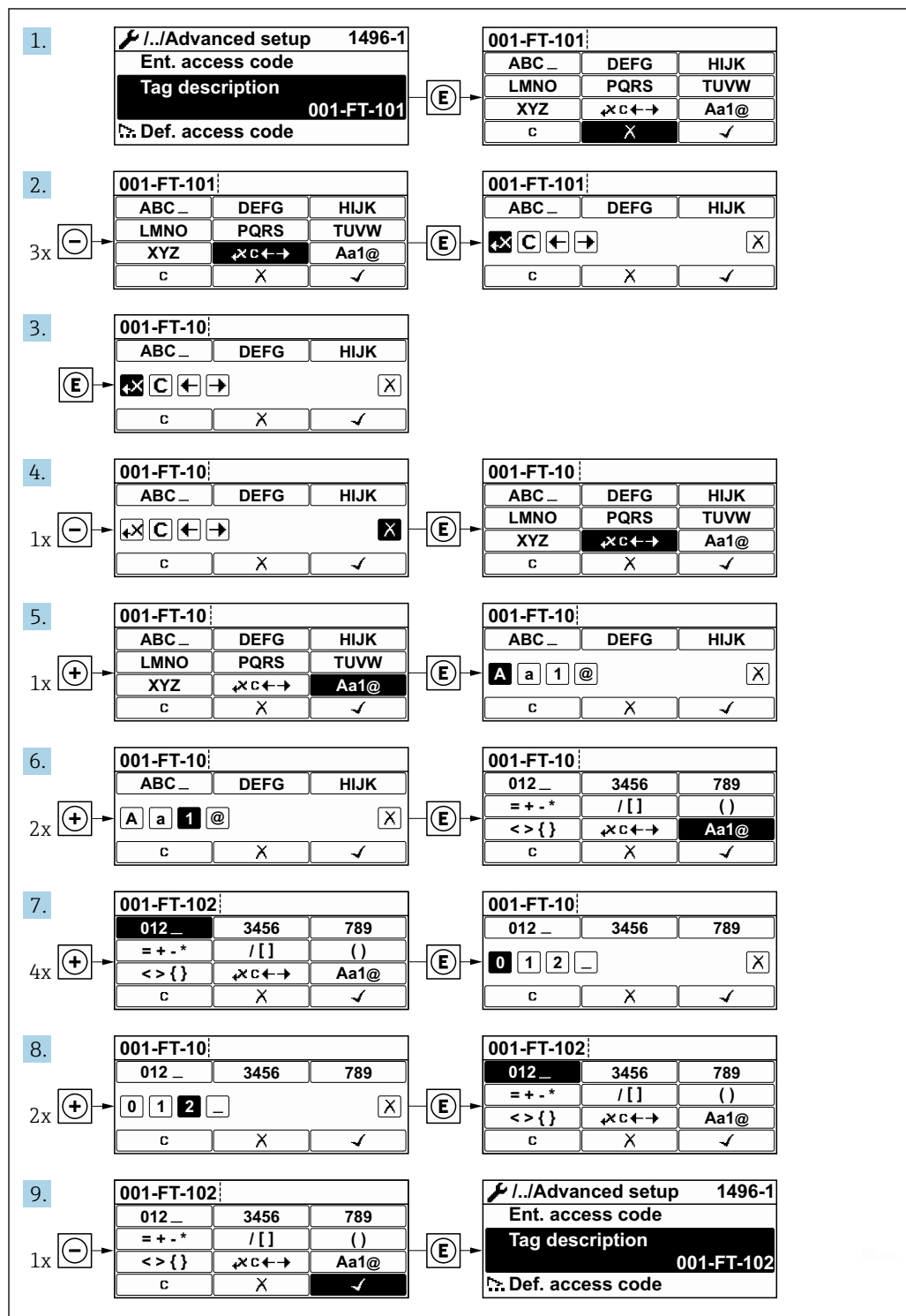
20 Example: Help text for parameter "Enter access code"

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

8.3.9 Changing the parameters

i For a description of the editing view - consisting of the text editor and numeric editor - with symbols → 58, for a description of the operating elements → 60

Example: Changing the tag name in the "Tag description" parameter from 001-FT-101 to 001-FT-102



A0029563-EN

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

Ent. access code Invalid or out of range input value Min:0 Max:9999

A0014049-EN

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.

Defining access authorization for user roles

An access code is not yet defined when the device is delivered from the factory. Access authorization (read and write access) to the device is not restricted and corresponds to the "Maintenance" user role.

- Define the access code.
 - ↳ The "Operator" user role is redefined in addition to the "Maintenance" user role. Access authorization differs for the two user roles.

Access authorization to parameters: "Maintenance" user role

Access code status	Read access	Write access
An access code has not yet been defined (factory setting).	✓	✓
After an access code has been defined.	✓	✓ ¹⁾

- 1) The user only has write access after entering the access code.

Access authorization to parameters: "Operator" user role

Access code status	Read access	Write access
After an access code has been defined.	✓	— ¹⁾

- 1) Despite the defined access code, certain parameters can always be modified and thus are excluded from the write protection as they do not affect the measurement: write protection via access code



The user role with which the user is currently logged on is indicated by the **Access status display** parameter. Navigation path: 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 local operation → 127.

Parameter write protection via local operation can be disabled by entering the user-specific access code in the **Enter access code** parameter via the respective access option.

1. After you press , 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 switched on and off via the context menu.

Switching on the keypad lock



For the SD03 display only

The keypad lock is switched on automatically:

- If the device has not been operated via the display for > 1 minute.
- Each time the device is restarted.

To activate the keylock manually:

1. The device is in the measured value display.
Press the  and  keys for 3 seconds.
↳ A context menu appears.
2. In the context menu select the **Keylock on** option.
↳ The keypad lock is switched on.



If the user attempts to access the operating menu while the keypad lock is active, the **Keylock on** message appears.

Switching off the keypad lock

- ▶ The keypad lock is switched on.
Press the  and  keys for 3 seconds.
↳ The keypad lock is switched off.

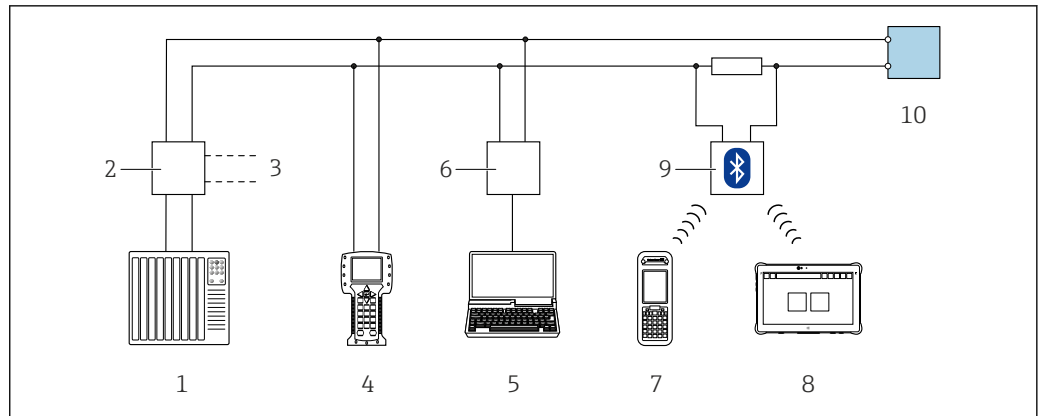
8.4 Access to the operating menu via the operating tool

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

8.4.1 Connecting the operating tool

Via HART protocol

This communication interface is available in device versions with a HART output.

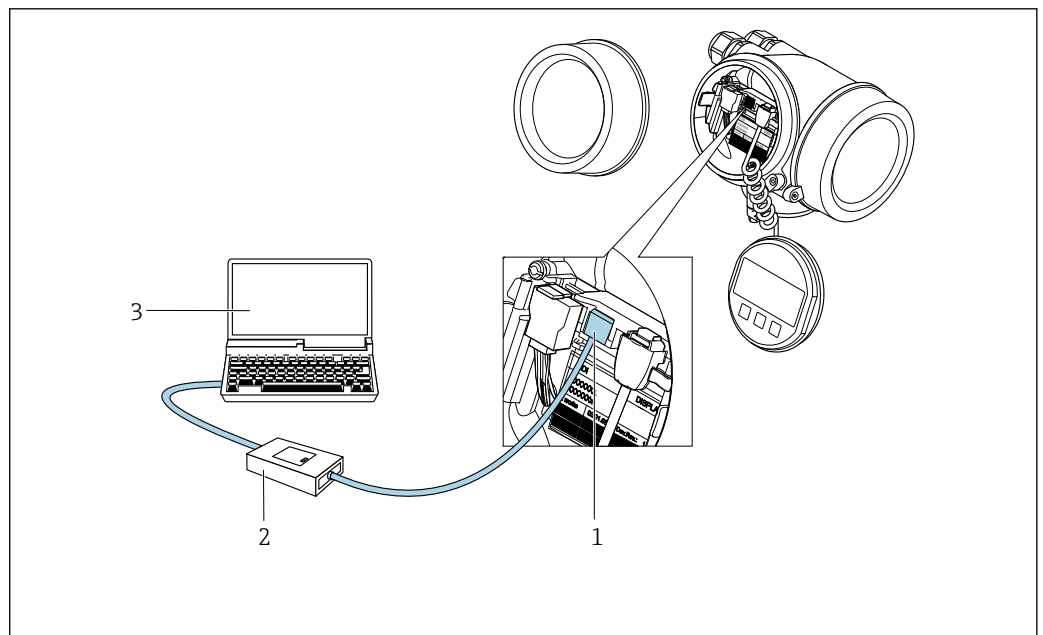


A0028746

21 Options for remote operation via HART protocol (passive)

- 1 Automation system (e.g. PLC)
- 2 Transmitter power supply unit, e.g. RN221N (with communication resistor)
- 3 Connection for Commubox FXA195 and Field Communicator 475
- 4 Field Communicator 475
- 5 Computer with Web browser (e.g. Internet Explorer) for accessing computers with an operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, AMS TREX Device Communicator, SIMATIC PDM) with COM DTM "CDI Communication TCP/IP"
- 6 Commubox FXA195 (USB)
- 7 Field Xpert SFX350 or SFX370
- 8 Field Xpert SMT50 (or 70 or 77)
- 9 VIATOR Bluetooth modem with connecting cable
- 10 Transmitter

Via service interface (CDI)



A0034056

- 1 Service interface (CDI = Endress+Hauser Common Data Interface) of the measuring instrument
- 2 Commubox FXA291
- 3 Computer with operating tool (e.g. FieldCare or DeviceCare) and (CDI) DeviceDTM

8.4.2 Field Xpert SFX350, SFX370

Function scope

Field Xpert SFX350 and Field Xpert SFX370 are mobile computers for commissioning and maintenance. They enable efficient device configuration and diagnostics for HART and

FOUNDATION Fieldbus devices in the **non-hazardous area** (SFX350, SFX370) and **hazardous area** (SFX370).



For details, see Operating Instructions BA01202S

Source for device description files

See information →  71

8.4.3 FieldCare

Function range

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

Access is via:

- HART protocol
- CDI service interface →  67

Typical functions:

- Transmitter parameter configuration
- Loading and saving of device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook



- Operating Instructions BA00027S
- Operating Instructions BA00059S



Source for device description files →  71

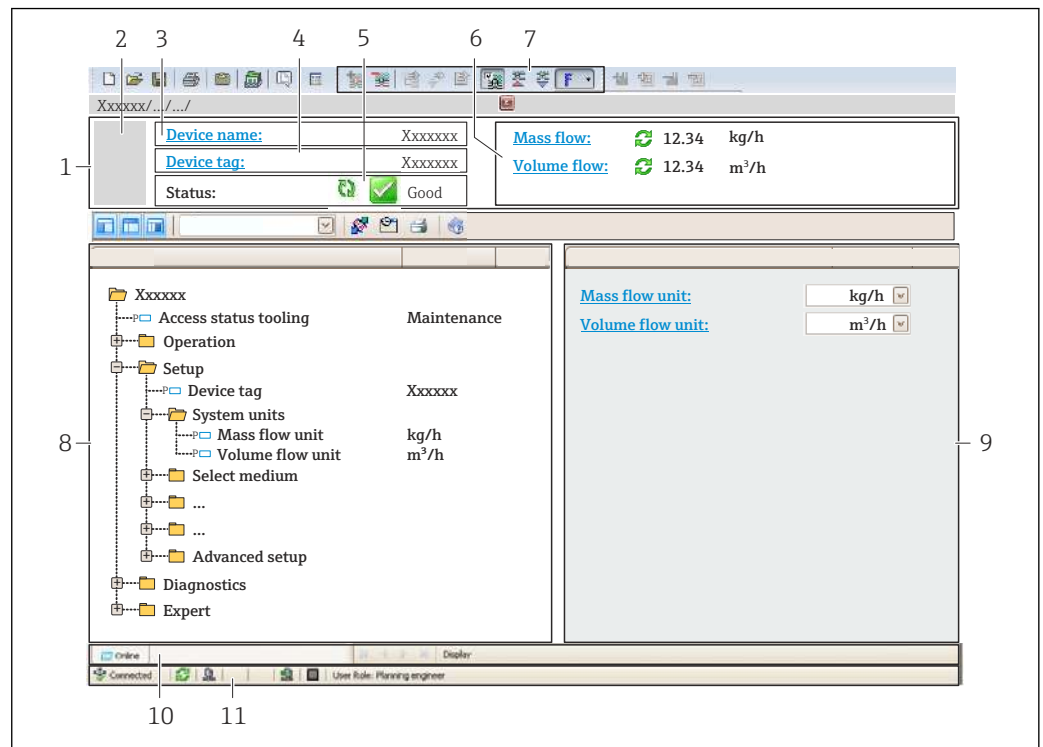
Establishing a connection

1. Start FieldCare and launch the project.
2. In the network: Add a device.
 - ↳ The **Add device** window opens.
3. Select the **CDI Communication TCP/IP** option from the list and press **OK** to confirm.
4. Right-click **CDI Communication TCP/IP** and select the **Add device** option in the context menu that opens.
5. Select the desired device from the list and press **OK** to confirm.
 - ↳ The **CDI Communication TCP/IP (Configuration)** window opens.
6. Enter the device address in the **IP address** field: 192.168.1.212 and press **Enter** to confirm.
7. Establish the online connection to the device.



- Operating Instructions BA00027S
- Operating Instructions BA00059S

User interface



A0021051-EN

- 1 Header
- 2 Picture of device
- 3 Device name
- 4 Tag name
- 5 Status area with status signal → 154
- 6 Display area for current measured values
- 7 Editing toolbar with additional functions such as save/load, event list and create documentation
- 8 Navigation area with operating menu structure
- 9 Work area
- 10 Action area
- 11 Status area

8.4.4 DeviceCare

Function range

Tool for connecting and configuring Endress+Hauser field devices.

The fastest way to configure Endress+Hauser field devices is with the dedicated "DeviceCare" tool. Together with the device type managers (DTMs) it presents a convenient, comprehensive solution.



Innovation brochure IN01047S



Source for device description files → 71

8.4.5 AMS Device Manager

Function range

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



Source for device description files → 71

8.4.6 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 → 71

8.4.7 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 information → 71

9 System integration

9.1 Overview of device description files

9.1.1 Current version data for the device

Firmware version	01.03.00	- On the title page of the manual - On the transmitter nameplate Firmware version parameter Diagnostics → Device information → Firmware version
Release date of firmware version	01.2018	---
Manufacturer ID	0x11	Manufacturer ID parameter Diagnostics → Device information → Manufacturer ID
Device type ID	0x38	Device type parameter Diagnostics → Device information → Device type
HART protocol revision	7	---
Device revision	4	- On the transmitter nameplate Device revision parameter Diagnostics → Device information → Device revision

 For an overview of the various firmware versions for the device →  166

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
FieldCare	www.endress.com → Downloads area - USB stick (contact Endress+Hauser) - DVD (contact Endress+Hauser)
DeviceCare	www.endress.com → Downloads area - CD-ROM (contact Endress+Hauser) - DVD (contact Endress+Hauser)
- Field Xpert SMT70 - Field Xpert SMT77	Use update function of handheld terminal
AMS Device Manager (Emerson Process Management)	www.endress.com → Downloads area
SIMATIC PDM (Siemens)	www.endress.com → Downloads area
Field Communicator 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)	Volume flow
Secondary dynamic variable (SV)	Temperature
Tertiary dynamic variable (TV)	Totalizer 1
Quaternary dynamic variable (QV)	Totalizer 2

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)

- Off
- Volume flow
- Corrected volume flow
- Mass flow
- Flow velocity
- Temperature
- Pressure
- Calculated saturated steam pressure
- Steam quality
- Total mass flow
- Energy flow
- Heat flow difference

Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)

- Volume flow
- Corrected volume flow
- Mass flow
- Flow velocity
- Temperature
- Calculated saturated steam pressure
- Steam quality
- Total mass flow
- Energy flow
- Heat flow difference
- Condensate mass flow
- Reynolds number
- Totalizer 1...3
- HART input
- Density
- Pressure
- Specific volume
- Degrees of superheat

Device variables

The device variables are permanently assigned. A maximum of 8 device variables can be transmitted:

- 0 = volume flow
- 1 = corrected volume flow
- 2 = Mass flow
- 3 = flow velocity

- 4 = temperature
- 5 = calculated saturated steam pressure
- 6 = steam quality
- 7 = total mass flow
- 8 = energy flow
- 9 = heat flow difference
- 17 = pressure

9.3 Other settings

Burst mode functionality in accordance with HART 7 Specification:

Navigation

"Expert" menu → Communication → HART output → Burst configuration → Burst configuration 1 to n

► Burst configuration 1 to n	
Burst mode 1 to n	→ 74
Burst command 1 to n	→ 74
Burst variable 0	→ 74
Burst variable 1	→ 74
Burst variable 2	→ 74
Burst variable 3	→ 74
Burst variable 4	→ 74
Burst variable 5	→ 74
Burst variable 6	→ 74
Burst variable 7	→ 74
Burst trigger mode	→ 74
Burst trigger level	→ 75
Min. update period	→ 75
Max. update period	→ 75

Parameter overview with brief description

Parameter	Description	Selection / User entry	Factory setting
Burst mode 1 to n	Activate the HART burst mode for burst message X.	■ Off ■ On	Off
Burst command 1 to n	Select the HART command that is sent to the HART master.	■ Command 1 ■ Command 2 ■ Command 3 ■ Command 9 ■ Command 33 ■ Command 48	Command 2
Burst variable 0	For HART command 9 and 33: select the HART device variable or the process variable.	■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure * ■ Steam quality * ■ Total mass flow * ■ Energy flow * ■ Heat flow difference * ■ Condensate mass flow * ■ Reynolds number * ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3 ■ HART input ■ Density * ■ Pressure * ■ Specific volume * ■ Degrees of superheat * ■ Percent of range ■ Measured current ■ Primary variable (PV) ■ Secondary variable (SV) ■ Tertiary variable (TV) ■ Quaternary variable (QV) ■ Not used	Volume flow
Burst variable 1	For HART command 9 and 33: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 2	For HART command 9 and 33: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 3	For HART command 9 and 33: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 4	For HART command 9: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 5	For HART command 9: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 6	For HART command 9: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst variable 7	For HART command 9: select the HART device variable or the process variable.	See the Burst variable 0 parameter.	Not used
Burst trigger mode	Select the event that triggers burst message X.	■ Continuous ■ Window ■ Rising ■ Falling ■ On change	Continuous

Parameter	Description	Selection / User entry	Factory setting
Burst trigger level	Enter the burst trigger value. Together with the option selected in the Burst trigger mode parameter the burst trigger value determines the time of burst message X.	Signed floating-point number	–
Min. update period	Enter the minimum time span between two burst commands of burst message X.	Positive integer	1 000 ms
Max. update period	Enter the maximum time span between two burst commands of burst message X.	Positive integer	2 000 ms

* Visibility depends on order options or device settings

10 Commissioning

10.1 Post-mounting and post-connection check

Before commissioning the device:

- ▶ Make sure that the post-installation and post-connection checks have been performed successfully.
- Checklist for "Post-installation" check → 35
- Checklist for "Post-connection" check → 50

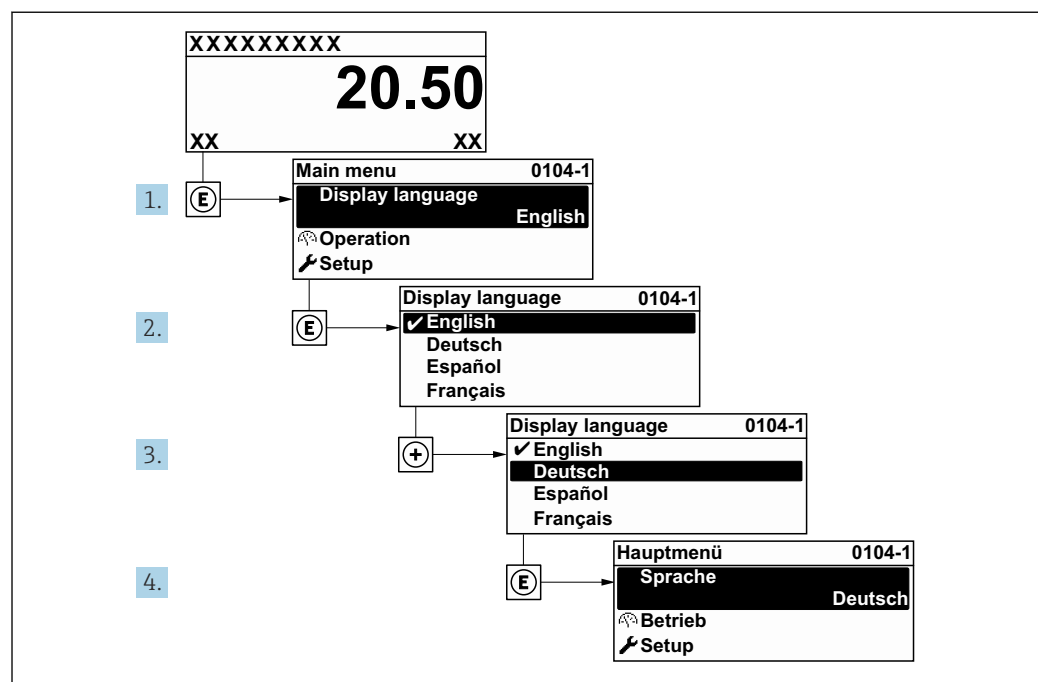
10.2 Switching on the measuring device

- ▶ Switch on the device upon successful completion of the post-mounting and post-connection check.
 - ↳ After a successful startup, the local display switches automatically from the startup display to the operational display.

i If nothing appears on the local display or if a diagnostic message is displayed, refer to the section on "Diagnostics and troubleshooting" → 149.

10.3 Setting the operating language

Factory setting: English or ordered local language

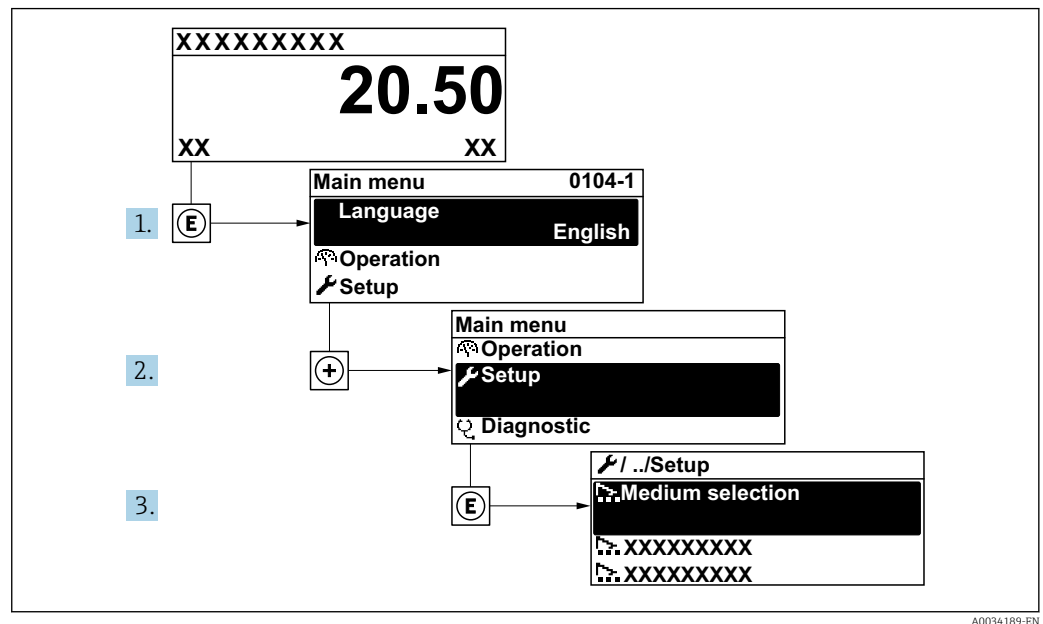


22 Taking the example of the local display

A0029420

10.4 Configuring the device

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

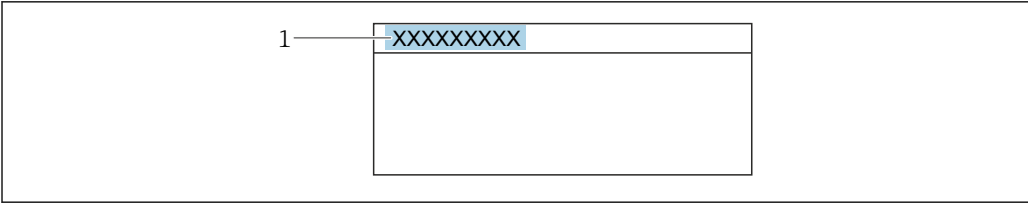


23 Navigation to the "Setup" menu using the example of the local display

Setup	
Device tag	→ 78
▶ System units	→ 78
▶ Medium selection	→ 82
▶ Current input	→ 85
▶ Current output 1 to n	→ 87
▶ Pulse/frequency/switch output	→ 88
▶ Display	→ 93
▶ Low flow cut off	→ 95
▶ Advanced setup	→ 97

10.4.1 Defining the tag name

To enable fast identification of the measuring point within the system, you can enter a unique designation using the **Device tag** parameter and thus change the factory setting.



24 Header of the operational display with tag name

1 Tag name

Enter the tag name in the "FieldCare" operating tool → 69

Navigation
"Setup" menu → Device tag

Parameter overview with brief description

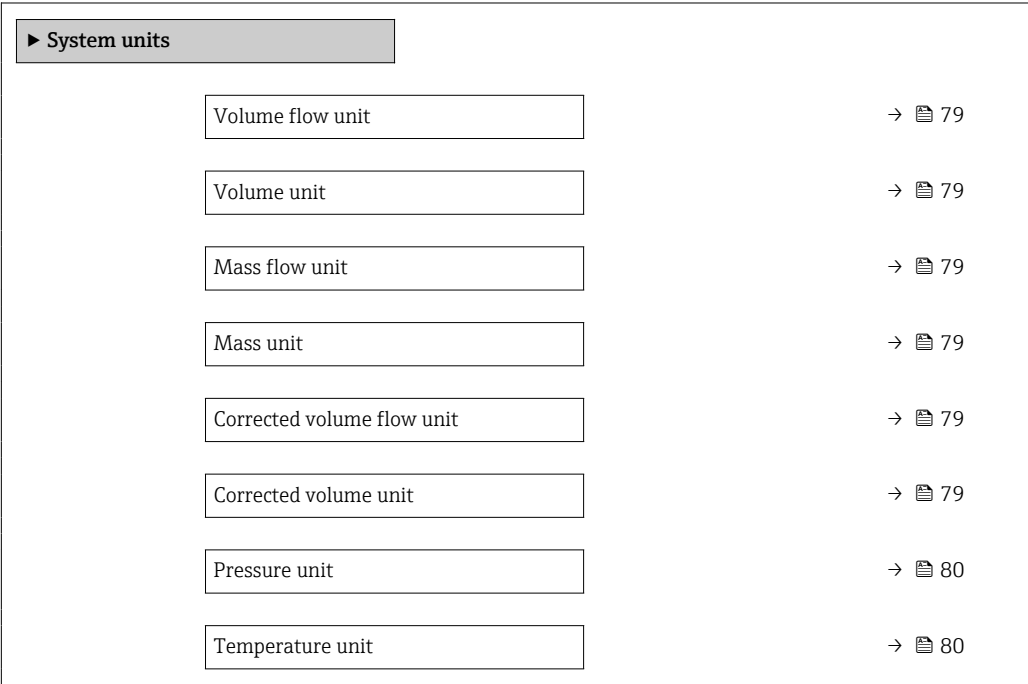
Parameter	Description	User entry	Factory setting
Device tag	Enter the name for the measuring point.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /).	Prowirl

10.4.2 Setting the system units

In the **System units** submenu the units of all the measured values can be set.

The number of submenus and parameters can vary depending on the device version. Certain submenus and parameters in these submenus are not described in the Operating Instructions. Instead a description is provided in the Special Documentation for the device ("Supplementary documentation").

Navigation
"Setup" menu → System units



Energy flow unit	→ 80
Energy unit	→ 80
Calorific value unit	→ 80
Calorific value unit	→ 81
Velocity unit	→ 81
Density unit	→ 81
Specific volume unit	→ 81
Dynamic viscosity unit	→ 81
Length unit	→ 81

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection	Factory setting
Volume flow unit	–	Select volume flow unit. <i>Effect</i> The selected unit applies to: - Output - Low flow cut off - Simulation process variable	Unit choose list	Country-specific: - m³/h - ft³/min
Volume unit	–	Select volume unit.	Unit choose list	Country-specific: - m³ - ft³
Mass flow unit	–	Select mass flow unit. <i>Effect</i> The selected unit applies to: - Output - Low flow cut off - Simulation process variable	Unit choose list	Country-specific: - kg/h - lb/min
Mass unit	–	Select mass unit.	Unit choose list	Country-specific: - kg - lb
Corrected volume flow unit	–	Select corrected volume flow unit. <i>Effect</i> The selected unit applies to: Corrected volume flow parameter (→ 141)	Unit choose list	Country-specific: - Nm³/h - Sft³/h
Corrected volume unit	–	Select corrected volume unit.	Unit choose list	Country-specific: - Nm³ - Sft³

Parameter	Prerequisite	Description	Selection	Factory setting
Pressure unit	With order code for "Sensor version": "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option	Select process pressure unit. <i>Effect</i> The unit is taken from: - Calculated saturated steam pressure - Atmospheric pressure - Maximum value - Fixed process pressure - Pressure - Reference pressure	Unit choose list	Country-specific: - bar - psi
Temperature unit	–	Select temperature unit. <i>Effect</i> The selected unit applies to: - Temperature - Maximum value - Minimum value - Average value - Maximum value - Minimum value - Maximum value - Minimum value 2nd temperature delta heat - Fixed temperature - Reference combustion temperature - Reference temperature - Saturation temperature	Unit choose list	Country-specific: °C °F
Energy flow unit	With order code for "Sensor version": "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option	Select energy flow unit. <i>Result</i> The selected unit applies to: Heat flow difference parameter Energy flow parameter	Unit choose list	Depends on country: - kW - Btu/h
Energy unit	With order code for "Sensor version": "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option	Select energy unit.	Unit choose list	Depends on country: - kWh - Btu
Calorific value unit	The following conditions are met: - Order code for "Sensor version", "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option - The Gross calorific value volume option or Net calorific value volume option is selected in the Calorific value type parameter.	Select calorific value unit. <i>Result</i> The selected unit applies to: Reference gross calorific value	Unit choose list	Depends on country: - kJ/Nm³ - Btu/Sft³

Parameter	Prerequisite	Description	Selection	Factory setting
Calorific value unit (Mass)	The following conditions are met: - Order code for "Sensor version", "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option - The Gross calorific value mass option or Net calorific value mass option is selected in the Calorific value type parameter.	Select calorific value unit.	Unit choose list	Depends on country: - kJ/kg - Btu/lb
Velocity unit	–	Select velocity unit. <i>Result</i> The selected unit applies to: - Flow velocity - Maximum value	Unit choose list	Depends on country: - m/s - ft/s
Density unit	–	Select density unit. <i>Effect</i> The selected unit applies to: - Output - Simulation process variable	Unit choose list	Country-specific: - kg/m³ - lb/ft³
Specific volume unit	With order code for "Sensor version": "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option	Select the unit for the specific volume. <i>Result</i> The selected unit applies to: Specific volume	Unit choose list	Depends on country: - m³/kg - ft³/lb
Dynamic viscosity unit	–	Select dynamic viscosity unit. <i>Result</i> The selected unit applies to: Dynamic viscosity parameter (gases) Dynamic viscosity parameter (liquids)	Unit choose list	Pa s
Length unit	–	Select length unit for nominal diameter.	- m - mm - ft - in	mm

10.4.3 Selecting and setting the medium

The **Medium selection** wizard systematically guides the user through all the parameters that must be configured in order to select and set the medium.

Navigation

"Setup" menu → Medium selection

► Medium selection	
Select medium	→ 82
Select gas type	→ 82
Gas type	→ 83
Relative humidity	→ 83
Select liquid type	→ 84
Steam calculation mode	→ 83
Steam quality	→ 83
Steam quality value	→ 84
Enthalpy calculation	→ 84
Density calculation	→ 85
Enthalpy type	→ 85

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Select medium	–	Select medium type.	- Gas - Liquid - Steam	Steam
Select gas type	The following conditions are met: - Order code for "Sensor version", - Option "Mass (integrated temperature measurement)" or - Option "Mass (integrated pressure/temperature measurement)" - The Gas option is selected in the Select medium parameter parameter.	Select measured gas type.	- Single gas - Gas mixture - Air - Natural gas - User-specific gas	User-specific gas

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Gas type	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Single gas option is selected.	Select measured gas type.	- Hydrogen H₂ - Helium He - Neon Ne - Argon Ar - Krypton Kr - Xenon Xe - Nitrogen N₂ - Oxygen O₂ - Chlorine Cl₂ - Ammonia NH₃ - Carbon monoxide CO - Carbon dioxide CO₂ - Sulfur dioxide SO₂ - Hydrogen sulfide H₂S - Hydrogen chloride HCl - Methane CH₄ - Ethane C₂H₆ - Propane C₃H₈ - Butane C₄H₁₀ - Ethylene C₂H₄ - Vinyl Chloride C₂H₃Cl	Methane CH ₄
Relative humidity	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Air option is selected.	Enter humidity content of air in %.	0 to 100 %	0 %
Steam calculation mode	The Steam option is selected in the Select medium parameter parameter.	Select calculation mode of steam: based on saturated steam (T-compensated) or automatic detection (p-/T-compensated).	- Saturated steam (T-compensated) - Automatic (p-/T-compensated)	Saturated steam (T-compensated)
Steam quality	The following conditions are met: - Order code for "Application package": - Option ES "Wet steam detection" - Option EU "Wet steam measurement" - The Steam option is selected in the Select medium parameter parameter.  The software options currently enabled are displayed in the Software option overview parameter.	Select compensation mode for steam quality.  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package →  211	- Fixed value - Calculated value	Fixed value

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Steam quality value	The following conditions are met: ■ The Steam option is selected in the Select medium parameter. ■ The Fixed value option is selected in the Steam quality parameter.	Enter fixed value for steam quality.  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package →  211	0 to 100 %	100 %
Select liquid type	The following conditions are met: ■ Order code for "Sensor version", ■ Option "Mass (integrated temperature measurement)" or ■ Option "Mass (integrated pressure/temperature measurement)" ■ The Liquid option is selected in the Select medium parameter.	Select measured liquid type.	■ Water ■ LPG (Liquefied Petroleum Gas) ■ User-specific liquid	Water
Fixed process pressure	The following conditions are met: ■ Order code for "Sensor version", ■ Option "Mass flow (integrated temperature measurement)" or ■ Option "Mass flow (integrated pressure/temperature measurement)" ■ In the External value parameter (→  86) the Pressure option is not selected.	Enter fixed value for process pressure. <i>Dependency</i> The unit is taken from the Pressure unit parameter.  For detailed information on the calculation of the measured variables with steam:  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package →  211	0 to 250 bar abs.	0 bar abs.
Enthalpy calculation	The following conditions are met: ■ Order code for "Sensor version", ■ Option "Mass (integrated temperature measurement)" or ■ Option "Mass (integrated pressure/temperature measurement)" ■ In the Select medium parameter, the Gas option is selected and in the Select gas type parameter, the Natural gas option is selected.	Select the norm the enthalpy calculation is based on.	■ AGA5 ■ ISO 6976	AGA5

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Density calculation	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected.	Select the norm the density calculation is based on.	- AGA Nx19 - ISO 12213- 2 - ISO 12213- 3	AGA Nx19
Enthalpy type	The following conditions are met: - In the Select gas type parameter, the User-specific gas option is selected. Or - In the Select liquid type parameter, the User-specific liquid option is selected.	Define which kind of enthalpy is used.	- Heat - Calorific value	Heat

10.4.4 Configuring the current input

The **"Current input" wizard** guides the user systematically through all the parameters that have to be set for configuring the current input.

Navigation

"Setup" menu → Current input

► Current input

External value

→ 86

Atmospheric pressure

→ 86

Current span

→ 86

4 mA value

→ 86

20 mA value

→ 86

Failure mode

→ 86

Failure value

→ 86

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
External value	With order code for "Sensor version": "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option	Assign variable from external device to process variable.  For detailed information on the calculation of the measured variables with steam:  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package → 211	- Off - Pressure - Gauge pressure - Density 2nd temperature delta heat	Off
Atmospheric pressure	In the External value parameter, the Gauge pressure option is selected.	Enter atmospheric pressure value to be used for pressure correction. <i>Dependency</i> The unit is taken from the Pressure unit parameter	0 to 250 bar	1.01325 bar
Current span	–	Select current range for process value output and upper/lower level for alarm signal.	4...20 mA 4...20 mA NAMUR 4...20 mA US	Country-specific: 4...20 mA NAMUR 4...20 mA US
4 mA value	–	Enter 4 mA value.	Signed floating-point number	0
20 mA value	–	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Failure mode	–	Define input behavior in alarm condition.	- Alarm - Last valid value - Defined value	Alarm
Failure value	In the Failure mode parameter, the Defined value option is selected.	Enter value to be used by the device if input value from external device is missing.	Signed floating-point number	0

10.4.5 Configuring the current output

The **Current output** wizard guides you systematically through all the parameters that have to be set for configuring the current output.

Navigation

"Setup" menu → Current output 1 to n

► Current output 1 to n		
Assign current output 1 to n	→	87
Current span	→	87
4 mA value	→	87
20 mA value	→	88
Fixed current	→	88
Damping output 1 to n	→	88
Failure mode	→	88
Failure current	→	88

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign current output	–	Select process variable for current output.	- Off - Volume flow - Corrected volume flow - Mass flow - Flow velocity - Temperature - Pressure - Calculated saturated steam pressure * - Steam quality * - Total mass flow * - Energy flow * - Heat flow difference *	Volume flow
Current span	–	Select current range for process value output and upper/lower level for alarm signal.	4...20 mA NAMUR 4...20 mA US 4...20 mA - Fixed current	Depends on country: 4...20 mA NAMUR 4...20 mA US
4 mA value	In Current span parameter (→ 87), one of the following options is selected: 4...20 mA NAMUR 4...20 mA US 4...20 mA	Enter 4 mA value.	Signed floating-point number	Depends on country: 0 m³/h 0 ft³/min

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
20 mA value	In Current span parameter (→  87), one of the following options is selected: ■ 4...20 mA NAMUR ■ 4...20 mA US ■ 4...20 mA	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Fixed current	The Fixed current option is selected in the Current span parameter (→  87).	Defines the fixed output current.	3.59 to 22.5 mA	4 mA
Damping output	A process variable is selected in the Assign current output parameter (→  87) and one of the following options is selected in the Current span parameter (→  87): ■ 4...20 mA NAMUR ■ 4...20 mA US ■ 4...20 mA	Set reaction time for output signal to fluctuations in the measured value.	0.0 to 999.9 s	1.0 s
Failure mode	A process variable is selected in the Assign current output parameter (→  87) and one of the following options is selected in the Current span parameter (→  87): ■ 4...20 mA NAMUR ■ 4...20 mA US ■ 4...20 mA	Define output behavior in alarm condition.	■ Min. ■ Max. ■ Last valid value ■ Actual value ■ Defined value	Max.
Failure current	The Defined value option is selected in the Failure mode parameter.	Enter current output value in alarm condition.	3.59 to 22.5 mA	22.5 mA

* Visibility depends on order options or device settings

10.4.6 Configuring the pulse/frequency/switch output

The **Pulse/frequency/switch output** wizard guides you systematically through all the parameters that can be set for configuring the selected output type.

Navigation

"Setup" menu → Pulse/frequency/switch output

Pulse/frequency/switch output

Operating mode

→  88

Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Operating mode	Define the output as a pulse, frequency or switch output.	■ Pulse ■ Frequency ■ Switch	Pulse

Configuring the pulse output

Navigation

"Setup" menu → Pulse/frequency/switch output

Pulse/frequency/switch output		
Assign pulse output 1		→ 89
Value per pulse		→ 89
Pulse width		→ 89
Failure mode		→ 89
Invert output signal		→ 89

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign pulse output 1	The Pulse option is selected in Operating mode parameter.	Select process variable for pulse output.	- Off - Volume flow - Corrected volume flow - Mass flow - Total mass flow * - Energy flow * - Heat flow difference *	Volume flow
Value per pulse	The Pulse option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign pulse output parameter (→ 89).	Enter measured value at which a pulse is output.	Positive floating point number	Depends on country and nominal diameter
Pulse width	The Pulse option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign pulse output parameter (→ 89).	Define time width of the output pulse.	5 to 2 000 ms	100 ms
Failure mode	The Pulse option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign pulse output parameter (→ 89).	Define output behavior in alarm condition.	- Actual value - No pulses	No pulses
Invert output signal	–	Invert the output signal.	- No - Yes	No

* Visibility depends on order options or device settings

Configuring the frequency output

Navigation

"Setup" menu → Pulse/frequency/switch output

Pulse/frequency/switch output		
Assign frequency output	→	📖 90
Minimum frequency value	→	📖 90
Maximum frequency value	→	📖 91
Measuring value at minimum frequency	→	📖 91
Measuring value at maximum frequency	→	📖 91
Failure mode	→	📖 91
Failure frequency	→	📖 91
Invert output signal	→	📖 91

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign frequency output	The Frequency option is selected in Operating mode parameter (→ 📖 88).	Select process variable for frequency output.	▪ Off ▪ Volume flow ▪ Corrected volume flow ▪ Mass flow ▪ Flow velocity ▪ Temperature ▪ Pressure ▪ Calculated saturated steam pressure * ▪ Steam quality * ▪ Total mass flow * ▪ Energy flow * ▪ Heat flow difference *	Off
Minimum frequency value	The Frequency option is selected in the Operating mode parameter (→ 📖 88) and a process variable is selected in the Assign frequency output parameter (→ 📖 90).	Enter minimum frequency.	0 to 1 000 Hz	0 Hz

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Maximum frequency value	The Frequency option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign frequency output parameter (→ 90).	Enter maximum frequency.	0 to 1000 Hz	1000 Hz
Measuring value at minimum frequency	The Frequency option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign frequency output parameter (→ 90).	Enter measured value for minimum frequency.	Signed floating-point number	Depends on country and nominal diameter
Measuring value at maximum frequency	The Frequency option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign frequency output parameter (→ 90).	Enter measured value for maximum frequency.	Signed floating-point number	Depends on country and nominal diameter
Failure mode	The Frequency option is selected in the Operating mode parameter (→ 88) and a process variable is selected in the Assign frequency output parameter (→ 90).	Define output behavior in alarm condition.	■ Actual value ■ Defined value ■ 0 Hz	0 Hz
Failure frequency	In the Operating mode parameter (→ 88), the Frequency option is selected, in the Assign frequency output parameter (→ 90) a process variable is selected, and in the Failure mode parameter, the Defined value option is selected.	Enter frequency output value in alarm condition.	0.0 to 1250.0 Hz	0.0 Hz
Invert output signal	–	Invert the output signal.	■ No ■ Yes	No

* Visibility depends on order options or device settings

Configuring the switch output

Navigation

"Setup" menu → Pulse/frequency/switch output

Pulse/frequency/switch output

Switch output function

→ 92

Assign diagnostic behavior

→ 92

Assign limit

→ 92

Assign status

→ 92

Switch-on value	→ 92
Switch-off value	→ 93
Switch-on delay	→ 93
Switch-off delay	→ 93
Failure mode	→ 93
Invert output signal	→ 93

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Switch output function	The Switch option is selected in the Operating mode parameter.	Select function for switch output.	- Off - On - Diagnostic behavior - Limit - Status	Off
Assign diagnostic behavior	- In the Operating mode parameter, the Switch option is selected. - In the Switch output function parameter, the Diagnostic behavior option is selected.	Select diagnostic behavior for switch output.	- Alarm - Alarm or warning - Warning	Alarm
Assign limit	- The Switch option is selected in Operating mode parameter. - The Limit option is selected in Switch output function parameter.	Select process variable for limit function.	- Volume flow - Corrected volume flow - Mass flow - Flow velocity - Temperature - Pressure - Calculated saturated steam pressure[*] - Steam quality[*] - Total mass flow[*] - Energy flow[*] - Heat flow difference[*] - Reynolds number[*] - Totalizer 1 - Totalizer 2 - Totalizer 3	Volume flow
Assign status	- The Switch option is selected in Operating mode parameter. - The Status option is selected in Switch output function parameter.	Select device status for switch output.	Low flow cut off	Low flow cut off
Switch-on value	- The Switch option is selected in the Operating mode parameter. - The Limit option is selected in the Switch output function parameter.	Enter measured value for the switch-on point.	Signed floating-point number	Depends on country: 0 m³/h 0 ft³/h

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Switch-off value	- The Switch option is selected in the Operating mode parameter. - The Limit option is selected in the Switch output function parameter.	Enter measured value for the switch-off point.	Signed floating-point number	Depends on country: 0 m³/h 0 ft³/h
Switch-on delay	- The Switch option is selected in the Operating mode parameter. - The Limit option is selected in the Switch output function parameter.	Define delay for the switch-on of status output.	0.0 to 100.0 s	0.0 s
Switch-off delay	- The Switch option is selected in the Operating mode parameter. - The Limit option is selected in the Switch output function parameter.	Define delay for the switch-off of status output.	0.0 to 100.0 s	0.0 s
Failure mode	–	Define output behavior in alarm condition.	- Actual status - Open - Closed	Open
Invert output signal	–	Invert the output signal.	- No - Yes	No

* Visibility depends on order options or device settings

10.4.7 Configuring the local display

The **Display** wizard guides you systematically through all the parameters that can be configured for configuring the local display.

Navigation

"Setup" menu → Display

► Display

Format display

→ 94

Value 1 display

→ 94

0% bargraph value 1

→ 94

100% bargraph value 1

→ 94

Value 2 display

→ 94

Value 3 display

→ 94

0% bargraph value 3

→ 94

100% bargraph value 3

→ 94

Value 4 display

→ 94

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Format display	A local display is provided.	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	A local display is provided.	Select the measured value that is shown on the local display.	■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure * ■ Steam quality * ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference * ■ Reynolds number * ■ Density * ■ Pressure * ■ Specific volume * ■ Degrees of superheat * ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3 ■ Current output 1 ■ Current output 2 *	Volume flow
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific: ■ 0 m³/h ■ 0 ft³/h
100% bargraph value 1	A local display is provided.	Enter 100% value for bar graph display.	Signed floating-point number	Depends on country and nominal diameter
Value 2 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
0% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific: ■ 0 m³/h ■ 0 ft³/h
100% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Value 5 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Value 6 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Value 7 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Value 8 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None

* Visibility depends on order options or device settings

10.4.8 Configuring the output conditioning

The **Output conditioning** wizard guides you systematically through all the parameters that have to be set for configuring the output conditioning.

Navigation

"Setup" menu → Output conditioning

► Output conditioning

Display damping

→ 95

Damping output 1

→ 95

Damping output 2

→ 95

Damping output 2

→ 95

Parameter overview with brief description

Parameter	Prerequisite	Description	User entry	Factory setting
Display damping	–	Set display reaction time to fluctuations in the measured value.	0.0 to 999.9 s	0.0 s
Damping output 1	–	Set the reaction time of the output signal of the current output to fluctuations in the measured value.	0 to 999.9 s	1 s
Damping output 2	The measuring device has a second current output.	Set the reaction time of the output signal of the second current output to fluctuations in the measured value.	0 to 999.9 s	1 s
Damping output 2	The measuring device has a pulse/frequency/switch output.	Set the reaction time of the output signal of the frequency output to fluctuations in the measured value.	0 to 999.9 s	1 s

10.4.9 Configuring the low flow cut off

The **Low flow cut off** wizard systematically guides the user through all the parameters that must be set to configure low flow cut off.

The measuring signal must have a certain minimum signal amplitude so that the signals can be evaluated without any errors. Using the nominal diameter, the corresponding flow can also be derived from this amplitude.

The minimum signal amplitude depends on the setting for the sensitivity of the DSC sensor, the steam quality **x** and the force of the vibrations present **a**.

The value **mf** corresponds to the lowest measurable flow velocity without vibration (no wet steam) for a density of 1 kg/m^3 (0.0624 lbm/ft^3).

The value **mf** can be set in the range of 20 to 6 m/s (6 to 1.8 ft/s) (factory setting 12 m/s (3.7 ft/s)) with the **Sensitivity** parameter (value range 1 to 9, factory setting 5).

The lowest flow velocity that can be measured on account of the signal amplitude **v_{AmpMin}** is derived from the **Sensitivity** parameter and steam quality **x** or from the force of vibrations present **a**.

Navigation

"Setup" menu → Low flow cut off

► Low flow cut off	
Sensitivity	→ 96
Turn down	→ 96

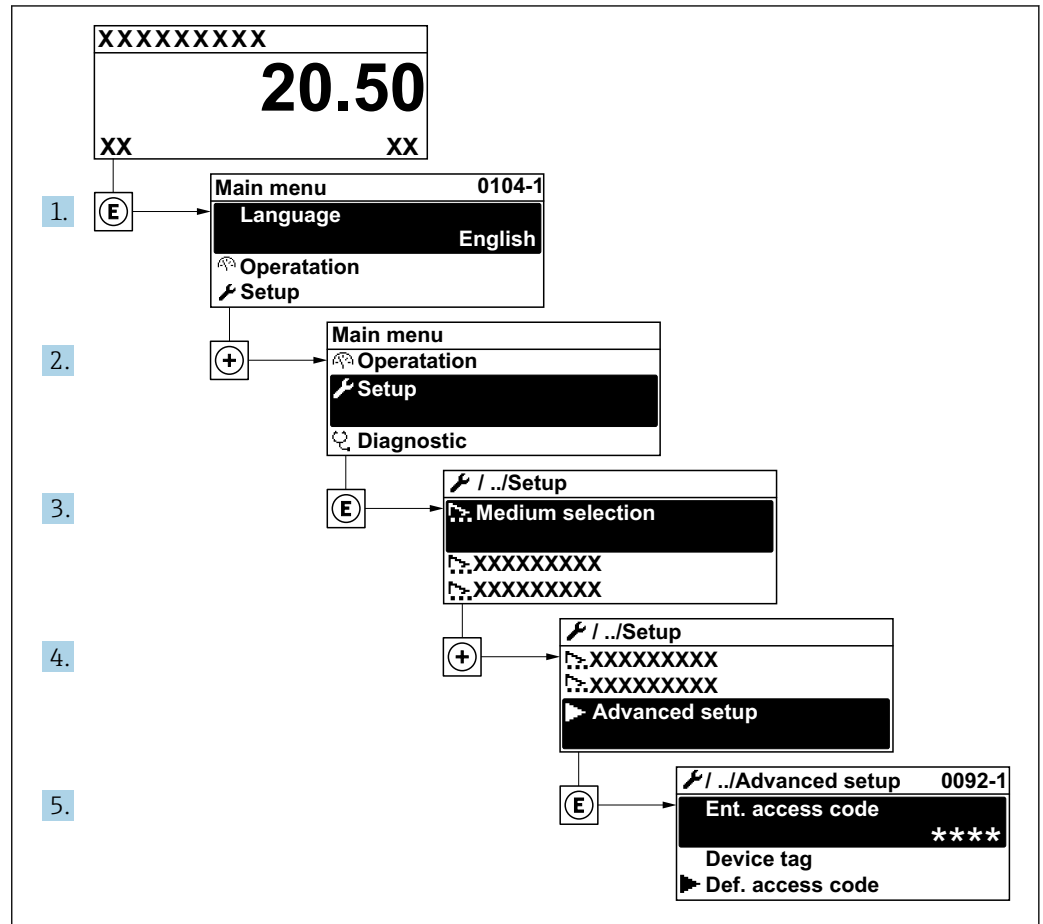
Parameter overview with brief description

Parameter	Description	User entry	Factory setting
Sensitivity	Adjust sensitivity of the device in the lower flow range. Lower sensitivity leads to more robustness against external interference. The parameter determines the level of sensitivity at the lower end of the measuring range (start of measuring range). Low values can improve the robustness of the device with regard to external influences. The start of measuring range is then set to a higher value. The smallest specified measuring range is when sensitivity is at a maximum.	1 to 9	5
Turn down	Adjust the turn down. Lower turn down increases the minimum measureable flow frequency. The measuring range can be limited with this parameter, if necessary. The upper end of the measuring range is not affected. The start of the low end of the measuring range can be changed to a higher flow value, making it possible to cut off low flows, for example.	50 to 100 %	100 %

10.5 Advanced settings

The **Advanced setup** submenu with its submenus contains parameters for specific settings.

Navigation to the "Advanced setup" submenu

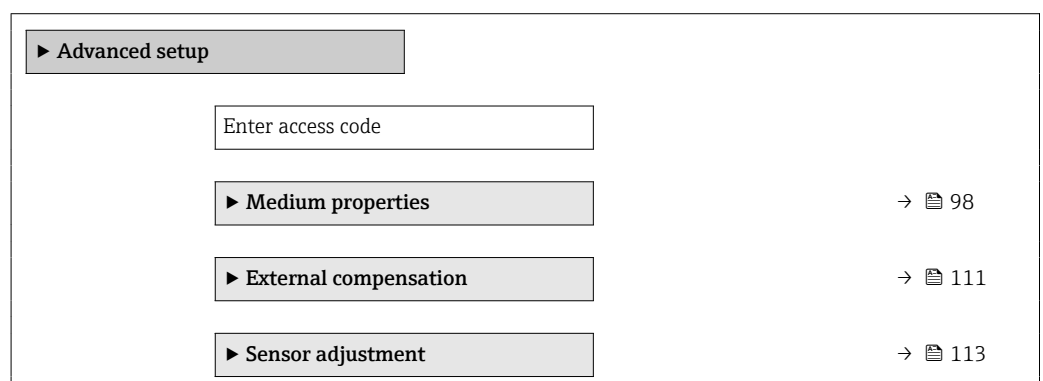


A0034208-EN

i The number of submenus and parameters can vary depending on the device version. Certain submenus and parameters in these submenus are not described in the Operating Instructions. Instead a description is provided in the Special Documentation for the device ("Supplementary documentation").

Navigation

"Setup" menu → Advanced setup



► Totalizer 1 to n	→ 116
► SIL confirmation	
► Deactivate SIL	
► Display	→ 118
► Heartbeat setup	
► Configuration backup display	→ 121
► Administration	→ 122

10.5.1 Setting the medium properties

In the **Medium properties** submenu the reference values for the measuring application can be set.

Navigation

"Setup" menu → Advanced setup → Medium properties

► Medium properties	
Enthalpy type	→ 99
Calorific value type	→ 99
Reference combustion temperature	→ 99
Reference density	→ 99
Reference gross calorific value	→ 99
Reference pressure	→ 100
Reference temperature	→ 100
Reference Z-factor	→ 100
Linear expansion coefficient	→ 100
Relative density	→ 100
Specific heat capacity	→ 100
Calorific value	→ 101
Z-factor	→ 101

Dynamic viscosity	→ 101
Dynamic viscosity	→ 101
► Gas composition	→ 101

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Enthalpy type	The following conditions are met: - In the Select gas type parameter, the User-specific gas option is selected. - Or - In the Select liquid type parameter, the User-specific liquid option is selected.	Define which kind of enthalpy is used.	- Heat - Calorific value	Heat
Calorific value type	The Calorific value type parameter is visible.	Select calculation based on gross calorific value or net calorific value.	- Gross calorific value volume - Net calorific value volume - Gross calorific value mass - Net calorific value mass	Gross calorific value mass
Reference combustion temperature	The Reference combustion temperature parameter is visible.	Enter reference combustion temperature to calculate the natural gas energy value. <i>Dependency</i> The unit is taken from the Temperature unit parameter	-200 to 450 °C	20 °C
Reference density	The following conditions are met: - In the Select gas type parameter, the User-specific gas option is selected. - Or - In the Select liquid type parameter, the Water option or User-specific liquid option is selected.	Enter fixed value for reference density. <i>Dependency</i> The unit is taken from the Density unit parameter	0.01 to 15 000 kg/m ³	1 000 kg/m ³
Reference gross calorific value	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-3 option is selected.	Enter reference gross calorific value of the natural gas. <i>Dependency</i> The unit is taken from the Calorific value unit parameter	Positive floating-point number	50 000 kJ/Nm ³

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Reference pressure	The following conditions are met: - Order code for "Sensor version", - Option "Mass (integrated temperature measurement)" or - Option "Mass (integrated pressure/temperature measurement)" - The Gas option is selected in the Select medium parameter parameter.	Enter reference pressure for the calculation of the reference density. <i>Dependency</i> The unit is taken from the Pressure unit parameter.	0 to 250 bar	1.01325 bar
Reference temperature	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - Or - In the Select medium parameter, the Liquid option is selected.	Enter reference temperature for calculating the reference density. <i>Dependency</i> The unit is taken from: Temperature unit parameter	-200 to 450 °C	0 °C
Reference Z-factor	In the Select gas type parameter, the User-specific gas option is selected.	Enter real gas constant Z for gas under reference conditions.	0.1 to 2	1
Linear expansion coefficient	The following conditions are met: - The Liquid option is selected in the Select medium parameter. - The User-specific liquid option is selected in the Select liquid type parameter.	Enter linear, medium-specific expansion coefficient for calculating the reference density.	$1.0 \cdot 10^{-6}$ to $2.0 \cdot 10^{-3}$	$2.06 \cdot 10^{-4}$
Relative density	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-3 option is selected.	Enter a relative density of the natural gas.	0.55 to 0.9	0.664
Specific heat capacity	The following conditions are met: - Selected medium: - In the Select gas type parameter, the User-specific gas option is selected. - Or - In the Select liquid type parameter, the User-specific liquid option is selected. - In the Enthalpy type parameter, the Heat option is selected.	Enter the specific heat capacity of the medium. <i>Dependency</i> The unit is taken from the Specific heat capacity unit parameter	0 to 50 kJ/(kgK)	4.187 kJ/(kgK)

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Calorific value	The following conditions are met: - Selected medium: - In the Select gas type parameter, the User-specific gas option is selected. - Or - In the Select liquid type parameter, the User-specific liquid option is selected. - In the Enthalpy type parameter, the Calorific value option is selected. - In the Calorific value type parameter, the Gross calorific value volume option or Gross calorific value mass option is selected.	Enter gross calorific value to calculate the energy flow.	Positive floating-point number	50 000 kJ/kg
Z-factor	In the Select gas type parameter, the User-specific gas option is selected.	Enter real gas constant Z for gas under operation conditions.	0.1 to 2.0	1
Dynamic viscosity (Gases)	The following conditions are met: - Order code for "Sensor version", - Option "Volume" or - Option "Volume high temperature" - The Gas option or the Steam option is selected in the Select medium parameter. - or - The User-specific gas option is selected in the Select gas type parameter.	Enter fixed value for dynamic viscosity for a gas/steam. <i>Dependency</i> The unit is taken from the Dynamic viscosity unit parameter.	Positive floating-point number	0.015 cP
Dynamic viscosity (Liquids)	The following conditions are met: - Order code for "Sensor version", - Option "Volume" or - Option "Volume high temperature" - The Liquid option is selected in the Select medium parameter. - or - The User-specific liquid option is selected in the Select liquid type parameter.	Enter fixed value for dynamic viscosity for a liquid. <i>Dependency</i> The unit is taken from the Dynamic viscosity unit parameter.	Positive floating-point number	1 cP

Configuring the gas composition

In the **Gas composition** submenu the gas composition for the measuring application can be set.

Navigation

"Setup" menu → Advanced setup → Medium properties → Gas composition

► Gas composition		
Gas mixture	→	📖 104
Mol% Ar	→	📖 104
Mol% C ₂ H ₃ Cl	→	📖 104
Mol% C ₂ H ₄	→	📖 105
Mol% C ₂ H ₆	→	📖 105
Mol% C ₃ H ₈	→	📖 105
Mol% CH ₄	→	📖 105
Mol% Cl ₂	→	📖 106
Mol% CO	→	📖 106
Mol% CO ₂	→	📖 106
Mol% H ₂	→	📖 106
Mol% H ₂ O	→	📖 107
Mol% H ₂ S	→	📖 107
Mol% HCl	→	📖 107
Mol% He	→	📖 107
Mol% i-C ₄ H ₁₀	→	📖 108
Mol% i-C ₅ H ₁₂	→	📖 108
Mol% Kr	→	📖 108
Mol% N ₂	→	📖 108
Mol% n-C ₁₀ H ₂₂	→	📖 108
Mol% n-C ₄ H ₁₀	→	📖 109
Mol% n-C ₅ H ₁₂	→	📖 109

Mol% n-C ₆ H ₁₄	→ 109
Mol% n-C ₇ H ₁₆	→ 109
Mol% n-C ₈ H ₁₈	→ 110
Mol% n-C ₉ H ₂₀	→ 110
Mol% Ne	→ 110
Mol% NH ₃	→ 110
Mol% O ₂	→ 110
Mol% SO ₂	→ 111
Mol% Xe	→ 111
Mol% other gas	→ 111

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Gas mixture	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected.	Select measured gas mixture.	- Hydrogen H₂ - Helium He - Neon Ne - Argon Ar - Krypton Kr - Xenon Xe - Nitrogen N₂ - Oxygen O₂ - Chlorine Cl₂ - Ammonia NH₃ - Carbon monoxide CO - Carbon dioxide CO₂ - Sulfur dioxide SO₂ - Hydrogen sulfide H₂S - Hydrogen chloride HCl - Methane CH₄ - Ethane C₂H₆ - Propane C₃H₈ - Butane C₄H₁₀ - Ethylene C₂H₄ - Vinyl Chloride C₂H₃Cl - Others	Methane CH ₄
Mol% Ar	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Argon Ar option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% C ₂ H ₃ Cl	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Vinyl Chloride C₂H₃Cl option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% C ₂ H ₄	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Ethylene C₂H₄ option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% C ₂ H ₆	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Ethane C₂H₆ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% C ₃ H ₈	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Propane C₃H₈ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% CH ₄	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Methane CH₄ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	100 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% Cl ₂	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Chlorine Cl₂ option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% CO	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Carbon monoxide CO option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% CO ₂	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Carbon dioxide CO₂ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% H ₂	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Hydrogen H₂ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the AGA N_x19 option is not selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% H ₂ O	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% H ₂ S	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Hydrogen sulfide H₂S option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% HCl	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Hydrogen chloride HCl option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% He	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Helium He option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% i-C ₄ H ₁₀	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% i-C ₅ H ₁₂	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% Kr	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Krypton Kr option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% N ₂	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Nitrogen N₂ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the AGA N_x19 option or the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% n-C ₁₀ H ₂₂	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% n-C ₄ H ₁₀	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Butane C₄H₁₀ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213- 2 option is selected. - Or - In the Select medium parameter, the Liquid option is selected and in the Select liquid type parameter, the LPG option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% n-C ₅ H ₁₂	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213- 2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% n-C ₆ H ₁₄	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213- 2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% n-C ₇ H ₁₆	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213- 2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% n-C ₈ H ₁₈	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% n-C ₉ H ₂₀	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Natural gas option is selected. - In the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% Ne	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Neon Ne option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% NH ₃	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Ammonia NH₃ option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% O ₂	The following conditions are met: In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected and in the Gas mixture parameter, the Oxygen O₂ option is selected. Or - In the Select gas type parameter, the Natural gas option is selected and in the Density calculation parameter, the ISO 12213-2 option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Mol% SO ₂	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Sulfur dioxide SO₂ option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% Xe	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Xenon Xe option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% other gas	The following conditions are met: - In the Select medium parameter, the Gas option is selected. - In the Select gas type parameter, the Gas mixture option is selected. - In the Gas mixture parameter, the Others option is selected.	Enter amount of substance for the gas mixture.	0 to 100 %	0 %

10.5.2 Performing external compensation

The **External compensation** submenu contains parameters which can be used to enter external or fixed values. These values are used for internal calculations.

Navigation

"Setup" menu → Advanced setup → External compensation

► External compensation

External value

→ 112

Atmospheric pressure

→ 112

Delta heat calculation

→ 112

Fixed density

→ 112

Fixed density

→ 112

Fixed temperature

→ 112

2nd temperature delta heat	→ 113
Fixed process pressure	→ 113

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
External value	With order code for "Sensor version": ■ "Mass (integrated temperature measurement)" option or ■ "Mass (integrated pressure/temperature measurement)" option	Assign variable from external device to process variable.  For detailed information on the calculation of the measured variables with steam:  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package → 211	■ Off ■ Pressure ■ Gauge pressure ■ Density ■ 2nd temperature delta heat	Off
Atmospheric pressure	In the External value parameter, the Gauge pressure option is selected.	Enter atmospheric pressure value to be used for pressure correction. <i>Dependency</i> The unit is taken from the Pressure unit parameter	0 to 250 bar	1.01325 bar
Delta heat calculation	The Delta heat calculation parameter is visible.	Calculates the transferred heat of a heat exchanger (= delta heat).	■ Off ■ Device on cold side ■ Device on warm side	Device on warm side
Fixed density	With order code for "Sensor version": ■ Option "Volume" - or ■ Option "Volume high temperature"	Enter fixed value for medium density. <i>Dependency</i> The unit is taken from the Density unit parameter.	0.01 to 15 000 kg/m ³	1 000 kg/m ³
Fixed density	With order code for "Sensor version": ■ Option "Volume" - or ■ Option "Volume high temperature"	Enter fixed value for medium density. <i>Dependency</i> The unit is taken from the Density unit parameter.	0.01 to 15 000 kg/m ³	5 kg/m ³
Fixed temperature	–	Enter a fixed value for process temperature. <i>Dependency</i> The unit is taken from the Temperature unit parameter	–200 to 450 °C	20 °C

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
2nd temperature delta heat	The 2nd temperature delta heat parameter is visible.	Enter 2nd temperature value to calculate the delta heat. <i>Dependency</i> The unit is taken from the Temperature unit parameter	–200 to 450 °C	20 °C
Fixed process pressure	The following conditions are met: - Order code for "Sensor version", - Option "Mass flow (integrated temperature measurement)" or - Option "Mass flow (integrated pressure/temperature measurement)" - In the External value parameter (→ 86) the Pressure option is not selected.	Enter fixed value for process pressure. <i>Dependency</i> The unit is taken from the Pressure unit parameter.  For detailed information on the calculation of the measured variables with steam:  For detailed information on setting the parameter in steam applications, see the Special Documentation for the Wet Steam Detection and Wet Steam Measurement application package → 211	0 to 250 bar abs.	0 bar abs.

10.5.3 Carrying out a sensor adjustment

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

Navigation

"Setup" menu → Advanced setup → Sensor adjustment

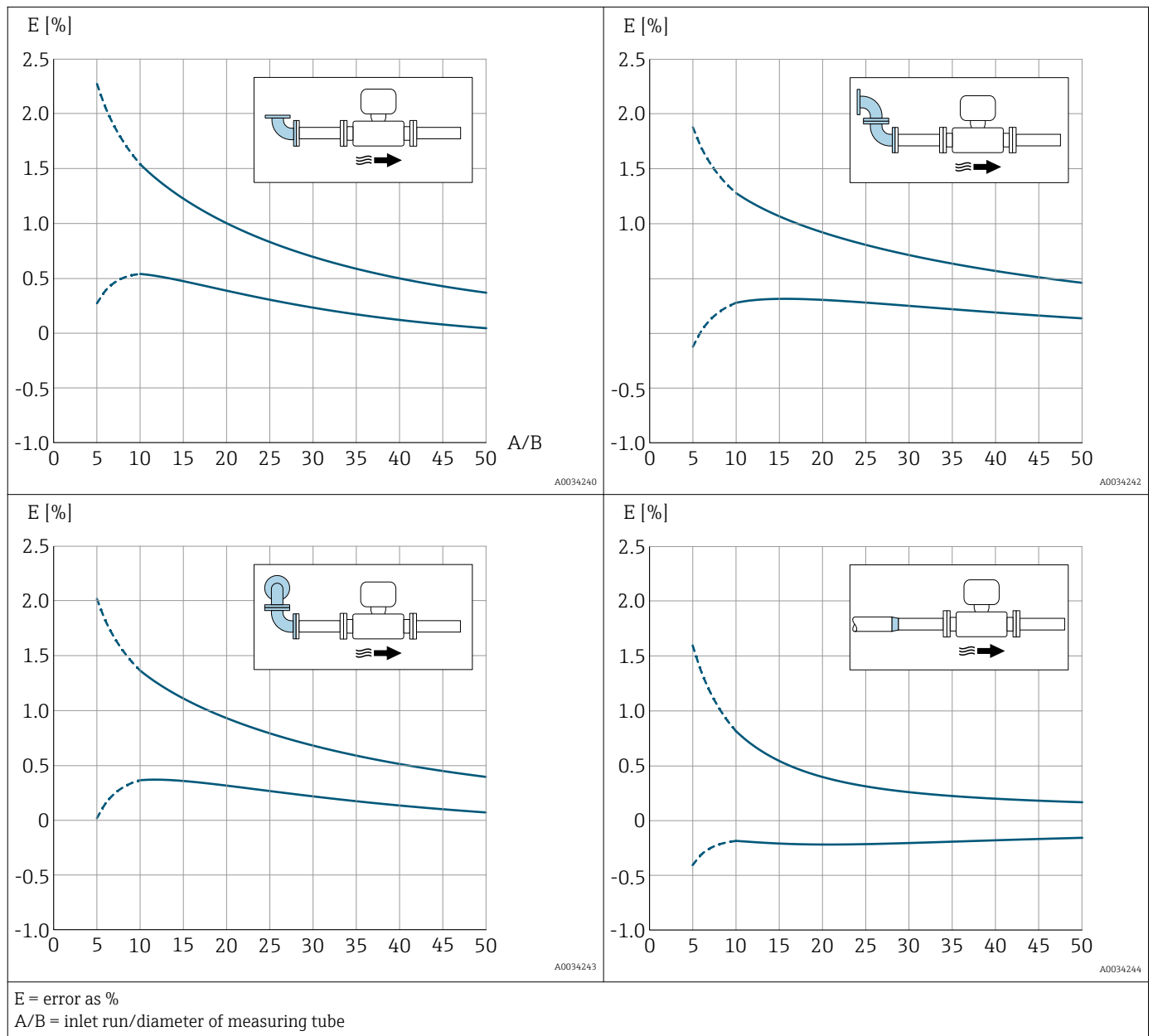
► Sensor adjustment	
Inlet configuration	→ 114
Inlet run	→ 114
Mating pipe diameter	→ 114
Installation factor	→ 114

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Inlet configuration	The inlet run correction feature: - Is a standard feature and can only be used in the Prowirl F 200. - Can be used for the following pressure ratings and nominal diameters: DN 15 to 150 (NPS 1 to 6) - EN (DIN) - ASME B16.5, Sch. 40/80 - JIS B2220	Select inlet configuration.	- Off - Single elbow - Double elbow - Double elbow 3D - Reduction	Off
Inlet run	The inlet run correction feature: - Is a standard feature and can only be used in the Prowirl F 200. - Can be used for the following pressure ratings and nominal diameters: DN 15 to 150 (NPS 1 to 6) - EN (DIN) - ASME B16.5, Sch. 40/80 - JIS B2220	Define length of the straight inlet run. <i>Dependency</i> The unit is taken from: Length unit parameter	0 to 20 m	0 m
Mating pipe diameter	–	Enter diameter of mating pipe to enable diameter mismatch correction. Detailed information on diameter mismatch correction: → 115 <i>Dependency</i> The unit is taken from the Length unit parameter.	0 to 1 m (0 to 3 ft) Input value = 0: Diameter mismatch correction is disabled.	Country-specific: 0 m 0 ft
Installation factor	–	Enter factor to adjust for installation conditions.	Positive floating-point number	1.0

Inlet run correction

The **Inlet Run Correction** feature of Endress+Hauser's measuring device presents an economic method for shortening the inlet run and does not generate any additional pressure loss. The typical systematic errors caused by the pipe component in question are corrected.

Effect on accuracy of reduced, straight inlet run**Diameter mismatch correction**

The measuring device is calibrated according to the ordered process connection. This calibration takes account of the edge at the transition from the mating pipe to the process connection. If the mating pipe used deviates from the ordered process connection, a diameter mismatch correction can compensate for the effects. The difference between the internal diameter of the ordered process connection and the internal diameter of the mating pipe used must be taken into consideration.

The measuring device can correct shifts in the calibration factor which are caused, for example, by a diameter mismatch between the device flange (e.g. ASME B16.5/Sch. 80, DN 50 (2")) and the mating pipe (e.g. ASME B16.5/Sch. 40, DN 50 (2")). Only apply diameter mismatch correction within the following limit values (listed below) for which test measurements have also been performed.

Flange connection:

- DN 15 (½"): ±20 % of the internal diameter
- DN 25 (1"): ±15 % of the internal diameter
- DN 40 (1½"): ±12 % of the internal diameter
- DN ≥ 50 (2"): ±10 % of the internal diameter

If the standard internal diameter of the ordered process connection differs from the internal diameter of the mating pipe, an additional measuring uncertainty of approx. 2 % o.r. must be expected.

Example

Influence of the diameter mismatch without using the correction function:

- Mating pipe DN 100 (4"), Schedule 80
- Device flange DN 100 (4"), Schedule 40
- This installation position results in a diameter mismatch of 5 mm (0.2 in). If the correction function is not used, an additional measuring uncertainty of approx. 2 % o.r. must be expected.
- If the basic conditions are met and the feature is enabled, the additional measuring uncertainty is 1 % o.r.

10.5.4 Configuring the totalizer

In the "Totalizer 1 to n" submenu, you can configure the specific totalizer.

Navigation

"Setup" menu → Advanced setup → Totalizer 1 to n

► Totalizer 1 to n	
Assign process variable	→ 117
Unit totalizer 1 to n	→ 117
Failure mode	→ 117

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection	Factory setting
Assign process variable	–	Select process variable for totalizer.	■ Off ■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference *	■ Totalizer 1: Volume flow ■ Totalizer 2: Mass flow ■ Totalizer 3: Corrected volume flow
Unit totalizer 1 to n	A process variable is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu.	Select process variable totalizer unit.	Unit choose list	Depends on country: ■ m³ ■ ft³
Failure mode	A process variable is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu.	Define totalizer behavior in alarm condition.	■ Stop ■ Actual value ■ Last valid value	Stop

* Visibility depends on order options or device settings

10.5.5 Carrying out additional display configurations

In the **Display** submenu you can set all the parameters associated with the configuration of the local display.

Navigation

"Setup" menu → Advanced setup → Display

► Display		
Format display	→	📖 119
Value 1 display	→	📖 119
0% bargraph value 1	→	📖 119
100% bargraph value 1	→	📖 119
Decimal places 1	→	📖 119
Value 2 display	→	📖 119
Decimal places 2	→	📖 119
Value 3 display	→	📖 119
0% bargraph value 3	→	📖 119
100% bargraph value 3	→	📖 120
Decimal places 3	→	📖 120
Value 4 display	→	📖 120
Decimal places 4	→	📖 120
Language	→	📖 120
Display interval	→	📖 120
Display damping	→	📖 120
Header	→	📖 120
Header text	→	📖 120
Separator	→	📖 120
Backlight	→	📖 120

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Format display	A local display is provided.	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	A local display is provided.	Select the measured value that is shown on the local display.	■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure * ■ Steam quality * ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference * ■ Reynolds number * ■ Density * ■ Pressure * ■ Specific volume * ■ Degrees of superheat * ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3 ■ Current output 1 ■ Current output 2 *	Volume flow
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific: ■ 0 m³/h ■ 0 ft³/h
100% bargraph value 1	A local display is provided.	Enter 100% value for bar graph display.	Signed floating-point number	Depends on country and nominal diameter
Decimal places 1	A measured value is specified in the Value 1 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	x.xx
Value 2 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Decimal places 2	A measured value is specified in the Value 2 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	x.xx
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
0% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific: ■ 0 m³/h ■ 0 ft³/h

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
100% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Decimal places 3	A measured value is specified in the Value 3 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	x.xx
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see Value 1 display parameter (→ 94)	None
Decimal places 4	A measured value is specified in the Value 4 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	x.xx
Language	A local display is provided.	Set display language.	■ English ■ Deutsch * ■ Français * ■ Español * ■ Italiano * ■ Nederlands * ■ Portuguesa * ■ Polski * ■ русский язык (Russian) * ■ Svenska * ■ Türkçe * ■ 中文 (Chinese) * ■ 日本語 (Japanese) * ■ 한국어 (Korean) * ■ tiếng Việt (Vietnamese) * ■ čeština (Czech) *	English (alternatively, the ordered language is preset in the device)
Display interval	A local display is provided.	Set time measured values are shown on display if display alternates between values.	1 to 10 s	5 s
Display damping	A local display is provided.	Set display reaction time to fluctuations in the measured value.	0.0 to 999.9 s	0.0 s
Header	A local display is provided.	Select header contents on local display.	■ Device tag ■ Free text	Device tag
Header text	The Free text option is selected in the Header parameter.	Enter display header text.	Max. 12 characters, such as letters, numbers or special characters (e.g. @, %, /)	-----
Separator	A local display is provided.	Select decimal separator for displaying numerical values.	■ . (point) ■ , (comma)	. (point)
Backlight	Order code for "Display; operation", option E "SD03 4-line, illum.; touch control + data backup function"	Switch the local display backlight on and off.	■ Disable ■ Enable	Disable

* Visibility depends on order options or device settings

10.5.6 Configuration management

After commissioning, you can save the current device configuration, copy it to another measuring point or restore the previous device configuration. The device configuration is managed via the **Configuration management** parameter.

Navigation

"Setup" menu → Advanced setup → Configuration backup display

► Configuration backup display	
Operating time	→ 121
Last backup	→ 121
Configuration management	→ 121
Comparison result	→ 121

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface / Selection	Factory setting
Operating time	–	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)	–
Last backup	A local display is provided.	Indicates when the last data backup was saved to the display module.	Days (d), hours (h), minutes (m) and seconds (s)	–
Configuration management	A local display is provided.	Select action for managing the device data in the display module.	■ Cancel ■ Execute backup ■ Restore ■ Duplicate ■ Compare ■ Clear backup data	Cancel
Comparison result	A local display is provided.	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

Function range of "Configuration management" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
Execute backup	A backup copy of the current device configuration is saved from the HistoROM backup to the display module of the device. The backup copy includes the transmitter data of the device.

Options	Description
Restore	The complete backup data from the original device is restored. This option may be used only with the original device and not with another device. The comparison function must be used to verify the serial numbers before the restore option can be used.
Compare	The device configuration saved in the display module is compared with the current device configuration of the HistoROM backup.
Duplicate	The transmitter configuration from another device is duplicated to the device using the display module.
Clear backup data	The backup copy of the device configuration is deleted from the display module of the device.

HistoROM backup

A HistoROM is a "non-volatile" device memory in the form of an EEPROM.

 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.

10.5.7 Using parameters for device administration

The **Administration** submenu systematically guides the user through all the parameters that can be used for device administration purposes.

Navigation

"Setup" menu → Advanced setup → Administration

► Administration

► Define access code

Device reset (0000) →  122

Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Device reset	Reset the device configuration - either entirely or in part - to a defined state.	- Cancel - To factory defaults - To delivery settings - Restart device	Cancel

"Define access code" wizard

Complete this wizard to specify an access code for the Maintenance role.

Navigation

"Setup" menu → Advanced setup → Administration → Define access code → Define access code

► Define access code

Define access code	→ 123
Confirm access code	→ 123

Parameter overview with brief description

Parameter	Description	User entry
Define access code	Restrict write-access to parameters to protect the configuration of the device against unintentional changes.	Max. 16-digit character string comprising numbers, letters and special characters
Confirm access code	Confirm the entered access code.	Max. 16-digit character string comprising numbers, letters and special characters

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. The device configuration is managed via the **Configuration management** parameter.

Navigation

"Setup" menu → Advanced setup → Configuration backup display

► Configuration backup display

Operating time

→  121

Last backup

→  121

Configuration management

→  121

Comparison result

→  121

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface / Selection	Factory setting
Operating time	–	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)	–
Last backup	A local display is provided.	Indicates when the last data backup was saved to the display module.	Days (d), hours (h), minutes (m) and seconds (s)	–

Parameter	Prerequisite	Description	User interface / Selection	Factory setting
Configuration management	A local display is provided.	Select action for managing the device data in the display module.	■ Cancel ■ Execute backup ■ Restore ■ Duplicate ■ Compare ■ Clear backup data	Cancel
Comparison result	A local display is provided.	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

10.6.1 Function range of "Configuration management" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
Execute backup	A backup copy of the current device configuration is saved from the HistoROM backup to the display module of the device. The backup copy includes the transmitter data of the device.
Restore	The complete backup data from the original device is restored. This option may be used only with the original device and not with another device. The comparison function must be used to verify the serial numbers before the restore option can be used.
Compare	The device configuration saved in the display module is compared with the current device configuration of the HistoROM backup.
Duplicate	The transmitter configuration from another device is duplicated to the device using the display module.
Clear backup data	The backup copy of the device configuration is deleted from the display module of the device.

HistoROM backup

A HistoROM is a "non-volatile" device memory in the form of an EEPROM.

 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.

10.7 Simulation

Via the **Simulation** submenu, it is possible to simulate various process variables in the process and the device alarm mode and verify downstream signal chains (switching valves or closed-control loops). The simulation can be performed without a real measurement (no flow of medium through the device).

Navigation

"Diagnostics" menu → Simulation

► Simulation		
Assign simulation process variable	→	📄 126
Process variable value	→	📄 126
Current input 1 simulation	→	📄 126
Value current input 1	→	📄 126
Current output 1 to n simulation	→	📄 126
Value current output 1 to n	→	📄 126
Frequency output simulation	→	📄 126
Frequency value	→	📄 126
Pulse output simulation	→	📄 126
Pulse value	→	📄 126
Switch output simulation	→	📄 126
Switch status	→	📄 127
Device alarm simulation	→	📄 127
Diagnostic event category	→	📄 127
Diagnostic event simulation	→	📄 127

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 ■ Flow velocity ■ Volume flow ■ Corrected volume flow ■ Temperature ■ Calculated saturated steam pressure * ■ Steam quality * ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow ■ Heat flow difference * ■ Reynolds number	Off
Process variable value	A process variable is selected in the Assign simulation process variable parameter (→ 126).	Enter the simulation value for the selected process variable.	Depends on the process variable selected	0
Current input 1 simulation	–	Switch simulation of the current input on and off.	■ Off ■ On	Off
Value current input 1	In the Current input simulation parameter, the On option is selected.	Enter the current value for simulation.	3.59 to 22.5 mA	3.59 mA
Current output 1 to n simulation	–	Switch the simulation of the current output on and off.	■ Off ■ On	Off
Value current output 1 to n	In the Current output 1 to n simulation parameter, the On option is selected.	Enter the current value for simulation.	3.59 to 22.5 mA	3.59 mA
Frequency output simulation	In the Operating mode parameter, the Frequency option is selected.	Switch the simulation of the frequency output on and off.	■ Off ■ On	Off
Frequency value	In the Frequency output simulation parameter, the On option is selected.	Enter the frequency value for the simulation.	0.0 to 1 250.0 Hz	0.0 Hz
Pulse output simulation	In the Operating mode parameter, the Pulse option is selected.	Set and switch off the pulse output simulation.  For Fixed value option: Pulse width parameter (→ 89) defines the pulse width of the pulses output.	■ Off ■ Fixed value ■ Down-counting value	Off
Pulse value	In the Pulse output simulation parameter (→ 126), the Down-counting value option is selected.	Enter the number of pulses for simulation.	0 to 65 535	0
Switch output simulation	In the Operating mode parameter, the Switch option is selected.	Switch the simulation of the switch output on and off.	■ Off ■ On	Off

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Switch status	In the Switch output simulation parameter (→ 126) Switch output simulation 1 to n parameter Switch output simulation 1 to n parameter, the On option is selected.	Select the status of the status output for the simulation.	- Open - Closed	Open
Device alarm simulation	–	Switch the device alarm on and off.	- Off - On	Off
Diagnostic event category	–	Select a diagnostic event category.	- Sensor - Electronics - Configuration - Process	Process
Diagnostic event simulation	–	Select a diagnostic event to simulate this event.	- Off - Diagnostic event picklist (depends on the category selected)	Off

* Visibility depends on order options or device settings

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
- Write protection via write protection switch
- Write protection via keypad lock

10.8.1 Write protection via access code

The effects of the user-specific access code are as follows:

- Via local operation, the parameters for the measuring device configuration are write-protected and their values can no longer be changed.
- Device access is protected via the Web browser, as are the parameters for the measuring device configuration.

Defining the access code via the local display

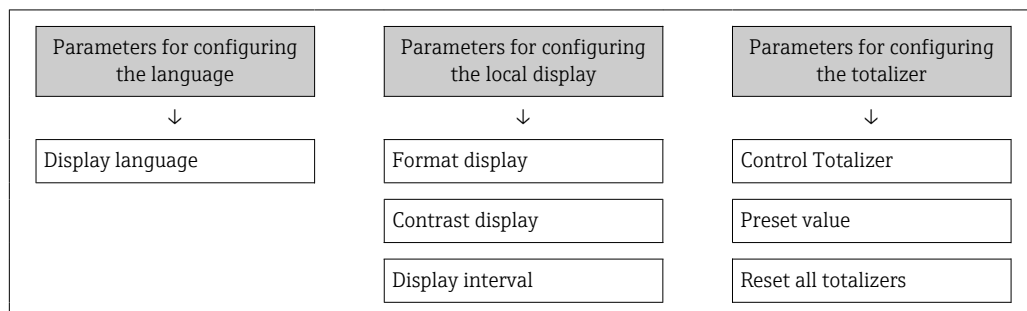
- Navigate to the **Enter access code** parameter.
- Maximum of 16-digit character string comprising numbers, letters and special characters as the access code.
- Enter the access code again in the to confirm.

↳ The  symbol appears in front of all write-protected parameters.

-  Disabling parameter write protection via access code → 65.
 - If the access code is lost: Resetting the access code .
 - The user role with which the user is currently logged in is displayed in **Access status display** parameter.
 - Navigation path: Operation → Access status display
 - User roles and their access rights → 65
- 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 operational display mode from the navigation and editing view.

Parameters which can always be modified via the local display

Certain parameters that do not affect the measurement are excepted from parameter write protection via the local display. Despite the user-specific access code, they can always be modified, even if the other parameters are locked.

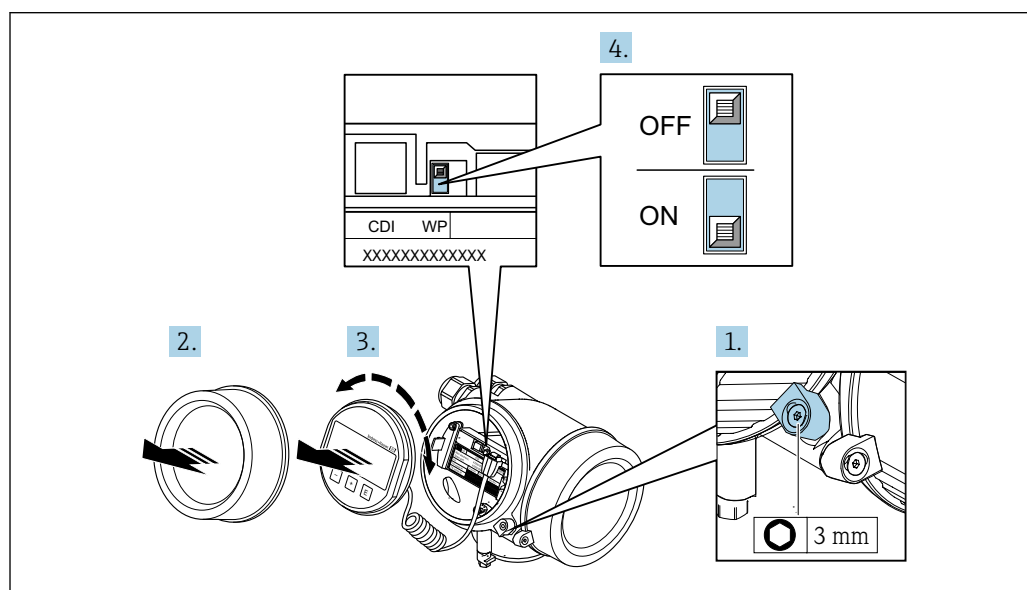


10.8.2 Write protection via write protection switch

Unlike parameter write protection via a user-specific access code, this allows the user to lock write access to the entire operating menu - apart from the **"Contrast display" parameter**.

The parameter values are now read only and cannot be edited any more (exception **"Contrast display" parameter**):

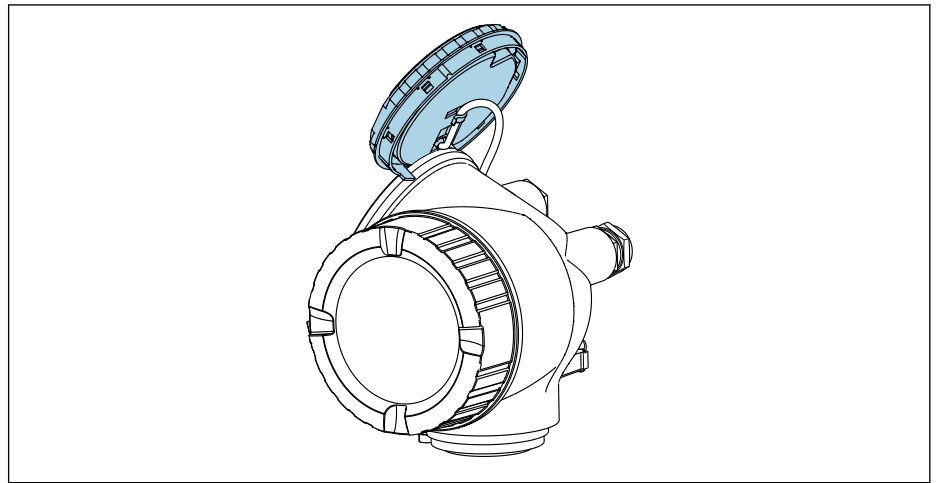
- Via local display
- Via service interface (CDI)
- Via HART protocol



A0032230

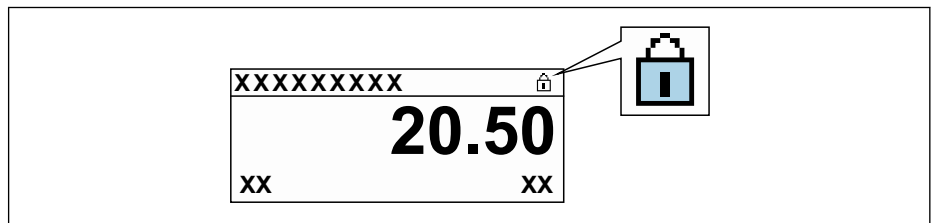
1. Loosen the securing clamp.
2. Unscrew the electronics compartment cover.

3. Pull out the display module with a gentle rotational movement. To make it easier to access the write protection switch, attach the display module to the edge of the electronics compartment.
 - ↳ Display module is attached to the edge of the electronics compartment.



A0032236

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



A0029425

If hardware write protection is disabled: No option is displayed in the **Locking status** parameter. On the local display, the  symbol disappears from in front of the parameters in the header of the operational display and in the navigation view.

5. Feed the cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment in the desired direction until it engages.
6. Reassemble the transmitter in the reverse order.

10.9 Application-specific commissioning

10.9.1 Steam application

Select medium

Navigation:

Setup → Medium selection

1. Open the **Medium selection** wizard.

2. In the **Select medium** parameter, select the **Steam** option.
3. When pressure measured value is read in ²⁾:
In the **Steam calculation mode** parameter, select the **Automatic (p-/T-compensated)** option.
4. If pressure measured value is not read in:
In the **Steam calculation mode** parameter, select the **Saturated steam (T-compensated)** option.
5. In the **Steam quality value** parameter, enter the steam quality present in the pipe.
 - ↳ Without Wet Steam Detection/Measurement application package: Measuring instrument uses this value to calculate the mass flow of the steam.
 - With Wet Steam Detection/Measurement application package: Measuring instrument uses this value if the steam quality cannot be calculated (steam quality is not compliant with basic conditions).

Configuring the current output

6. Configure current output →  87.

Configuring the external compensation

7. With Wet Steam Detection/Measurement application package:
In the **Steam quality** parameter, select the **Calculated value** option.



For detailed information on the basic conditions for wet steam applications, see the Special Documentation.

10.9.2 Liquid application

User-specific liquid, e. g. heat carrier oil

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter, select the **Liquid** option.
3. In the **Select liquid type** parameter, select the **User-specific liquid** option.
4. In the **Enthalpy type** parameter, select the **Heat** option.
 - ↳ **Heat** option: Non-flammable liquid that serves as a heat carrier.
 - Calorific value** option: Flammable liquid whose combustion energy is calculated.

Configuring fluid properties

Navigation:

Setup → Advanced setup → Medium properties

5. Call up the **Medium properties** submenu.
6. In the **Reference density** parameter, enter the reference density of the fluid.
7. In the **Reference temperature** parameter, enter the fluid temperature associated with the reference density.
8. In the **Linear expansion coefficient** parameter, enter the expansion coefficient of the fluid.
9. In the **Specific heat capacity** parameter, enter the heat capacity of the fluid.

2) Sensor version option "Mass (integrated pressure and temperature measurement)", Pressure read in via Current input/HART/

10. In the **Dynamic viscosity** parameter, enter the viscosity of the fluid.

10.9.3 Gas applications

-  For accurate mass or corrected volume measurement, it is recommended to use the pressure-/temperature-compensated sensor version. If this sensor version is not available, read in the pressure via the current input/HART. If neither of these two options is possible, the pressure can also be entered as a fixed value in the **Fixed process pressure** parameter.
-  Flow computer available only with the order code for "Sensor version", option "mass" (integrated temperature measurement)" or option "mass (integrated pressure/temperature measurement)".

Single gas

Combustion gas, e. g. methane CH_4

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter, select the **Gas** option.
3. In the **Select gas type** parameter, select the **Single gas** option.
4. In the **Gas type** parameter, select the **Methane CH4** option.

Configuring medium properties

Navigation:

Setup → Advanced setup → Medium properties

5. Open the **Medium properties** submenu.
6. In the **Reference combustion temperature** parameter, enter the reference combustion temperature of the medium.

Configuring the current output

7. Configure the current output for the "energy flow" process variable →  87.

Configuring medium properties

Navigation:

Setup → Advanced setup → Medium properties

8. Open the **Medium properties** submenu.
9. In the **Reference combustion temperature** parameter, enter the reference combustion temperature of the medium.

Gas mixture

Forming gas for steel mills and rolling mills, e. g. N_2/H_2

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter, select the **Gas** option.
3. In the **Select gas type** parameter, select the **Gas mixture** option.

Configuring gas composition

Navigation:

Setup → Advanced setup → Medium properties → Gas composition

4. Call up the **Gas composition** submenu.
5. In the **Gas mixture** parameter, select the **Hydrogen H2** option and the **Nitrogen N2** option.
6. In the **Mol% H2** parameter, enter the quantity of hydrogen.
7. In the **Mol% N2** parameter, enter the quantity of nitrogen.
 - ↳ All quantities must add up to 100 %.
 - The density is determined according to NEL 40.

Configuring optional fluid properties for output of corrected volume flow

Navigation:

Setup → Advanced setup → Medium properties

8. Call up the **Medium properties** submenu.
9. In the **Reference pressure** parameter, enter the reference pressure of the fluid.
10. In the **Reference temperature** parameter, enter the reference temperature of the fluid.

Air

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter (→  82), select the **Gas** option.
3. In the **Select gas type** parameter (→  82), select the **Air** option.
 - ↳ The density is determined according to NEL 40.
4. Enter the value in the **Relative humidity** parameter (→  83).
 - ↳ The relative humidity is entered as a %. The relative humidity is converted internally to absolute humidity and is then factored into the density calculation according to NEL 40.
5. In the **Fixed process pressure** parameter (→  84), enter the value of the process pressure present.

Configuring fluid properties

Navigation:

Setup → Advanced setup → Medium properties

6. Call up the **Medium properties** submenu.
7. In the **Reference pressure** parameter (→  100) enter the reference pressure for calculating the reference density.
 - ↳ Pressure that is used as a static reference for combustion. This makes it possible to compare combustion processes at different pressures.
8. In the **Reference temperature** parameter (→  100) enter the temperature for calculating the reference density.

 Endress+Hauser recommends the use of active pressure compensation. This fully rules out the risk of measured errors due to pressure variations and incorrect entries.

Natural gas

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter (→  82), select the **Gas** option.
3. In the **Select gas type** parameter (→  82), select the **Natural gas** option.
4. In the **Fixed process pressure** parameter (→  84), enter the value of the process pressure present.
5. In the **Enthalpy calculation** parameter (→  84), select one of the following options:
 - ↳ AGA5
 - ISO 6976 option (contains GPA 2172)
6. In the **Density calculation** parameter (→  85), select one of the following options.
 - ↳ AGA Nx19
 - ISO 12213- 2 option (contains AGA8-DC92)
 - ISO 12213- 3 option (contains SGERG-88, AGA8 Gross Method 1)

Configuring fluid properties

Navigation:

Setup → Advanced setup → Medium properties

7. Call up the **Medium properties** submenu.
8. In the **Calorific value type** parameter, select one of the options.
9. In the **Reference gross calorific value** parameter, enter the reference gross calorific value of the natural gas.
10. In the **Reference pressure** parameter (→  100) enter the reference pressure for calculating the reference density.
 - ↳ Pressure that is used as a static reference for combustion. This makes it possible to compare combustion processes at different pressures.
11. In the **Reference temperature** parameter (→  100) enter the temperature for calculating the reference density.
12. In the **Relative density** parameter, enter the relative density of the natural gas.



Endress+Hauser recommends the use of active pressure compensation. This fully rules out the risk of measured errors due to pressure variations and incorrect entries.

Ideal gas

The unit "corrected volume flow" is often used to measure industrial gas mixtures, in particular natural gas. To do so, the calculated mass flow is divided by a reference density. To calculate the mass flow, knowledge of the exact composition of the gas is essential. In practice, however, this information is often not available (e. g. as it varies over time). In this case, it can be useful to regard the gas as an ideal gas. This means that only the operating temperature and operating pressure variables as well as the reference temperature and reference pressure variables are needed to calculate the corrected volume flow. The error resulting from this assumption (typically 1 to 5 %) is often considerably smaller than the error caused by inaccurate composition data. This method should not be used for condensing gases (e. g. saturated steam).

Select medium

Navigation:

Setup → Medium selection

1. Call up the **Medium selection** wizard.
2. In the **Select medium** parameter, select the **Gas** option.
3. In the **Select gas type** parameter, select the **User-specific gas** option.
4. For non-flammable gas:
In the **Enthalpy type** parameter, select the **Heat** option.

Configuring fluid properties

Navigation:

Setup → Advanced setup → Medium properties

5. Call up the **Medium properties** submenu.
6. In the **Reference density** parameter, enter the reference density of the fluid.
7. In the **Reference pressure** parameter, enter the reference pressure of the fluid.
8. In the **Reference temperature** parameter, enter the fluid temperature associated with the reference density.
9. In the **Reference Z-factor** parameter, enter the value **1**.
10. If specific heat capacity is to be measured:
In the **Specific heat capacity** parameter, enter the heat capacity of the fluid.
11. In the **Z-factor** parameter, enter the value **1**.
12. In the **Dynamic viscosity** parameter, enter the viscosity of the fluid under operating conditions.

10.9.4 Calculation of the measured variables

A flow computer can be found in the electronics of the measuring device with order code for "Sensor version", option "mass (integrated temperature measurement)" and option "mass (integrated pressure/temperature measurement)". This computer can calculate the following secondary measured variables directly from the primary measured variables recorded using the pressure value (entered or external) and/or temperature value (measured or entered).

Mass flow and corrected volume flow

Medium	Fluid	Standards	Explanation
Steam ¹⁾	Water vapor	IAPWS-IF97/ ASME	- For integrated temperature measurement - For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART
Gas	Single gas	NEL40	For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART
	Gas mixture	NEL40	
	Air	NEL40	
	Natural gas	ISO 12213-2	- Contains AGA8-DC92 - For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART
		AGA NX-19	For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART
		ISO 12213-3	- Contains SGERG-88, AGA8 Gross Method 1 - For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART
	Other gases	Linear equation	- Ideal gases - For fixed process pressure, pressure measured directly at the meter body or if the pressure is read in via current input/HART

Medium	Fluid	Standards	Explanation
Liquids	Water	IAPWS-IF97/ ASME	–
	Liquefied gas	Tables	Propane and butane mixture
	Other liquid	Linear equation	Ideal liquids

- 1) The measuring device is capable of calculating the volume flow, and other measured variables derived from the volume flow, across all steam types with full compensation using the pressure and temperature. To configure device behavior → 111

Mass flow calculation

Volume flow × operating density

- Operating density for saturated steam, water and other liquids: depends on the temperature
- Operating density for superheated steam and all other gases: depends on the temperature and process pressure

Corrected volume flow calculation

(Volume flow × operating density)/reference density

- Operating density for water and other liquids: depends on the temperature
- Operating density for all other gases: depends on the temperature and process pressure

Energy flow

Medium	Fluid	Standards	Explanation	Heat/energy option
Steam ¹⁾	–	IAPWS-IF97/ASME	For fixed process pressure or if the pressure is read in via current input/HART	Heat Gross calorific value ²⁾ in relation to mass Net calorific value ³⁾ in relation to mass Gross calorific value ²⁾ in relation to corrected volume Net calorific value ³⁾ in relation to corrected volume
Gas	Single gas	ISO 6976	■ Contains GPA 2172 ■ For fixed process pressure or if the pressure is read in via current input/HART	
	Gas mixture	ISO 6976	■ Contains GPA 2172 ■ For fixed process pressure or if the pressure is read in via current input/HART	
	Air	NEL40	For fixed process pressure or if the pressure is read in via current input/HART	
	Natural gas	ISO 6976	■ Contains GPA 2172 ■ For fixed process pressure or if the pressure is read in via current input/HART	
		AGA 5	–	
Liquids	Water	IAPWS-IF97/ASME	–	

Medium	Fluid	Standards	Explanation	Heat/energy option
	Liquefied gas	ISO 6976	Contains GPA 2172	
	Other liquid	Linear equation	–	

- 1) The measuring device is capable of calculating the volume flow, and other measured variables derived from the volume flow, across all steam types with full compensation using the pressure and temperature. To configure device behavior →  111
- 2) Gross calorific value: combustion energy + condensation energy of the flue gas (gross calorific value > net calorific value)
- 3) Net calorific value: only combustion energy

Mass flow and energy flow calculation

NOTICE

The process pressure (p) in the process pipe is required to calculate the process variables and the limit values of the measuring range.

- With the HART device, the process pressure can be entered via the 4 to 20mA current input or via HART from an external pressure measuring device (e. g. Cerabar M) or entered as a fixed value in the **External compensation** submenu (→  111).

Steam is calculated based on the following factors:

- Fully compensated calculation of density using the "pressure" and "temperature" measured variables
- Calculation based on overheated steam until saturation point is reached
Configuration of diagnostic behavior of the **△S871 Near steam saturation limit** diagnostic message **Assign behavior of diagnostic no. 871** parameter set to **Off** option (factory setting) as standard →  156
Optional configuration of diagnostic behavior to the **Alarm** option or **Warning** option →  155 option.
At 2 K above saturation, activation of the **△S871 Near steam saturation limit** diagnostic message.
- The smaller of the following two pressure values is always used to calculate the density:
 - Pressure measured directly at meter body or pressure read in via current input/HART
 - Saturated steam pressure, which is derived from the saturated steam line (IAPWS-IF97/ASME)
- Depending on setting in the **Steam calculation mode** parameter (→  83)
 - If **Saturated steam (T-compensated)** option is selected, the measuring device only calculates on the saturated steam curve using temperature compensation.
 - If **Automatic (p-/T-compensated)** option is selected, the device calculates using full compensation either along the saturation line or in the superheated region, depending on the steam state.
 - If **Automatic (p-/T-compensated)** option is selected in combination with one of the application packages **wet steam detection** or **wet steam measurement**, the measuring device can also calculate in the wet steam region.

 For detailed information on how to perform external compensation, see →  111.

Calculated value

The unit calculates the mass flow, heat flow, energy flow, density and specific enthalpy from the measured volume flow and the measured temperature and/or the pressure based on international standard IAPWS-IF97/ASME.

Formulae for calculation:

- Mass flow: $\dot{m} = \dot{V} \cdot \rho(T, p)$
- Heat flow: $\dot{Q} = \dot{V} \cdot \rho(T, p) \cdot h_D(T, p)$

$\dot{m}$ = Mass flow

$\dot{Q}$ = Heat flow

$\dot{V}$ = Volume flow (measured)

h_D = Specific enthalpy

T = Process temperature (measured)

p = Process pressure

ρ = Density³⁾

Pre-programmed gases

The following gases are pre-programmed in the flow computer:

Hydrogen ¹⁾	Helium 4	Neon	Argon
Krypton	Xenon	Nitrogen	Oxygen
Chlorine	Ammonia	Carbon monoxide ¹⁾	Carbon dioxide
Sulfur dioxide	Hydrogen sulfide ¹⁾	Hydrogen chloride	Methane ¹⁾
Ethane ¹⁾	Propane ¹⁾	Butane ¹⁾	Ethylene (ethene) ¹⁾
Vinyl chloride	Mixtures of up to 8 components of these gases ¹⁾		

- 1) The energy flow is calculated as per ISO 6976 (contains GPA 2172) or AGA5 - in relation to the net calorific value or gross calorific value .

Energy flow calculation

Volume flow × operating density × specific enthalpy

- Operating density for saturated steam and water: depends on the temperature
- Operating density for superheated steam, natural gas ISO 6976 (contains GPA 2172), natural gas AGA5: depends on the temperature and pressure

Heat flow difference

- Between saturated steam upstream from a heat exchanger and condensate downstream from the heat exchanger (second temperature read in via current input/HART) in accordance with IAPWS-IF97/ASME
- Between warm and cold water (second temperature read in via current input/HART) in accordance with IAPWS-IF97/ASME

Vapor pressure and steam temperature

The measuring device can perform the following in saturated steam measurements between the feed line and return line of any heating liquid (second temperature read in via current input/HART and Cp value entered:

- Calculation of saturation pressure of steam from the measured temperature and output in accordance with IAPWS-IF97/ASME
- Calculation of saturation temperature of steam from the preset pressure and output in accordance with IAPWS-IF97/ASME

Saturated steam alarm

In applications involving the measurement of superheated steam, the measuring device can trigger a saturated steam alarm when the value approaches the saturation curve.

3) From steam data as per IAPWS-IF97 (ASME), for the measured temperature and the specified pressure

Volume flow, mass flow and energy flow

Using the **Wet Steam Detection/Measurement** application packages, the measuring device can correct the measured variables "volume flow", "mass flow" and "energy flow" depending on the quality of the steam.

 For detailed information on the correction of these measured variables, see Special Documentation for **Wet Steam Detection** application package and **Wet Steam Measurement** →  211 application package.

Steam quality, total mass flow and condensate mass flow

The following additional measured variables are available with the **Wet Steam Measurement** application package:

- Steam quality is output as a direct measured value (on local display/current output/HART)
- Calculation of total mass flow using steam quality and output in terms of proportions of gas and liquid
- Calculation of condensate mass flow using steam quality and output in terms of proportion of liquid

 For detailed information on calculation dependent on steam quality and the correction of these measured variables, see Special Documentation for **Wet Steam Detection** application package and **Wet Steam Measurement** →  211 application package.

11 Operation

11.1 Reading off the device locking status

Device active write protection: **Locking status** parameter

Operation → Locking status

Function scope of the "Locking status" parameter

Options	Description
None	The access authorization displayed in the Access status display parameter applies → 65. Only appears on local display.
Hardware locked	The DIP switch for hardware locking is activated on the main electronics module. This locks write access to the parameters (e.g. via local display or operating tool) → 128.
SIL locked	The SIL mode is enabled. This locks write access to the parameters (e.g. via local display or operating tool).
Temporarily locked	Write access to the parameters is temporarily locked on account of internal processes running in the device (e.g. data upload/download, reset, etc.). Once the internal processing has been completed, the parameters can be changed once again.

11.2 Adjusting the operating language



Detailed information:

- To configure the operating language → 76
- For information on the operating languages supported by the measuring device → 206

11.3 Configuring the display

Detailed information:

- On the basic settings for the local display → 93
- On the advanced settings for the local display → 118

11.4 Reading off measured values

With the **Measured values** submenu, it is possible to read all the measured values.

Navigation

"Diagnostics" menu → Measured values → Process variables

► Measured values	
► Process variables	→ 140
► Totalizer	→ 143
► Input values	→ 143
► Output values	→ 144

11.4.1 Process variables

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

Navigation

"Diagnostics" menu → Measured values → Process variables

► Process variables		
Volume flow	→	📄 141
Corrected volume flow	→	📄 141
Mass flow	→	📄 141
Flow velocity	→	📄 141
Temperature	→	📄 141
Calculated saturated steam pressure	→	📄 141
Steam quality	→	📄 141
Total mass flow	→	📄 141
Condensate mass flow	→	📄 141
Energy flow	→	📄 142
Heat flow difference	→	📄 142
Reynolds number	→	📄 142
Density	→	📄 142
Specific volume	→	📄 142
Pressure	→	📄 142
Compressibility factor	→	📄 142
Degrees of superheat	→	📄 142

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Volume flow	–	Displays the volume flow that is currently measured. <i>Dependency</i> The unit is taken from: Volume flow unit parameter (→ 79)	Signed floating-point number
Corrected volume flow	–	Displays the corrected volume flow that is currently calculated. <i>Dependency</i> The unit is taken from the Corrected volume flow unit parameter (→ 79).	Signed floating-point number
Mass flow	–	Displays the mass flow that is currently calculated. <i>Dependency</i> The unit is taken from the Mass flow unit parameter (→ 79).	Signed floating-point number
Flow velocity	–	Displays the flow velocity that is currently calculated. <i>Dependency</i> The unit is taken from: Velocity unit parameter (→ 81)	Signed floating-point number
Temperature	–	Displays the temperature that is currently measured. <i>Dependency</i> The unit is taken from: Temperature unit parameter (→ 80)	Signed floating-point number
Calculated saturated steam pressure	The following conditions are met: - Order code for "Sensor version", "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option - The Steam option is selected in the Select medium parameter (→ 82).	Displays the saturated steam pressure that is currently calculated. <i>Dependency</i> The unit is taken from: Pressure unit parameter (→ 80)	Signed floating-point number
Steam quality	The following conditions are met: - Order code for "Sensor version", "Mass (integrated temperature measurement)" option or "Mass (integrated pressure/temperature measurement)" option - The Steam option is selected in the Select medium parameter.	Displays the current steam quality. <i>Dependency</i> Depends on the compensation mode of the steam quality: Steam quality parameter (→ 83)	Signed floating-point number
Total mass flow	The following conditions are met: - Order code for "Application package", option EU "Wet steam measurement" - The Steam option is selected in the Select medium parameter (→ 82).	Displays the total mass flow that is currently calculated (steam and condensate). <i>Dependency</i> The unit is taken from: Mass flow unit parameter (→ 79)	Signed floating-point number
Condensate mass flow	The following conditions are met: - Order code for "Application package", option EU "Wet steam measurement" - The Steam option is selected in the Select medium parameter (→ 82).	Displays the condensate mass flow that is currently calculated. <i>Dependency</i> The unit is taken from: Mass flow unit parameter (→ 79)	Signed floating-point number

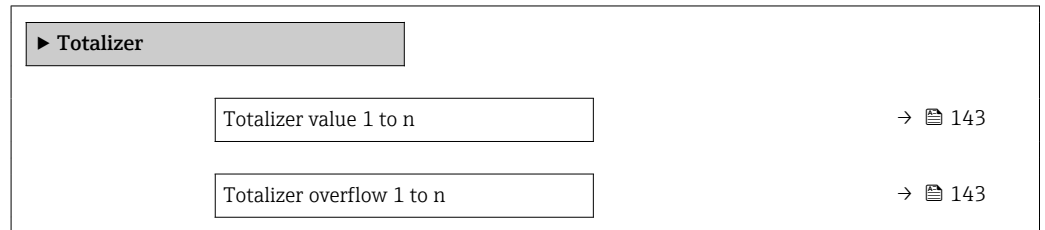
Parameter	Prerequisite	Description	User interface
Energy flow	With order code for "Sensor version": ■ "Mass (integrated temperature measurement)" option - or ■ "Mass (integrated pressure/temperature measurement)" option	Displays the energy flow that is currently calculated. <i>Dependency</i> The unit is taken from: Energy flow unit parameter (→ 80)	Signed floating-point number
Heat flow difference	The following conditions are met: ■ Order code for "Sensor version" ■ "Mass (integrated temperature measurement)" option - or ■ "Mass (integrated pressure/temperature measurement)" option ■ In Select gas type parameter (→ 82), one of the following options is selected: Single gas Gas mixture Natural gas User-specific gas	Displays the heat flow difference that is currently calculated. <i>Dependency</i> The unit is taken from: Energy flow unit parameter (→ 80)	Signed floating-point number
Reynolds number	With order code for "Sensor version": ■ "Mass (integrated temperature measurement)" option - or ■ "Mass (integrated pressure/temperature measurement)" option	Displays the Reynolds number that is currently calculated.	Signed floating-point number
Density	With order code for "Sensor version": ■ Option "Mass (integrated temperature measurement)" - or ■ Option "Mass (integrated pressure/temperature measurement)"	Displays the density currently measured. <i>Dependency</i> The unit is taken from the Density unit parameter.	Positive floating-point number
Specific volume	With order code for "Sensor version": ■ Option "Mass (integrated temperature measurement)" - or ■ Option "Mass (integrated pressure/temperature measurement)"	Displays the current value for the specific volume. <i>Dependency</i> The unit is taken from the Specific volume unit parameter.	Positive floating-point number
Pressure	One of the following conditions is met: ■ Order code for "Sensor version", ■ Option "Mass (integrated temperature measurement)" - or ■ Option "Mass (integrated pressure/temperature measurement)" ■ The Pressure option is selected in the External value parameter	Displays the current process pressure. <i>Dependency</i> The unit is taken from the Pressure unit parameter.	0 to 250 bar
Compressibility factor	The following conditions are met: Order code for "Sensor version" ■ Option "Mass (integrated temperature measurement)" - or ■ Option "Mass (integrated pressure/temperature measurement)" The Gas option or the Steam option is selected in the Select medium parameter.	Displays the compressibility factor currently calculated.	0 to 2
Degrees of superheat	In the Select medium parameter, the Steam option is selected.	Displays the degree of superheating currently calculated.	0 to 500 K

11.4.2 "Totalizer" submenu

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

Navigation

"Diagnostics" menu → Measured values → Totalizer



Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Totalizer value 1 to n	One of the following options is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu: ■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference *	Displays the current totalizer counter value.	Signed floating-point number
Totalizer overflow 1 to n	One of the following options is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu: ■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference *	Displays the current totalizer overflow.	Integer with sign

* Visibility depends on order options or device settings

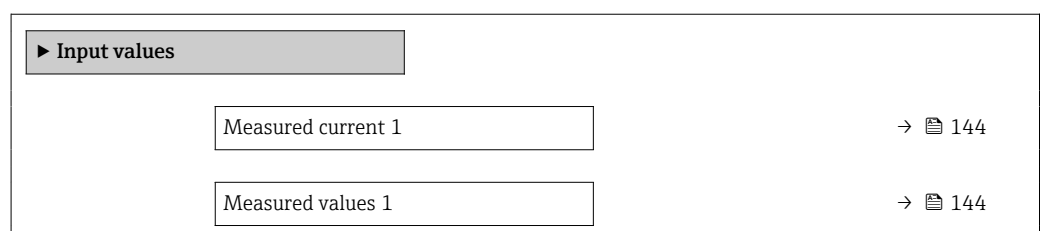
11.4.3 Input values

The **Input values** submenu guides you systematically to the individual input values.

The submenu appears only if the device was ordered with a current input.

Navigation

"Diagnostics" menu → Measured values → Input values



Parameter overview with brief description

Parameter	Description	User interface
Measured current 1	Displays the current value of the current input.	3.59 to 22.5 mA
Measured values 1	Displays the current input value. <i>Dependency</i> The display depends on the option selected in the External value parameter.	Signed floating-point number

11.4.4 Output variables

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

Navigation

"Diagnostics" menu → Measured values → Output values

► Output values		
Output current 1		
Measured current 1		→ 144
Terminal voltage 1		→ 144
Output current 2		
Pulse output		→ 144
Output frequency		→ 144
Switch status		→ 144

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Output current 1	–	Displays the current value currently calculated for the current output.	3.59 to 22.5 mA
Measured current 1	–	Displays the current value currently measured for the current output.	0 to 30 mA
Terminal voltage 1	–	Displays the current terminal voltage that is applied at the output.	0.0 to 50.0 V
Output current 2	–	Displays the current value currently calculated for the current output.	3.59 to 22.5 mA
Pulse output	The Pulse option is selected in the Operating mode parameter parameter.	Displays the pulse frequency currently output.	Positive floating-point number
Output frequency	In the Operating mode parameter, the Frequency option is selected.	Displays the value currently measured for the frequency output.	0 to 1 250 Hz
Switch status	The Switch option is selected in the Operating mode parameter.	Displays the current switch output status.	■ Open ■ Closed

11.5 Adapting the measuring device to the process conditions

The following are available for this purpose:

- Basic settings using the **Setup** menu (→ 77)
- Advanced settings using the **Advanced setup** submenu (→ 97)

11.6 Performing a totalizer reset

The totalizers are reset in the **Operation** submenu:

- Control Totalizer
- Reset all totalizers

Navigation

"Operation" menu → Totalizer handling

► Totalizer handling	
Control Totalizer 1 to n	→ 145
Preset value 1 to n	→ 145
Reset all totalizers	→ 145

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Control Totalizer 1 to n	A process variable is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu.	Control totalizer value.	■ Totalize ■ Reset + hold ■ Preset + hold ■ Reset + totalize ■ Preset + totalize ■ Hold	Totalize
Preset value 1 to n	A process variable is selected in the Assign process variable parameter (→ 117) of the Totalizer 1 to n submenu.	Specify start value for totalizer. <i>Dependency</i>  The unit of the selected process variable is defined in the Unit totalizer parameter (→ 117) for the totalizer.	Signed floating-point number	Depends on country: ■ 0 m³ ■ 0 ft³
Reset all totalizers	–	Reset all totalizers to 0 and start.	■ Cancel ■ Reset + totalize	Cancel

11.6.1 Function scope of "Control Totalizer" parameter

Options	Description
Totalize	The totalizer is started or continues running.
Reset + hold	The totaling process is stopped and the totalizer is reset to 0.
Preset + hold ¹⁾	The totaling process is stopped and the totalizer is set to its defined start value from the Preset value parameter.

Options	Description
Reset + totalize	The totalizer is reset to 0 and the totaling process is restarted.
Preset + totalize ¹⁾	The totalizer is set to the defined start value in the Preset value parameter and the totaling process is restarted.

1) Visible depending on the order options or device settings

11.6.2 Function range of "Reset all totalizers" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
Reset + totalize	Resets all totalizers to 0 and restarts the totaling process. This deletes all the previously aggregated flow values.

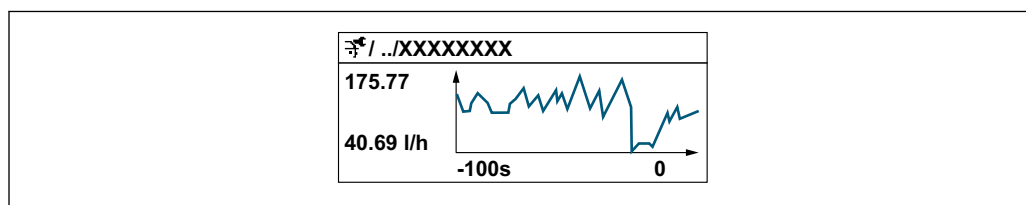
11.7 Displaying the measured value history

The **Extended HistoROM** application package must be enabled in the device (order option) for the **Data logging** submenu to appear. This contains all the parameters for the measured value history.

 Data logging is also available via:
Plant Asset Management Tool FieldCare →  68.

Function scope

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



A0034352

- 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.

Navigation

"Diagnostics" menu → Data logging

► Data logging

Assign channel 1 →  147

Assign channel 2 →  147

Assign channel 3	→ 148
Assign channel 4	→ 148
Logging interval	→ 148
Clear logging data	→ 148
Data logging	→ 148
Logging delay	→ 148
Data logging control	→ 148
Data logging status	→ 148
Entire logging duration	→ 148

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Assign channel 1	The Extended HistoROM application package is available.	Assign process variable to logging channel.	■ Off ■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure * ■ Steam quality * ■ Total mass flow * ■ Condensate mass flow * ■ Energy flow * ■ Heat flow difference * ■ Reynolds number * ■ Current output 1 * ■ Current output 2 * ■ Density * ■ Pressure * ■ Specific volume * ■ Degrees of superheat * ■ Vortex frequency ■ Electronic temperature	Off
Assign channel 2	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see Assign channel 1 parameter (→ 147)	Off

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Assign channel 3	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see Assign channel 1 parameter (→  147)	Off
Assign channel 4	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see Assign channel 1 parameter (→  147)	Off
Logging interval	The Extended HistoROM application package is available.	Define the logging interval for data logging. This value defines the time interval between the individual data points in the memory.	1.0 to 3 600.0 s	1.0 s
Clear logging data	The Extended HistoROM application package is available.	Clear the entire logging data.	■ Cancel ■ Clear data	Cancel
Data logging	–	Select the type of data logging.	■ Overwriting ■ Not overwriting	Overwriting
Logging delay	In the Data logging parameter, the Not overwriting option is selected.	Enter the time delay for measured value logging.	0 to 999 h	0 h
Data logging control	In the Data logging parameter, the Not overwriting option is selected.	Start and stop measured value logging.	■ None ■ Delete + start ■ Stop	None
Data logging status	In the Data logging parameter, the Not overwriting option is selected.	Displays the measured value logging status.	■ Done ■ Delay active ■ Active ■ Stopped	Done
Entire logging duration	In the Data logging parameter, the Not overwriting option is selected.	Displays the total logging duration.	Positive floating-point number	0 s

* Visibility depends on order options or device settings

12 Diagnostics and troubleshooting

12.1 General troubleshooting

For local display

Error	Possible causes	Remedial action
Local display is dark, but signal output is within the valid range	The cable of the display module is not plugged in correctly.	Insert the plug correctly into the main electronics module and display module.
Local display dark and no output signals	Supply voltage does not match the voltage specified on the nameplate.	Apply the correct supply voltage → 169.
Local display dark and no output signals	Supply voltage has incorrect polarity.	Reverse polarity of supply voltage.
Local display dark and no output signals	No contact between connecting cables and terminals.	Ensure electrical contact between the cable and the terminal.
Local display dark and no output signals	Terminals are not plugged into the I/O electronics module correctly.	Check terminals.
Local display dark and no output signals	I/O electronics module is defective.	Order spare part → 169.
Local display dark and output signals in failure current	Sensor short-circuit, electronics module short-circuit	1. Contact service organization.
Local display cannot be read, but signal output is within the valid range	Display is set too bright or too dark.	- Set the display brighter by simultaneously pressing $\square + \square$. - Set the display darker by simultaneously pressing $\square + \square$.
Local display is dark, but signal output is within the valid range	Display module is defective.	Order spare part → 169.
Backlighting of local display is red	Diagnostic event with "Alarm" diagnostic behavior has occurred.	Take remedial measures → 156
Text on local display appears in a language that cannot be understood.	The selected operating language cannot be understood.	1. Press $\square + \square$ for 2 s ("home position"). 2. Press $\square$. 3. Configure the required language in the Display language parameter (→ 120).
Message on local display: "Communication Error" "Check Electronics"	Communication between the display module and the electronics is interrupted.	- Check the cable and the connector between the main electronics module and display module. - Order spare part → 169.

For output signals

Error	Possible causes	Remedial action
Signal output outside the valid range	Main electronics module is defective.	Order spare part → 169.
Signal output outside the valid current range (< 3.6 mA or > 22 mA)	I/O electronics module is defective.	Order spare part → 169.
Device shows correct value on local display, but signal output is incorrect, though in the valid range.	Parameter configuration error	Check and adjust 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".

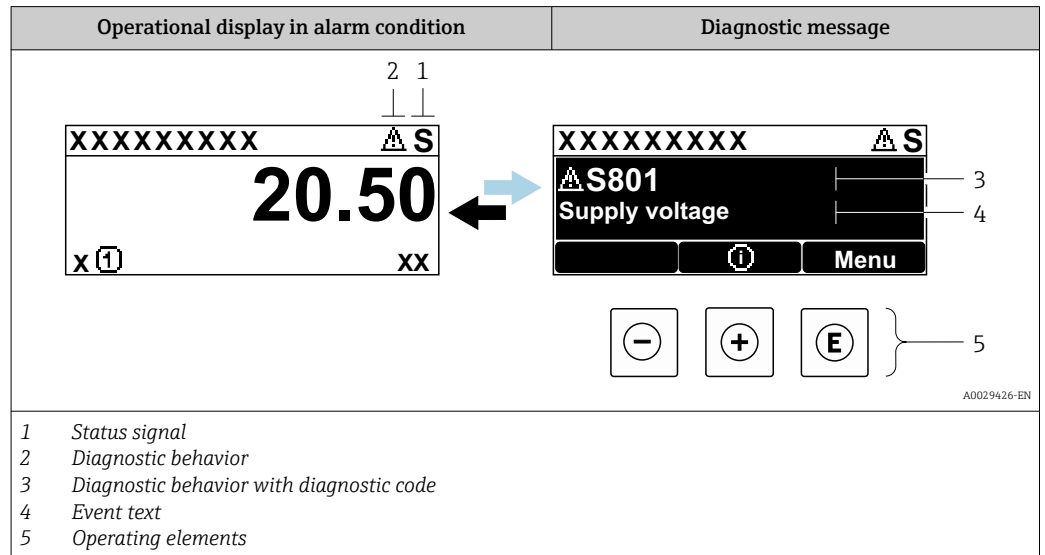
For access

Fault	Possible causes	Remedial action
Write access to parameters is not possible.	Hardware write protection is enabled.	Set the write protection switch on the main electronics module to the OFF position → 128.
Write access to parameters is not possible.	Current user role has limited access authorization.	1. Check user role → 65. 2. Enter correct customer-specific access code → 65.
Connection via HART protocol is not possible.	Missing or incorrectly installed communication resistor	Install the communication resistor (250 Ω) correctly. Observe the maximum load .
Connection via HART protocol is not possible.	Commubox - Incorrectly connected. - Incorrectly configured. - Driver is not installed correctly. - The USB port on the PC is incorrectly configured.	Refer to the documentation on Commubox FXA195 HART: Technical Information TI00404F
Connection via service interface is not possible.	- The USB port on the PC is incorrectly configured. - The driver is not installed correctly.	Refer to the documentation on Commubox FXA291: Technical Information TI00405C
Web browser frozen and operation no longer possible	Data transfer is active.	Wait until data transfer or current action is finished.
	Connection lost	▶ Check cable connection and power supply. ▶ Refresh the web browser and restart if necessary.
Display of web browser content is difficult to read or incomplete.	Web browser version used is not optimal.	▶ Use correct web browser version . ▶ Empty the web browser cache. ▶ Restart the web browser.
	Unsuitable view settings.	Change the font size/display ratio of the Web browser.

12.2 Diagnostic information on local display

12.2.1 Diagnostic message

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



If two or more diagnostic events are pending simultaneously, only the message of the diagnostic event with the highest priority is shown.

- i** Other diagnostic events that have occurred can be displayed in the **Diagnostics** menu:
- Via parameter → 161
 - Via submenus → 161

Status signals

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

- i** The status signals are categorized in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107:
- F = Failure
 - C = Function Check
 - S = Out of Specification
 - M = Maintenance Required

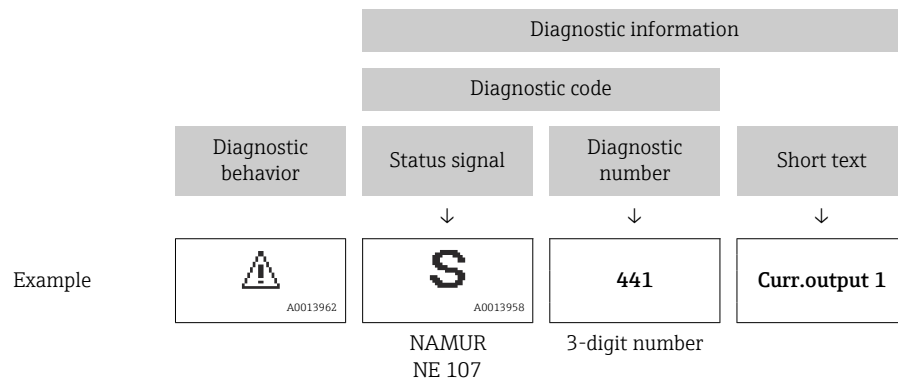
Symbol	Meaning
F	Failure A device error has occurred. The measured value is no longer valid.
C	Function check The device is in the service mode (e.g. during a simulation).
S	Out of specification The device is being operated: ■ Outside its technical specification limits (e.g. outside the process temperature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

Diagnostic behavior

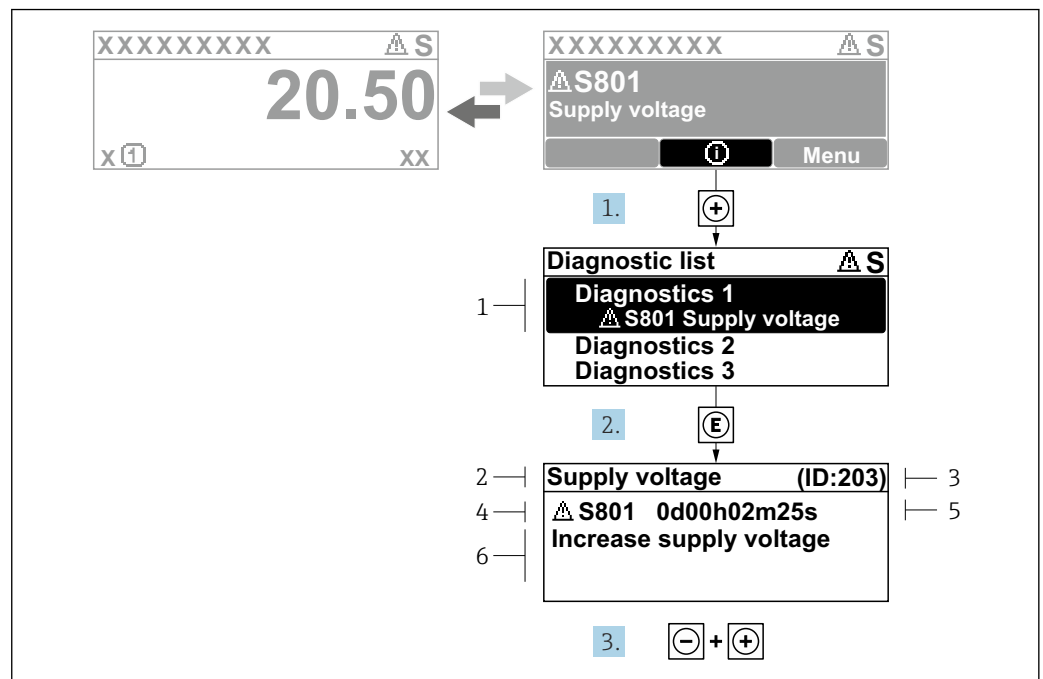
Symbol	Meaning
	Alarm - Measurement is interrupted. - Signal outputs and totalizers assume the defined alarm condition. - A diagnostic message is generated. - For local display with touch control: the background lighting changes to red.
	Warning - Measurement is resumed. - The signal outputs and totalizers 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 on the local display.



12.2.2 Calling up remedial measures



25 Message for remedial actions

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

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

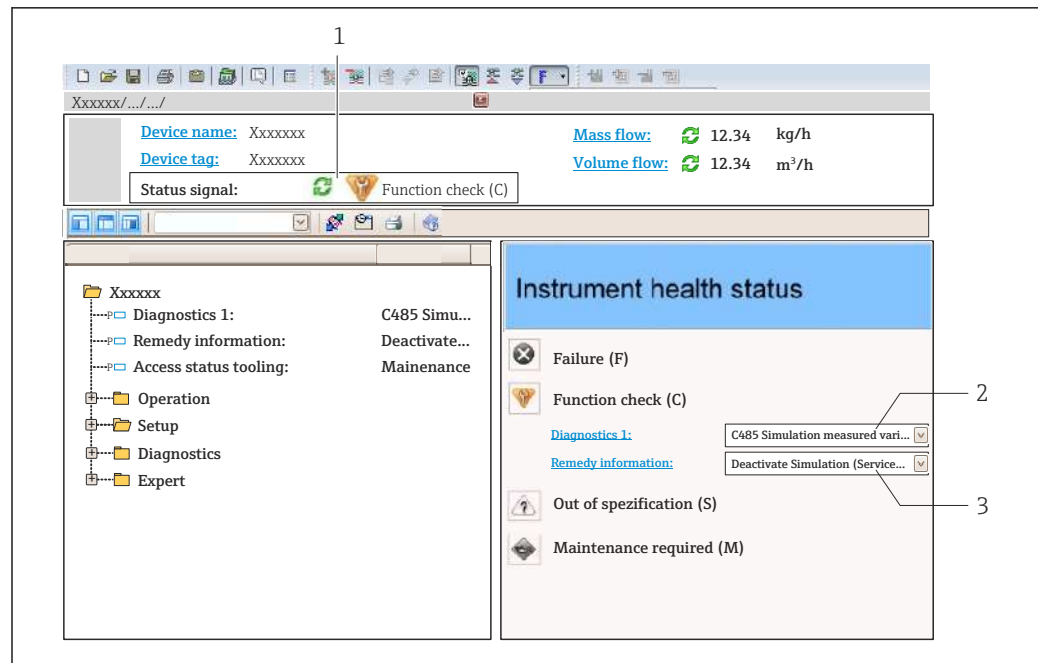
The user is in the **Diagnostics** menu at an entry for a diagnostics event, e.g. in the **Diagnostic list** submenu or **Previous diagnostics** parameter.

1. Press $\boxplus$.
↳ The message for the remedial measures for the selected diagnostic event opens.
2. Press $\ominus + \oplus$ simultaneously.
↳ The message for the remedial measures closes.

12.3 Diagnostic information in FieldCare or DeviceCare

12.3.1 Diagnostic options

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



A0021799-EN

- 1 Status area with status signal → 151
 2 Diagnostic information → 152
 3 Remedial actions with service ID

i In addition, diagnostic events which have occurred can be shown in the **Diagnostics** menu:

- Via parameter → 161
- Via submenu → 161

Status signals

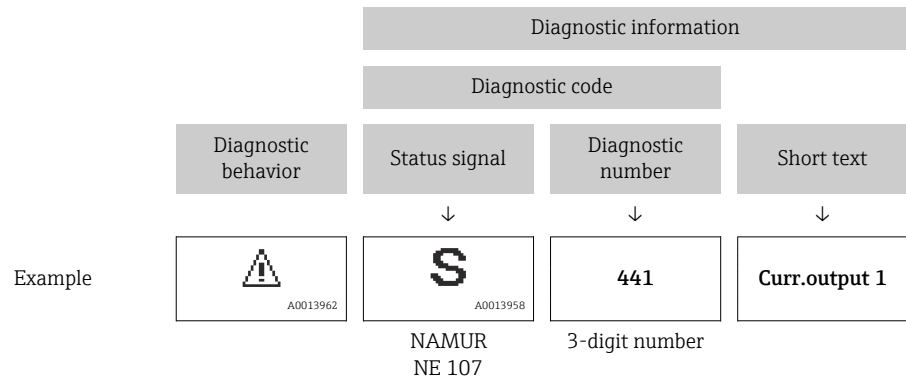
The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

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

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

Diagnostic information

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



12.3.2 Calling up remedy information

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

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

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

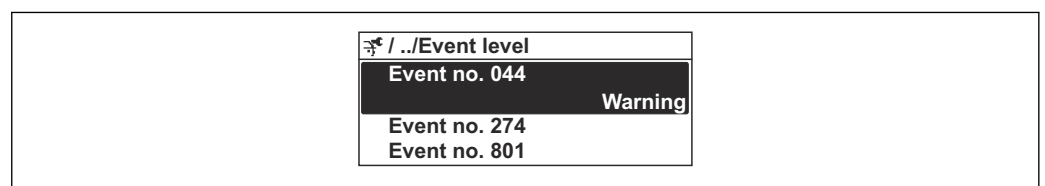
1. Call up the desired parameter.
2. On the right in the working area, mouse over the parameter.
↳ A tool tip with remedy information for the diagnostic event appears.

12.4 Adapting the diagnostic information

12.4.1 Adapting the diagnostic behavior

Each item of diagnostic information is assigned a specific diagnostic behavior at the factory. The user can change this assignment for specific diagnostic information in the **Diagnostic behavior** submenu.

Expert → System → Diagnostic handling → Diagnostic behavior



A0014048-EN

26 Using the example of the local display

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

Options	Description
Alarm	The device stops measurement. The signal outputs and totalizers assume the defined alarm condition. A diagnostic message is generated. For local display with touch control: the background lighting changes to red.
Warning	The device continues to measure. The signal outputs and totalizers are not affected. A diagnostic message is generated.

Options	Description
Logbook entry only	The device continues to measure. The diagnostic message is only displayed in the Event logbook submenu (Event list submenu) and is not displayed in alternating sequence with the operational display.
Off	The diagnostic event is ignored, and no diagnostic message is generated or entered.

12.4.2 Adapting the status signal

Each item of diagnostic information is assigned a specific status signal at the factory. The user can change this assignment for specific diagnostic information in the **Diagnostic event category** submenu.

Expert → Communication → Diagnostic event category

Available status signals

Configuration as per HART 7 Specification (Condensed Status), in accordance with NAMUR NE107.

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 remains valid.
N A0023076	Has no effect on the condensed status.

12.5 Overview of diagnostic information

-  The amount of diagnostic information and the number of measured variables affected increase if the measuring device has one or more application packages.
-  In the case of some items of diagnostic information, the status signal and the diagnostic behavior can be changed. Change the diagnostic information →  155
-  In the case of some items of diagnostic information, the diagnostic behavior can be changed. Adapting the diagnostic information

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
004	Sensor defective	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	F	Alarm
022	Temperature sensor defective	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	F	Alarm ¹⁾

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
046	Sensor limit exceeded	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	S	Warning
062	Sensor connection defective	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	F	Alarm
082	Data storage	1. Check module connections 2. Contact service	F	Alarm
083	Memory content	1. Restart device 2. Restore S-Dat data 3. Change sensor	F	Alarm
114	Sensor leaky	Change DSC sensor	F	Alarm
122	Temperature sensor defective	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	M	Warning ¹⁾
170	Pressure cell connection defective	1. Check plug connections 2. Replace pressure cell	F	Alarm
171	Ambient temperature too low	Increase ambient temperature	S	Warning
172	Ambient temperature too high	Reduce ambient temperature	S	Warning
173	Sensor range exceeded	1. Check process cond. 2. Increase system pressure	S	Warning
174	Pressure cell electronics defective	Replace pressure cell	F	Alarm
175	Pressure cell deactivated	Enable pressure cell	M	Warning
Diagnostic of electronic				
242	Software incompatible	1. Check software 2. Flash or change main electronics module	F	Alarm
252	Modules incompatible	1. Check if correct electronic modul is plugged 2. Replace electronic module	F	Alarm
261	Electronic modules	1. Restart device 2. Check electronic modules 3. Change I/O Modul or main electronics	F	Alarm
262	Module connection	1. Check module connections 2. Change electronic modules	F	Alarm
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	1. Restart device 2. Change main electronic module	F	Alarm
272	Main electronic failure	1. Restart device 2. Contact service	F	Alarm
272	ECC settings faulty		F	Alarm
273	Main electronic failure	1. Emergency operation via display 2. Change main electronics	F	Alarm
275	I/O module defective	Change I/O module	F	Alarm
276	I/O module faulty	1. Restart device 2. Change I/O module	F	Alarm
276	I/O module faulty		F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
277	Electronics defective	1. Change pre-amplifier 2. Change main electronic module	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
302	Device verification active	Device verification active, please wait.	C	Warning
311	Electronic failure	Maintenance required! 1. Do not perform reset 2. Contact service	M	Warning
350	Pre-amplifier defective	Change pre-amplifier	F	Alarm ¹⁾
351	Pre-amplifier defective	Change pre-amplifier	F	Alarm
370	Pre-amplifier defective	1. Check plug connections 2. Check cable connection of remote version 3. Change pre-amplifier or main electronic module	F	Alarm
371	Temperature sensor defective	1. Check plug connections 2. Change pre-amplifier 3. Change DSC sensor	M	Warning ¹⁾
Diagnostic of configuration				
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
412	Processing download	Download active, please wait	C	Warning
431	Trim 1 to n	Carry out trim	C	Warning
437	Configuration incompatible	1. Restart device 2. Contact service	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
441	Current output 1 to n	1. Check process 2. Check current output settings	S	Warning ¹⁾
442	Frequency output	1. Check process 2. Check frequency output settings	S	Warning ¹⁾
443	Pulse output	1. Check process 2. Check pulse output settings	S	Warning ¹⁾
444	Current input 1	1. Check process 2. Check current input settings	S	Warning ¹⁾
453	Flow override	Deactivate flow override	C	Warning
484	Failure mode simulation	Deactivate simulation	C	Alarm
485	Measured variable simulation	Deactivate simulation	C	Warning
486	Current input 1 simulation	Deactivate simulation	C	Warning
491	Current output 1 to n simulation	Deactivate simulation	C	Warning
492	Simulation frequency output	Deactivate simulation frequency output	C	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
493	Simulation pulse output	Deactivate simulation pulse output	C	Warning
494	Switch output simulation	Deactivate simulation switch output	C	Warning
495	Diagnostic event simulation	Deactivate simulation	C	Warning
538	Flow computer configuration incorrect	Check input value (pressure, temperature)	S	Warning
539	Flow computer configuration incorrect	1. Check input value (pressure, temperature) 2. Check allowed values of the medium properties	S	Alarm
540	Flow computer configuration incorrect	Check entered reference value using the document Operating Instructions	S	Warning
570	Inverted delta heat	Check configuration of mounting location (parameter Installation direction)	F	Alarm
Diagnostic of process				
801	Supply voltage too low	Increase supply voltage	F	Alarm ¹⁾
803	Current loop	1. Check wiring 2. Change I/O module	F	Alarm
828	Ambient temperature too low	Increase ambient temperature of pre-amplifier	S	Warning ¹⁾
829	Ambient temperature too high	Reduce ambient temperature of pre-amplifier	S	Warning ¹⁾
832	Electronic temperature too high	Reduce ambient temperature	S	Warning ¹⁾
833	Electronic temperature too low	Increase ambient temperature	S	Warning ¹⁾
834	Process temperature too high	Reduce process temperature	S	Warning ¹⁾
835	Process temperature too low	Increase process temperature	S	Warning ¹⁾
841	Flow velocity too high	Reduce flow velocity	S	Warning ¹⁾
842	Process limit	Low flow cut off active! 1. Check low flow cut off configuration	S	Warning
844	Sensor range exceeded	Reduce flow velocity	S	Warning ¹⁾
870	Measuring inaccuracy increased	1. Check process 2. Increase flow volume	S	Warning ¹⁾
871	Near steam saturation limit	Check process conditions	S	Warning ¹⁾
872	Wet steam detected	1. Check process 2. Check plant	S	Warning ¹⁾
873	Water detected	Check process (water in piping)	S	Warning ¹⁾
874	X% spec invalid	1. Check pressure, temperature 2. Check flow velocity 3. Check for flow fluctuation	S	Warning ¹⁾
882	Input signal	1. Check input configuration 2. Check external device or process conditions	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
945	Sensor range exceeded	Check immediately process conditions (pressure-temperature rating)	S	Warning ¹⁾
946	Vibration detected	Check installation	S	Warning
947	Vibration exceeded	Check installation	S	Alarm ¹⁾
948	Signal quality bad	1. Check process conditions: wet gas, pulsation 2. Check installation: vibration	S	Warning
972	Degrees of superheat limit exceeded	1. Controll process conditions 2. Install pressure transmitter or enter correct fixed pressure value	S	Warning ¹⁾

1) Diagnostic behavior can be changed.

12.5.1 Operating conditions for displaying the following diagnostics information

- i** Operating conditions for displaying the following diagnostics information:
- **871 Near steam saturation limit** diagnostic message: The process temperature is less than 2K from the saturated steam line.
 - Diagnostics information 872: The measured steam quality has dropped below the configured limit value for the steam quality (limit value: Expert → System → Diagnostic handling → Diagnostic limits → Steam quality limit).
 - Diagnostics information 873: The process temperature is $\leq 0^{\circ}\text{C}$.
 - Diagnostics information 874: Wet steam detection/measurement is outside the specified limits for the following process parameters: pressure, temperature, velocity.
 - Pressure: 0.5 to 100 bar
 - Temperature: $+81.3$ to $+320^{\circ}\text{C}$ ($+178.3$ to $+608^{\circ}\text{F}$)
 - Velocity: Depends on the measuring tube and is configured via EhDS.
 - Diagnostics information 972: The degree of superheat has exceeded the configured limit value (limit value: Expert → System → Diagnostic handling → Diagnostic limits → Degrees of superheat limit).

12.5.2 Emergency mode in the event of pressure compensation

- Disable the pressure measuring cell: in the **Disable pressure cell** parameter (7747) select the **Yes** option.
 - ↳ The measuring device uses the fixed process pressure to calculate.

12.5.3 Emergency mode in event of temperature compensation

- Change temperature measurement: PT1+PT2 to the **PT1** option, **PT2** option or the **Off** option.
 - ↳ If the **Off** option is selected, the measuring device calculates by using the fixed process pressure.

12.6 Pending diagnostic events

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

 To call up the measures to rectify a diagnostic event:

- Via local display →  153
- Via "FieldCare" operating tool →  155
- Via "DeviceCare" operating tool →  155

 Other pending diagnostic events can be displayed in the **Diagnostic list** submenu
→  161.

Navigation

"Diagnostics" menu

 Diagnostics	
Actual diagnostics	→  161
Previous diagnostics	→  161
Operating time from restart	→  161
Operating time	→  161

Parameter overview with brief description

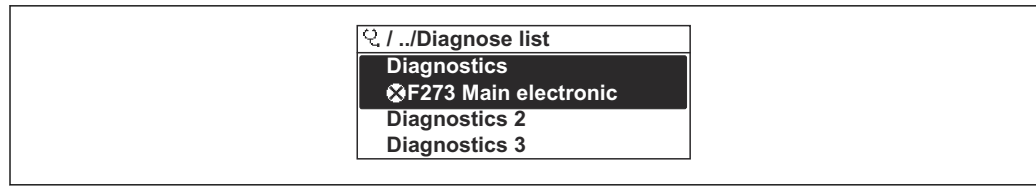
Parameter	Prerequisite	Description	User interface
Actual diagnostics	A diagnostic event has occurred.	Shows the current occurred diagnostic event along with its diagnostic information.  If two or more messages occur simultaneously, the message with the highest priority is shown on the display.	Symbol for diagnostic behavior, diagnostic code and short message.
Previous diagnostics	Two diagnostic events have already occurred.	Shows the diagnostic event that occurred prior to the current diagnostic event along with its diagnostic information.	Symbol for diagnostic behavior, diagnostic code and short message.
Operating time from restart	–	Shows the time the device has been in operation since the last device restart.	Days (d), hours (h), minutes (m) and seconds (s)
Operating time	–	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)

12.7 Diagnostics list

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

Navigation path

Diagnostics → Diagnostic list



A0014006-EN

27 Using the example of the local display

i To call up the measures to rectify a diagnostic event:

- Via local display → 153
- Via "FieldCare" operating tool → 155
- Via "DeviceCare" operating tool → 155

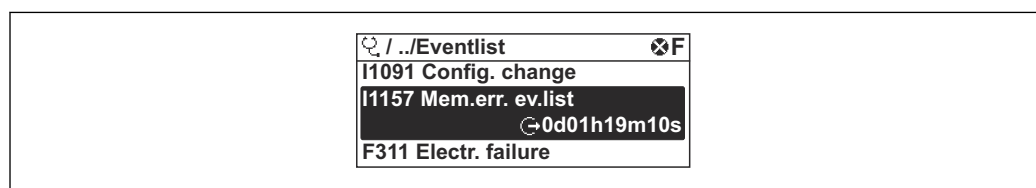
12.8 Event logbook

12.8.1 Reading out the event logbook

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

Navigation path

Diagnostics menu → **Event logbook** submenu → Events list



A0014006-EN

28 Using the example of the local display

- A maximum of 20 event messages can be displayed in chronological order.
- If the **Extended HistoROM** application package (order option) is enabled in the device, the event list can contain up to 100 entries.

The event history includes entries for:

- Diagnostic events → 156
- Information events → 163

In addition to the operating time when the event occurred, each event is also assigned a symbol that indicates whether the event has occurred or is finished:

- Diagnostics event
 - ☹: Occurrence of the event
 - ☺: End of the event
- Information event
 - ☹: Occurrence of the event

i To call up the measures to rectify a diagnostic event:

- Via local display → 153
- Via "FieldCare" operating tool → 155
- Via "DeviceCare" operating tool → 155

i For filtering the displayed event messages → 162

12.8.2 Filtering the event logbook

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

Navigation path

Diagnostics → 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.

Info number	Info name
I1000	----- (Device ok)
I1079	Sensor changed
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed
I1092	HistoROM backup deleted
I1110	Write protection switch changed
I1137	Electronic changed
I1151	History reset
I1154	Reset terminal voltage min/max
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1185	Display backup done
I1186	Restore via display done
I1187	Settings downloaded with display
I1188	Display data cleared
I1189	Backup compared
I1227	Sensor emergency mode activated
I1228	Sensor emergency mode failed
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1444	Device verification passed
I1445	Device verification failed
I1459	I/O module verification failed
I1461	Sensor verification failed
I1512	Download started
I1513	Download finished

Info number	Info name
I1514	Upload started
I1515	Upload finished
I1552	Failed: Main electronic verification
I1553	Failed: Pre-amplifier verification
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off

12.9 Resetting the device

The entire device configuration or some of the configuration can be reset to a defined state with the **Device reset** parameter (→  122).

12.9.1 Function scope of the "Device reset" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
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 the 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 with data stored in volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.

12.10 Device information

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

Navigation

"Diagnostics" menu → Device information

► Device information

Device tag

Serial number

Firmware version

Device name

Order code

Extended order code 1

→  165

→  165

→  165

→  165

→  165

→  165

Extended order code 2	→ 165
Extended order code 3	→ 165
ENP version	→ 165
Device revision	→ 166
Device ID	→ 166
Device type	→ 166
Manufacturer ID	→ 166

Parameter overview with brief description

Parameter	Description	User interface	Factory setting
Device tag	Shows name of measuring point.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /).	Prowirl
Serial number	Shows the serial number of the measuring device.	Max. 11-digit character string comprising letters and numbers.	–
Firmware version	Shows the device firmware version installed.	Character string in the format xx.yy.zz	–
Device name	Shows the name of the transmitter.  The name can be found on the nameplate of the transmitter.	Max. 32 characters such as letters or numbers.	Prowirl
Order code	Shows the device order code.  The order code can be found on the nameplate of the sensor and transmitter in the "Order code" field.	Character string composed of letters, numbers and certain punctuation marks (e.g. /).	–
Extended order code 1	Shows the 1st part of the extended order code.  The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string	–
Extended order code 2	Shows the 2nd part of the extended order code.  The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string	–
Extended order code 3	Shows the 3rd part of the extended order code.  The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string	–
ENP version	Shows the version of the electronic nameplate (ENP).	Character string	2.02.00

Parameter	Description	User interface	Factory setting
Device revision	Shows the device revision with which the device is registered with the HART Communication Foundation.	2-digit hexadecimal number	0x03
Device ID	Shows the device ID for identifying the device in a HART network.	6-digit hexadecimal number	–
Device type	Shows the device type with which the measuring device is registered with the HART Communication Foundation.	Hexadecimal number	0x0038 (for Prowirl 200)
Manufacturer ID	Shows the manufacturer ID device is registered with the HART Communication Foundation.	2-digit hexadecimal number	0x11 (for Endress+Hauser)

12.11 Firmware history

Release date	Firmware version	Order code for "Firmware version"	Firmware changes	Documentation type	Documentation
04.2025	01.03.zz	Option 72	No firmware modification.	Operating Instructions	BA01686D/06/EN/04.24
01.2018	01.03.zz	Option 72	- Support for "mass vortex" order option - Upgrade to Heartbeat Technology application package - Permanent activation of natural gas, air and industrial gases application packages - Extension of low flow cut off - Extension of measuring range for steam - Extension of two-phase measurement	Operating Instructions	BA01686D/06/EN/01.18

-  It is possible to flash the firmware to the current version or an existing previous version via the service interface.
-  For the compatibility of the firmware version with the previous version, the installed device description files and operating tools, observe the information about the device in the "Manufacturer's information" document.
-  The manufacturer's information is available:
- In the Download Area of the Endress+Hauser Web site: www.endress.com → Downloads
 - Specify the following details:
 - Product root: e.g. 7F2C
The product root is the first part of the order code: see the nameplate on the device.
 - Text search: Manufacturer's information
 - Media type: Documentation – Technical Documentation

13 Maintenance

13.1 Maintenance tasks

No special maintenance work is required.

13.1.1 Exterior cleaning

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

13.1.2 Interior cleaning

NOTICE

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

- ▶ Do not use pigs to clean the pipe.

13.1.3 Replacing seals

Replacing sensor seals

NOTICE

Seals in contact with fluid must always be replaced!

- ▶ Only Endress+Hauser sensor seals may be used: replacement seals

Replacing housing seals

NOTICE

When using the device in a dusty atmosphere:

- ▶ only use the associated Endress+Hauser housing seals.

1. Replace defect seals only with original seals from Endress+Hauser.
2. The housing seals must be clean and undamaged when inserted into their grooves.
3. Dry, clean or replace the seals if necessary.

13.1.4 Adjusting the pressure measuring cell

Navigation:

Expert → Sensor → Sensor adjustment

1. Apply reference pressure to pressure measuring cell.
2. Enter this reference pressure as a value in the **Reference pressure** parameter (7748).
3. Select an option in the **Pressure cell adjustment** parameter (7754):
 - ↳ **Yes** option: Confirm entry.
 - Cancel** option: Cancel entry by entering "Cancel".
 - Discard offset** option: Reset offset to 0.

The **Pressure cell offset value** parameter (7749) indicates the calculated offset value.

13.2 Measuring and test equipment

Endress+Hauser offers a variety of measuring and testing equipment, such as Netilion or device tests.

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

List of some of the measuring and testing equipment: →  174

13.3 Endress+Hauser services

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

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

14 Repair

14.1 General notes

14.1.1 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 appropriately trained customers.
- Certified devices can only be converted to other certified devices by Endress+Hauser Service or at the factory.

14.1.2 Notes for repair and conversion

For repair and conversion of a measuring device, observe the following notes:

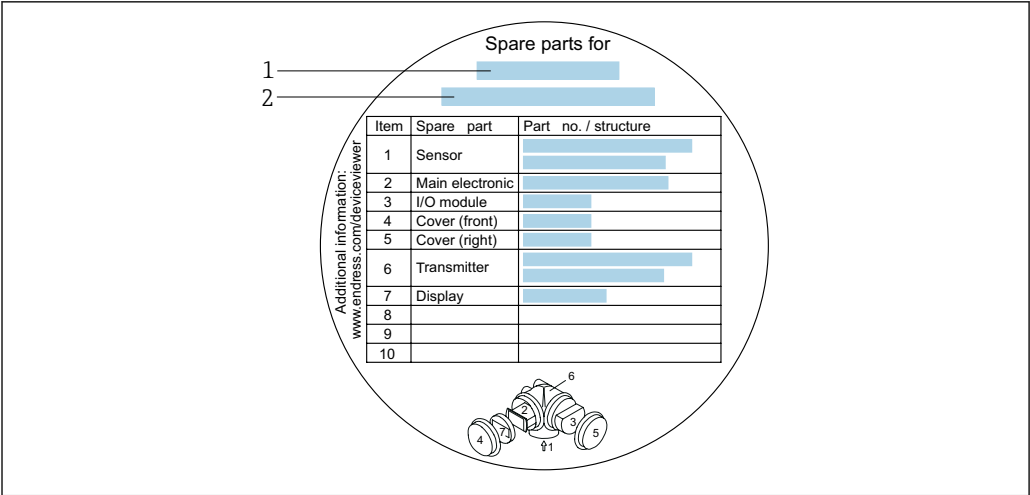
- ▶ Use only original Endress+Hauser spare parts.
- ▶ Carry out the repair according to the Installation Instructions.
- ▶ Observe the applicable standards, federal/national regulations, Ex documentation (XA) and certificates.
- ▶ Document all repairs and conversions and enter the details in Netilion Analytics.

14.2 Spare parts

Some interchangeable measuring device components are listed on an overview sign in the connection compartment cover.

The spare part overview sign contains the following information:

- A list of the most important spare parts for the measuring device, including their ordering information.
- The URL to the *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.



29 Example for "Spare part overview sign" in connection compartment cover

- 1 Measuring device name
- 2 Measuring device serial number

- 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 (→ 165) in the **Device information** submenu.

14.3 Endress+Hauser services

Endress+Hauser offers a wide range of services.

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

14.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

- Refer to the web page for information:
<https://www.endress.com/support/return-material>
 Select the region.
- If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

14.5 Disposal

- If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

14.5.1 Removing the measuring device

- Switch off the device.

⚠ WARNING**Danger to persons from process conditions!**

- ▶ Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive media.
- 2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" sections in reverse order. Observe the safety instructions.

14.5.2 Disposing of the measuring device**⚠ WARNING****Danger to personnel and environment from fluids that are hazardous to health.**

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

Observe the following notes during disposal:

- ▶ Observe valid federal/national regulations.
- ▶ Ensure proper separation and reuse of the device components.

15 Accessories

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

15.1 Device-specific accessories

15.1.1 For the transmitter

Accessories	Description
Prowirl 200 transmitter	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Output, input ▪ Display/operation ▪ Housing ▪ Software  Installation Instructions EA01056D  (Order number: 7X2CXX)
Remote display FHX50	FHX50 housing for accommodating a display module . ▪ FHX50 housing suitable for: ▪ SD02 display module (push buttons) ▪ SD03 display module (touch control) ▪ Length of connecting cable: up to max. 60 m (196 ft) (cable lengths available for order: 5 m (16 ft), 10 m (32 ft), 20 m (65 ft), 30 m (98 ft)) The measuring instrument can be ordered with the FHX50 housing and a display module. The following options must be selected in the separate order codes: ▪ Order code for measuring instrument, feature 030: Option L or M "Prepared for FHX50 display" ▪ Order code for FHX50 housing, feature 050 (device version): Option A "Prepared for FHX50 display" ▪ Order code for FHX50 housing, depends on the desired display module in feature 020 (display, operation): ▪ Option C: for an SD02 display module (push buttons) ▪ Option E: for an SD03 display module (touch control) The FHX50 housing can also be ordered as a retrofit kit. The measuring instrument display module is used in the FHX50 housing. The following options must be selected in the order code for the FHX50 housing: ▪ Feature 050 (measuring instrument version): option B "Not prepared for FHX50 display" ▪ Feature 020 (display, operation): option A "None, existing displayed used"  The FHX50 remote display cannot be combined with the order code for "Sensor version; DSC sensor; measuring tube": ▪ option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement), -200 to +400 °C (-328 to +750 °F)" ▪ option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement), -40 to +100 °C (-40 to +212 °F)"  Special Documentation SD01007F (Order number: FHX50)

Accessories	Description
Overvoltage protection for 2-wire devices	Ideally, the overvoltage protection module should be ordered directly with the device. See product structure, feature 610 "Accessory mounted", option NA "Overvoltage protection". Separate order necessary only if retrofitting. ■ OVP10: For 1-channel devices (feature 020, option A): ■ OVP20: For 2-channel devices (feature 020, options B, C, E or G)  Special Documentation SD01090F (Order number OVP10: 71128617) (Order number OVP20: 71128619)
Protective cover	The protective cover is used to protect against direct sunlight, precipitation and ice. It can be ordered together with the device via the product structure: Order code for "Accessories enclosed" option PB "Protective cover"  Special Documentation SD00333F (Order number: 71162242)
Transmitter holder (pipe mounting)	To secure the remote version to the pipe DN 20 to 80 (3/4 to 3") Order code for "Accessory enclosed", option PM

15.1.2 For the sensor

Accessories	Description
Flow conditioner	Is used to shorten the necessary inlet run. (Order number: DK7ST)  Dimensions of flow conditioner

15.2 Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface.  Technical Information TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.  Technical Information TI00405C
HART loop converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. ■ Technical Information TI00429F ■ Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.  Operating Instructions BA00061S
Fieldgate FXA42	Transmission of the measured values of connected 4 to 20 mA analog measuring instruments, as well as digital measuring instruments ■ Technical Information TI01297S ■ Operating Instructions BA01778S ■ Product page: www.endress.com/fxa42

Field Xpert SMT50	The Field Xpert SMT50 tablet PC for device configuration enables mobile plant asset management in non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.  ■ Technical Information TI01555S ■ Operating Instructions BA02053S ■ Product page: www.endress.com/smt50
Field Xpert SMT70	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.  ■ Technical Information TI01342S ■ Operating Instructions BA01709S ■ Product page: www.endress.com/smt70
Field Xpert SMT77	The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1.  ■ Technical Information TI01418S ■ Operating Instructions BA01923S ■ Product page: www.endress.com/smt77

15.3 Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring instruments: ■ Choice of measuring instruments for industrial requirements ■ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy. ■ Graphic display of the calculation results ■ Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator
Netilion	IIoT ecosystem: Unlock knowledge With the Netilion IIoT ecosystem, Endress+Hauser allows you to optimize your plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability - ultimately resulting in a more profitable plant. www.netilion.endress.com
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all intelligent field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.  Operating Instructions BA00027S and BA00059S
DeviceCare	Tool to connect and configure Endress+Hauser field devices.  Innovation brochure IN01047S

15.4 System components

Accessories	Description
Memograph M graphic data manager	The Memograph M graphic data manager provides information on all the relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick.  ■ Technical Information TI00133R ■ Operating Instructions BA00247R
RN221N	Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission.  ■ Technical Information TI00073R ■ Operating Instructions BA00202R
RNS221	Supply unit for powering two 2-wire measuring devices solely in the non-hazardous area. Bidirectional communication is possible via the HART communication jacks.  ■ Technical Information TI00081R ■ Brief Operating Instructions KA00110R

16 Technical data

16.1 Application

The measuring device is intended for the flow measurement of liquids, gas and steam.

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 sufficiently resistant.

16.2 Function and system design

Measuring principle Vortex meters work on the principle of the *Karman vortex street*.

Measuring system The device consists of a transmitter and a sensor.

Two device versions are available:

- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

For information on the structure of the measuring instrument →  12

16.3 Input

Measured variable Direct measured variables

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
AA	Volume; 316L; 316L	Volume flow
AB	Volume; Alloy C22; 316L	
AC	Volume; Alloy C22; Alloy C22	
BA	Volume high-temperature; 316L; 316L	
BB	Volume high-temperature; Alloy C22; 316L	

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
CA	Mass; 316L; 316L (integrated temperature measurement)	■ Volume flow ■ Temperature
CB	Mass; Alloy C22; 316L (integrated temperature measurement)	
CC	Mass; Alloy C22; Alloy C22 (integrated temperature measurement)	

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
DA	Mass steam; 316L; 316L (integrated pressure/temperature measurement)	■ Volume flow ■ Temperature ■ Pressure
DB	Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement)	

Calculated measured variables

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
AA	Volume; 316L; 316L	Under constant process conditions: ■ Mass flow ¹⁾ ■ Corrected volume flow
AB	Volume; Alloy C22; 316L	
AC	Volume; Alloy C22; Alloy C22	The totalized values for: ■ Volume flow ■ Mass flow ■ Corrected volume flow
BA	Volume high-temperature; 316L; 316L	
BB	Volume high-temperature; Alloy C22; 316L	

- 1) A fixed density must be entered for calculating the mass flow (**Setup** menu → **Advanced setup** submenu → **External compensation** submenu → **Fixed density** parameter).

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Measured variable
CA	Mass; 316L; 316L (integrated temperature measurement)	■ Corrected volume flow ■ Mass flow ■ Calculated saturated steam pressure ■ Energy flow ■ Heat flow difference ■ Specific volume ■ Degrees of superheat
CB	Mass; Alloy C22; 316L (integrated temperature measurement)	
CC	Mass; Alloy C22; Alloy C22 (integrated temperature measurement)	
DA	Mass steam; 316L; 316L (integrated pressure/temperature measurement)	
DB	Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement)	

Order code for "Sensor version", option "mass flow (integrated temperature measurement)" combined with order code for "Application package"		
Option	Description	Measured variable
EU	Wet steam measurement	■ Steam quality ■ Total mass flow ■ Condensate mass flow

Measuring range

The measuring range is dependent on the nominal diameter, the fluid and environmental influences.

-  The following specified values are the largest possible flow measuring ranges ($Q_{\min}$ to $Q_{\max}$) for each nominal diameter. Depending on the fluid properties and environmental influences, the measuring range may be subject to additional restrictions. Additional restrictions apply to both the lower range value and the upper range value.

Flow measuring ranges in SI units

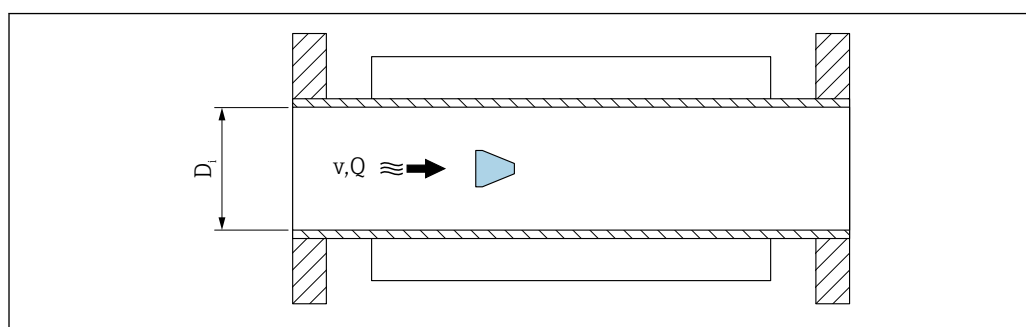
DN [mm]	Liquids [m³/h]	Gas/steam [m³/h]
15	0.076 to 4.9	0.39 to 25
25	0.23 to 15	1.2 to 130
40	0.57 to 37	2.9 to 310
50	0.96 to 62	4.9 to 820
80	2.2 to 140	11 to 1800
100	3.7 to 240	19 to 3200
150	8.5 to 540	43 to 7300
200	15 to 950	75 to 13000

DN [mm]	Liquids [m³/h]	Gas/steam [m³/h]
250	23 to 1 500	120 to 20 000
300	33 to 2 100	170 to 28 000

Flow measuring ranges in US units

DN [in]	Liquids [ft³/min]	Gas/steam [ft³/min]
½	0.045 to 2.9	0.23 to 15
1	0.14 to 8.8	0.7 to 74
1½	0.34 to 22	1.7 to 180
2	0.56 to 36	2.9 to 480
3	1.3 to 81	6.4 to 1 100
4	2.2 to 140	11 to 1 900
6	5 to 320	25 to 4 300
8	8.7 to 560	44 to 7 500
10	14 to 880	70 to 12 000
12	19 to 1 300	99 to 17 000

Flow velocity



A0033468

D_i Measuring tube internal diameter (corresponds to dimension K)

v Velocity in measuring tube

Q Flow



The internal diameter of measuring tube D_i is denoted in the dimensions as dimension K.

For detailed information, see the Technical Information → 211

Calculation of flow velocity:

$$v \text{ [m/s]} = \frac{4 \cdot Q \text{ [m³/h]}}{\pi \cdot D_i \text{ [m]}^2} \cdot \frac{1}{3600 \text{ [s/h]}}$$

$$v \text{ [ft/s]} = \frac{4 \cdot Q \text{ [ft³/min]}}{\pi \cdot D_i \text{ [ft]}^2} \cdot \frac{1}{60 \text{ [s/min]}}$$

A0034301

Lower range value*Reynolds number*

A restriction applies to the lower range value due to the turbulent flow profile, which only occurs with Reynolds numbers greater than 5 000. The Reynolds number is dimensionless and indicates the ratio of the inertia force of a fluid to its viscous force when flowing and is used as a characteristic variable for pipe flows. In the case of pipe flows with Reynolds numbers less than 5 000, periodic vortices are no longer generated and flow rate measurement is no longer possible.

The Reynolds number is calculated as follows:

$$Re = \frac{4 \cdot Q \text{ [m}^3/\text{s}] \cdot \rho \text{ [kg/m}^3\text{]}}{\pi \cdot D_i \text{ [m]} \cdot \mu \text{ [Pa} \cdot \text{s]}}$$

$$Re = \frac{4 \cdot Q \text{ [ft}^3/\text{s}] \cdot \rho \text{ [lbm/ft}^3\text{]}}{\pi \cdot D_i \text{ [ft]} \cdot \mu \text{ [lbf} \cdot \text{s/ft}^2\text{]}}$$

A0034291

Re *Reynolds number*

Q *Flow*

D_i *Internal diameter of measuring tube (corresponds to dimension K)*

μ *Dynamic viscosity*

ρ *Density*

The Reynolds number 5 000, together with the density and viscosity of the fluid and the nominal diameter, is used to calculate the corresponding flow rate.

$$Q_{Re=5000} \text{ [m}^3/\text{h}] = \frac{5000 \cdot \pi \cdot D_i \text{ [m]} \cdot \mu \text{ [Pa} \cdot \text{s]}}{4 \cdot \rho \text{ [kg/m}^3\text{]}} \cdot 3600 \text{ [s/h]}$$

$$Q_{Re=5000} \text{ [ft}^3/\text{h}] = \frac{5000 \cdot \pi \cdot D_i \text{ [ft]} \cdot \mu \text{ [lbf} \cdot \text{s/ft}^2\text{]}}{4 \cdot \rho \text{ [lbm/ft}^3\text{]}} \cdot 60 \text{ [s/min]}$$

A0034302

Q_{Re=5000} *Flow rate is dependent on the Reynolds number*

D_i *Internal diameter of measuring tube (corresponds to dimension K)*

μ *Dynamic viscosity*

ρ *Density*

Minimum measurable flow velocity based on signal amplitude

The measuring signal must have a certain minimum signal amplitude so that the signals can be evaluated without any errors. Using the nominal diameter, the corresponding flow can also be derived from this amplitude.

The minimum signal amplitude depends on the setting for the sensitivity of the DSC sensor, the steam quality **x** and the force of the vibrations present **a**.

The value **mf** corresponds to the lowest measurable flow velocity without vibration (no wet steam) for a density of 1 kg/m³ (0.0624 lbm/ft³).

The value **mf** can be set in the range of 20 to 6 m/s (6 to 1.8 ft/s) (factory setting 12 m/s (3.7 ft/s)) with the **Sensitivity** parameter (value range 1 to 9, factory setting 5).

The lowest flow velocity that can be measured on account of the signal amplitude v_{AmpMin} is derived from the **Sensitivity** parameter and steam quality x or from the force of vibrations present a .

$$v_{\text{AmpMin}} [\text{m/s}] = \max \left\{ \begin{array}{l} \frac{mf [\text{m/s}]}{x^2 \cdot \sqrt{\frac{\rho [\text{kg/m}^3]}{1 [\text{kg/m}^3]}}} \\ \frac{\sqrt{50 [\text{m}] \cdot a [\text{m/s}^2]}}{x^2} \end{array} \right.$$

$$v_{\text{AmpMin}} [\text{ft/s}] = \max \left\{ \begin{array}{l} \frac{mf [\text{ft/s}]}{x^2 \cdot \sqrt{\frac{\rho [\text{lbm/ft}^3]}{0.0624 [\text{lbm/ft}^3]}}} \\ \frac{\sqrt{164 [\text{ft}] \cdot a [\text{ft/s}^2]}}{x^2} \end{array} \right.$$

A0034303

v_{AmpMin}	Minimum measurable flow velocity based on signal amplitude
mf	Sensitivity
x	Steam quality
ρ	Density

Minimum measurable flow rate based on signal amplitude

$$Q_{\text{AmpMin}} [\text{m}^3/\text{h}] = \frac{v_{\text{AmpMin}} [\text{m/s}] \cdot \pi \cdot (D_i [\text{m}])^2}{4} \cdot 3600 [\text{s/h}]$$

$$Q_{\text{AmpMin}} [\text{ft}^3/\text{min}] = \frac{v_{\text{AmpMin}} [\text{ft/s}] \cdot \pi \cdot (D_i [\text{ft}])^2}{4} \cdot 60 [\text{s/min}]$$

A0034304

Q_{AmpMin}	Minimum measurable flow rate based on signal amplitude
v_{AmpMin}	Minimum measurable flow velocity based on signal amplitude
D_i	Internal diameter of measuring tube (corresponds to dimension K)
ρ	Density

Effective lower range value

The effective lower range value Q_{Low} is determined using the largest of the three values Q_{min} , $Q_{\text{Re}} = 5000$ and Q_{AmpMin} .

$$Q_{Low} [m^3/h] = \max \begin{cases} Q_{min} [m^3/h] \\ Q_{Re = 5000} [m^3/h] \\ Q_{AmpMin} [m^3/h] \end{cases}$$

$$Q_{Low} [ft^3/min] = \max \begin{cases} Q_{min} [ft^3/min] \\ Q_{Re = 5000} [ft^3/min] \\ Q_{AmpMin} [ft^3/min] \end{cases}$$

A0034313

- Q_{Low} Effective lower range value
- Q_{min} Minimum measurable flow rate
- $Q_{Re = 5000}$ Flow rate is dependent on the Reynolds number
- Q_{AmpMin} Minimum measurable flow rate based on signal amplitude

 The Applicator is available for calculation purposes.

Upper range value

Maximum measurable flow rate based on signal amplitude

The measuring signal amplitude must be below a certain limit value to ensure that the signals can be evaluated without error. This results in a maximum permitted flow rate Q_{AmpMax} .

$$Q_{AmpMax} [m^3/h] = \frac{URV [m/s] \cdot \pi \cdot D_i [m]^2}{4 \cdot \sqrt{\frac{\rho [kg/m^3]}{1 [kg/m^3]}}} \cdot 3600 [s/h]$$

$$Q_{AmpMax} [ft^3/min] = \frac{URV [ft/s] \cdot \pi \cdot D_i [ft]^2}{4 \cdot \sqrt{\frac{\rho [lbm/ft^3]}{0.0624 [lbm/ft^3]}}} \cdot 60 [s/min]$$

A0034316

- Q_{AmpMax} Maximum measurable flow rate based on signal amplitude
- D_i Internal diameter of measuring tube (corresponds to dimension K)
- ρ Density
- URV Limit value for determining the maximum flow rate:
- DN 15 to 40: URV = 350
 - DN 50 to 300: URV = 600
 - NPS ½ to 1½: URV = 1148
 - NPS 2 to 12: URV = 1969

Restricted upper range value is dependent on Mach number

For gas applications, an additional restriction applies to the upper range value with regard to the Mach number in the measuring instrument, which must be less than 0.3. The Mach number Ma describes the ratio of the flow velocity v to the sound velocity c in the fluid.

$$Ma = \frac{v \text{ [m/s]}}{c \text{ [m/s]}}$$

$$Ma = \frac{v \text{ [ft/s]}}{c \text{ [ft/s]}}$$

A0034321

Ma Mach number

v Flow velocity

c Speed of sound

The corresponding flow rate can be derived using the nominal diameter.

$$Q_{Ma=0.3} \text{ [m}^3\text{/h]} = \frac{0.3 \cdot c \text{ [m/s]} \cdot \pi \cdot D_i \text{ [m]}^2}{4} \cdot 3600 \text{ [s/h]}$$

$$Q_{Ma=0.3} \text{ [ft}^3\text{/min]} = \frac{0.3 \cdot c \text{ [ft/s]} \cdot \pi \cdot D_i \text{ [ft]}^2}{4} \cdot 60 \text{ [s/min]}$$

A0034327

$Q_{Ma=0.3}$ Restricted upper range value is dependent on Mach number

c Speed of sound

D_i Internal diameter of measuring tube (corresponds to dimension K)

ρ Density

Effective upper range value

The effective upper range value Q_{High} is determined using the smallest of the three values Q_{max} , Q_{AmpMax} and $Q_{Ma=0.3}$.

$$Q_{High} \text{ [m}^3\text{/h]} = \min \begin{cases} Q_{max} \text{ [m}^3\text{/h]} \\ Q_{AmpMax} \text{ [m}^3\text{/h]} \\ Q_{Ma=0.3} \text{ [m}^3\text{/h]} \end{cases}$$

$$Q_{High} \text{ [ft}^3\text{/min]} = \min \begin{cases} Q_{max} \text{ [ft}^3\text{/min]} \\ Q_{AmpMax} \text{ [ft}^3\text{/min]} \\ Q_{Ma=0.3} \text{ [ft}^3\text{/min]} \end{cases}$$

A0034338

Q_{High} Effective upper range value

Q_{max} Maximum measurable flow rate

Q_{AmpMax} Maximum measurable flow rate based on signal amplitude

$Q_{Ma=0.3}$ Restricted upper range value is dependent on Mach number

For liquids, the occurrence of cavitation may also restrict the upper range value.

 The Applicator is available for calculation purposes.

Operable flow range	The value, which is typically up to 49: 1, may vary depending on the operating conditions (ratio between upper range value and lower range value)
---------------------	---

Input signal

Current input

Current input	4-20 mA (passive)
Resolution	1 µA
Voltage drop	Typically: 2.2 to 3 V for 3.6 to 22 mA
Maximum voltage	≤ 35 V
Possible input variables	■ Pressure ■ Temperature ■ Density

External measured values

To increase the measurement accuracy of certain measured variables or to calculate the corrected volume flow, the automation system can continuously write different measured values to the measuring instrument:

- Operating pressure to increase measurement accuracy (Endress+Hauser recommends the use of a pressure measuring instrument for absolute pressure, e.g. Cerabar M or Cerabar S)
- Medium temperature to increase measurement accuracy (e.g. iTEMP)
- Reference density for calculating the corrected volume flow



- Various pressure measuring devices can be ordered as accessories from Endress+Hauser.
- If using pressure measuring devices, pay attention to outlet runs when installing external devices → 26.

If the measuring instrument does not have pressure or temperature compensation ⁴⁾, it is recommended that external pressure measured values be read in so that the following measured variables can be calculated:

- Energy flow
- Mass flow
- Corrected volume flow

Integrated pressure and temperature measurement

The measuring device can also directly record external variables for density and energy compensation.

This product version offers the following benefits:

- Measurement of pressure, temperature and flow in a true 2-wire version
- Recording of pressure and temperature at the same point, thus ensuring maximum accuracy of density and energy compensation.
- Continuous monitoring of pressure and temperature, thus enabling complete integration in Heartbeat.
- Easy testing of pressure measurement accuracy:
 - Application of pressure by pressure calibration unit, followed by input into measuring device
 - Automatic error correction performed by device in the event of a deviation
- Availability of calculated line pressure.

Current input

The measured values are written from the automation system to the measuring device via the current input → 183.

4) Order code for "Sensor version", DSC sensor; measuring tube" option DA, DB

HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The pressure transmitter must support the following protocol-specific functions:

- HART protocol
- Burst mode

16.4 Output

Output signal

Current output

Current output 1	4-20 mA HART (passive)
Current output 2	4-20 mA (passive)
Resolution	< 1 μ A
Damping	Configurable: 0.0 to 999.9 s
Assignable measured variables	■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Pressure ■ Calculated saturated steam pressure ■ Steam quality ■ Total mass flow ■ Energy flow ■ Heat flow difference

Pulse/frequency/switch output

Function	Can be configured as pulse, frequency or switch output
Version	Passive, open collector
Maximum input values	■ DC 35 V ■ 50 mA
Voltage drop	■ For ≤ 2 mA: 2 V ■ For 10 mA: 8 V
Residual current	≤ 0.05 mA
Pulse output	
Pulse width	Configurable: 5 to 2 000 ms
Maximum pulse rate	100 Impulse/s
Pulse value	Configurable
Assignable measured variables	■ Mass flow ■ Volume flow ■ Corrected volume flow ■ Total mass flow ■ Energy flow ■ Heat flow difference
Frequency output	
Output frequency	Configurable: 0 to 1 000 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1

Assignable measured variables	■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure ■ Steam quality ■ Total mass flow ■ Energy flow ■ Heat flow difference ■ Pressure
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	■ Off ■ On ■ Diagnostic behavior ■ Limit value ■ Volume flow ■ Corrected volume flow ■ Mass flow ■ Flow velocity ■ Temperature ■ Calculated saturated steam pressure ■ Steam quality ■ Total mass flow ■ Energy flow ■ Heat flow difference ■ Pressure ■ Reynolds number ■ Totalizer 1-3 ■ Status ■ Status of low flow cut off

Signal on alarm

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

Current output*Current output 4-20 mA*

Failure mode	Choose from: ■ 4 to 20 mA in accordance with NAMUR recommendation NE 43 ■ 4 to 20 mA in accordance with US ■ Min. value: 3.59 mA ■ Max. value: 22.5 mA ■ Definable value between: 3.59 to 22.5 mA ■ Actual value ■ Last valid value
---------------------	---

Pulse/frequency/switch output

Pulse output	
Failure mode	No pulses
Frequency output	
Failure mode	Choose from: ■ Actual value ■ 0 Hz ■ Definable value between: 0 to 1 250 Hz

Switch output	
Failure mode	Choose from: ■ Current status ■ Open ■ Closed

Local display

Plain text display	With information on cause and remedial measures
Backlight	Additionally for device version with SD03 local display: red lighting indicates a device error.

 Status signal as per NAMUR recommendation NE 107

Interface/protocol

- Via digital communication:
HART protocol
- Via service interface
Endress+Hauser Common Data Interface (CDI)

Plain text display	With information on cause and remedial measures
--------------------	---

Load →  42

Low flow cut off The switch points for low flow cut off are preset and can be configured.

Galvanic isolation All inputs and outputs are galvanically isolated from one another.

Protocol-specific data	Manufacturer ID	0x11
	Device type ID	0x0038
	HART protocol revision	7
	Device description files (DTM, DD)	Information and files at: www.endress.com → Download Area
	HART load	■ Min. 250 Ω ■ Max. 500 Ω
	System integration	For information on system integration, see →  71 ■ Measured variables via HART protocol ■ Burst Mode functionality

16.5 Power supply

Terminal assignment →  38

Supply voltage

Transmitter

An external power supply is required for each output.

The following supply voltage values apply for the outputs available:

Supply voltage for a compact version without a local display¹⁾

Order code for "Output; input"	Minimum terminal voltage ²⁾	Maximum Terminal voltage
Option A: 4-20 mA HART	≥ DC 12 V	DC 35 V
Option B: 4-20 mA HART, pulse/frequency/switch output	≥ DC 12 V	DC 35 V
Option C: 4-20 mA HART + 4-20 mA analog	≥ DC 12 V	DC 30 V
Option D: 4-20 mA HART, pulse/frequency/switch output, 4-20 mA current input ³⁾	≥ DC 12 V	DC 35 V

1) In event of external supply voltage of the power supply unit with load

2) The minimum terminal voltage increases if local operation is used: see the following table

3) Voltage drop 2.2 to 3 V for 3.59 to 22 mA

Increase of minimum terminal voltage with local operation

Order code for "Display; operation"	Increase in minimum Terminal voltage
Option C: Local operation SD02	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting not used)	+ DC 1 V
Option E: Local operation SD03 with lighting (backlighting used)	+ DC 3 V

Order code for "Sensor version; DSC sensor; measuring tube"	Increase in minimum Terminal voltage
Option DA: Mass steam; 316L; 316L (integrated pressure/temperature measurement)	+ DC 1 V
Option DB: Mass gas/liquid; 316L; 316L (integrated pressure/temperature measurement)	+ DC 1 V

Power consumption

Transmitter

Order code for "Output; input"	Maximum power consumption
Option A: 4-20 mA HART	770 mW
Option B: 4-20 mA HART, pulse/frequency/switch output	- Operation with output 1: 770 mW - Operation with output 1 and 2: 2 770 mW
Option C: 4-20 mA HART + 4-20 mA analog	- Operation with output 1: 660 mW - Operation with output 1 and 2: 1 320 mW
Option D: 4-20 mA HART, pulse/frequency/switch output, 4-20 mA current input	- Operation with output 1: 770 mW - Operation with output 1 and 2: 2 770 mW - Operation with output 1 and input: 840 mW - Operation with output 1, 2 and input: 2 840 mW

Current consumption

Current output

For every 4-20 mA current output or current output: 3.6 to 22.5 mA

 If the option **Defined value** is selected in the **Failure mode** parameter :
3.59 to 22.5 mA

Current input

3.59 to 22.5 mA

 Internal current limiting: max. 26 mA

Power supply failure

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

Electrical connection

→  43

Potential equalization

→  50

Terminals

- For device version without integrated overvoltage protection: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- For device version with integrated overvoltage protection: screw terminals for wire cross-sections 0.2 to 2.5 mm² (24 to 14 AWG)

Cable entries

 The type of cable entry available depends on the specific device version.

Cable gland (not for Ex d)

M20 × 1.5

Thread for cable entry

- NPT ½"
- G ½"
- M20 × 1.5

Cable specification

→  36

Overvoltage protection

The device can be ordered with integrated overvoltage protection:
Order code for "Accessory mounted", option NA "Overvoltage protection"

Input voltage range	Values correspond to supply voltage specifications →  41 ¹⁾
Resistance per channel	2 · 0.5 Ω max.
DC sparkover voltage	400 to 700 V
Trip surge voltage	< 800 V
Capacitance at 1 MHz	< 1.5 pF

Nominal discharge current (8/20 μs)	10 kA
Temperature range	−40 to +85 °C (−40 to +185 °F)

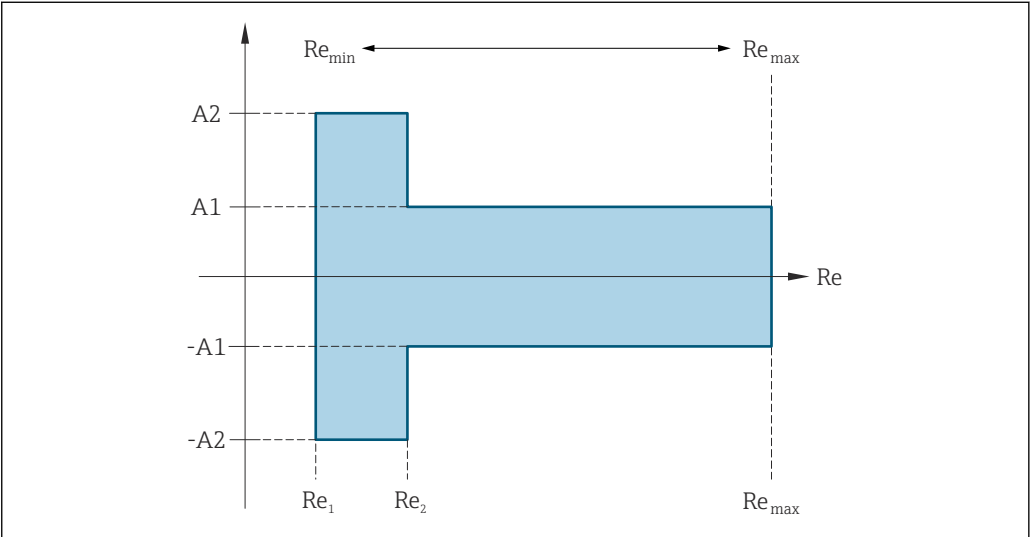
1) The voltage is reduced by the amount of the internal resistance $I_{min} \cdot R_i$

-  Depending on the temperature class, restrictions apply to the ambient temperature for device versions with overvoltage protection .
-  For detailed information on the temperature tables, see the "Safety Instructions" (XA) for the device.

16.6 Performance characteristics

Reference operating conditions	▪ Error limits following ISO/DIN 11631 ▪ +20 to +30 °C (+68 to +86 °F) ▪ 2 to 4 bar (29 to 58 psi) ▪ Calibration system traceable to national standards ▪ Calibration with the process connection corresponding to the particular standard  To obtain measured errors, use the <i>Applicator</i> sizing tool →  174
--------------------------------	--

Maximum measurement error	Base accuracy o.r. = of reading
---------------------------	---



A0034077

Reynolds number	
Re ₁	5 000
Re ₂	10 000
Re _{min}	Reynolds number for minimum permitted volume flow in measuring tube ▪ Standard ▪ Option N °0.65% volume PremiumCal 5-point

Reynolds number	
	$Q_{\text{AmpMin}} [\text{m}^3/\text{h}] = \frac{v_{\text{AmpMin}} [\text{m/s}] \cdot \pi \cdot (D_i [\text{m}])^2}{4} \cdot 3600 [\text{s/h}]$ $Q_{\text{AmpMin}} [\text{ft}^3/\text{min}] = \frac{v_{\text{AmpMin}} [\text{ft/s}] \cdot \pi \cdot (D_i [\text{ft}])^2}{4} \cdot 60 [\text{s/min}]$ A0034304
Re _{max}	Defined by internal diameter of measuring tube, Mach number and maximum permitted velocity in measuring tube $\text{Re}_{\text{max}} = \frac{\rho \cdot 4 \cdot Q_{\text{Heigh}}}{\mu \cdot K}$ A0034339  Further information on effective upper range value Q_{High} →  181

Volume flow

Medium type		Incompressible		Compressible	
Reynolds number Range	Measurement error	PremiumCal ¹⁾	Standard	PremiumCal ¹⁾	Standard
Re ₂ to Re _{max}	A1	< 0.65 %	< 0.75 %	< 0.9 %	< 1.0 %
Re ₁ to Re ₂	A2	< 2.5 %	< 5.0 %	< 2.5 %	< 5.0 %

1) Order code for "Calibration flow", option N "0.65% volume PremiumCal 5-point"

Temperature

- Saturated steam and liquids at room temperature, if T > 100 °C (212 °F):
< 1 °C (1.8 °F)
- Gas: < 1 % o.r. [K]
- Rise time 50 % (stirred under water, following IEC 60751): 8 s

Pressure

Order code for "Pressure component"	Nominal value [bar abs.]	Pressure ranges and measured errors ¹⁾	
		Pressure range [bar abs.]	Measurement error
Option B Pressure measuring cell 2 bar_a	2	0.01 ≤ p ≤ 0.4 0.4 ≤ p ≤ 2	0.5 % of 0.4 bar abs. 0.5 % o.r.
Option C Pressure measuring cell 4 bar_a	4	0.01 ≤ p ≤ 0.8 0.8 ≤ p ≤ 4	0.5 % of 0.8 bar abs. 0.5 % o.r.
Option D Pressure measuring cell 10 bar_a	10	0.01 ≤ p ≤ 2 2 ≤ p ≤ 10	0.5 % of 2 bar abs. 0.5 % o.r.
Option E Pressure measuring cell 40 bar_a	40	0.01 ≤ p ≤ 8 8 ≤ p ≤ 40	0.5 % of 8 bar abs. 0.5 % o.r.
Option F Pressure measuring cell 100 bar_a	100	0.01 ≤ p ≤ 20 20 ≤ p ≤ 100	0.5 % of 20 bar abs. 0.5 % o.r.

1) The specific measured errors refer to the position of the measurement in the measuring tube and do not correspond to the pressure in the pipe connection line upstream or downstream from the measuring instrument. No measured error is specified for the measured error for the "pressure" measured variable that can be assigned to the outputs.

Mass flow saturated steam

Sensor version				Mass (integrated temperature measurement) ¹⁾		Mass (integrated pressure/temperature measurement) ¹⁾	
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number Range	Measurement error	PremiumCal ²⁾	Standard	PremiumCal ²⁾	Standard
> 4.76	20 to 50 (66 to 164)	Re ₂ to Re _{max}	A1	< 1.6 %	< 1.7 %	< 1.4 %	< 1.5 %
> 3.62	10 to 70 (33 to 230)	Re ₂ to Re _{max}	A1	< 1.9 %	< 2.0 %	< 1.7 %	< 1.8 %

In all cases not specified here, the following applies: < 5.7 %

- 1) Detailed calculation with Applicator
 2) Order code for "Calibration flow", option N "0.65% volume PremiumCal 5-point"

Mass flow of superheated steam/gases ^{5) 6)}

Sensor version				Mass (integrated pressure/temperature measurement) ¹⁾		Mass (integrated temperature measurement) + external pressure compensation ²⁾	
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number Range	Measurement error	PremiumCal ³⁾	Standard	PremiumCal ³⁾	Standard
< 40	All velocities	Re ₂ to Re _{max}	A1	< 1.4 %	< 1.5 %	< 1.6 %	< 1.7 %
< 120		Re ₂ to Re _{max}	A1	< 2.3 %	< 2.4 %	< 2.5 %	< 2.6 %

In all cases not specified here, the following applies: < 6.6 %

- 1) Detailed calculation with Applicator
 2) The use of a Cerabar S is required for the measurement errors listed in the following section. The measurement error used to calculate the error in the measured pressure is 0.15 %.
 3) Order code for "Calibration flow", option N "0.65% volume PremiumCal 5-point"

Water mass flow

Sensor version				Mass (integrated temperature measurement)	
Process pressure [bar abs.]	Flow velocity [m/s (ft/s)]	Reynolds number range	Measured value deviation	PremiumCal ¹⁾	Standard
All pressures	All velocities	Re ₂ to Re _{max}	A1	< 0.75 %	< 0.85 %
		Re ₁ to Re ₂	A2	< 2.6 %	< 2.7 %

- 1) Order code for "Calibration flow", option N "0.65% volume PremiumCal 5-point"

Mass flow (user-specific liquids)

To specify the system accuracy, Endress+Hauser requires information about the type of liquid and its operating temperature or information in table form about the dependency between the liquid density and the temperature.

- 5) Single gas, gas mixture, air: NEL40; natural gas: ISO 12213-2 contains AGA8-DC92, AGA NX-19, ISO 12213-3 contains SGERG-88 and AGA8 Gross Method 1
 6) The measuring instrument is calibrated with water and has been verified under pressure on gas calibration rigs.

Example

- Acetone is to be measured at fluid temperatures from +70 to +90 °C (+158 to +194 °F).
- For this purpose, the **Reference temperature** parameter (7703) (here 80 °C (176 °F)), **Reference density** parameter (7700) (here 720.00 kg/m³) and **Linear expansion coefficient** parameter (7621) (here $18.0298 \times 10^{-4} \text{ 1/°C}$) must be entered in the transmitter.
- The overall system uncertainty, which is less than 0.9 % for the example above, is comprised of the following measurement uncertainties: uncertainty of volume flow measurement, uncertainty of temperature measurement, uncertainty of the density-temperature correlation used (including the resulting uncertainty of density).

Mass flow (other media)

Depends on the selected fluid and the pressure value, which is specified in the parameters. Individual error analysis must be performed.

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	±10 µA
----------	--------

Pulse/frequency output

o.r. = of reading

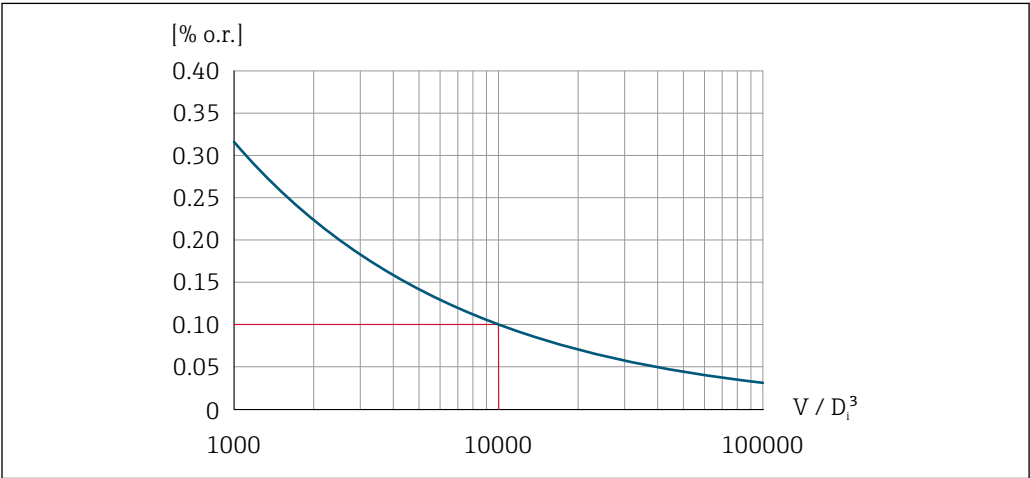
Accuracy	Max. ±100 ppm o.r.
----------	--------------------

Repeatability

o.r. = of reading

$$r = \left\{ \frac{100 \cdot D_i^3}{V} \right\}^{\frac{1}{2}} \% \text{ o.r.}$$

A0042121-EN



30 Repeatability = 0.1 % o.r. with a measured volume [m³] of $V = 10\,000 \cdot D_i^3$

The repeatability can be improved if the measured volume is increased. Repeatability is not a device characteristic but a statistical variable that is dependent on the boundary conditions indicated.

Response time If all the configurable functions for filter times (flow damping, display damping, current output time constant, frequency output time constant, status output time constant) are set to 0, in the event of vortex frequencies of 10 Hz and higher a response time of $\max(T_v, 100 \text{ ms})$ can be expected.

In the event of measuring frequencies $< 10 \text{ Hz}$, the response time is $> 100 \text{ ms}$ and can be up to 10 s. T_v is the average vortex period duration of the flowing fluid.

Relative humidity The device is suitable for use in outdoor and indoor areas with a relative humidity of 5 to 95%.

Operating height According to EN 61010-1

- $\leq 2\,000 \text{ m}$ (6 562 ft)
- $> 2\,000 \text{ m}$ (6 562 ft) with additional overvoltage protection (e.g. Endress+Hauser HAW Series)

Influence of ambient temperature **Current output**
o.r. = of reading
Additional error, in relation to the span of 16 mA:

Temperature coefficient at zero point (4 mA)	0.02 %/10 K
Temperature coefficient with span (20 mA)	0.05 %/10 K

Pulse/frequency output

o.r. = of reading

Temperature coefficient	Max. $\pm 100 \text{ ppm}$ o.r.
-------------------------	---------------------------------

16.7 Installation

Installation requirements → 22

16.8 Environment

Ambient temperature range → 27

Temperature tables



Observe the interdependencies between the permitted ambient and fluid temperatures when operating the device in hazardous areas.



For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.

Storage temperature All components apart from the display modules:
 -50 to $+80 \text{ °C}$ (-58 to $+176 \text{ °F}$)

Display modules

–40 to +80 °C (–40 to +176 °F)

Remote display FHX50:

–40 to +80 °C (–40 to +176 °F)

Relative humidity	The device is suitable for use in outdoor and indoor areas with a relative humidity of 5 to 95%.
-------------------	--

Climate class	DIN EN 60068-2-38 (test Z/AD)
---------------	-------------------------------

Degree of protection	Transmitter - Standard: IP66/67, Type 4X enclosure, suitable for pollution degree 4 - When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2 - Display module: IP20, Type 1 enclosure, suitable for pollution degree 2
----------------------	--

Sensor

IP66/67, Type 4X enclosure, suitable for pollution degree 4

Vibration-resistance and shock resistance	Vibration sinusoidal, in accordance with IEC 60068-2-6 Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)" 2 to 8.4 Hz, 3.5 mm peak 8.4 to 500 Hz, 1 g peak Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote" 2 to 8.4 Hz, 7.5 mm peak 8.4 to 500 Hz, 2 g peak Vibration broad-band random, according to IEC 60068-2-64 Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)" 10 to 200 Hz, 0.003 g²/Hz 200 to 500 Hz, 0.001 g²/Hz - Total: 0.93 g rms Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote" 10 to 200 Hz, 0.01 g²/Hz 200 to 500 Hz, 0.003 g²/Hz - Total: 1.67 g rms Half-sine shocks according to IEC 60068-2-27
---	--

Vibration sinusoidal, in accordance with IEC 60068-2-6

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"

- 2 to 8.4 Hz, 3.5 mm peak
- 8.4 to 500 Hz, 1 g peak

Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"

- 2 to 8.4 Hz, 7.5 mm peak
- 8.4 to 500 Hz, 2 g peak

Vibration broad-band random, according to IEC 60068-2-64

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"

- 10 to 200 Hz, 0.003 g²/Hz
- 200 to 500 Hz, 0.001 g²/Hz
- Total: 0.93 g rms

Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"

- 10 to 200 Hz, 0.01 g²/Hz
- 200 to 500 Hz, 0.003 g²/Hz
- Total: 1.67 g rms

Half-sine shocks according to IEC 60068-2-27

- Order code for "Housing", option B "GT18 dual compartment, 316L, compact" and order code for "Sensor version; DSC sensor; Meas. tube", option DA "Mass steam; 316L; 316L (integrated pressure/temperature measurement)" or option DB "Mass gas/liquid; 316L; 316L (integrated pressure/temp. measurement)"
6 ms 30 g
- Order code for "Housing", option C "GT20 dual compartment, alu, coated, compact" or option J "GT20 dual compartment, alu, coated, remote" or option K "GT18 dual compartment, 316L, remote"
6 ms 50 g

Rough handling shocks according to IEC 60068-2-31

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21), NAMUR Recommendation 21 (NE 21) is fulfilled when installed in accordance with NAMUR Recommendation 98 (NE 98)
- As per IEC/EN 61000-6-2 and IEC/EN 61000-6-4



Details are provided in the Declaration of Conformity.



This unit is not intended for use in residential environments and cannot guarantee adequate protection of the radio reception in such environments.

16.9 Process

Medium temperature range DSC sensor¹⁾

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Medium temperature range
AA	Volume; 316L; 316L	-40 to +260 °C (-40 to +500 °F), stainless steel
AB	Volume; Alloy C22; 316L	
AC	Volume; Alloy C22; Alloy C22	-40 to +260 °C (-40 to +500 °F), Alloy C22
BA	Volume high-temperature; 316L; 316L	-200 to +400 °C (-328 to +752 °F), stainless steel
BB	Volume high-temperature; Alloy C22; 316L	
CA	Mass; 316L; 316L	-200 to +400 °C (-328 to +752 °F), stainless steel
CB	Mass; Alloy C22; 316L	
CC	Mass; Alloy C22; Alloy C22	-40 to +260 °C (-40 to +500 °F), Alloy C22

1) Capacitance sensor

Order code for "Sensor version; DSC sensor; measuring tube"		
Option	Description	Medium temperature range
Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.		
DA	Mass steam; 316L; 316L	-200 to +400 °C (-328 to +752 °F), stainless steel ^{1) 2)}
DB	Mass gas/liquid; 316L; 316L	-40 to +100 °C (-40 to +212 °F), stainless steel ²⁾

- 1) Siphon enables use for extended temperature range (up to +400 °C (+752 °F)).
- 2) In steam applications, in conjunction with the siphon, the steam temperature may be higher (up to +400 °C (+752 °F)) than the permitted temperature of the pressure measuring cell. Without a siphon, the gas temperature is limited by the maximum permitted temperature of the pressure measuring cell. This applies regardless of whether or not a stop cock is present.

Pressure measuring cell

Order code for "Pressure component"		
Option	Description	Medium temperature range
B	Pressure measuring cell 2bar/29psi abs	-40 to +100 °C (-40 to +212 °F)
C	Pressure measuring cell 4bar/58psi abs	
D	Pressure measuring cell 10bar/145psi abs	
E	Pressure measuring cell 40bar/580psi abs	
F	Pressure measuring cell 100bar/1450psi abs	

Seals

Order code for "DSC sensor seal"		
Option	Description	Medium temperature range
A	Graphite	-200 to +400 °C (-328 to +752 °F)
B	Viton	-15 to +175 °C (+5 to +347 °F)
C	Gylon	-200 to +260 °C (-328 to +500 °F)
D	Kalrez	-20 to +275 °C (-4 to +527 °F)

Pressure-temperature ratings



For an overview of the pressure-temperature ratings for the process connections, see the Technical Information

Nominal pressure of sensor

The following overpressure resistance values apply to the sensor shaft in the event of a membrane rupture:

Sensor version; DSC sensor; measuring tube	Overpressure, sensor shaft in [bar a]
Volume	200
Volume high-temperature	200
Mass (integrated temperature measurement)	200
Mass steam (integrated pressure/temperature measurement) Mass gas/liquid (integrated pressure/temperature measurement)	200

Pressure specifications



Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.

The OPL (over pressure limit = sensor overload limit) for the measuring instrument depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the appropriate standards and further information → 190. The OPL may only be applied for a limited period of time.

The MWP (maximum working pressure) for the sensors depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Also observe pressure-temperature dependency. For the appropriate standards and further information → 190. The MWP may be applied at the device for an unlimited period. The MWP can also be found on the nameplate.

⚠ WARNING

The maximum pressure for the measuring instrument depends on the lowest-rated element with regard to pressure.

- ▶ Note specifications regarding pressure range →  190.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP of the device.
- ▶ MWP: The MWP is indicated on the nameplate. This value refers to a reference temperature of +20 °C (+68°F) and may be applied to the device for an unlimited time. Note temperature dependence of MWP.
- ▶ OPL: The test pressure corresponds to the over pressure limit of the sensor and may be applied only temporarily to ensure that the measurement is within the specifications and no permanent damage occurs. In the case of sensor range and process connection combinations where the OPL of the process connection is less than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If using the entire sensor range, select a process connection with a higher OPL value.

Sensor	Maximum sensor measuring range		MWP	OPL
	Lower (LRL)	Upper (URL)		
	[bar (psi)]	[bar (psi)]		
2 bar (30 psi)	0 (0)	+2 (+30)	6.7 (100.5)	10 (150)
4 bar (60 psi)	0 (0)	+4 (+60)	10.7 (160.5)	16 (240)
10 bar (150 psi)	0 (0)	+10 (+150)	25 (375)	40 (600)
40 bar (600 psi)	0 (0)	+40 (+600)	100 (1 500)	160 (2 400)
100 bar (1 500 psi)	0 (0)	+100 (+1 500)	100 (1 500)	160 (2 400)

Pressure loss

For a precise calculation, use the Applicator →  174.

Vibrations

16.10 Mechanical construction

Design, dimensions



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

Weight

Compact version

Weight data:

- Including the transmitter:
 - Order code for "Housing", option C "GT20, two-chamber, aluminum, coated, compact" 1.8 kg (4.0 lb):
 - Order code for "Housing", option B "GT18 two-chamber, 316L, compact" 4.5 kg (9.9 lb):
- Excluding packaging material

Weight in SI units

All values (weight) refer to devices with EN (DIN), PN 40 flanges. Weight information in [kg].

DN [mm]	Weight [kg]	
	Order code for "Housing", option C "GT20 two-chamber, aluminum, coated, compact" ¹⁾	Order code for "Housing", option B "GT18 two-chamber, 316L, compact" ¹⁾
15	5.1	7.8
25	7.1	9.8
40	9.1	11.8
50	11.1	13.8
80	16.1	18.8
100	21.1	23.8
150	37.1	39.8
200	72.1	74.8
250	111.1	113.8
300	158.1	160.8

1) For high-temperature/low-temperature version: values + 0.2 kg

Weight in US units

All values (weight) refer to devices with ASME B16.5, Class 300/Sch. 40 flanges. Weight information in [lbs].

DN [in]	Weight [lbs]	
	Order code for "Housing", option C "GT20 two-chamber, aluminum, coated, compact" ¹⁾	Order code for "Housing", option B "GT18 two-chamber, 316L, compact" ¹⁾
½	11.3	17.3
1	15.7	21.7
1½	22.4	28.3
2	26.8	32.7
3	42.2	48.1
4	66.5	72.4
6	110.5	116.5
8	167.9	173.8
10	240.6	246.6
12	357.5	363.4

1) For high-temperature/low-temperature version: values + 0.4 lbs

Transmitter remote version

Wall-mount housing

Dependent on the material of wall-mount housing:

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote" 2.4 kg (5.2 lb):
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote" 6.0 kg (13.2 lb):

Sensor remote version

Weight data:

- Including sensor connection housing:
 - Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote" 0.8 kg (1.8 lb):
 - Order code for "Housing", option K "GT18 two-chamber, 316L, remote" 2.0 kg (4.4 lb):
- Excluding the connecting cable
- Excluding packaging material

Weight in SI units

All values (weight) refer to devices with EN (DIN), PN 40 flanges. Weight information in [kg].

DN [mm]	Weight [kg]	
	sensor connection housing Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote" ¹⁾	sensor connection housing Order code for "Housing", option K "GT18 two-chamber, 316L, remote" ¹⁾
15	4.1	5.3
25	6.1	7.3
40	8.1	9.3
50	10.1	11.3
80	15.1	16.3
100	20.1	21.3
150	36.1	37.3
200	71.1	72.3
250	110.1	111.3
300	157.1	158.3

1) For high-temperature/low-temperature version: values + 0.2 kg

Weight in US units

All values (weight) refer to devices with ASME B16.5, Class 300/Sch. 40 flanges. Weight information in [lbs].

DN [in]	Weight [lbs]	
	sensor connection housing Order code for "Housing", option J "GT20 two-chamber, aluminum, coated, remote" ¹⁾	sensor connection housing Order code for "Housing", option K "GT18 two-chamber, 316L, remote" ¹⁾
½	8.9	11.7
1	13.4	16.1
1½	20.0	22.7
2	24.4	27.2
3	39.8	42.6
4	64.1	66.8
6	108.2	110.9
8	165.5	168.3
10	238.2	241.0
12	355.1	357.8

1) For high-temperature/low-temperature version: values + 0.4 lbs

Accessories*Flow conditioner**Weight in SI units*

DN ¹⁾ [mm]	Pressure rating	Weight [kg]
15	PN 10 to 40	0.04
25	PN 10 to 40	0.1
40	PN 10 to 40	0.3
50	PN 10 to 40	0.5
80	PN 10 to 40	1.4
100	PN10 to 40	2.4
150	PN 10/16 PN 25/40	6.3 7.8
200	PN 10 PN 16/25 PN 40	11.5 12.3 15.9
250	PN 10 to 25 PN 40	25.7 27.5
300	PN10 to 25 PN 40	36.4 44.7

1) EN (DIN)

DN ¹⁾ [mm]	Pressure rating	Weight [kg]
15	Class 150 Class 300	0.03 0.04
25	Class 150 Class 300	0.1
40	Class 150 Class 300	0.3
50	Class 150 Class 300	0.5
80	Class 150 Class 300	1.2 1.4
100	Class 150 Class 300	2.7
150	Class 150 Class 300	6.3 7.8
200	Class 150 Class 300	12.3 15.8
250	Class 150 Class 300	25.7 27.5
300	Class 150 Class 300	36.4 44.6

1) ASME

DN ¹⁾ [mm]	Pressure rating	Weight [kg]
15	20K	0.06
25	20K	0.1
40	20K	0.3
50	10K 20K	0.5
80	10K 20K	1.1
100	10K 20K	1.80
150	10K 20K	4.5 5.5
200	10K 20K	9.2
250	10K 20K	15.8 19.1
300	10K 20K	26.5

1) JIS

Weight in US units

DN ¹⁾ [in]	Pressure rating	Weight [lbs]
½	Class 150 Class 300	0.07 0.09
1	Class 150 Class 300	0.3
1½	Class 150 Class 300	0.7
2	Class 150 Class 300	1.1
3	Class 150 Class 300	2.6 3.1
4	Class 150 Class 300	6.0
6	Class 150 Class 300	14.0 16.0
8	Class 150 Class 300	27.0 35.0
10	Class 150 Class 300	57.0 61.0
12	Class 150 Class 300	80.0 98.0

1) ASME

Materials

Transmitter housing

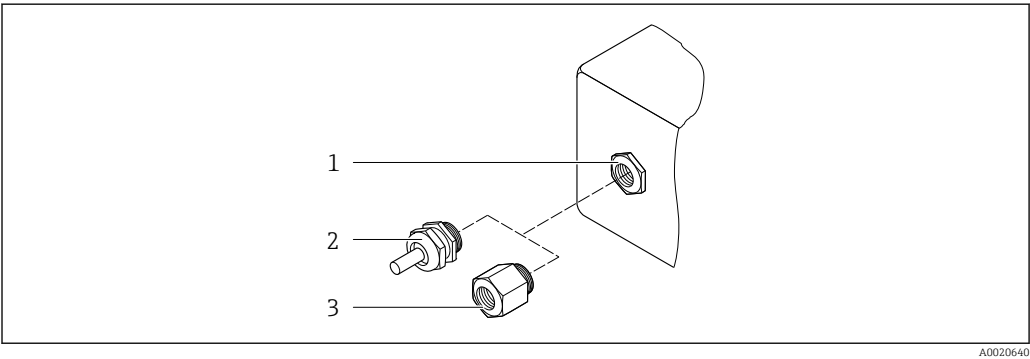
Compact version

- Order code for "Housing", option B "GT18 two-chamber, 316L, compact":
Stainless steel, CF3M
- Order code for "Housing", option C "GT20, two-chamber, aluminum, coated, compact":
Aluminum, AlSi10Mg, coated
- Window material: glass

Remote version

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote":
Aluminum, AlSi10Mg, coated
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote":
For maximum corrosion resistance: Stainless steel, CF3M
- Window material: glass

Cable entries/cable glands



31 Possible cable entries/cable glands

1 Internal thread M20 × 1.5

2 Cable gland M20 × 1.5

3 Adapter for cable entry with internal thread G ½" or NPT ½"

Order code for "Housing", option B "GT18 dual compartment, 316L, compact" option K "GT18 dual compartment, 316L, remote"

Cable entry/cable gland	Type of protection	Material
Cable gland M20 × 1.5	■ Non-hazardous area ■ Ex ia ■ Ex ic ■ Ex nA, Ex ec ■ Ex tb	Stainless steel ,1.4404
Adapter for cable entry with internal thread G ½"	Non-hazardous area and hazardous area (except for XP)	Stainless steel, 1.4404 (316L)
Adapter for cable entry with internal thread NPT ½"	Non-hazardous area and hazardous area	

Order code for "Housing": option C "GT20 dual compartment, aluminum, coated, compact", option J "GT20 dual compartment, aluminum, coated remote"

- i** Applies also to the following device versions in combination with HART communication mode:
- Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam; 316L; 316L", option DB "Mass gas/liquid; 316L; 316L"

Cable entry/cable gland	Type of protection	Material
Cable gland M20 × 1.5	- Non-hazardous area - Ex ia - Ex ic	Plastic
	Adapter for cable entry with internal thread G ½"	Nickel-plated brass
Adapter for cable entry with internal thread NPT ½"	Non-hazardous area and hazardous area (except for XP)	Nickel-plated brass
Thread NPT ½" via adapter	Non-hazardous area and hazardous area	

Connecting cable for remote version

- Standard cable: PVC cable with copper shield
- Reinforced cable: PVC cable with copper shield and additional steel wire braided jacket

Connecting cable, pressure measuring cell

 Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.

Standard cable: PVC cable with copper shield

Sensor connection housing

The material of the sensor connection housing is dependent on the material selected for the transmitter housing.

- Order code for "Housing" option J "GT20 two-chamber, aluminum, coated, remote": Coated aluminum AlSi10Mg
- Order code for "Housing", option K "GT18 two-chamber, 316L, remote": Stainless cast steel, 1.4408 (CF3M)
Compliant with:
 - NACE MR0175
 - NACE MR0103

Measuring tubes

DN 15 to 300 (½ to 12"), pressure ratings PN 10/16/25/40 /63/100, Class 150/300 /600 , and JIS 10K/20K

- Stainless cast steel, CF3M/1.4408
- Complies with:
 - NACE MR0175-2003
 - NACE MR0103-2003
- DN15 to 150 (½ to 6"): AD2000, permitted temperature range -10 to +400 °C (+14 to +752 °F) restricted

DN 15 to 150 (½ to 6"), pressure ratings PN 10/16/25/40, Class 150/300:

- CX2MW similar to Alloy C22/2.4602
- Complies with:
 - NACE MR0175-2003
 - NACE MR0103-2003

DSC sensor

Order code for "Sensor version; DSC sensor; measuring tube", option **AA, BA, CA, DA, DB**

Pressure ratings PN 10/16/25/40/63/100, Class 150/300/600, as well as JIS 10K/20K:

Parts in contact with medium (marked as "wet" on the DSC sensor flange):

- Stainless steel 1.4404 and 316 and 316L
- Compliant with:
 - NACE MR0175/ISO 15156-2015
 - NACE MR0103/ISO 17945-2015

Parts not in contact with medium:

Stainless steel 1.4301 (304)

Order code for "Sensor version; DSC sensor; measuring tube", option **AB, AC, BB, CB, CC**

Pressure ratings PN 10/16/25/40/63/100, Class 150/300/600, as well as JIS 10K/20K:

Parts in contact with medium (marked as "wet" on the DSC sensor flange):

- Alloy C22, UNS N06022 similar to Alloy C22/2.4602
- Compliant with:
 - NACE MR0175/ISO 15156-2015
 - NACE MR0103/ISO 17945-2015

Parts not in contact with medium:

Alloy C22, UNS N06022 similar to Alloy C22/2.4602

Pressure measuring cell

 Order code for "Sensor version; DSC sensor; measuring tube", option DA "Mass steam" and DB "Mass gas/liquid" is available for nominal diameters from DN 25/1. Oil-free or grease-free cleaning is not possible.

- Wetted parts:
 - Process connection
Stainless steel, 1.4404/316L
 - Membrane
Stainless steel, 1.4435/316L
- Non-wetted parts:
 - Housing
Stainless steel, 1.4404

Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB

- Connection on meter body: Stainless steel, 1.4404/316/316L
- Connection on siphon ⁷⁾: Stainless steel, 316/316L
Siphon: Stainless steel, 1.4571
- Clamping sleeve: Stainless steel: 1.4571 (316Ti)
- Seals on meter body siphon: Sigraflex foil Z TM (BAM-certified (Federal Institute for Materials Research and Testing) for oxygen applications)
- Manometer valve:
 - PTFE (polytetrafluoro-ethylene)
 - Stainless steel, 1.4571 ⁸⁾
- Pressure measuring cell manometer valve: Copper

Process connections

DN 15 to 300 (½ to 12"), pressure ratings PN 10/16/25/40/63/100, Class 150/300/600, as well as JIS 10K/20K:

Welding neck flanges DN 15 to 300 (½ to 12")

Compliant with:

NACE MR0175-2003
NACE MR0103-2003

7) Only available with order code for "Sensor version; DSC sensor; measuring tube", option DA.

8) Only for the order code for "Additional approval", option LV IBR: 316ti

The following materials are available depending on the pressure rating:

- Stainless steel, multiple certifications, 1.4404/F316/F316L)
- Alloy C22/2.4602



Available process connections

Seals

- Graphite
Sigraflex foil ZTM (BAM-certified for oxygen applications)
- FPM (VitonTM)
- Kalrez 6375TM
- Gylon 3504TM (BAM-certified for oxygen applications)

Order code for "Sensor version; DSC sensor; measuring tube", option DA, DB
Copper



The technical tightness of tightness class L0.01 according to the TA-Luft regulation (Technical Instructions on Air Quality Control of December 1, 2021; Section 5.2.6.3 Flange connections), with a corresponding specific leakage rate of less than 0.01 mg/(s·m) was verified by means of type-based component tests at a test pressure of 40 bar_a.

Housing support

Stainless steel, 1.4408 (CF3M)

Screws for DSC sensor

- Order code for "Sensor version", option AA "Stainless steel, A4-80 according to ISO 3506-1 (316)"
- Order code for "Sensor version", option BA, CA, DA, DB
Stainless steel, A2 as per ISO 3506-1 (304)
- Order code for "Additional approval", option LL "AD 2000 (including option JA+JB+JK) > DN25 including option LK"
Stainless steel, A4 as per ISO 3506-1 (316)
- Order code for "Sensor version", option AB, AC, BB, CB, CC
Stainless steel, 1.4980 according to EN 10269 (Gr. 660 B)

Accessories

Protective cover

Stainless steel, 1.4404 (316L)

Flow conditioner

- Stainless steel, multiple certifications, 1.4404 (316, 316L)
- Compliant with:
 - NACE MR0175-2003
 - NACE MR0103-2003

Process connections

DN 15 to 300 (½ to 12"), pressure ratings PN 10/16/25/40/63/100, Class 150/300/600, as well as JIS 10K/20K:

Welding neck flanges DN 15 to 300 (½ to 12")

Compliant with:

NACE MR0175-2003

NACE MR0103-2003

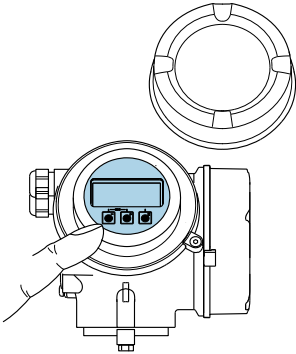
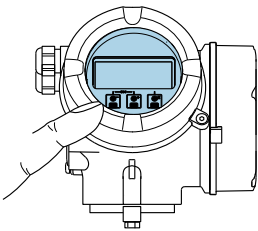
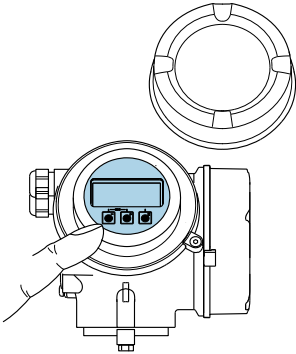
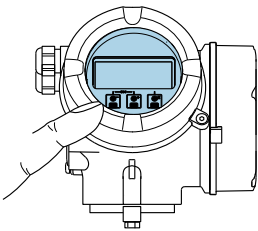
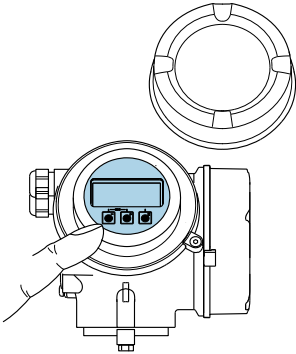
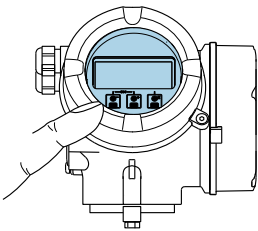
The following materials are available depending on the pressure rating:

- Stainless steel, multiple certifications, 1.4404/F316/F316L)
- Alloy C22/2.4602

 Available process connections

16.11 Operability

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

Onsite operation	Via display module Two display modules are available: <table><thead><tr><th>Order code for "Display; Operation", option C "SD02"</th><th>Order code for "Display; Operation", option E "SD03"</th></tr></thead><tbody><tr><td> A0032219</td><td> A0032221</td></tr><tr><td>1 Operation with pushbuttons</td><td>1 Operation with touch control</td></tr></tbody></table>	Order code for "Display; Operation", option C "SD02"	Order code for "Display; Operation", option E "SD03"	 A0032219	 A0032221	1 Operation with pushbuttons	1 Operation with touch control
Order code for "Display; Operation", option C "SD02"	Order code for "Display; Operation", option E "SD03"						
 A0032219	 A0032221						
1 Operation with pushbuttons	1 Operation with touch control						

Display elements

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured

Operating elements

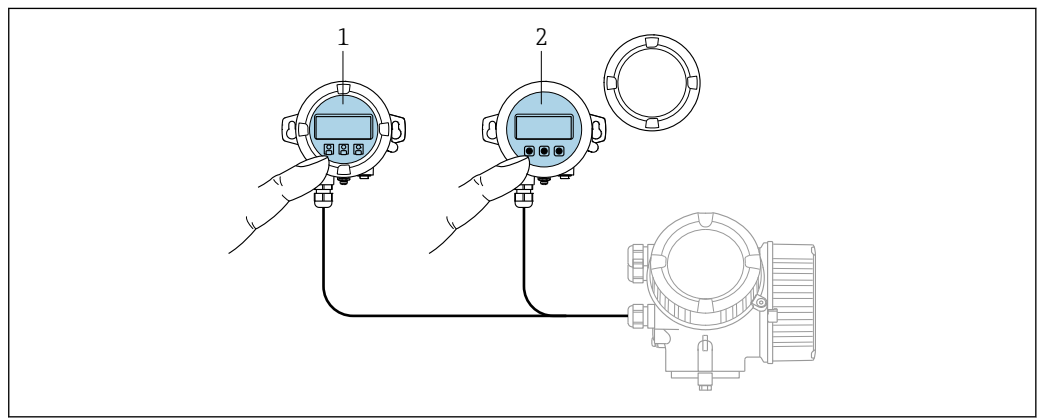
- Operation with 3 push buttons with open housing: , , 
- or
- External operation via touch control (3 optical keys) without opening the housing: , , 
- Operating elements also accessible in the various zones of the hazardous area

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.

Via remote display FHX50

-  ■ The remote display FHX50 can be ordered as an optional extra →  172.
- The remote display FHX50 cannot be combined with the order code for "Sensor version; DSC sensor; measuring tube", option DA "mass steam" or option DB "mass gas/liquid".



A0032215

 32 *FHX50 operating options*

- 1 SD02 display and operating module, push buttons: cover must be opened for operation
- 2 SD03 display and operating module, optical buttons: operation possible through cover glass

Display and operating elements

The display and operating elements correspond to those of the display module .

Remote operation →  66

Service interface →  67

16.12 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

CE mark

The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

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

UKCA marking	The device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards. By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark. Contact address Endress+Hauser UK: Endress+Hauser Ltd. Floats Road Manchester M23 9NF United Kingdom www.uk.endress.com
RCM marking	The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex-approval	The devices are certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.
Functional safety	The measuring instrument can be used for flow monitoring systems (min., max., range) up to SIL 2 (single-channel architecture; order code for "Additional approval", option LA) and SIL 3 (multi-channel architecture with homogeneous redundancy) and is independently evaluated and certified in accordance with IEC 61508. The following types of monitoring in safety equipment are possible:  Functional safety manual with information for the SIL device
Pressure Equipment Directive	■ With the marking a) PED/G1/x (x = category) or b) PESR/G1/x (x = category) on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" a) specified in Annex I of the Pressure Equipment Directive 2014/68/EU or b) Schedule 2 of Statutory Instruments 2016 No. 1105. ■ Devices not bearing this marking (without PED or PESR) are designed and manufactured according to sound engineering practice. They meet the requirements of a) Art. 4 Para. 3 of the Pressure Equipment Directive 2014/68/EU or b) Part 1, Para. 8 of Statutory Instruments 2016 No. 1105. The scope of application is indicated a) in diagrams 6 to 9 in Annex II of the Pressure Equipment Directive 2014/68/EU or b) Schedule 3, Para. 2 of Statutory Instruments 2016 No. 1105.
Experience	The Prowirl 200 measuring system is the successor model of the Prowirl 72 and Prowirl 73.
External standards and guidelines	■ EN 60529 Degrees of protection provided by enclosure (IP code) ■ DIN ISO 13359 Measurement of conductive liquid flow in closed conduits - Flanged-type electromagnetic flowmeters - Overall length ■ ISO 12764:2017 Measurement of fluid flow in closed conduits – Flow rate measurement by means of vortex shedding flowmeters inserted in circular cross-section conduits running full

- EN 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- EN 61326-1/-2-3
EMC requirements for electrical equipment for measurement, control and laboratory use
- NAMUR NE 21
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 32
Data retention in the event of a power failure in field and control instruments with microprocessors
- NAMUR NE 43
Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 105
Specifications for integrating fieldbus devices in engineering tools for field devices
- NAMUR NE 107
Self-monitoring and diagnosis of field devices
- NAMUR NE 131
Requirements for field devices for standard applications
- ETSI EN 300 328
Guidelines for 2.4 GHz radio components.
- EN 301489
Electromagnetic compatibility and radio spectrum matters (ERM).

16.13 Application packages

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

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

 Detailed information on the application packages:
Special Documentation →  212

Diagnostic functionality

Order code for "Application package", option EA "Extended HistoROM"

Comprises extended functions concerning the event log and the activation of the measured value memory.

Event log:

Memory volume is extended from 20 message entries (standard version) to up to 100 entries.

Data logging (line recorder):

- Memory capacity for up to 1000 measured values is activated.
- 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user.
- Measured value logs can be accessed via the local display or operating tool e.g. FieldCare, DeviceCare or Web server.

 For detailed information, see the Operating Instructions for the device.

Heartbeat Technology	Order code for "Application package", option EB "Heartbeat Verification" Heartbeat Verification Meets the requirement for traceable verification in accordance with DIN ISO 9001:2008 Clause 7.6 a) "Control of monitoring and measuring equipment". ■ Functional testing in the installed state without interrupting the process. ■ Traceable verification results on request, including a report. ■ Simple testing process via local operation or other operating interfaces. ■ Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications. ■ Extension of calibration intervals according to operator's risk assessment.  Detailed information on Heartbeat Technology: Special Documentation →  212
Wet steam detection	Order code for "Application package", option ES "Wet steam detection" Wet steam detection provides a qualitative parameter for monitoring the steam application. It is an additional indicator for checking steam quality. A warning is displayed as soon as the steam quality drops below $x = 0.80$ (80%). ■ Additional quality parameter for ensuring a safe and efficient steam process ■ Additional indicator to monitor the operation of steam traps  For detailed information, see the Operating Instructions for the device.
Wet steam measurement	Order code for "Application package", option EU "Wet steam measurement" Innovative measurement of the steam quality and degree of overheating. The wet steam detection application package extends wet steam measurement to include the continuous display of the steam quality. The steam quality is used to calculate the correct volume flow and mass flow and can be assigned to outputs. The condensate amount can be displayed. By evaluating the data, deviations in the process can be quickly detected. ■ As the warning values can be freely defined, users have optimum control of the steam process. ■ Additional quality parameter for ensuring a safe and efficient steam process. ■ Additional indicator to monitor the operation of steam traps. ■ Combined with active pressure compensation, the device guarantees correct steam measurement. ■ Automatic calculation of the steam state and correct measurement of the steam amount. ■ Automatic navigation through the steam areas (wet steam, saturated steam and superheated steam).  For detailed information, see the Operating Instructions for the device.

16.14 Accessories

 Overview of accessories available to order →  172

16.15 Documentation

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

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Standard Documentation

Brief Operating Instructions

Brief Operating Instructions for the sensor

Measuring device	Documentation code
Prowirl F 200	KA01323D

Brief Operating Instructions for the transmitter

Measuring instrument	Documentation code
Prowirl 200	KA01326D

Technical Information

Measuring device	Documentation code
Prowirl F 200	TI01333D

Description of Device Parameters

Measuring instrument	Documentation code
Prowirl 200	GP01109D

Supplementary device-dependent documentation

Safety instructions

Contents	Documentation code
ATEX/IECEX Ex d	XA01635D
ATEX/IECEX Ex ia	XA01636D
ATEX/IECEX Ex ec, Ex ic	XA01637D
cCSA _{US} XP	XA01638D
cCSA _{US} IS	XA01639D
EAC Ex d	XA01684D
EAC Ex ia	XA01782D
EAC Ex ec, Ex ic	XA01685D
INMETRO Ex d	XA01642D
INMETRO Ex ia	XA01640D
INMETRO Ex ec, Ex ic	XA01641D
JPN Ex d	XA01766D
NEPSI Ex d	XA01643D
NEPSI Ex ia	XA01644D
NEPSI Ex ec, Ex ic	XA01645D

Contents	Documentation code
UKEX Ex d	XA02630D
UKEX Ex ia	XA02631D
UKEX Ex ec, Ex ic	XA02632D

Functional Safety Manual

Contents	Documentation code
Proline Prowirl 200	SD02025D

Special Documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Heartbeat Technology	SD02029D
Wet steam detection	SD02032D
Wet steam measurement	SD02035D
Protective cover	SD00333F

Installation Instructions

Contents	Note
Installation instructions for spare part sets and accessories	- Access the overview of all the available spare part sets via <i>Device Viewer</i> → 169 - Accessories available for order with Installation Instructions → 172

Index

A

Access authorization to parameters	
Read access	65
Write access	65
Access code	65
Incorrect input	65
Adapting the diagnostic behavior	155
Adapting the status signal	156
Ambient conditions	
Ambient temperature	27
Operating height	193
Storage temperature	193
Vibration resistance and shock resistance	194
Ambient temperature	
Influence	193
Ambient temperature range	27
AMS Device Manager	69
Function	69
Application	176
Applicator	177
Approvals	207

B

Burst mode	73
------------	----

C

Cable entries	
Technical data	188
Cable entry	
Degree of protection	50
CE mark	10, 207
Certificates	207
Checklist	
Post-connection check	50
Post-mounting check	35
Cleaning	
Exterior cleaning	167
Interior cleaning	167
Replacing housing seals	167
Replacing seals	167
Replacing sensor seals	167
Climate class	194
Commissioning	76
Advanced settings	97
Configuring the device	77
Communication-specific data	71
Connecting the device	43
Connection	
see Electrical connection	
Connection cable	36
Connection preparations	43
Connection tools	36
Context menu	
Calling up	61
Closing	61
Explanation	61

Current consumption	188
---------------------	-----

D

Date of manufacture	15, 16
Declaration of Conformity	10
Defining the access code	127
Degree of protection	50, 194
Design	
Measuring device	12
Device	
Configuring	77
Device components	12
Device description files	71
Device locking, status	139
Device name	
Pressure measuring cell	19
Sensor	16
Transmitter	15
Device repair	169
Device revision	71
Device type ID	71
Device Viewer	169
DeviceCare	69
Device description file	71
Diagnostic behavior	
Explanation	152
Symbols	152
Diagnostic information	
Design, description	152, 154
DeviceCare	153
FieldCare	153
Local display	151
Overview	156
Remedial measures	156
Diagnostic message	151
Diagnostics	
Symbols	151
Diagnostics list	161
DIP switch	
see Write protection switch	
Direct access	62
Disabling write protection	127
Display	
Current diagnostic event	161
Previous diagnostic event	161
see Local display	
Display area	
For operational display	55
In the navigation view	57
Display values	
For locking status	139
Displaying the measured value history	146
Disposal	170
Document	
Function	6
Symbols	6

Document function	6
Documentation	211

E

Electrical connection	
A transmitter power supply unit	66
Commubox FXA195 (USB)	66
Commubox FXA291	67
Degree of protection	50
Field Communicator 475	66
Field Xpert SFX350/SFX370	66
Measuring instrument	36
Operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)	66
Operating tools	
Via HART protocol	66
Via service interface (CDI)	67
VIATOR Bluetooth modem	66
Electromagnetic compatibility	195
Enabling write protection	127
Enabling/disabling the keypad lock	66
Endress+Hauser services	
Maintenance	168
Repair	170
Error messages	
see Diagnostic messages	
Event logbook	162
Events list	162
Ex-approval	208
Experience	208
Extended order code	
Pressure measuring cell	19
Sensor	16
Transmitter	15
Exterior cleaning	167

F

Field Communicator	
Function	70
Field Communicator 475	70
Field of application	
Residual risks	10
Field Xpert	
Function	67
Field Xpert SFX350	67
FieldCare	68
Device description file	71
Establishing a connection	68
Function	68
User interface	69
Filtering the event logbook	162
Firmware	
Release date	71
Version	71
Firmware history	166
Flow direction	22
Function range	
AMS Device Manager	69
SIMATIC PDM	70

Function scope	
Field Communicator	70
Field Communicator 475	70
Field Xpert	67
Functional Safety (SIL)	208
Functions	
see Parameters	

G

Galvanic isolation	186
--------------------------	-----

H

Hardware write protection	128
HART protocol	
Device variables	71
Measured variables	71
Help text	
Calling up	63
Closing	63
Explanation	63
HistoROM	121, 123

I

I/O electronics module	12, 43
Identifying the measuring instrument	14
Incoming acceptance	14
Influence	
Ambient temperature	193
Information about this document	6
Inlet runs	24
Input	176
Input screen	59
Inspection	
Connection	50
Installation	35
Received goods	14
Installation	22
Installation dimensions	26
Installation requirements	
Inlet and outlet runs	24
Orientation	22
Thermal insulation	27
Intended use	9
Interior cleaning	167

L

Languages, operation options	206
Line recorder	146
Load	42
Local display	
Editing view	58
Navigation view	57
see Diagnostic message	
see In alarm condition	
see Operational display	
Low flow cut off	186

M

Main electronics module	12
Maintenance tasks	167

Managing the device configuration 121, 123
 Manufacturer ID 71
 Manufacturing date 19
 Materials 202
 Maximum measurement error 189
 Measured variables
 Calculated 176
 Measured 176
 see Process variables
 Measuring and test equipment 168
 Measuring device
 Conversion 169
 Design 12
 Disposal 171
 Preparing for mounting 30
 Removing 170
 Repairs 169
 Switching on 76
 Measuring instrument
 Installing the sensor 30
 Preparing for electrical connection 43
 Measuring principle 176
 Measuring range 177
 Measuring system 176
 Medium temperature range 195
 Menu
 Diagnostics 161
 Setup 77
 Menus
 For device configuration 77
 For specific settings 97
 Mounting dimensions
 see Installation dimensions
 Mounting location 22
 Mounting preparations 30
 Mounting requirements
 Installation dimensions 26
 Mounting location 22
 Mounting tools 30
N
 Nameplate
 Pressure measuring cell 19
 Sensor 16
 Transmitter 15
 Navigation path (navigation view) 57
 Navigation view
 In the submenu 57
 In the wizard 57
 Netilion 168
 Nominal pressure
 Sensor 196
 Numeric editor 58
O
 Onsite display 206
 Operable flow range 183
 Operating elements 60, 152
 Operating height 193

Operating keys
 see Operating elements
 Operating menu
 Menus, submenus 53
 Structure 53
 Submenus and user roles 54
 Operating philosophy 54
 Operation 139
 Operation options 52
 Operational display 55
 Operational safety 10
 Order code 14, 15, 16, 19
 Orientation (vertical, horizontal) 22
 Outlet runs 24
 Output signal 184
 Output variables 184

P

Packaging disposal 21
 Parameter settings
 Administration (Submenu) 122
 Burst configuration 1 to n (Submenu) 73
 Configuration backup display (Submenu) 121, 123
 Current input (Wizard) 85
 Current output 1 to n (Wizard) 87
 Data logging (Submenu) 146
 Define access code (Wizard) 122
 Device information (Submenu) 164
 Diagnostics (Menu) 161
 Display (Submenu) 118
 Display (Wizard) 93
 External compensation (Submenu) 111
 Gas composition (Submenu) 101
 Input values (Submenu) 143
 Low flow cut off (Wizard) 95
 Medium properties (Submenu) 98
 Medium selection (Wizard) 82
 Output conditioning (Wizard) 95
 Output values (Submenu) 144
 Process variables (Submenu) 140
 Pulse/frequency/switch output (Wizard)
 88, 89, 90, 91
 Sensor adjustment (Submenu) 113
 Setup (Menu) 77
 Simulation (Submenu) 124
 System units (Submenu) 78
 Totalizer (Submenu) 143
 Totalizer 1 to n (Submenu) 116
 Totalizer handling (Submenu) 145
 Parameters
 Changing 64
 Entering a value 64
 Performance characteristics 189
 Post-connection check 76
 Post-connection check (checklist) 50
 Post-installation check 76
 Post-mounting check (checklist) 35
 Potential equalization 50
 Power consumption 187

Power supply failure	188
Pressure Equipment Directive	208
Pressure loss	197
Pressure-temperature ratings	196
Process conditions	
Medium temperature	195
Pressure loss	197
Product safety	10
Protecting parameter settings	127

R

RCM marking	208
Read access	65
Reading off measured values	139
Recalibration	168
Reference operating conditions	189
Registered trademarks	8
Remedial actions	
Calling up	153
Closing	153
Remote operation	207
Remote version	
Connecting the connecting cable	45
Repair	169
Notes	169
Repair of a device	169
Repeatability	192
Replacement	
Device components	169
Replacing seals	167
Requirements for personnel	9
Response time	193
Return	170

S

Safety	9
Sensor	
Installing	30
Serial number	15, 16, 19
Setting the operating language	76
Settings	
Adapting the measuring device to the process	
conditions	145
Administration	122
Advanced display configurations	118
Current input	85
Current output	87
External compensation	111
Gas composition	101
Local display	93
Low flow cut off	95
Managing the device configuration	121, 123
Medium	82
Medium properties	98
Operating language	76
Output conditioning	95
Pulse output	89
Pulse/frequency/switch output	88, 90
Resetting the device	164

Resetting the totalizer	145
Sensor adjustment	113
Simulation	124
Switch output	91
System units	78
Tag name	77
Totalizer	116
Totalizer reset	145
Signal on alarm	185
SIL (functional safety)	208
SIMATIC PDM	70
Function	70
Spare part	169
Spare parts	169
Standards and guidelines	208
Status area	
For operational display	55
In the navigation view	57
Status signals	151, 154
Storage conditions	20
Storage temperature	20
Storage temperature range	193
Structure	
Operating menu	53
Submenu	
Administration	122
Advanced setup	97
Burst configuration 1 to n	73
Configuration backup display	121, 123
Data logging	146
Device information	164
Display	118
Events list	162
External compensation	111
Gas composition	101
Input values	143
Medium properties	98
Output values	144
Overview	54
Process variables	139, 140
Sensor adjustment	113
Simulation	124
System units	78
Totalizer	143
Totalizer 1 to n	116
Totalizer handling	145
Supply unit	
Requirements	41
Supply voltage	41, 186
Symbols	
For communication	55
For correction	59
For diagnostic behavior	55
For locking	55
For measured variable	55
For measurement channel number	55
For menus	57
For parameters	57
For status signal	55

- For submenu 57
- For wizards 57
- In the status area of the local display 55
- In the text and numeric editor 59
- System design
 - Measuring system 176
 - see Measuring device design
- System integration 71
- T**
- Technical data, overview 176
- Temperature range
 - Storage temperature 20
- Terminal assignment 38, 43
- terminal voltage 42
- Terminals 188
- Text editor 58
- Thermal insulation 27
- Tool
 - Transporting 20
- Tool tip
 - see Help text
- Tools
 - Electrical connection 36
 - Installation 30
- Totalizer
 - Configuring 116
- Transmitter
 - Connecting the signal cables 43
 - Turning the display module 35
 - Turning the housing 34
- Transporting the measuring instrument 20
- Troubleshooting
 - General 149
- Turning the display module 35
- Turning the electronics housing
 - see Turning the transmitter housing
- Turning the transmitter housing 34
- U**
- UKCA marking 208
- Use of measuring device
 - Borderline cases 9
 - Incorrect use 9
- Use of measuring instrument
 - see Intended use
- User roles 54
- V**
- Version data for the device 71
- Vibration resistance and shock resistance 194
- W**
- W@M Device Viewer 14
- Weight
 - Compact version
 - SI units 197
 - US units 198
 - Flow conditioner 200
- Sensor remote version
 - SI units 199
 - US units 199
- Transport (notes) 20
- Wizard
 - Current input 85
 - Current output 1 to n 87
 - Define access code 122
 - Display 93
 - Low flow cut off 95
 - Medium selection 82
 - Output conditioning 95
 - Pulse/frequency/switch output 88, 89, 90, 91
- Workplace safety 10
- Write access 65
- Write protection
 - Via access code 127
 - Via write protection switch 128
- Write protection switch 128



71701602

www.addresses.endress.com

Endress+Hauser 
People for Process Automation

www.nicsanat.com

021-87700210

