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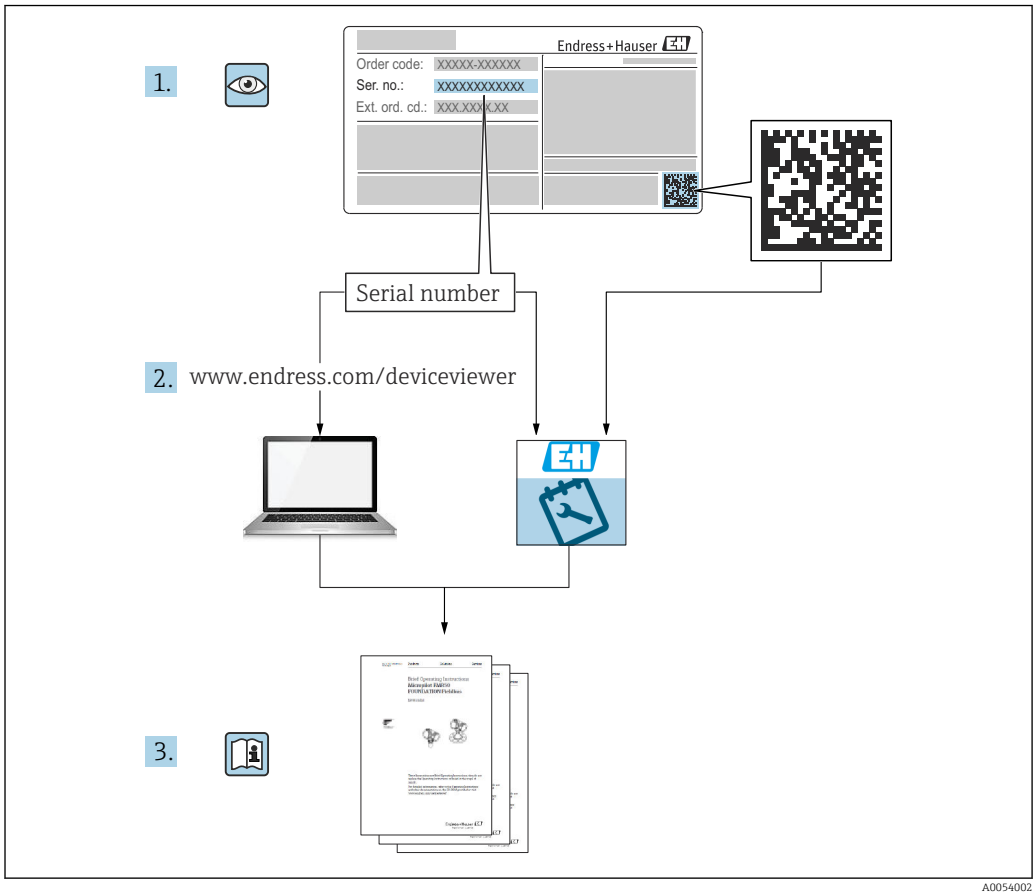
Valid as of version
01.00.zz (Device firmware)

Operating Instructions
Deltabar PMD50

Differential pressure measurement
HART

Endress+Hauser
People for Process Automation



- Make sure the document is stored in a safe place such that it is always available when working on or with the device
- 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. The Endress+Hauser sales organization will supply you with current information and updates to these instructions.

Table of contents

1 About this document

1.1 Document function

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

1.2 Symbols

1.2.1 Safety symbols

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Electrical symbols

Ground connection: ⏚

Terminal for connection to the grounding system.

1.2.3 Symbols for certain types of information

Permitted: ✓

Procedures, processes or actions that are permitted.

Forbidden: ✗

Procedures, processes or actions that are forbidden.

Additional information:

Reference to documentation:

Reference to page:

Series of steps: 1., 2., 3.

Result of an individual step:

1.2.4 Symbols in graphics

Item numbers: 1, 2, 3 ...

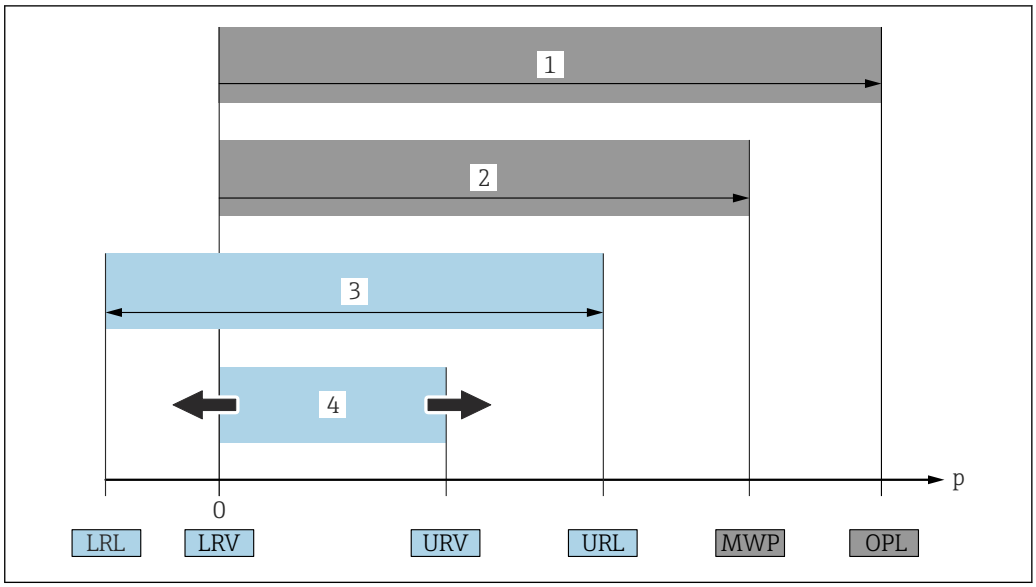
Series of steps: 1., 2., 3.

Views: A, B, C, ...

1.2.5 Symbols on the device

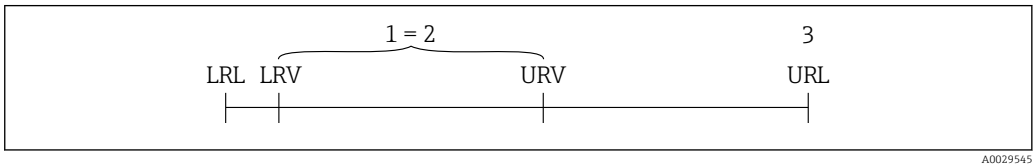
Safety instructions: →
Observe the safety instructions contained in the associated Operating Instructions.

1.3 List of abbreviations



1 OPL: The OPL (overpressure limit = measuring cell overload limit) for the device 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. Pay attention to the pressure/temperature dependency.
2 The MWP (maximum working pressure) for the measuring cells 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. Pay attention to the pressure/temperature dependency. The MWP may be applied at the device for an unlimited period of time. The MWP can be found on the nameplate.
3 The maximum measuring range corresponds to the span between the LRL and URL. This measuring range is equivalent to the maximum calibratable/adjustable span.
4 The calibrated/adjusted span corresponds to the span between the LRV and URV. Factory setting: 0 to URL. Other calibrated spans can be ordered as customized spans.
p Pressure
LRL Lower range limit
URL Upper range limit
LRV Lower range value
URV Upper range value
TD Turn down. Example - see the following section.

1.4 Turn down calculation



1 Calibrated/adjusted span
2 Zero-based span
3 Upper range limit

Example:
- Measuring cell: 16 bar (240 psi)
- Upper range limit (URL) = 16 bar (240 psi)
- Calibrated/adjusted span: 0 to 8 bar (0 to 120 psi)
- Lower range value (LRV) = 0 bar (0 psi)
- Upper range value (URV) = 8 bar (120 psi)

$$TD = \frac{URL}{|URV - LRV|}$$

In this example, the TD is therefore 2:1. This measuring span is based on the zero point.

1.5 Documentation

All available documents can be downloaded using:
- the serial number of the device (see cover page for description) or
- the data matrix code of the device (see cover page for description) or
- the "Downloads" area of the website www.endress.com

1.5.1 Supplementary device-dependent documentation

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

1.6 Registered trademarks

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

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- Follow instructions and comply with conditions

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

2.2 Intended use

The Deltabar is a differential pressure transmitter for measuring pressure, flow, level and differential pressure.

2.2.1 Incorrect use

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

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.

2.3 Workplace safety

When working on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.
- Switch off the supply voltage before connecting the device.

2.4 Operational safety

Risk of injury!
- Operate the device only if it is in proper technical condition, free from errors and faults.
- 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, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety and reliability:
- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.

- Use original spare parts and accessories from Endress+Hauser only.

Hazardous area

To eliminate the risk of danger to persons or the facility when the device is used in the approval-related area (e.g. explosion protection, pressure equipment safety):
- Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area.
- Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.5 Product safety

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

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

2.6 Functional Safety SIL (optional)

The Functional Safety Manual must be strictly observed for devices that are used in functional safety applications.

2.7 IT security

Endress+Hauser can only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings. IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

2.8 Device-specific IT security

The device offers specific functions to support protective measures by the operator. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. An overview of the most important functions is provided in the following section:

- Write protection via hardware write protection switch
- Access code to change the user role (applies to operation via FieldCare, DeviceCare, Asset Management Tools. e.g. AMS, PDM)

Function/interface	Factory setting	Recommendation
Access code (FieldCare connection)	Not enabled (0000)	Assign a customized access code during commissioning.
Service interface (CDI)	Enabled	On an individual basis following risk assessment.
Write protection via hardware write protection switch	Not enabled	On an individual basis following risk assessment.

2.8.1 Protecting access via a password

Protect write access to the parameters of the device via the operating tool e.g. FieldCare., DeviceCare). Access authorization is clearly regulated through the use of a user-specific access code.

The device is not supplied with an access code on delivery.

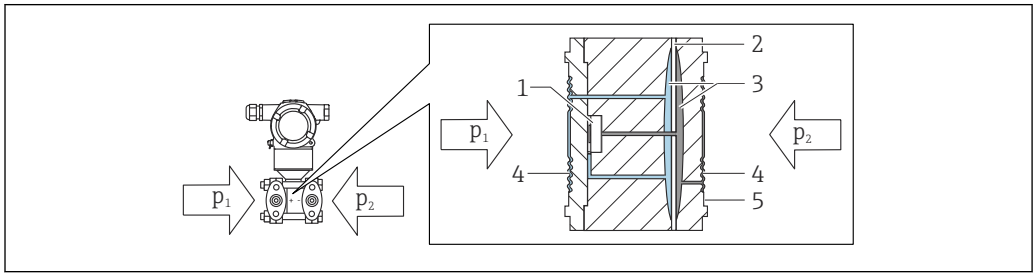
General notes on the use of passwords

- Assign a secure password when defining and managing the access code.
- The user is responsible for managing the access code and for using the code with due care.
- If the password is lost, see the "Reset device" section.

3 Product description

3.1 Product design

3.1.1 Measuring cell for differential pressure with metal process membrane



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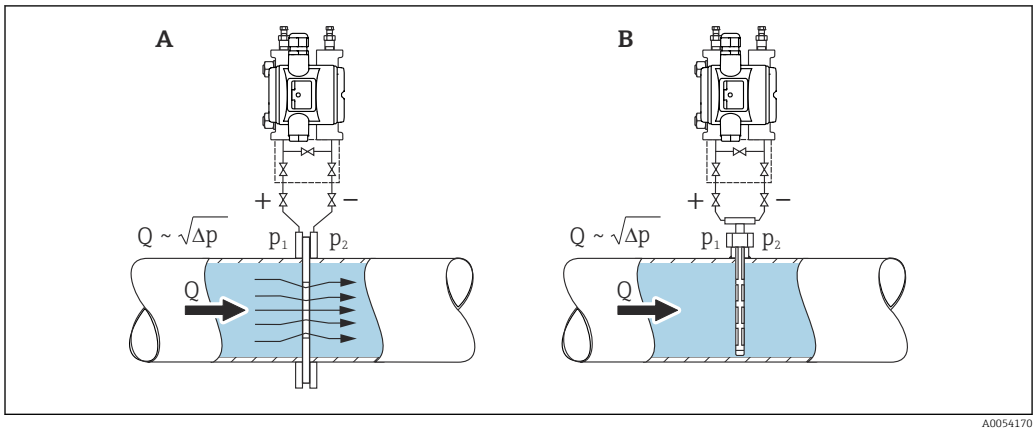
1 Measuring element
2 Middle diaphragm
3 Fill fluid
4 Process membrane
5 Seal
p_1 Pressure 1
p_2 Pressure 2

The process membrane is deflected on both sides by the acting pressures. A fill fluid transfers the pressure to a side of the measuring element where a resistance bridge is located (semiconductor technology). The change in the bridge output voltage, which depends on the differential pressure, is measured and processed further.

3.1.2 Flow measurement

Flow measurement with Deltabar and differential pressure sensor:



A0054170

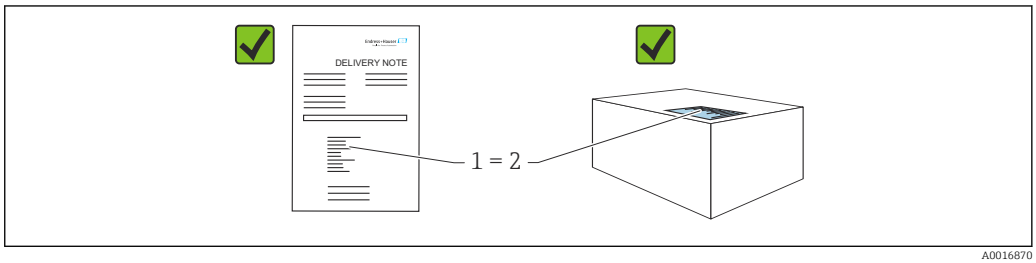
A Orifice plate
B Pitot tube
Q Flow
Δp Differential pressure, $\Delta p = p_1 - p_2$

Advantages:

- A specific unit is defined
- With the **Low flow cut off** parameter, positive zero return can be configured in the lower measuring range.

4 Incoming acceptance and product identification

4.1 Incoming acceptance



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- Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?
- Are the goods undamaged?
- Do the data on the nameplate correspond to the order specifications and the delivery note?
- Is the documentation available?
- If required (see nameplate): are the Safety Instructions (XA) provided?

If you can answer "no" to any of these questions, please contact Endress+Hauser.

4.1.1 Scope of delivery

The scope of delivery comprises:
- Device
- Optional accessories

Accompanying documentation:
- Brief Operating Instructions
- Final inspection report
- Additional Safety Instructions for devices with approvals (e.g. ATEX, IECEx, NEPSI, etc.)
- Optional: factory calibration form, test certificates

The Operating Instructions are available on the Internet at:

www.endress.com → Download

4.2 Product identification

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

4.2.1 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

Place of manufacture: See nameplate.

4.2.2 Nameplate

Different nameplates are used depending on the device version.

The nameplates contain the following information:
- Manufacturer name and device name
- Address of the certificate holder and country of manufacture
- Order code and serial number
- Technical data
- Approval-specific information

Compare the data on the nameplate with your order.

4.3 Storage and transport

4.3.1 Storage conditions

- Use the original packaging
- Store the device in clean and dry conditions and protect from damage caused by shocks

Storage temperature range

See Technical Information.

4.3.2 Transporting the product to the measuring point

⚠ WARNING

Incorrect transport!

Housing and membrane may become damaged, and there is a risk of injury!

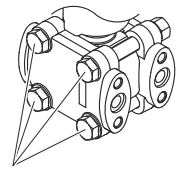
► Transport the device to the measuring point in the original packaging.

5 Mounting

NOTICE

The device can be damaged if handled incorrectly!

- The removal of the screws with item number (1) is not permissible under any circumstances and will void the warranty.



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5.1 Mounting requirements

5.1.1 General instructions

- Do not clean or touch the membrane with hard and/or pointed objects.
- Do not remove the membrane protection until shortly before installation.

Always firmly tighten the housing cover and the cable entries.

1. Counter-tighten the cable entries.
2. Tighten the coupling nut.

5.1.2 Installation instructions

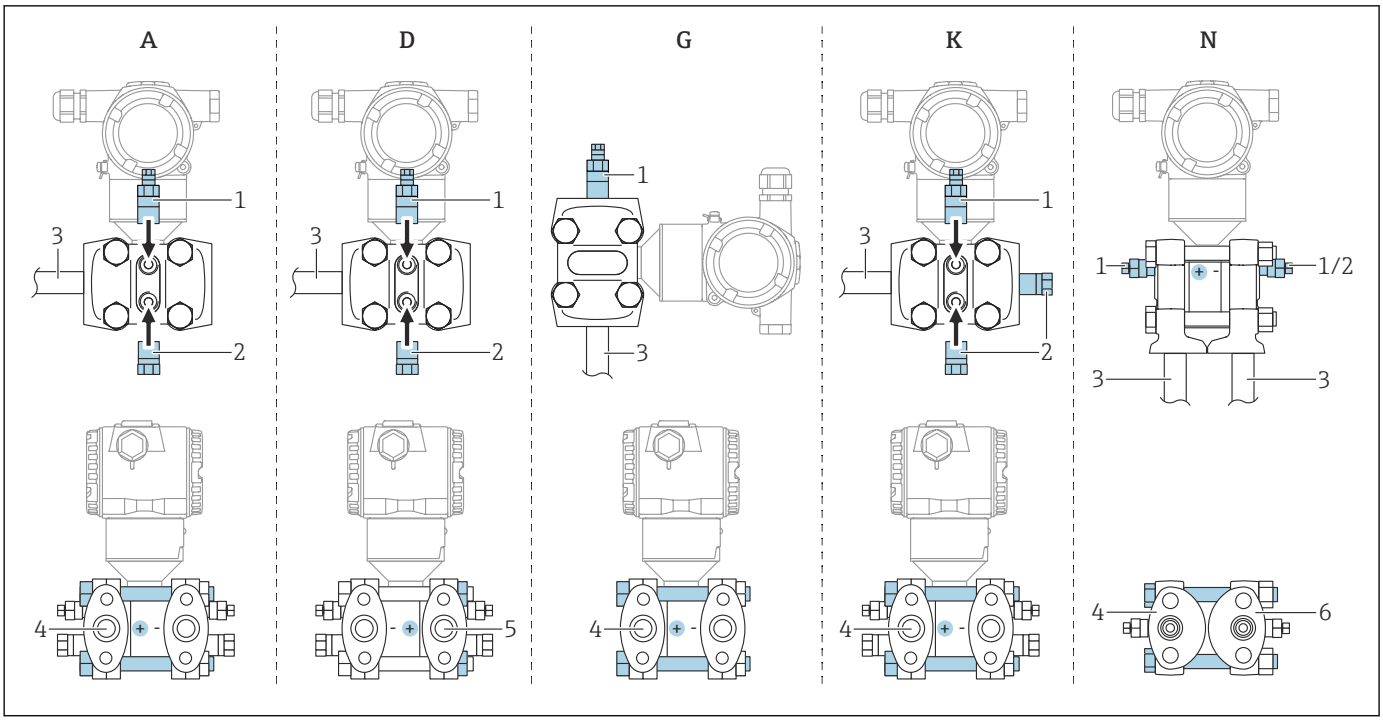
- The devices are mounted according to the same guidelines as pressure gauges (DIN EN837-2).
- The devices are mounted according to the same guidelines as pressure gauges (DIN EN837-2).
- To ensure optimal readability of the onsite display, align the housing and local display.
- Endress+Hauser offers a mounting bracket for installing the device on pipes or walls.
- For measurements in media containing solides (e.g. dirty liquids), it makes sense to install strainer and drain valves.
- Using a valve manifold allows for easy commissioning, installation and maintenance without interrupting the process
- When mounting the device, establishing the electrical connection and during operation: prevent the penetration of moisture into the housing
- Point the cable downwards where possible to prevent moisture from entering (e.g. rain or condensation water).

5.1.3 Installing pressure piping

- For recommendations for routing pressure piping, refer to DIN 19210 "Differential pressure piping for flow measurement devices" or the corresponding national or international standards
- When routing the pressure piping outdoors, ensure sufficient anti-freeze protection, e.g. by using pipe trace heaters.
- Install the pressure piping with a monotonic gradient of at least 10%.

5.1.4 Orientation

The installation depends on the supply and proper connection of the impulse lines.



1 A, D, G, K, N: order options

A Horizontal impulse line, left side high pressure (screw head side), with side vent Thread on one side and side thread for horizontal impulse line

D Horizontal impulse line, right side high pressure (screw nuts side), with side vent Thread on one side and side thread for horizontal impulse line

G Horizontal impulse line, left or right side high pressure (screw head side), with side vent Thread on each side for vertical impulse line.

K Universal side flange, left or right side high pressure (screw head side), with vent. Thread on each side and side thread for universal mounting.

N Bottom process connection, left side high pressure (screw head side), vent. Thread on each side and side thread for mounting on existing manifolds.

1 Vent valve

2 Sealing plug

3 Impulse line

4 High pressure side (screw head side)

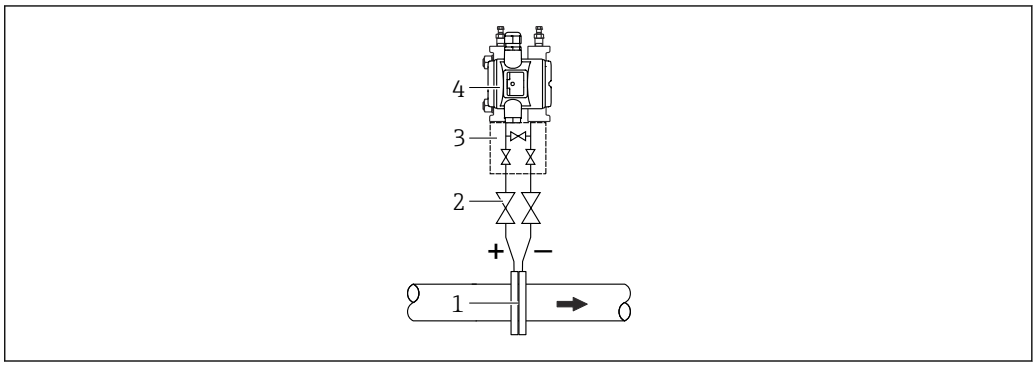
5 High pressure side (screw nuts side)

6 IEC upright, view from below

5.2 Mounting the device

5.2.1 Flow measurement

Flow measurement in gases

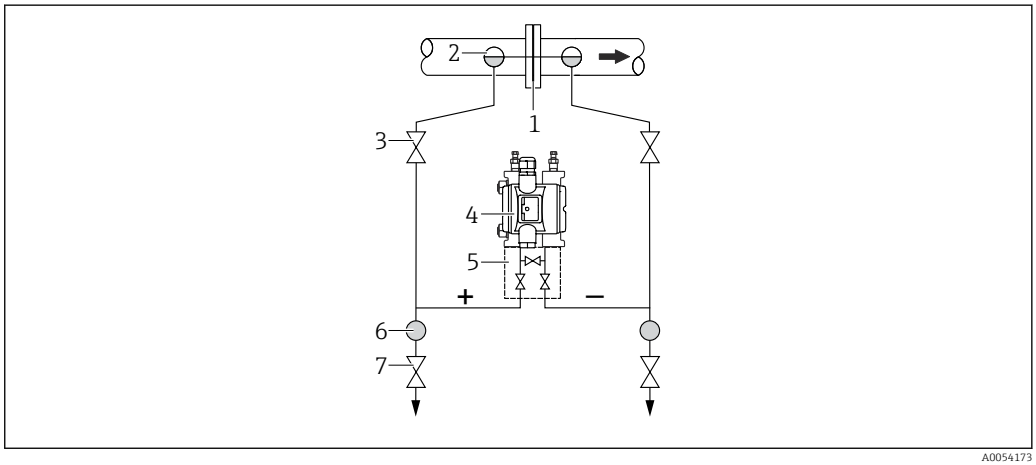


A0054172

1 Orifice plate or pitot tube
2 Shutoff valves
3 Three-valve manifold
4 Device

Mount the device above the measuring point so that the condensate can drain into the process pipe.

Flow measurement in vapors

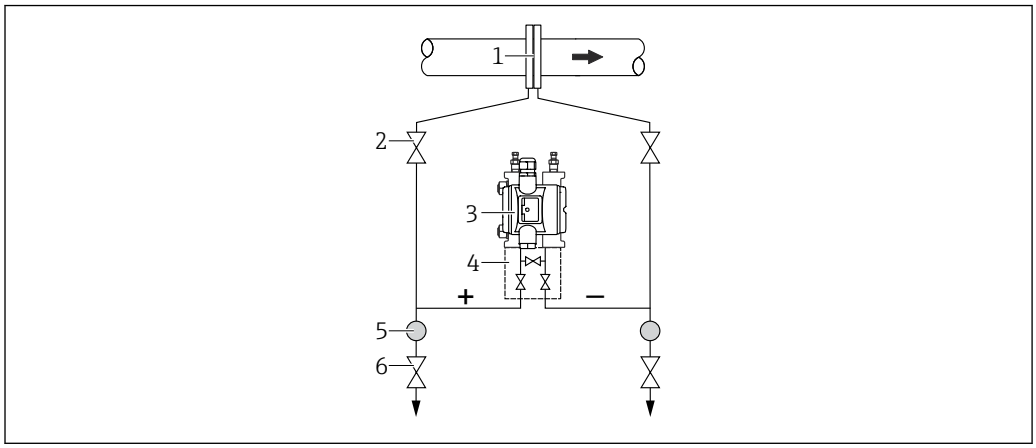


A0054173

1 Orifice plate or pitot tube
2 Condensate traps
3 Shutoff valves
4 Device
5 Three-valve manifold
6 Separator
7 Drain valves

- Mount the device below the measuring point.
- Mount the condensate traps at the same level as the tapping points and at the same distance to the device.
- Prior to commissioning, fill the piping to the height of the condensate traps

Flow measurement in liquids

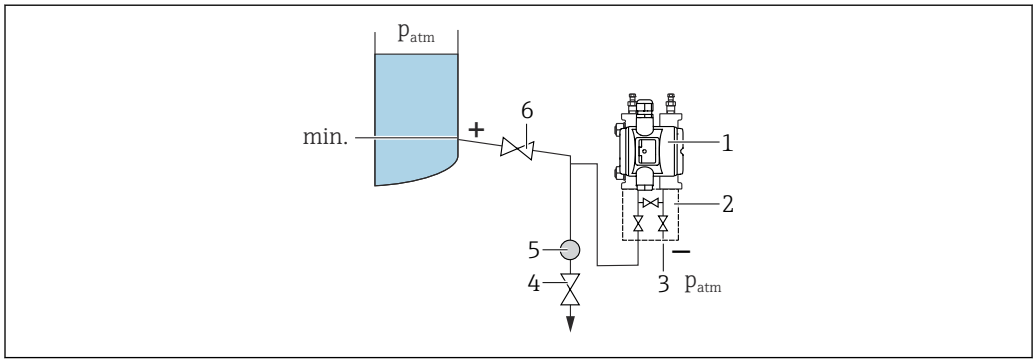


1 *Orifice plate or pitot tube*
2 *Shutoff valves*
3 *Device*
4 *Three-valve manifold*
5 *Separator*
6 *Drain valves*

- Mount the device below the measuring point so that the impulse lines are always filled with liquid and gas bubbles can rise back into the process piping.
- When measuring in media with solid parts, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.

5.2.2 Level measurement

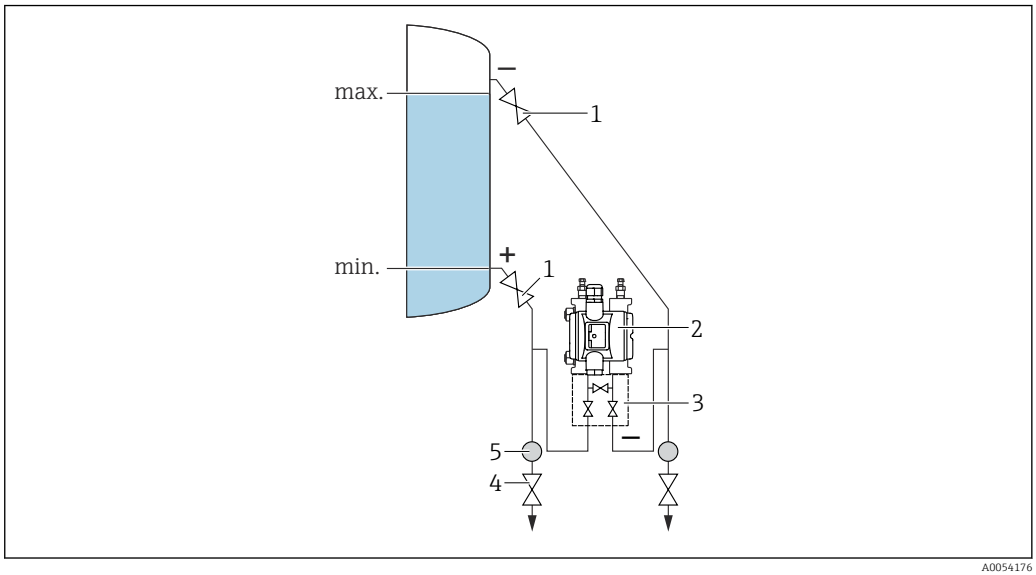
Level measurement in open vessels



1 *Device*
2 *Three-valve manifold*
3 *Low-pressure side is open to atmospheric pressure.*
4 *Drain valve*
5 *Separator*
6 *Shut-off valve*

- Mount the device below the lower measuring connection so that the impulse lines are always filled with liquid.
- The low-pressure side is open to atmospheric pressure.
- When measuring in media with solid parts, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.

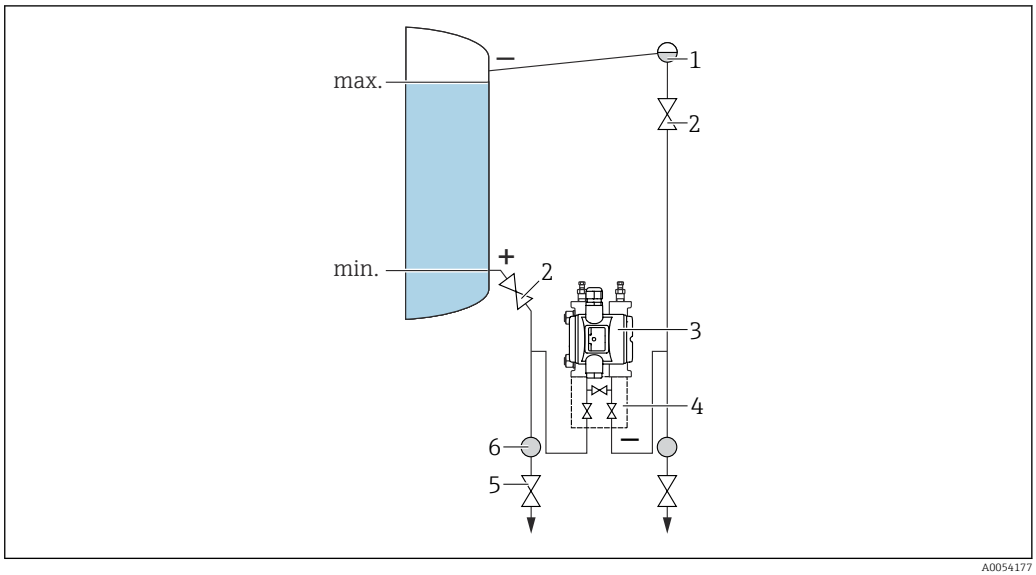
Level measurement in a closed vessel



1 *Shutoff valves*
2 *Device*
3 *Three-valve manifold*
4 *Drain valves*
5 *Separator*

- Mount the device below the lower measuring connection so that the impulse lines are always filled with liquid.
- Always connect the low-pressure side above the maximum level
- When measuring in media with solid parts, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.

Level measurement in a closed vessel with superimposed vapor

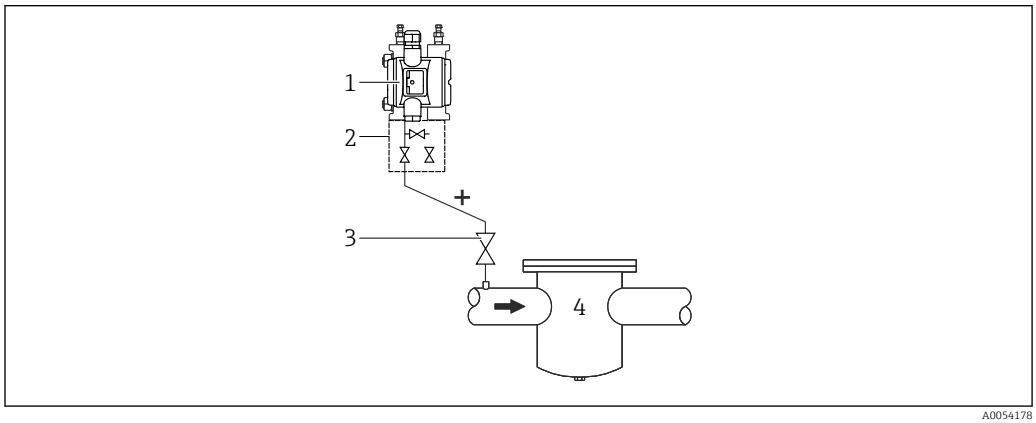


1 *Condensate trap*
2 *Shutoff valves*
3 *Device*
4 *Three-valve manifold*
5 *Drain valves*
6 *Separator*

- Mount the device below the lower measuring connection so that the impulse lines are always filled with liquid.
- Always connect the low-pressure side above the maximum level
- The condensate trap ensures constant pressure on the low-pressure side
- When measuring in media with solid parts, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.

5.2.3 Pressure measurement

Pressure measurement with 160 bar (2 400 psi) and 250 bar (3 750 psi) measuring cell

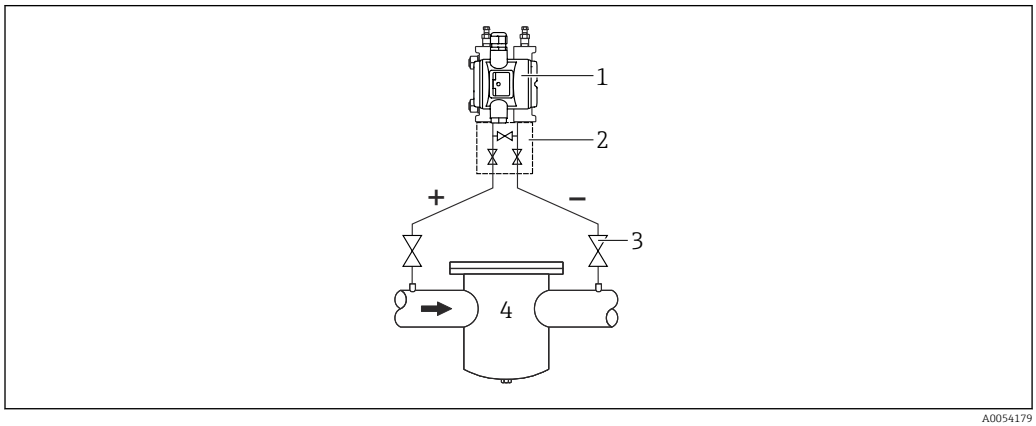


1 Device with blind flange on low-pressure side
2 Three-valve manifold
3 Shutoff valves
4 Pressurized container

- Mount the device above the measuring point so that the condensate can drain into the process pipe.
- The negative side is open to atmospheric pressure, via the screwed-in reference air filter of the side flange of the low-pressure side.

5.2.4 Differential pressure measurement

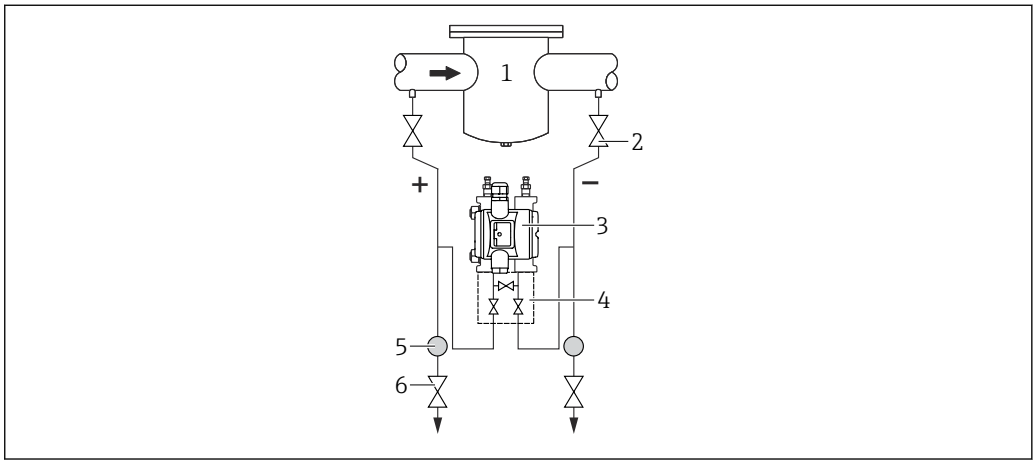
Differential pressure measurement in gases and vapors



1 Device
2 Three-valve manifold
3 Shutoff valves
4 e.g. filter

Mount the device above the measuring point so that the condensate can drain into the process pipe.

Differential pressure measurement in liquids



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1 e.g. filter
2 Shutoff valves
3 Device
4 Three-valve manifold
5 Separator
6 Drain valves

- Mount the device below the measuring point so that the impulse lines are always filled with liquid and gas bubbles can rise back into the process piping.
- When measuring in media with solid parts, such as dirty liquids, installing separators and drain valves is useful for capturing and removing sediment.

5.2.5 Oxygen applications (gaseous)

Oxygen and other gases can react explosively to oils, grease and plastics. The following precautions must be taken:
- All components of the system, such as devices, must be cleaned in accordance with national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded for oxygen applications.

The cleaning of the device (not accessories) is provided as an optional service.

- p_{max}: 80 bar (1 200 psi)
- T_{max}: 60 °C (140 °F)

5.2.6 Oxygen applications (gaseous)

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- All components of the system, such as devices, must be cleaned in accordance with national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded for oxygen applications.

The cleaning of the device (not accessories) is provided as an optional service.

- p_{max}: 80 bar (1 200 psi)
- T_{max}: 60 °C (140 °F)

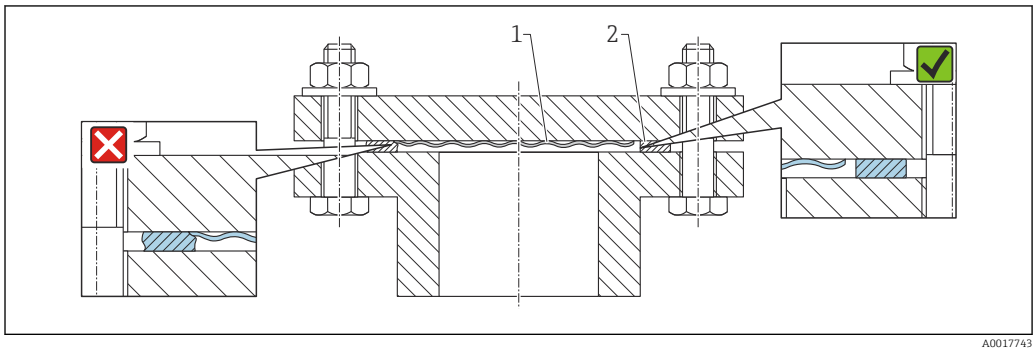
5.2.7 Seal for flange mounting

NOTICE

Seal pressing against the membrane!

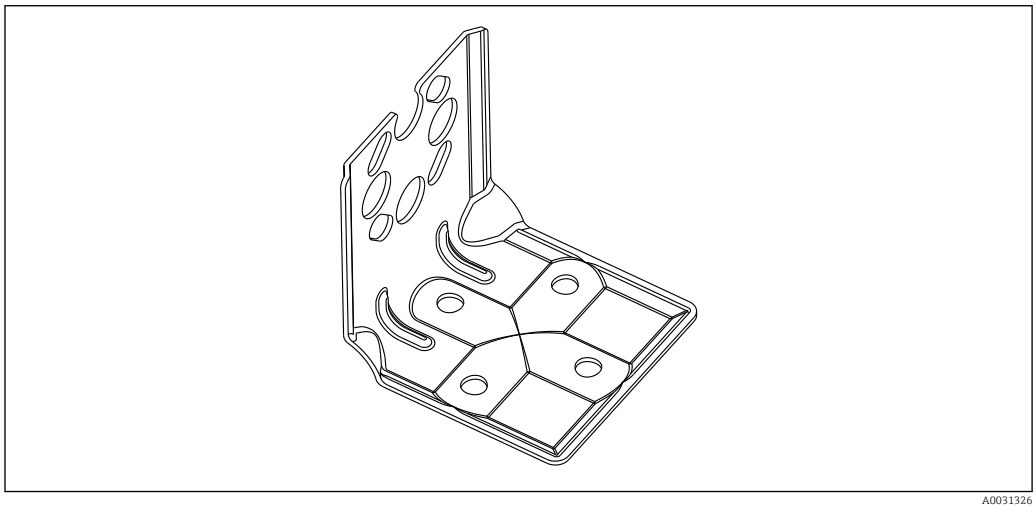
Incorrect measurement results!

▶ Ensure that the seal is not touching the membrane.



1 Membrane
2 Seal

5.2.8 Wall and pipe mounting



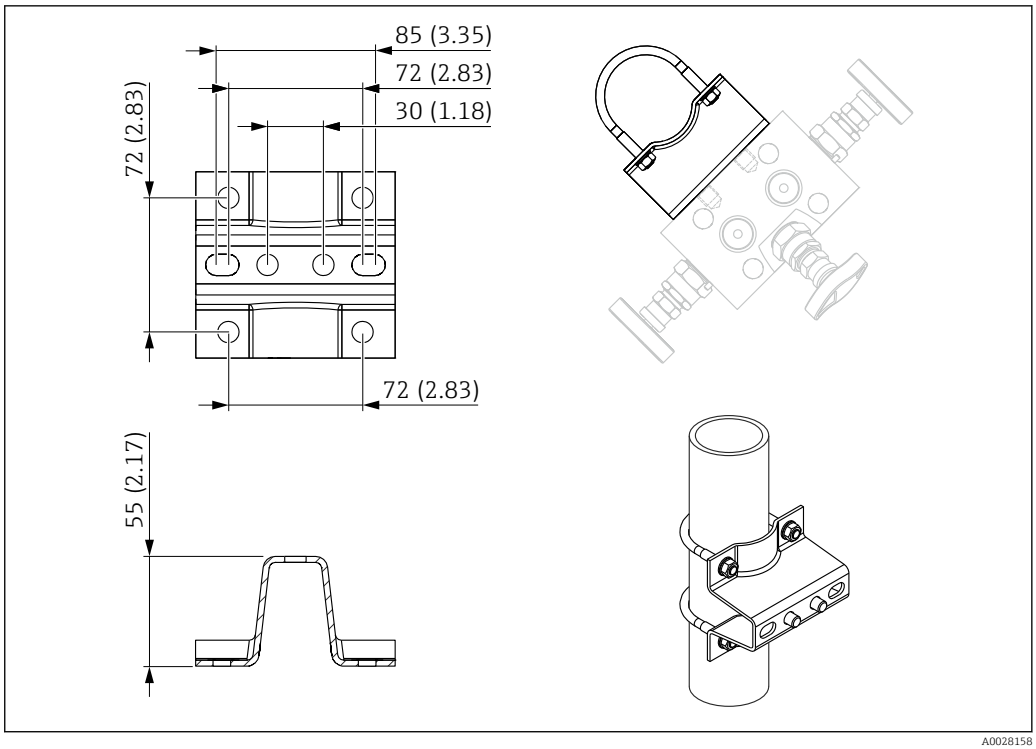
- If a valve manifold is used, its dimensions should also be taken into consideration
- Bracket for wall and pipe mounting including retaining bracket for pipe mounting and two nuts
- The material of the screws used to secure the device depends on the order code

For technical data (e.g. materials, dimensions or order numbers), see the accessory document SD01553P.

5.2.9 Wall and pipe mounting with a manifold (optional)

- Mount the device on a shutoff device, e.g. manifold or shutoff valve
- Use the bracket provided. This make device removal easier.

For technical data (e.g. materials, dimensions or order numbers), see the accessory document SD01553P.



5.2.10 Closing the housing covers

NOTICE

Thread and housing cover damaged from dirt and fouling!

- ▶ Remove dirt (e.g. sand.) on the thread of the cover and housing.
- ▶ If you continue to encounter resistance when closing the cover, check the thread again for fouling.

Housing thread

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

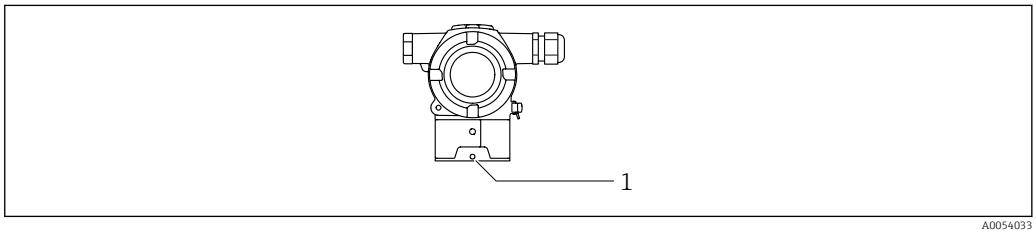
Do not lubricate the housing threads.

5.2.11 Turning the housing

The housing can be rotated up to 380° by loosening the locking screw.

Your benefits

- Easy mounting due to optimum alignment of housing
- Easily accessible device operation
- Optimum readability of the local display (optional)



1 Locking screw

NOTICE

The housing cannot be unscrewed fully.

- ▶ Loosen the external locking screw by a maximum of 1.5 turns. If the screw is unscrewed too much or completely (beyond the screw anchor point), small parts (counter disk) can become loose and fall out.
- ▶ Tighten the securing screw (hexagon socket 4 mm (0.16 in)) with maximum 3.5 Nm (2.58 lbf ft) ± 0.3 Nm (0.22 lbf ft).

5.3 Post-mounting check

❑ Is the device undamaged (visual inspection)?

❑Are the measuring point identification and labeling correct (visual inspection)?

❑ Is the device protected against precipitation and direct sunlight?

❑ Are the securing screws and cover lock tightened securely?

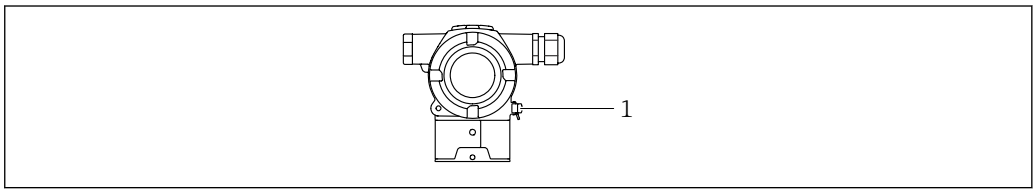
❑ Does the measuring device meet the measuring point specifications?
For example:
- Process temperature
- Process pressure
- Ambient temperature
- Measuring range

6 Electrical connection

6.1 Connecting requirements

6.1.1 Potential equalization

The protective ground on the device must not be connected. If necessary, the potential matching line can be connected to the outer ground terminal of the device before the device is connected.



1 Ground terminal for connecting the potential matching line

If necessary, the potential matching line can be connected to the outer ground terminal of the device before the device is connected.

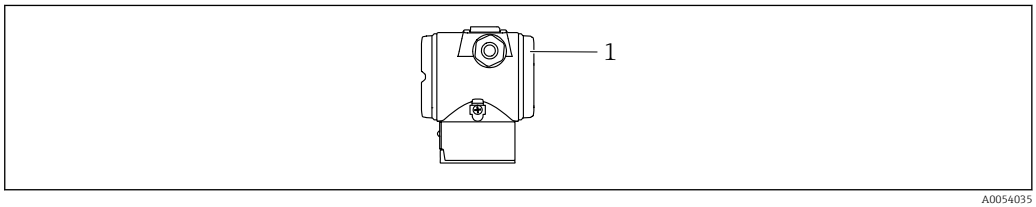
WARNING

Risk of explosion!

- Please refer to the separate documentation on applications in hazardous areas for the safety instructions.

For optimum electromagnetic compatibility:
- Potential matching line as short as possible
- Maintain a cross-section of at least 2.5 mm^2 (14 AWG)

6.2 Connecting the device



1 Connection compartment cover

Housing thread

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

Do not lubricate the housing threads.

6.2.1 Supply voltage

- Ex d, Ex e, non Ex: supply voltage: 10.5 to 35 V_{DC}
- Ex i: supply voltage: 10.5 to 30 V_{DC}
- Nominal current: 4 to 20 mA HART

The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV, Class 2) and must comply with the relevant protocol specifications. For 4 to 20 mA, the same requirements apply as for HART.

A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010.

6.2.2 Power consumption

To ensure the safety of the device, the maximum supply current must be limited to 500 mA (e.g. connect a fuse upstream).

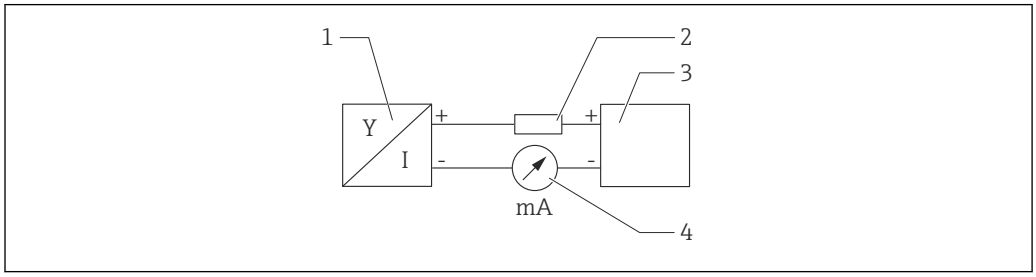
6.2.3 Terminals

- Supply voltage and internal ground terminal: 0.5 to 2.5 mm^2 (20 to 14 AWG)
- External ground terminal: 0.5 to 4 mm^2 (20 to 12 AWG)

6.2.4 Cable specification

- Protective ground or grounding of the cable shield: rated cross-section > 1 mm^2 (17 AWG)
  Rated cross-section of 0.5 mm^2 (20 AWG) to 2.5 mm^2 (13 AWG)
- Cable outer diameter: Ø5 to 9 mm (0.2 to 0.35 in) depends on the cable gland used (see Technical Information)

6.2.5 4-20 mA HART



2 Block diagram of HART connection

1 Device with HART communication
2 HART communication resistor
3 Power supply
4 multimeter

The HART communication resistor of 250 Ω in the signal line is always necessary in the case of a low-impedance power supply.

Take the voltage drop into consideration:
Maximum 6 V for a communication resistor of 250 Ω

6.2.6 Overvoltage protection

Devices without optional overvoltage protection

Equipment from Endress+Hauser fulfills the requirements of the product standard IEC/DIN EN 61326-1 (Table 2 Industrial Environment).

Depending on the type of port (DC power supply, input/output port) different testing levels according to IEC/DIN EN 61326-1 against transient overvoltages (Surge) are applied (IEC/DIN EN 61000-4-5 Surge):
Test level on DC power ports and input / output ports is 1000 V line to earth

Devices with optional overvoltage protection

- Spark-over voltage: min. 400 V DC
- Tested according to IEC/DIN EN 60079-14 sub chapter 12.3 (IEC/DIN EN 60060-1 chapter 7)
- Nominal discharge current: 10 kA

Overvoltage category

Overvoltage category II

6.2.7 Wiring

⚠ WARNING

Supply voltage might be connected!
Risk of electric shock and/or explosion!

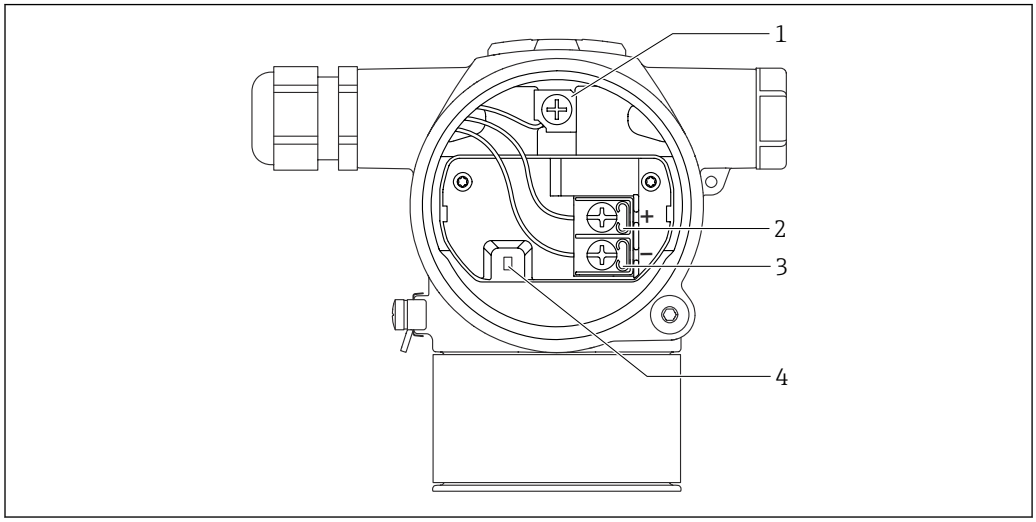
- ▶ When operating the device in hazardous areas, ensure compliance with national standards and the specifications outlined in the Safety Instructions (XAs). Use the specified cable gland.
- ▶ The supply voltage must match the specifications on the nameplate.
- ▶ Switch off the supply voltage before connecting the device.
- ▶ If necessary, the potential matching line can be connected to the outer ground terminal of the transmitter before the device is connected.
- ▶ A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010.
- ▶ The cables must be adequately insulated, with due consideration given to the supply voltage and the overvoltage category.
- ▶ The connecting cables must offer adequate temperature stability, with due consideration given to the ambient temperature.
- ▶ Only operate the device with the covers closed.
- ▶ Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.

Connect the device in the following order:

1. Release the cover lock (if provided).
2. Unscrew the cover.
3. Guide the cables into the cable glands or cable entries.
4. Connect the cables.
5. Tighten the cable glands or cable entries so that they are leak-tight. Counter-tighten the housing entry. Use a suitable tool with width across flats AF24/25
   8 Nm (5.9 lbf ft) for the M20 cable gland.
6. Screw the cover securely back onto the connection compartment.

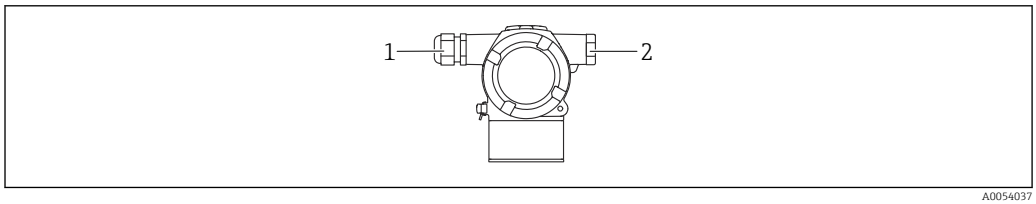
6.2.8 Terminal assignment

Dual-compartment housing



1 Internal ground terminal
2 Positive terminal
3 Negative terminal
4 Interlock diode: An interlock diode is used for uninterrupted measurement of the output signal.

6.2.9 Cable entries



1 Cable entry
2 Dummy plug

The type of cable entry depends on the device version ordered.

Always route connecting cables downwards so that moisture cannot penetrate the connection compartment.

If necessary, create a drip loop or use a weather protection cover.

6.3 Ensuring the degree of protection

6.3.1 Cable entries

- Gland M20, plastic, IP66/68 TYPE 4X/6P
- Gland M20, brass nickel plated, IP66/68 TYPE 4X/6P
- Gland M20, 316L, IP66/68 TYPE 4X/6P
- Thread M20, IP66/68 TYPE 4X/6P

- Thread G1/2, IP66/68 TYPE 4X/6P
  If the G1/2 thread is selected, the device is delivered with an M20 thread as standard and a G1/2 adapter is included with the delivery, along with the corresponding documentation
- Thread NPT1/2, IP66/68 TYPE 4X/6P
- Dummy plug transport protection: IP22, TYPE 2

6.4 Post-connection check

After wiring the device, perform the following checks:

❑ Is the potential matching line connected?

❑ Is the terminal assignment correct?

❑ Are the cable glands and dummy plugs leak-tight?

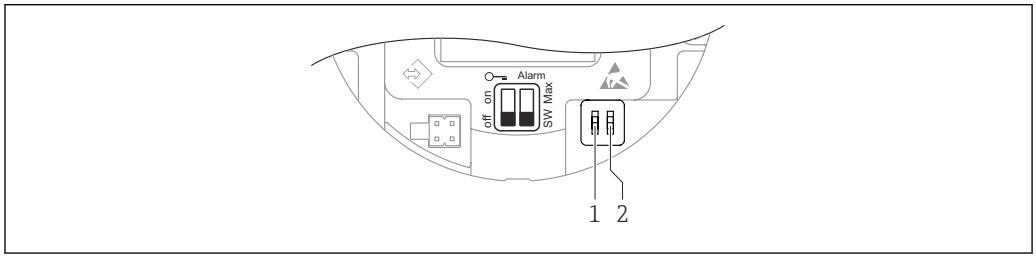
❑ Are the covers screwed down correctly?

7 Operation options

7.1 Overview of operation options

- Operation via DIP-switch on the electronic insert
- Operation via 2 magnetic keys
- Operation via operating tool (Endress+Hauser FieldCare/DeviceCare or FDI Package)
- Operation via handheld terminal

7.2 DIP switch on the electronic insert



A0054038

1 DIP switch for locking and unlocking the device
2 DIP switch for alarm current

The setting of the DIP switches has priority over the settings made via other operation methods (e.g. FieldCare/DeviceCare).

7.3 Structure and function of the operating menu

The differences between the structure of the operating menus of the onsite display and the Endress+Hauser FieldCare or DeviceCare operating tools can be summarized as follows:

The zero point and span can be configured via the operating keys and onsite display.

More elaborate applications can be configured with the Endress+Hauser FieldCare or DeviceCare tools.

"Wizards" help the user to commission the various applications. The user is guided through the individual configuration steps.

7.3.1 User roles and related access authorization

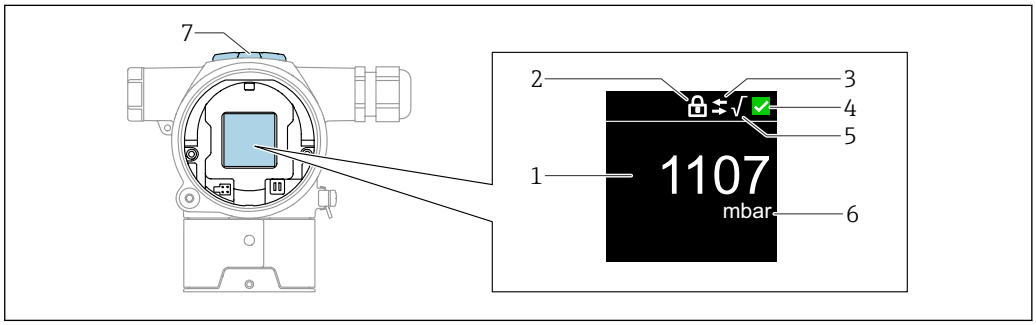
The two user roles**Operator** and**Maintenance** (as-delivered state) have different write access to the parameters if a device-specific access code has been defined. This access code protects the device configuration from unauthorized access.

If an incorrect access code is entered, the user retains the **Operator** option user role.

7.4 Access via color display (optional) and magnetic button

Functions that can be executed with the magnetic button:
- Zero point and span
- Turning the display
- Position adjustment
- Resetting user role password
- Device reset

The brightness of the color display is adjusted depending on the supply voltage and the current consumption.



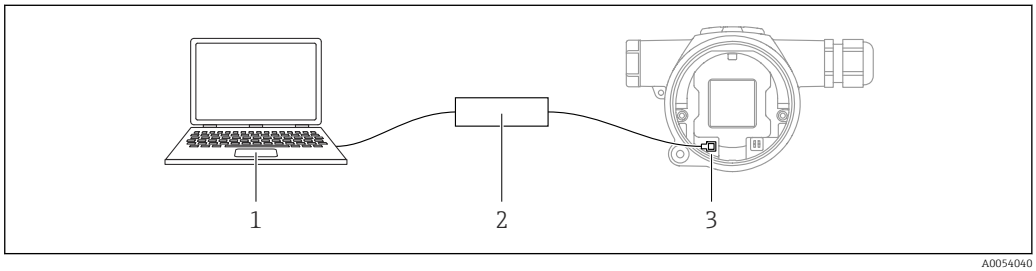
3 *Color display*

1 *Measured value (up to 5 digits)*
2 *Locking (symbol appears when device is locked)*
3 *HART communication (symbol appears when HART communication is enabled)*
4 *Status symbol according to NAMUR*
5 *Square root extraction (appears when applied to measured value)*
6 *Measured value output in %*
7 *Magnetic keys (Zero and Span)*

7.5 Access to the operating menu via the operating tool

7.5.1 Connecting the operating tool

Service interface



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

At least 22 mA is required to update (flash) the device firmware.

7.5.2 FieldCare

Function scope

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

Access is via:
- CDI service interface
- HART communication

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

For additional information about FieldCare, see Operating Instructions BA00027S and BA00059S

7.5.3 DeviceCare

Function scope

Tool for connecting and configuring Endress+Hauser field devices.

Together with the device type managers (DTMs), DeviceCare presents a convenient, comprehensive solution.

Access is via:
- CDI service interface
- HART communication

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

For details, see Innovation Brochure IN01047S

8 System integration

8.1 Overview of device description files

- Manufacturer ID: 17 (0x0011)
- Device type ID: 0x11E1
- HART specification: 7.6

8.2 Measured variables via HART protocol

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) [1]	Pressure [2]
Secondary variable (SV)	Sensor temperature
Tertiary variable (TV)	Electronics temperature
Quaternary variable (QV)	Sensor pressure [3]

1) The PV is always applied to the current output.
2) The pressure is the calculated signal after damping and position adjustment.
3) The Sensor pressure is the raw signal of the measuring cell before damping and position adjustment.

In a HART Multidrop loop, only one device may use the analog current value for signal transmission. For all other devices in the **"Loop current mode" parameter**, select the **Disable** option.

8.2.1 Device variables and measured values

The following codes are assigned to the device variables at the factory:

Device variable	Device variable code
Pressure	0
Scaled variable	1
Sensor temperature	2
Sensor pressure	3
Electronics temperature	4
Terminal current	5
Terminal voltage	6
Median of pressure signal	7
Noise of pressure signal	8
Percent of range	244
Loop current	245
Not used	250

The device variables can be queried by a HART® master using HART® command 9 or 33.

8.2.2 System units

The following table describes the supported pressure measuring units.

Index number	Description	Hart unit code
0	mbar	8
1	bar	7
2	Pa	11
3	kPa	12
4	MPa	237
5	psi	6
6	torr	13
7	atm	14
8	mmH2O	4
9	mmH2O (4°C)	239
10	mH2O	240
11	mH2O (4°C)	240
10	ftH2O	3
11	inH2O	1
12	inH2O (4°C)	238
13	mmHg	5
14	inHg	2
15	gf/cm²	9
16	kgf/cm²	10

9 Commissioning

9.1 Preliminaries

The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

⚠ WARNING

The settings of the current output are relevant for safety!
This situation can result in product overflow.
- ▶ The setting of the current output depends on the setting in the **Assign PV** parameter.
- ▶ After changing the **Assign PV** parameter, check the span settings (LRV and URV) and reconfigure if necessary.

⚠ WARNING

Process pressure above or below permitted maximum/minimum!
Risk of injury if parts burst! Warnings are displayed if the pressure is too high.
- ▶ If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, a message is output.
- ▶ Only use the device within the measuring range limits.

9.1.1 As-delivered state

If no customized settings were ordered:

- **Assign PV** parameter **Pressure** option
- Calibration values defined by defined measuring cell nominal value
- The alarm current is set to min. (3.6 mA), (only if no other option was selected when ordering)
- DIP switch to Off position

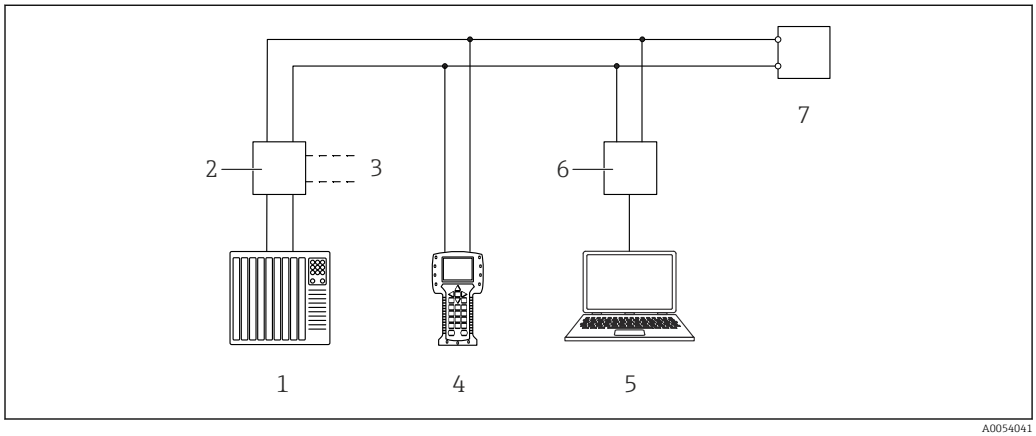
9.2 Function check

Perform a function check before putting the measuring point into operation:

- "Post-installation check" checklist (see the "Installation" section)
- "Post-connection check" checklist (see the "Electrical connection" section)

9.3 Connecting via FieldCare and DeviceCare

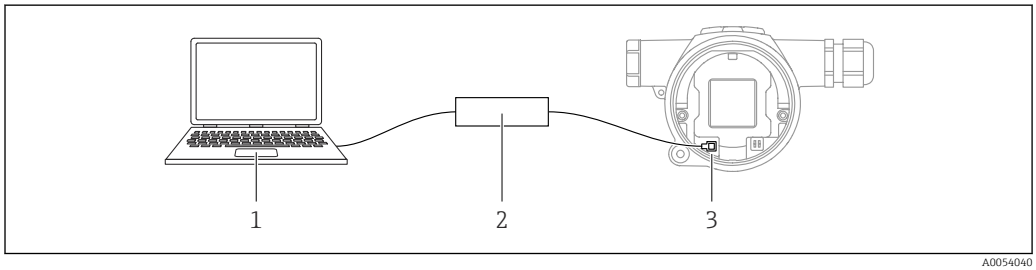
9.3.1 Via HART protocol



4 *Options for remote operation via HART protocol*

1 *PLC (programmable logic controller)*
2 *Transmitter power supply unit with communication resistor*
3 *Connection for Commubox (HART interface)*
4 *Field Communicator*
5 *Computer with operating tool (e.g. FieldCare/DeviceCare, AMS Device Manager, SIMATIC PDM)*
6 *Commubox*
7 *Device*

9.3.2 FieldCare/DeviceCare via service interface (CDI)



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

At least 22 mA is required to update (flash) the device firmware.

9.4 Configuring the device address via software

See the **HART address** parameter.

9.5 Setting the operating language

The operating language is set via the operating tool.

9.5.1 Farbanzeige - Locking or unlocking

Operation is locked from the outside using a plastic cover that can be secured with a screw.

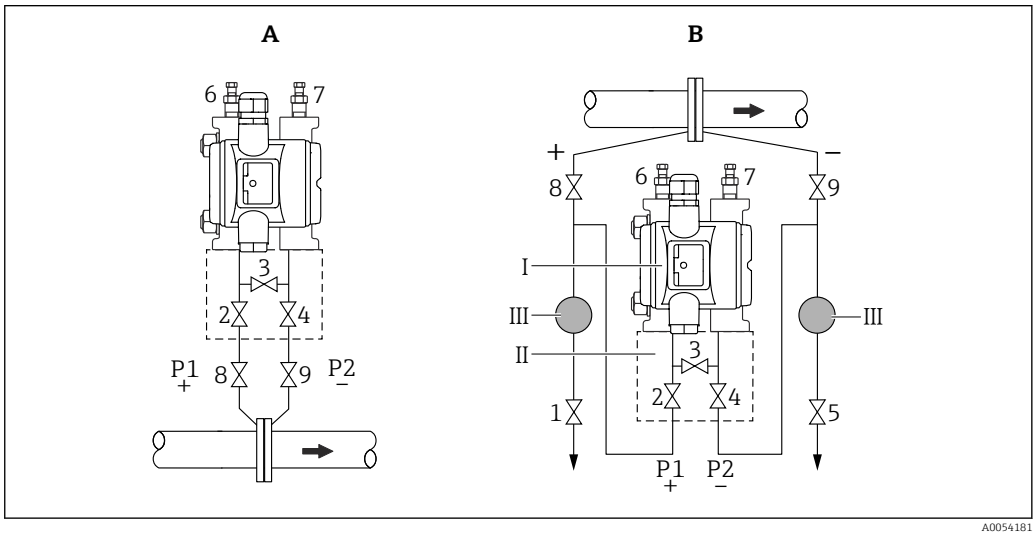
9.5.2 Operating tool

See the description of the relevant operating tool.

9.6 Configuring the device

9.6.1 Differential pressure measurement (e.g. flow measurement)

Before adjusting the device, the pressure piping may need to be cleaned and filled with medium.



A Preferred installation for gases
B Preferred installation for liquids
I Device
II Three-valve manifold
III Separator
1, 5 Drain valves
2, 4 Inlet valves
3 Equalization valve
6, 7 Vent valves on device
8, 9 Shutoff valves

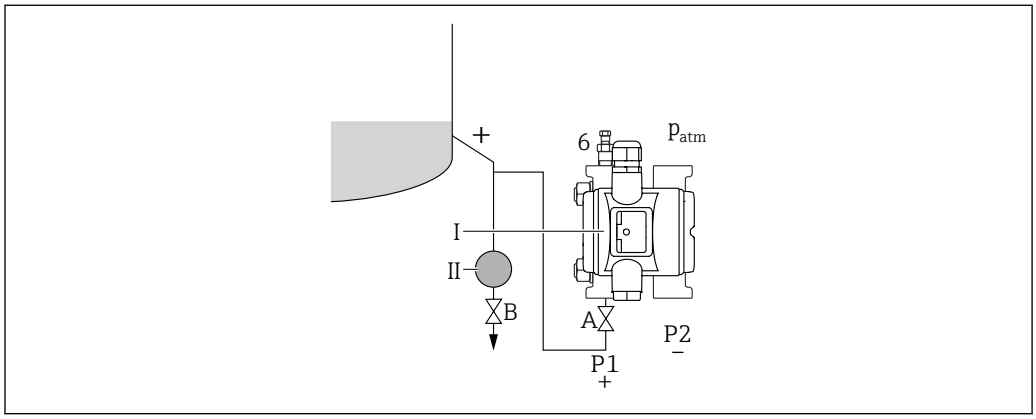
1. Close 3.
2. Fill the measuring system with medium.
   ↳ Open A, B, 2, 4. Fluid flows in.
3. Vent device.
   ↳ Liquids: Open 6 and 7 until the system (pressure piping, valves and side flanges) is completely filled with medium.
   Gases: Open 6 and 7 until the system (pressure piping, valves and side flanges) is completely filled with gas and free from condensation.
   Close 6 and 7.

Check the adjustment and perform again if necessary.

9.6.2 Level measurement

Open vessel

Before adjusting the device, the pressure piping may need to be cleaned and filled with medium.

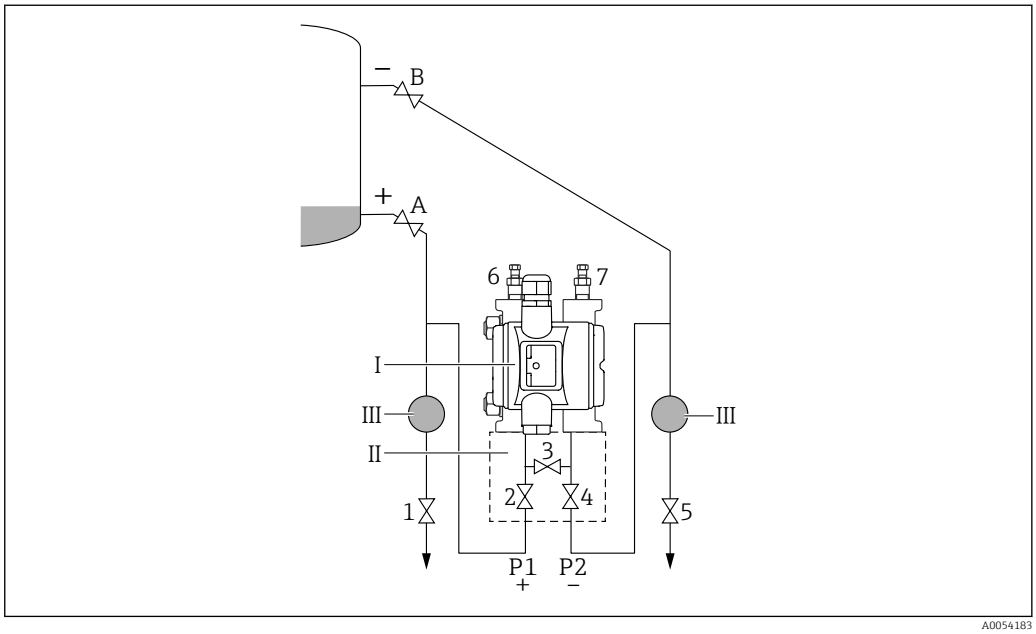


I Device
II Separator
6 Vent valve on device
A Shutoff valve
B Drain valve

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
   ↳ Open A (shutoff valve).
3. Vent device.
   ↳ Open 6 until the system (pressure piping, valve and side flange) is completely filled with medium.

Closed vessel

Before adjusting the device, the pressure piping may need to be cleaned and filled with medium.

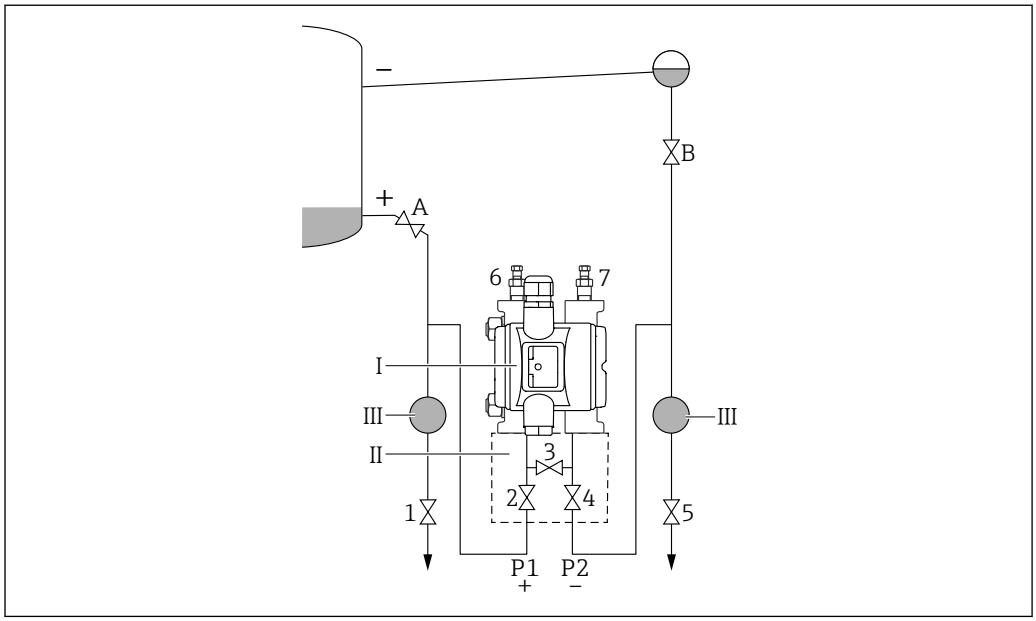


I Device
II Three-valve manifold
III Separator
1, 5 Drain valves
2, 4 Inlet valves
3 Equalization valve
6, 7 Vent valves on device
A, B Shutoff valves

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
   ↳ Close 3 (separate high-pressure side and low-pressure side).
   Open A and B (shutoff valves).
3. Vent high-pressure side (empty low-pressure side if necessary).
   ↳ Open 2 and 4 (introduce fluid on high-pressure side).
   Open 6 until the system (pressure piping, valve and side flange) is completely filled with medium.
   Open 7 until the system (pressure piping, valve and side flange) is completely empty.

Closed vessel with superimposed vapor

Before adjusting the device, the pressure piping may need to be cleaned and filled with medium.



I Device
II Three-valve manifold
III Separator
1, 5 Drain valves
2, 4 Inlet valves
3 Equalization valve
6, 7 Vent valves on device
A, B Shutoff valves

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
   ↳ Open A and B (shutoff valves).
   Fill the negative pressure piping to the height of the condensate trap.
3. Vent device.
   ↳ Open 2 and 4 (introduce fluid).
   Open 6 and 7 until the system (pressure piping, valve and side flange) is completely filled with medium.

9.6.3 Commissioning with keys

The following functions can be activated using the keys:

- Rotating the color display
- Position adjustment (zero point correction)
  The orientation of the measuring device may cause a pressure shift.
  This pressure shift can be corrected by a position adjustment
- Setting the lower range value and upper range value
  The pressure applied must be within the nominal pressure limits of the sensor (see the specifications on the nameplate)
- Resetting the device

Performing position adjustment

1. Ensure the device is installed in the desired position and without applied pressure.
2. Press the "Zero" and "Span" keys simultaneously for at least 3 seconds.

3. After "done" appears on the color display, the applied pressure is used for position adjustment.

Setting the lower range value (pressure or scaled variable)

1. The desired pressure for the lower range value is present at the device.
2. Press "Zero" for at least 3 seconds.
3. After "done" appears on the color display, the applied pressure is accepted for the lower range value.

Setting the upper range value (pressure or scaled variable)

1. The desired pressure for the upper range value is present at the device.
2. Press "Span" for at least 3 seconds.
3. After "done" appears on the color display, the applied pressure is used for the upper range value.
4. Does the "done" flag not appear on the colour display?
   ↳ Applied pressure for upper range value has not been accepted.
   If **Table** option selected, wet calibration is not possible.

Checking the settings (pressure or scaled variable)

1. Briefly press "Zero" key (approx. 1 second) to display lower range value.
2. Briefly press "Span" key (approx. 1 second) to display upper range value.
3. Briefly press "Zero" and "Span" keys simultaneously (approx. 1 second) to display position offset.

Resetting the device

► Press and hold the "Zero" and "Span" keys simultaneously for at least 12 seconds.

Rotating the color display

To activate this function:

1. Press the **Span**-key 3x briefly in succession.
2. Press and hold the **Span**-key for at least 3 seconds within 15 seconds.

Resetting user role password

To activate this function:

1. Press the Zero key 3x briefly in succession.
2. Press the Zerokey again within 15 seconds.

9.6.4 Commissioning with the commissioning wizard

Available in FieldCare, DeviceCare [1] the **Commissioning** wizard guides the user through initial commissioning.

1. Connect the device with FieldCare or DeviceCare.
2. Open the device in FieldCare or DeviceCare.
   ↳ The dashboard (homepage) of the device is displayed:
3. In the **Guidance** menu, click the **Commissioning** wizard to open the wizard.
4. Enter the appropriate value in each parameter or select the appropriate option. These values are written directly to the device.
5. Click "Next" to go to the next page.
6. Once all the pages are completed, click "End" to close the **Commissioning** wizard.

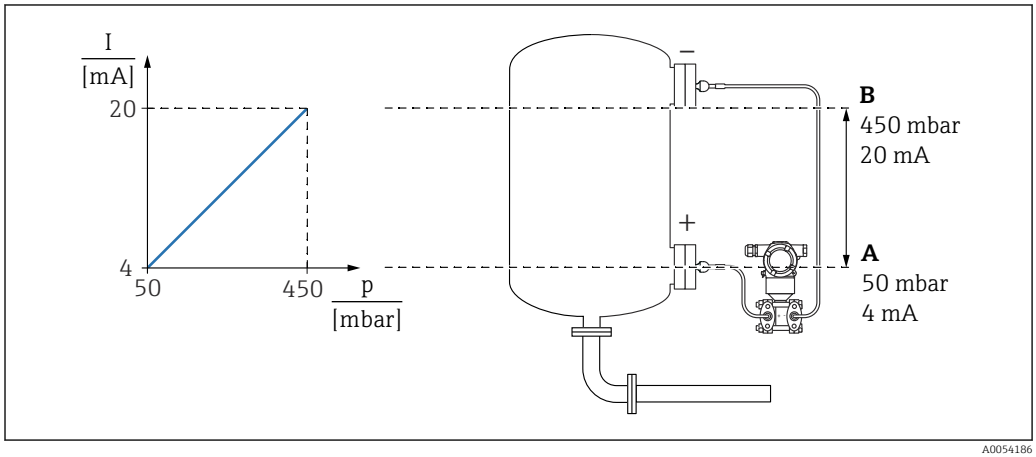
If the **Commissioning** wizard is canceled before all necessary parameters have been configured, the device may be in an undefined state. In such situations, it is advisable to reset the device to the factory default settings.

Example: Outputting of the pressure value at the current output

Pressure and temperature units are converted automatically. Other units are not converted.

In the following example, the pressure value should be measured in a tank and output on the current output. The maximum pressure of 450 mbar (6.75 psi) corresponds to the 20 mA current. The 4 mA current corresponds to a pressure of 50 mbar (0.75 psi).

Prerequisites:
- Measured variable in direct proportion to the pressure
- Due to the orientation of the device, there may be pressure shifts in the measured value (when the vessel is empty or partly filled, the measured value is not zero).
  Perform a position adjustment if necessary.
- In the **Assign PV** parameter, the **Pressure** option must be selected (factory setting).



A Lower range value output
B Upper range value output

Adjustment:

1. Enter the pressure value for the 4 mA current via the **Lower range value output** parameter (50 mbar (0.75 psi)).

1) DeviceCare is available for download at www.software-products.endress.com. To download the software, it is necessary to register on the Endress +Hauser software portal.

2. Enter the pressure value for the 20 mA current via the **Upper range value output** parameter (450 mbar (6.75 psi))

Result: The measuring range is set to 4 to 20 mA.

9.6.5 Commissioning without the commissioning wizard

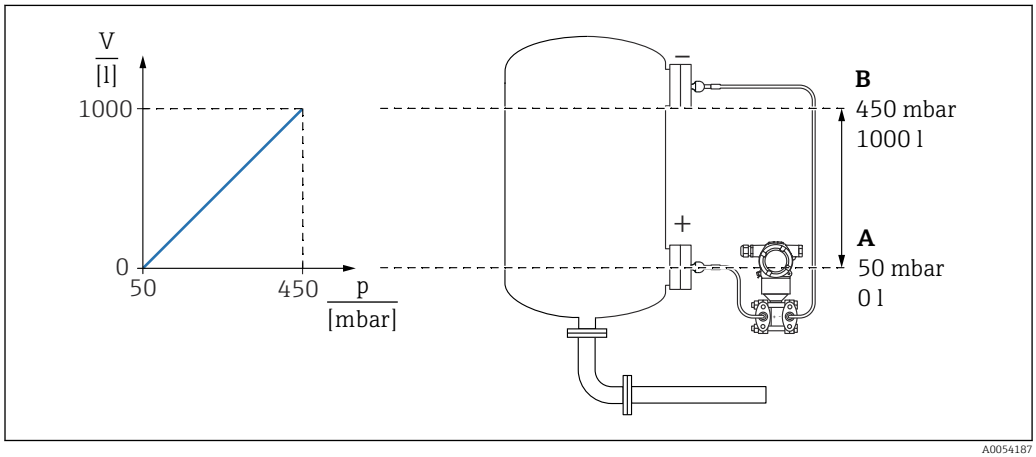
Example: Commissioning a volume measurement in the tank

Pressure and temperature units are converted automatically. Other units are not converted.

In the following example, the volume in a tank should be measured in liters. The maximum volume of 1 000 l (264 gal) corresponds to a pressure of 450 mbar (6.75 psi).

The minimum volume of 0 liters corresponds to a pressure of 50 mbar (0.75 psi).

Prerequisites:
- Measured variable in direct proportion to the pressure
- Due to the orientation of the device, there may be pressure shifts in the measured value (when the vessel is empty or partly filled, the measured value is not zero). Perform position adjustment if necessary



A "Pressure value 1" parameter and "Scaled variable value 1" parameter
B "Pressure value 2" parameter and "Scaled variable value 2" parameter

The pressure present is displayed in the operating tool on the same settings page in the "Pressure" field.

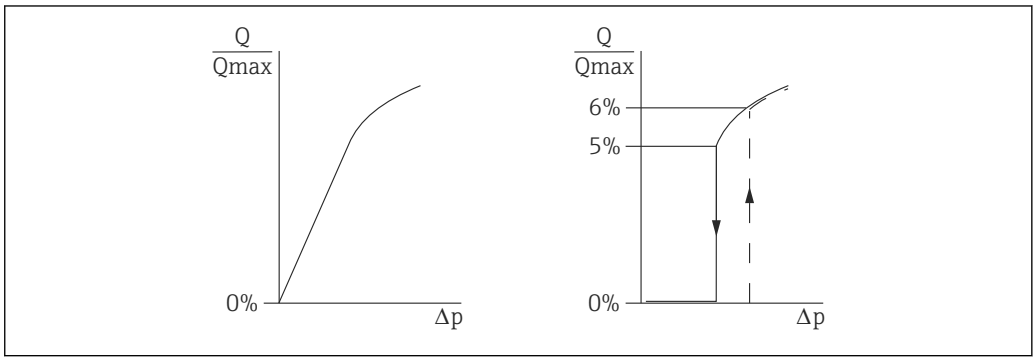
1. Enter the pressure value for the lower calibration point via the **Pressure value 1** parameter: 50 mbar (0.75 psi)
   ↳ Menu path: Application → Sensor → Scaled variable → Pressure value 1
2. Enter the volume value for the lower calibration point via the **Scaled variable value 1** parameter: 0 l (0 gal)
   ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable value 1
3. Enter the pressure value for the upper calibration point via the **Pressure value 2** parameter: 450 mbar (6.75 psi)
   ↳ Menu path: Application → Sensor → Scaled variable → Pressure value 2
4. Enter the volume value for the upper calibration point via the **Scaled variable value 2** parameter: 1 000 l (264 gal)
   ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable value 2

Result: The measuring range is set for 0 to 1 000 l (0 to 264 gal). Only the **Scaled variable value 1** parameter and **Scaled variable value 2** parameter are set with this setting. This setting has no effect on the current output.

9.6.6 Low flow cut off (square root extraction)

With the **Low cutoff** parameter, positive zero return can be configured in the lower measuring range.

Prerequisites:
- Measured variable with square root extraction in relation to pressure
- In the **Output current transfer function** parameter, set the **Square** option.
  Menu path: Application → Sensor → Sensor configuration → Output current transfer function
- Enter the switch-on point for the low flow cut off in the **Low cutoff** parameter (default 5 %)
  Menu path:Application → Sensor → Sensor configuration → Low cutoff



A0025191

- The hysteresis between the switch-on point and the switch-off point is always 1 % of the maximum flow value
- If 0 % is entered for the switch-on point, low flow cut off is disabled

In the **Assign PV** parameter, the **Pressure** option must be set (factory setting)
Menu path: Application → Sensor → Scaled variable → Assign PV
Alternative menu path: Application → HART output
The set unit is also output on the fieldbus.

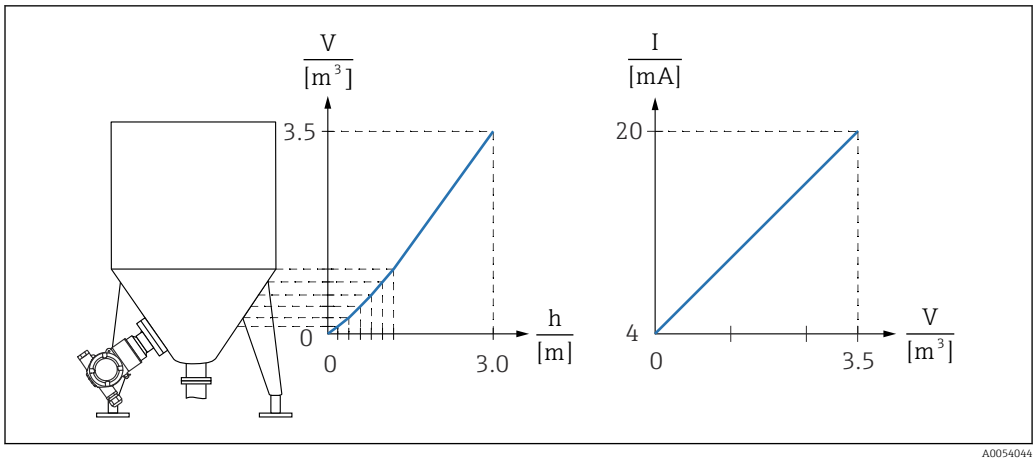
9.6.7 Linearization

In the following example, the volume in a tank with a conical outlet should be measured in m^3.

Prerequisites:
- Points for linearization table are known
- Level calibration is performed
- Linearization characteristic must continually increase or decrease

⚠ WARNING

The settings of the current output are relevant for safety!
This situation can result in product overflow.
- ▶ The setting of the current output depends on the setting in the **Assign PV** parameter.
- ▶ After changing the **Assign PV** parameter, check the settings for the range (LRV and URV) and reconfigure them if necessary.



1. In the **Assign PV** parameter, the **Scaled variable** option must be set
   ↳ Menu path: Application → HART output → HART output → Assign PV
2. Set the desired unit in the **Scaled variable unit** parameter
   ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable unit
3. The linearization table can be opened via the **Go to linearization table** parameter **Table** option.
   ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable transfer function
4. Enter the desired table values.
5. The table is activated once all the points in the table have been entered.
6. Activate the table using the **Activate table** parameter.

Result:

The measured value after linearization is displayed.

- Error message F435 "Linearization" and the alarm current appear as long as the table is being entered and until the table is activated
- The 0% value (= 4 mA) is defined by the smallest point in the table
  The 100% value (= 20 mA) is defined by the largest point in the table
- The assignment of the volume/mass values to the current values can be changed with the **Lower range value output** parameter and **Upper range value output** parameter

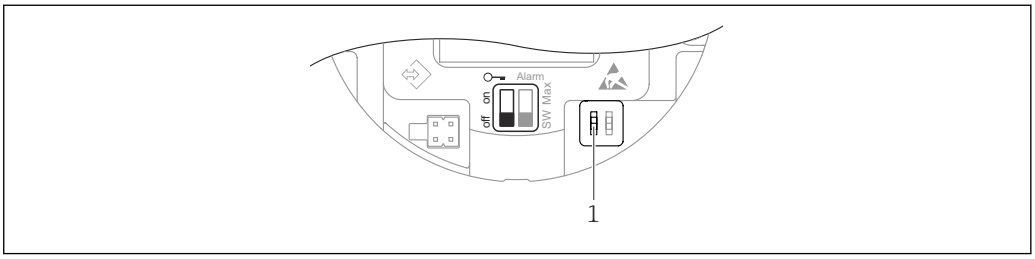
9.7 "Simulation" submenu

With the **Simulation** submenu, the pressure, current and diagnostic events can be simulated.

Menu path: Diagnostics → Simulation

9.8 Protecting settings from unauthorized access

9.8.1 Hardware locking or unlocking



1 DIP switch for locking and unlocking the device

DIP switch 1 on the electronic insert is used to lock or unlock operation.

If operation is locked via the DIP switch, you can only unlock operation again via the DIP switch.

If operation is locked via the operating menu, you can only unlock operation again via the operating menu.

If operation is locked via the DIP switch, the key symbol appears on the onsite display.

9.8.2 Software locking or unlocking

If operation is locked by means of the DIP switch, you can only unlock operation again by means of the DIP switch.

Locking via password in FieldCare/DeviceCare

Access to parameter configuration of the device can be locked by assigning a password. When the device is delivered from the factory, the user role is set to **Maintenance** option. The device can be fully configured with the **Maintenance** option user role. Afterwards, access to the configuration can be locked by assigning a password. The **Maintenance** option switches to the **Operator** option as a result of this locking. The configuration can be accessed by entering the password.

The password is defined under:

System menu **User management** submenu

The user role is changed from the **Maintenance** option to **Operator** option under:

System → User management

Disabling locking via FieldCare / DeviceCare

After entering the password, you can enable parameter configuration of the device as an **Operator** option with the password. The user role then changes to the **Maintenance** option.

If necessary, the password can be deleted in the **User management** submenu: System → User management

10 Operation

10.1 Reading the device locking status

Displaying active write protection:
- In the **Locking status** parameter
  Menu path of operating tool: System → Device management
- In the operating tool (FieldCare/DeviceCare) in the DTM header

10.2 Reading off measured values

All the measured values can be read off using the **Measured values** submenu.

Navigation
"Application" menu → Measured values

10.3 Adapting the device to process conditions

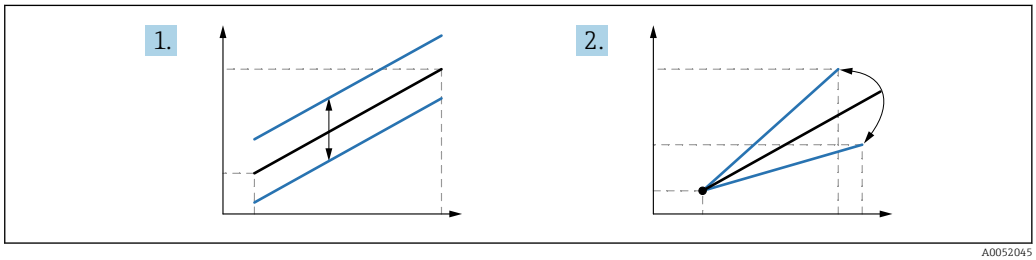
The following are available for this purpose:
- Basic settings using the **Guidance** menu
- Advanced settings using the **Diagnostics** menu, **Application** menu and **System** menu

10.3.1 Sensor calibration [2].

In the course of their life cycle, pressure sensors **can** deviate, or drift, [3] from the original pressure characteristic curve. This deviation depends on the operating conditions and can be corrected in the **Sensor calibration** submenu.

Set the value of the zero point shift before the Sensor calibration to 0.00. Application → Sensor → Sensor calibration → Zero adjustment offset

1. Apply the lower pressure value (value measured with pressure reference) to the device. Enter this pressure value in the **Lower sensor trim** parameter. Application → Sensor → Sensor calibration → Lower sensor trim
   ↳ The value entered causes a parallel shift of the pressure characteristic in relation to the current Sensor calibration.
2. Apply the upper pressure value (value measured with pressure reference) to the device. Enter this pressure value in the **Upper sensor trim** parameter. Application → Sensor → Sensor calibration → Upper sensor trim
   ↳ The value entered causes a change in the slope of the current Sensor calibration.



The accuracy of the pressure reference determines the accuracy of the device. The pressure reference must be more accurate than the device.

2) Not possible with color display
3) Deviations caused by physical factors are also known as "Sensor drift".

11 Diagnosis and troubleshooting

11.1 General troubleshooting

11.1.1 General errors

Device is not responding
- Possible cause: Supply voltage does not match the specification on the nameplate
  Remedial action: Apply the correct voltage
- Possible cause: The polarity of the supply voltage is wrong
  Remedial action: Correct the polarity
- Possible cause: The connecting cables are not in contact with the terminals.
  Remedial action: Check the electrical contact between cables and correct if necessary
- Possible cause: Load resistance too high
  Remedial action: Increase the supply voltage to reach the minimum terminal voltage

No indication on the color display
Possible cause: Defective color display
Remedial action: Replace main electronics.

"Communication error" appears on the color display when the device is started.
- Possible cause: Electromagnetic interference influence
  Remedial action: Check grounding of the device
- Possible cause: Defective cable connection
  Remedial action: Replace main electronics.

HART communication not working
- Possible cause: Communication resistor missing or incorrectly installed
  Remedial action: Install the communication resistor (250 Ω) correctly.
- Possible cause: Commubox is connected incorrectly
  Remedial action: Connect Commubox correctly

Communication via CDI interface not working
Possible cause: Wrong setting of the COM port on the computer
Remedial action: Check the setting of the COM port on the computer and correct it if necessary

11.1.2 Additional tests

If no clear cause of the error can be identified or the source of the problem can be both the device and the application, the following additional tests can be performed:

1. Check the digital pressure value (color display, HART, etc.).
2. Check that the device concerned is functioning correctly. Replace the device if the digital value does not correspond to the expected pressure value.
3. Switch on simulation and check the current output. Replace the main electronics if the current output does not correspond to the simulated value.

11.1.3 Behavior of the current output in the event of a failure

The behavior of the current output in the event of failures is defined by the **Failure behavior current output** parameter.

Parameter overview with brief description

Parameter	Description	Selection / User entry
Failure behavior current output	Defines which current the output assumes in the case of an error. Min: < 3.6 mA Max: >21.5 mA Note: The hardware DIP Switch for alarm current has priority over software setting.	▪ Min. ▪ Max.
Failure current	Enter current output value in alarm condition.	21.5 to 23 mA

11.2 Diagnostic information on color display

11.2.1 Diagnostic message

Measured value display and diagnostic message in the event of a failure

Failures detected by the device's self-monitoring system are displayed as a diagnostic message in alternation with the unit.

Status signals

F

"Failure (F)" option
A device error has occurred. The measured value is no longer valid.

C

"Function check (C)" option
The device is in the service mode (e.g. during a simulation).

S

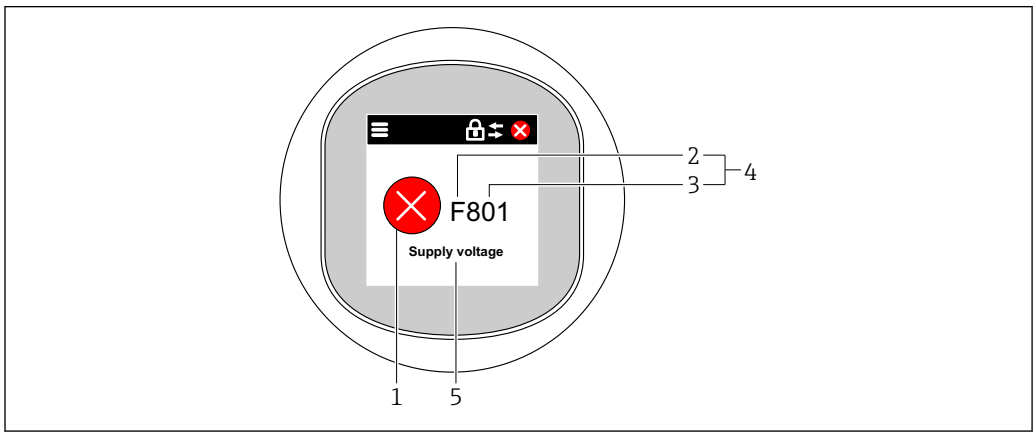
"Out of specification (S)" option
The device is operated:
- Outside of its technical specifications (e.g. during startup or a cleaning)
- Outside of the configuration performed by the user (e.g. level outside configured span)

M

"Maintenance required (M)" option
Maintenance required. The measured value remains valid.

Diagnostic event and event text

The failure can be identified by means of the diagnostic event.



1 Status symbol
2 Status signal
3 Event number
4 Diagnostic event
5 Brief description of the diagnostic event

If several diagnostic events are pending at the same time, only the diagnostic message with the highest priority is displayed.

11.3 Diagnostic event in the operating tool

If a diagnostic event has occurred in the device, the status signal appears in the top left status area of the operating tool together with the corresponding symbol for the event level according to NAMUR NE 107:

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

Click the status signal to see the detailed status signal.

The diagnostic events and remedial measures can be printed out in the **Diagnostic list** submenu.

11.4 Adapting the diagnostic information

The event level can be configured:

Menu path: Diagnostics → Diagnostic settings → Configuration

11.5 Pending diagnostic messages

Pending diagnostic messages are shown in alternating sequence with the measured value display on the color display.

Pending diagnostic messages can also be displayed in the **Active diagnostics** parameter.

Menu path: Diagnostics → Active diagnostics

11.6 Diagnostic list

All of the diagnostic messages currently pending can be displayed in the **Diagnostic list** submenu.

Navigation path
Diagnostics → Diagnostic list

11.6.1 List of diagnostic events

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
062	Sensor connection faulty	Check sensor connection	F	Alarm
081	Sensor initialization faulty	1. Restart device 2. Contact service	F	Alarm
100	Sensor error	1. Restart the device 2. Contact Endress+Hauser Service	F	Alarm
101	Sensor temperature	1. Check process temperature 2. Check ambient temperature	F	Alarm
102	Sensor incompatible error	1. Restart device 2. Contact service	F	Alarm
Diagnostic of electronic				
203	HART Device Malfunction	Check device specific diagnosis.	S	Warning
204	HART Electronic Defect	Check device specific diagnosis.	F	Alarm
242	Firmware incompatible	1. Check software 2. Flash or change main electronic module	F	Alarm
252	Module incompatible	1. Check if correct electronic module is plugged 2. Replace electronic module	F	Alarm
263	Incompatibility detected	Check electronic module type	M	Warning
270	Main electronics defective	Replace main electronics	F	Alarm
272	Main electronics faulty	1. Restart device 2. Contact service	F	Alarm
273	Main electronics defective	Replace main electronics	F	Alarm
282	Data storage inconsistent	Restart device	F	Alarm
283	Memory content inconsistent	1. Restart device 2. Contact service	F	Alarm
287	Memory content inconsistent	1. Restart device 2. Contact service	M	Warning
388	Electronics and HistoROM defective	1. Restart device 2. Replace electronics and HistoROM 3. Contact service	F	Alarm
Diagnostic of configuration				
410	Data transfer failed	1. Retry data transfer 2. Check connection	F	Alarm
412	Processing download	Download active, please wait	C	Warning
420	HART Device Configuration Locked	Check device locking configuration.	S	Warning
421	HART Loop Current fixed	Check Multi-drop mode or current simulation.	S	Warning
431	Trim required	Carry out trim	C	Warning
435	Linearization faulty	Check data points and min span	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
437	Configuration incompatible	1. Update firmware 2. Execute factory reset	F	Alarm
438	Dataset different	1. Check dataset file 2. Check device parameterization 3. Download new device parameterization	M	Warning
441	Current output 1 saturated	1. Check process 2. Check current output settings	S	Warning
484	Failure mode simulation active	Deactivate simulation	C	Alarm
485	Process variable simulation active	Deactivate simulation	C	Warning
491	Current output simulation active	Deactivate simulation	C	Warning
495	Diagnostic event simulation active	Deactivate simulation	S	Warning
500	Process alert pressure	1. Check process pressure 2. Check configuration of process alert	S	Warning [1)]
501	Process alert scaled variable	1. Check process conditions 2. Check scaled variable configuration	S	Warning [1)]
502	Process alert temperature	1. Check process temperature 2. Check configuration of process alert	S	Warning [1)]
503	Zero adjustment	1. Check measuring range 2. Check position adjustment	M	Warning
Diagnostic of process				
801	Supply voltage too low	Increase supply voltage	F	Alarm
802	Supply voltage too high	Decrease supply voltage	S	Warning
805	Loop current faulty	1. Check wiring 2. Replace electronics	F	Alarm
806	Loop diagnostics	1. Check supply voltage 2. Check wiring and terminals	M	Warning [1)]
807	No Baseline due to insuf. volt. at 20 mA	Increase supply voltage	M	Warning
822	Sensor temperature out of range	1. Check process temperature 2. Check ambient temperature	S	Warning [1)]
825	Electronics temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
841	Operating range	1. Check the process pressure 2. Check the sensor range	S	Warning [1)]
846	HART Non-Primary Variable Out of Limit	Check device specific diagnosis.	S	Warning
847	HART Primary Variable Out of Limit	Check device specific diagnosis.	S	Warning
848	HART Device Variable Alert	Check device specific diagnosis.	S	Warning
900	High signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning [1)]

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
901	Low signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning [1]
902	Min signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning [1]
906	Out of range signal detected	1. Process Information. No action 2. Rebuild baseline 3. Adapt signal range thresholds	S	Warning [1]

1) Diagnostic behavior can be changed.

11.7 Event logbook

11.7.1 Event history

The **Event list** submenu provides a chronological overview of the event messages that have occurred. [4].

Navigation path
Diagnostics → Event logbook

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

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

In addition to the operating time when the event occurred, each event is also assigned a symbol that indicates whether the event has occurred or is finished:
- Diagnostic event
  - ⊕: Occurrence of the event
  - ⊖: End of the event
- Information event
  ⊕: Occurrence of the event

11.7.2 Filtering the event logbook

Filters can be used to determine which category of event messages is displayed in the **Event list** submenu.

Navigation path
Diagnostics → Event logbook

11.7.3 Overview of information events

Info number	Info name
I1000	--------(Device ok)
I1079	Sensor changed
I1089	Power on
I1090	Configuration reset

4) If operating via FieldCare, the event list can be displayed with the "Event List/HistoROM" function in FieldCare

Info number	Info name
I1091	Configuration changed
I11074	Device verification active
I1110	Write protection switch changed
I11104	Loop diagnostics
I11284	DIP MIN setting to HW active
I11285	DIP SW setting active
I11341	SSD baseline created
I1151	History reset
I1154	Reset terminal voltage min/max
I1155	Reset electronics temperature
I1157	Memory error event list
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1440	Main electronic module changed
I1444	Device verification passed
I1445	Device verification failed
I1461	Sensor verification failed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1551	Assignment error fixed
I1552	Failed: Main electronic verification
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off
I1956	Reset

11.8 Resetting the device

11.8.1 Resetting the device via operating software

The device can be reset with the **Device reset** parameter.

Menu path: System → Device management

11.8.2 Resetting the device via the keys

Press the "Zero" and "Span" magnetic keys simultaneously for at least 12 seconds.

11.9 Device information

All the device information is contained in the **Information** submenu.

Menu path: System → Information

For details see the "Description of device parameters" document.

11.10 Firmware history

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

11.10.1 Version 01.00.zz

Original software

12 Maintenance

12.1 Cleaning

12.1.1 Cleaning of surfaces not in contact with the medium

- Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
- Do not use any sharp objects or aggressive cleaning agents that corrode the surfaces (displays, housing, for example) and seals.
- Do not use high-pressure steam.
- Observe the degree of protection of the device.

The cleaning agent used must be compatible with the materials of the device configuration. Do not use cleaning agents with concentrated mineral acids, bases or organic solvents.

12.1.2 Cleaning of surfaces in contact with the medium

Note the following for cleaning and sterilization in place (CIP/SIP):
- Use only cleaning agents to which the materials in contact with the medium are sufficiently resistant.
- Observe the permitted maximum medium temperature.

12.2 Pressure compensation element

There are two pressure compensation elements located opposite each other behind the nameplate.

▶ Keep the pressure compensation element free from contamination.

13 Repair

13.1 General information

13.1.1 Repair concept

Under the Endress+Hauser repair concept, devices have a modular design and repairs are carried out by Endress+Hauser Service or by properly trained customers.

Spare parts are grouped into logical kits with the associated replacement instructions.

For more information on service and spare parts contact Endress+Hauser Service.

13.1.2 Repair of Ex-certified devices

⚠ WARNING

Incorrect repair can compromise electrical safety!
Explosion Hazard!

- ▶ Repairs to Ex-certified devices must be carried out by Endress+Hauser Service or by specialist personnel according to national regulations.
- ▶ Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- ▶ Use only original Endress+Hauser spare parts.
- ▶ Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- ▶ Carry out repairs according to the instructions.
- ▶ Only the Endress+Hauser service team is permitted to modify a certified device and convert it to another certified version.

13.2 Spare parts

- Some replaceable device components are identified by a spare part nameplate. This contains information about the spare part.
- All the spare parts for the measuring device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer) and can be ordered. If available, users can also download the associated Installation Instructions.

Device serial number:
- Located on the device and spare part nameplate.
- Can be read out via the device software.

13.3 Replacement

⚠ CAUTION

Data upload/download is not permitted if the device is used for safety-related applications.

- ▶ After an entire device or an electronics module has been replaced, the parameters can be downloaded to the device again via the communication interface. For this, the data must have been uploaded to the PC beforehand using the "FieldCare/DeviceCare" software.

13.4 Return

The device must be returned in the event of a factory calibration, or if the wrong device has been ordered or delivered.

As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium. To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website http://www.endress.com/support/return-material.

- Select country.
  - The website of the responsible sales office opens with all the relevant information relating to returns.

1. If the desired country is not listed:
   Click on the "Choose your location" link.
   - An overview of Endress+Hauser sales offices and representatives opens.
2. Contact the Endress+Hauser sales organization responsible for your area.

13.5 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 Accessories

14.1 Device-specific accessories

14.1.1 Mechanical accessories

- Mounting bracket for housing
- Mounting bracket for manifolds
- Manifolds:
  - Manifolds can be ordered as a separate accessory (screws and seals for mounting are enclosed).
  - Manifolds can be ordered as a **separate** accessory (mounted manifolds are supplied with a documented leak test).
  - Certificates (e.g. 3.1 material certificate and NACE) and tests (e.g. PMI and pressure test) that are ordered with the device apply for the transmitter and the manifold.
  - During the operating life of the valves, it may be necessary to re-tighten the pack.
- Oval flange adapter
- Calibration adapter 5/16"-24 UNF, to screw into vent valves
- Weather protection covers

For technical data (e.g. materials, dimensions or order numbers), see the accessory document SD01553P.

14.2 Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer).

15 Technical data

15.1 Input

Measured variable

Measured process variables

- Differential pressure
- Gauge pressure

Measuring range

Depending on the device configuration, the maximum working pressure (MWP) and the overpressure limit (OPL) can deviate from the values in the tables.

PN 160/16 MPa/2400 psi

Measuring cell	Maximum measuring range		Smallest (factory-preconfigured) calibratable span [1) 2)]
	lower (LRL)	upper (URL)	
[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[mbar (psi)]
100 (1.5)	−100 (-1.5)	+100 (+1.5)	5 (0.075)
500 (7.5)	−500 (-7.5)	+500 (+7.5)	25 (0.375)
3000 (45)	−3000 (-45)	+3000 (+45)	150 (2.25)
16000 (240)	−16000 (-240)	+16000 (+240)	800 (12)
40000 (600)	−40000 (-600)	+40000 (+600)	2000 (30)

1) Turn down > 20:1 on request
2) For platinum, the maximum is TD 5:1.

PN 160/16 MPa/2400 psi

Measuring cell	MWP	OPL		Burst pressure [1) 2)]
		[bar (psi)]	on both sides	
[mbar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]
100 (1.5)	160 (2400) [3)]	160 (2400)	240 (3600)	470 (6815)
500 (7.5)	160 (2400) [3)]	160 (2400)	240 (3600)	470 (6815)
3000 (45)	160 (2400) [3)]	160 (2400)	240 (3600)	470 (6815)
16000 (240)	160 (2400) [3) 4)]	160 (2400)	240 (3600)	470 (6815)
40000 (600)	160 (2400) [3) 4)]	"+" side: 160 (2400) "–" side: 100 (1500)	240 (3600)	470 (6815)

1) Applies for the process seal materials FKM, PTFE, FFKM, EPDM and for pressure applied on both sides.
2) If the side vent valves (sv) option is selected and a PTFE seal is used, the burst pressure is 470 bar (6 815 psi).
3) If CRN approval is selected, the following limited maximum working pressure values apply: with copper seals: 124 bar (1 798.5 psi)
4) If pressure is applied on the negative side only, the maximum working pressure is 100 bar (1 500 psi).

Standard: PN 250 / 25 MPa / 3626 psi

Measuring cell	Maximum measuring range		Smallest (factory-preconfigured) calibratable span [1) 2)]
	lower (LRL)	upper (URL)	
[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[mbar (psi)]
100 (1.5)	−100 (-1.5)	+100 (+1.5)	5 (0.075)
500 (7.5)	−500 (-7.5)	+500 (+7.5)	25 (0.375)

Measuring cell	Maximum measuring range		Smallest (factory-preconfigured) calibratable span [1) 2)]
	lower (LRL)	upper (URL)	
[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[mbar (psi)]
3000 (45)	−3000 (-45)	+3000 (+45)	150 (2.25)
16000 (240)	−16000 (-240)	+16000 (+240)	800 (12)
40000 (600)	−40000 (-600)	+40000 (+600)	2000 (30)

1) Turn down > 20:1 on request
2) For platinum, the maximum is TD 5:1.

Standard: PN 250 / 25 MPa / 3626 psi

Measuring cell	MWP [1)]	OPL		Burst pressure [2) 3) 4)]
		[bar (psi)]	on both sides	
[mbar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]
100 (1.5)	250 (3626) [5)]	250 (3626)	375 (5625)	695 (10078)
500 (7.5)	250 (3626) [5)]	250 (3626)	375 (5625)	695 (10078)
3000 (45)	250 (3626) [5)]	250 (3626)	375 (5625)	695 (10078)
16000 (240)	250 (3626) [5) 6)]	250 (3626)	375 (5625)	695 (10078)
40000 (600)	250 (3626) [5) 6)]	"+" side: 250 (3626) "-" side: 100 bar (1 500 psi)	375 (5625)	695 (10078)

1) Maximum working pressure only on both sides.
2) Applies for the process seal materials FKM, FFKM, EPDM and for pressure applied on both sides.
3) If the side vent valves (sv) option is selected, the burst pressure is 690 bar (10 005 psi).
4) For the process seal material PTFE, the burst pressure is 690 bar (10 005 psi).
5) If a CRN approval is selected, the following limited maximum working pressures apply: with side venting: 179 bar (2 596.2 psi); with copper seals: 124 bar (1 798.5 psi)
6) If pressure is applied on the negative side only, the maximum working pressure is 100 bar (1 500 psi).

Minimum static pressure

- Minimum static pressure at reference operating conditions for silicone oil: 25 mbar (0.0375 psi) $_{abs}$
- Minimum static pressure for 85 °C (185 °F) silicone oil: to 250 mbar (4 psi) $_{abs}$

Option as gauge pressure measuring cell (all measuring cells)
- Minimum static pressure at reference operating conditions for silicone oil: 10 mbar (0.15 psi) $_{abs}$
- Minimum static pressure for 85 °C (185 °F) silicone oil: to 10 mbar (0.15 psi) $_{abs}$

15.2 Output

Output signal

Current output

4 to 20 mA with superimposed digital communication protocol HART, 2-wire

The current output offers a choice of three different operating modes:
- 4.0 to 20.5 mA
- NAMUR NE 43: 3.8 to 20.5 mA (factory setting)
- US mode: 3.9 to 20.8 mA

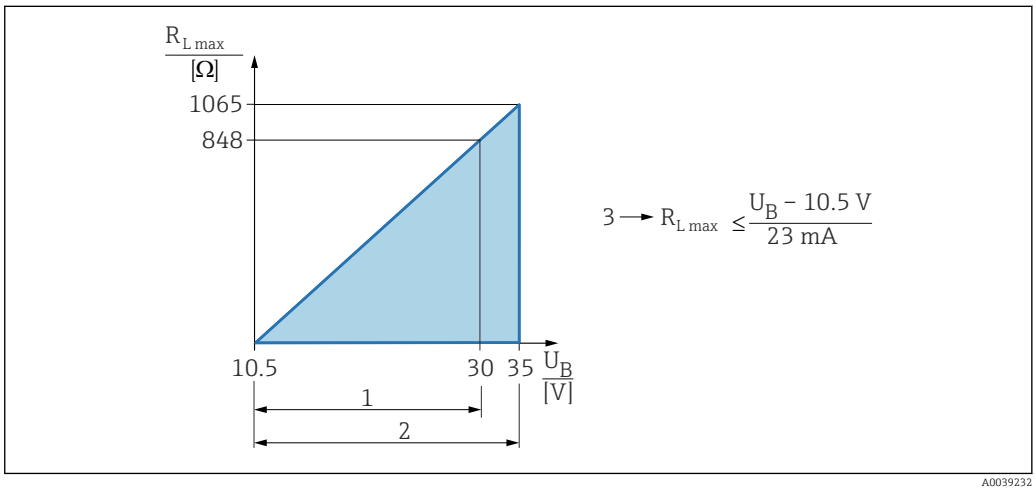
Signal on alarm

Signal on alarm in accordance with NAMUR recommendation NE 43.

4 to 20 mA HART:
Options:
- Max alarm: can be set from 21.5 to 23 mA
- Min. alarm: < 3.6 mA (factory setting)

Load

4 to 20 mA HART



1 Power supply 10.5 to 30 VDC Ex i
2 Power supply 10.5 to 35 VDC, for other types of protection and non-certified device versions
3 R_{Lmax} maximum load resistance
U Supply voltage

Operation via handheld terminal or PC with operating program: take minimum communication resistance of 250 Ω into consideration.

Damping

Damping affects all outputs (output signal, color display). Damping can be enabled as follows:
- Handheld device or PC with operating program: continuous from 0 to 999 s
- Factory setting: 1 s

Ex connection data

See the separate technical documentation (Safety Instructions (XA)) on www.endress.com/download.

Linearization

The device's linearization function allows the user to convert the measured value to any units of height or volume. User-defined linearization tables of up to 32 value pairs can be entered if necessary.

Flow measurement with Deltabar and differential pressure sensor

Low flow cut off parameter: When the **Low flow cut off** parameter is activated, small flows which can lead to large fluctuations in the measured value are suppressed.

The **Low flow cut off** parameter is set to 5% by default when the **Output current transfer function** parameter is set to **Square root** option.

Protocol-specific data

HART

- Manufacturer ID: 17 (0x11{hex})
- Device type ID: 0x11E1
- Device revision: 1
- HART specification: 7
- DD revision: 1
- Device description files (DTM, DD) information and files at:
  - www.endress.com
  - www.fieldcommgroup.org
- HART load: min. 250 Ohm

HART device variables (preset at the factory)

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) [1]	Pressure [2]
Secondary variable (SV)	Sensor temperature
Tertiary variable (TV)	Electronics temperature
Quaternary variable (QV)	Sensor pressure [3]

1) The PV is always applied to the current output.
2) The pressure is the calculated signal after damping and position adjustment.
3) The Sensor pressure is the raw signal of the measuring cell before damping and position adjustment.

The assignment of the measured values to the device variables can be changed in the following submenu:
Application → HART output → HART output

In a HART Multidrop loop, only one device may use the analog current value for signal transmission. For all other devices in the **"Loop current mode" parameter**, select the **Disable** option.

Choice of HART device variables

- **Pressure** option (after position correction and damping)
- Scaled variable
- Sensor temperature
- Sensor pressure
  Sensor Pressure is the raw signal from sensor before damping and position adjustment.
- Electronics temperature
- Percent of range
- Loop current
  The loop current is the output current set by the applied pressure.

Supported functions

- Burst mode
- Additional transmitter status
- Device locking

Wireless HART data
- Minimum starting voltage: 11.5 V
- Start-up current: 3.6 mA
- Start-up time: <5 s
- Minimum operating voltage: 10.5 V
- Multidrop current: 4 mA

15.3 Environment

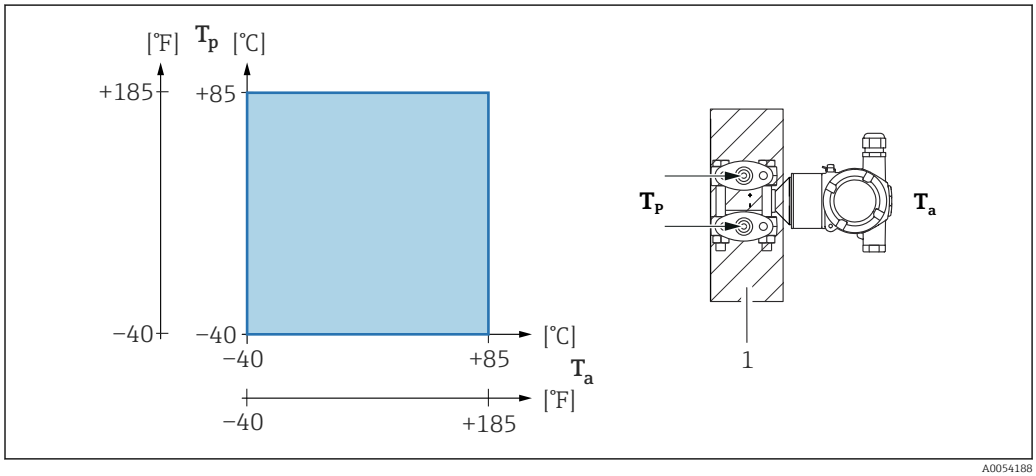
Ambient temperature range

The following values apply up to a process temperature of +85 °C (+185 °F). The permitted ambient temperature is reduced at higher process temperatures.
With display: −40 to +85 °C (−40 to +185 °F) with limitations in optical properties such as display speed and contrast for example. Can be used without limitations up to −20 to +60 °C (−4 to +140 °F)

Devices with inert oil: minimum process and ambient temperature −20 °C (−4 °F)

Ambient temperature T_a depending on the process temperature T_p

The process connection must be fully insulated for ambient temperatures below −20 °C (−4 °F).



1 Insulation material

Hazardous area

For devices for use in hazardous areas, see the Safety Instructions, Installation Drawing or Control Drawing.

Storage temperature

With color display: −40 to +85 °C (−40 to +185 °F)

Operating altitude

Up to 5 000 m (16 404 ft) above sea level.

Climate class

Class 4K4H (air temperature: −20 to +55 °C (−4 to +131 °F), relative humidity: 4 to 100 %) satisfied as per DIN EN 60721-3-4.

Condensation is possible.

Atmosphere

Operation in very corrosive environment

Endress+Hauser recommends the stainless steel housing for corrosive environments, e.g. maritime environment/coastal proximity).

The transmitter can be additionally protected by a special coating (Technical Special Product (TSP)).

Degree of protection

Test as per IEC 60529 and NEMA 250-2014

Housing and process connection

IP66/68, TYPE 4X/6P

(IP68: (1.83 mH_2O for 24 h))

Cable entries

- Gland M20, plastic, IP66/68 TYPE 4X/6P
- Gland M20, brass nickel plated, IP66/68 TYPE 4X/6P
- Gland M20, 316L, IP66/68 TYPE 4X/6P
- Thread M20, IP66/68 TYPE 4X/6P
- Thread G1/2, IP66/68 TYPE 4X/6P
  If the G1/2 thread is selected, the device is delivered with an M20 thread as standard and a G1/2 adapter is included with the delivery, along with the corresponding documentation
- Thread NPT1/2, IP66/68 TYPE 4X/6P
- Dummy plug transport protection: IP22, TYPE 2

Vibration resistance

Aluminum dual compartment housing

Measuring range	Sinusoidal oscillation IEC62828-1/IEC61298-3	Shock
10 mbar (0.15 psi) and 30 mbar (0.45 psi)	10 Hz to 60 Hz: ±0.21 mm (0.0083 in) 60 Hz to 2000 Hz: 3 g	30 g
0.1 to 250 bar (1.5 to 3 750 psi)	10 Hz to 60 Hz: ±0.35 mm (0.0138 in) 60 Hz to 1000 Hz: 5 g	30 g

Stainless steel dual compartment housing

Measuring range	Sinusoidal oscillation IEC62828-1/IEC61298-3	Shock
10 mbar (0.15 psi) and 30 mbar (0.45 psi) (only up to PN63)	10 Hz to 60 Hz: ±0.075 mm (0.0030 in) 60 Hz to 500 Hz: 1 g	15 g
0.1 to 250 bar (1.5 to 3 750 psi)	10 Hz to 60 Hz: ±0.15 mm (0.0059 in) 60 Hz to 500 Hz: 2 g	15 g

Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- With regard to the safety function (SIL), the requirements of EN 61326-3-x are satisfied
- Maximum deviation with interference influence: < 0.5% of span with full measuring range (TD 1:1)

For more details refer to the EU Declaration of Conformity.

15.4 Process

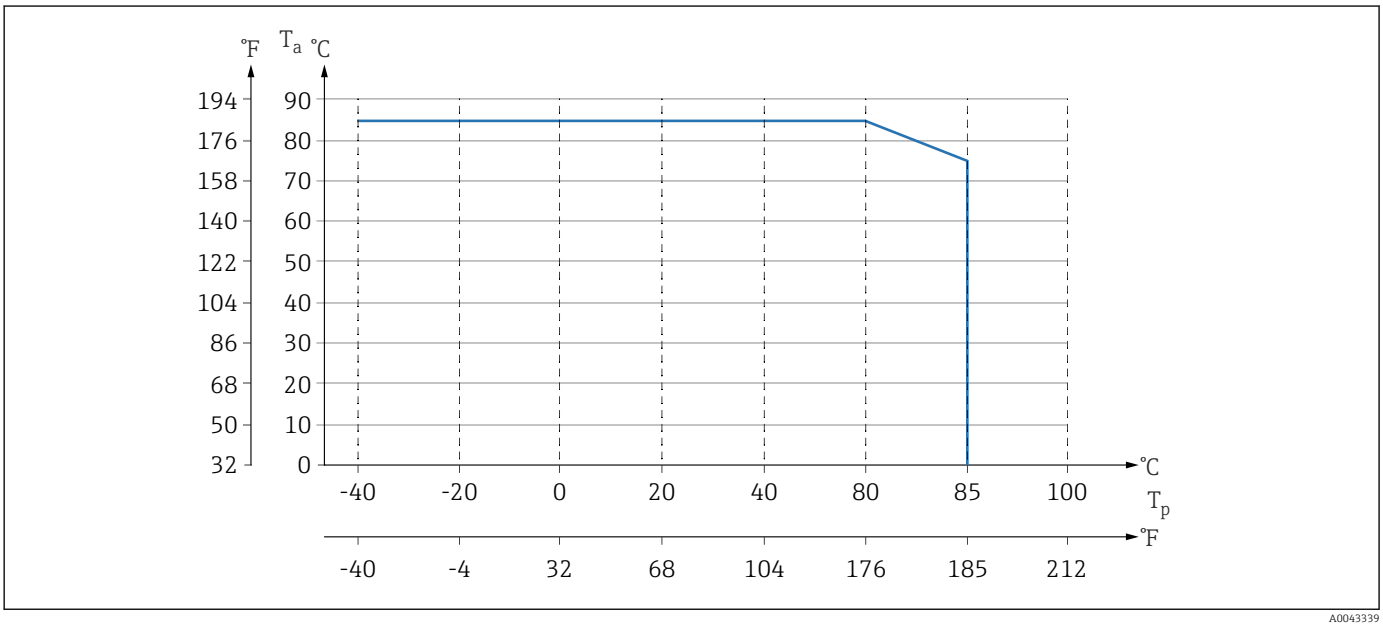
Process temperature range

NOTICE

The permitted process temperature depends on the process connection, the ambient temperature and the type of approval.

► All the temperature data in this document must be taken into consideration when selecting the device.

Devices without a manifold



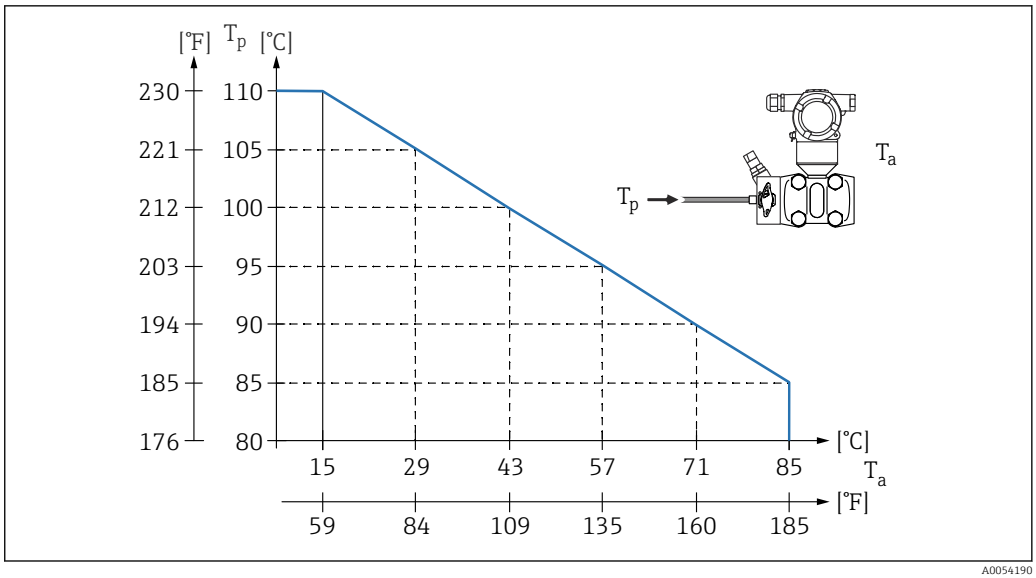
5 *Values apply for vertical mounting without insulation.*

T_p *Process temperature*
T_a *Ambient temperature*

Devices with a manifold

The maximum permitted process temperature at the manifold is 110 °C (230 °F).

For process temperatures >85 °C (185 °F)C where non-insulated side flanges are installed horizontally on a valve manifold, a reduced ambient temperature applies (see the following graphic).



T_a Maximum ambient temperature at the manifold
T_p Maximum process temperature at the manifold

Oxygen applications (gaseous)

Oxygen and other gases can react explosively to oils, grease and plastics. The following precautions must be taken:
- All components of the system, such as devices, must be cleaned in accordance with national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded for oxygen applications.

The cleaning of the device (not accessories) is provided as an optional service.

- p_{max}: 80 bar (1 200 psi)
- T_{max}: 60 °C (140 °F)

Seals

Seal	Temperature	Pressure specifications
FKM	−20 to +85 °C (−4 to +185 °F)	PN > 160 bar (2 320 psi): T_{min} −15 °C (+5 °F)
FKM Cleaned of oil and grease	−10 to +85 °C (+14 to +185 °F)	-
FKM Cleaned for oxygen service	−10 to +60 °C (+14 to +140 °F)	-
FFKM	−10 to +85 °C (+14 to +185 °F)	MWP: 160 bar (2 320 psi)
	−25 to +85 °C (−13 to +185 °F)	MWP: 100 bar (1 450 psi)
EPDM	−40 to +85 °C (−40 to +185 °F)	-
PTFE	−40 to +85 °C (−40 to +185 °F)	PN > 160 bar (2 320 psi) Minimum process temperature: −20 °C (−4 °F)
PTFE Cleaned for oxygen applications	−20 to +60 °C (−4 to +140 °F)	PN > 160 bar (2 320 psi) Minimum process temperature: −20 °C (−4 °F)

Process temperature range (temperature at transmitter)

Device without a manifold

- −40 to +85 °C (−40 to +185 °F)
- Pay attention to the process temperature range of the seal

Device with a manifold

The maximum permitted process temperature at the manifold is 110 °C (230 °F) (restricted by IEC standard).

For process temperatures >85 °C (185 °F) where non-insulated side flanges are installed horizontally on a manifold, a reduced ambient temperature applies up to a maximum ambient temperature, calculated according to the following formula:

$T_{Ambient\_Temperature\_max} = 85\ °C - 2.8 \cdot (T_{Process\_Temperature} - 85\ °C)$

$T_{Ambient\_Temperature\_max} = 185\ °F - 2.8 \cdot (T_{Process\_Temperature} - 185\ °F)$

$T_{Ambient\_Temperature\_max}$ = maximum ambient temperature in °C or °F

$T_{Process\_Temperature}$ = process temperature at a manifold in °C or °F

Pressure range

Pressure specifications

⚠ WARNING

The maximum pressure for the device depends on the lowest-rated component with regard to pressure (components are: process connection, optional mounted parts or accessories).

- Only operate the device within the specified limits for the components!
- MWP (maximum working pressure): The maximum working pressure is specified 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 maximum working pressure. For flanges, refer to the following standards for the permitted pressure values at higher temperatures: EN 1092-1 (with regard to their stability/temperature property, the materials 1.4435 and 1.4404 are grouped together under EN 1092-1. The chemical composition of the two materials can be identical), ASME B 16.5a (the latest version of the standard applies in each case). MWP data that deviate from this are provided in the relevant sections of the Technical Information.
- The overpressure limit (OPL) is the maximum pressure that a device may be subjected to during a test. This value refers to a reference temperature of +20 °C (+68 °F).
- The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.
- In the case of measuring cell range and process connection combinations where the overpressure limit (OPL) of the process connection is less than the nominal value of the measuring cell, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If the entire measuring cell range must be used, select a process connection with a higher OPL value (1.5 x PN; MWP = PN).
- Oxygen applications: do not exceed values for P_{max} and T_{max}.

Burst pressure

As of the specified burst pressure, the complete destruction of the pressure-bearing parts and/or a device leak must be expected. It is therefore imperative to avoid such operating conditions by carefully planning and sizing your facility.

Ultrapure gas applications

Endress+Hauser also offers devices for special applications, such as for ultrapure gas, that are cleaned of oil and grease. No special restrictions regarding the process conditions apply to these devices.

Hydrogen applications

A **gold-coated** metal membrane provides universal protection against hydrogen diffusion, both in gas applications and in applications with aqueous solutions.

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