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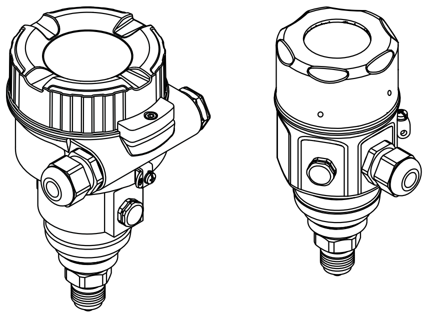
01.00.zz

Operating Instructions
Cerabar M
Deltabar M
Deltapilot M

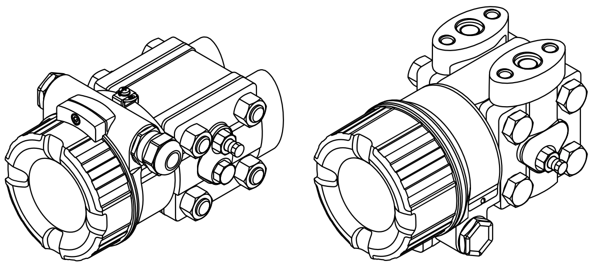
Process pressure/differential pressure, flow/hydrostatic
HART

HART COMMUNICATION PROTOCOL

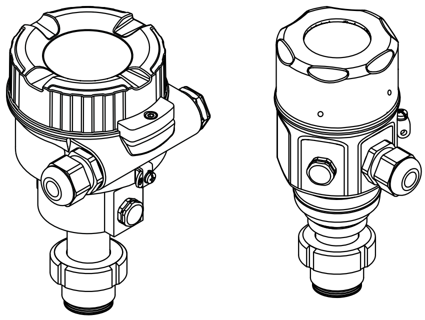
Cerabar M



Deltabar M



Deltapilot M



Endress+Hauser
People for Process Automation

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

Contents

1 About this document

1.1 Document function

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

1.2 Symbols

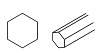
1.2.1 Safety symbols

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

1.2.2 Electrical symbols

Symbol	Meaning	Symbol	Meaning
⎓	Direct current	∼	Alternating current
≂	Direct current and alternating current	⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	**Protective ground connection** A terminal that must be connected to the ground prior to establishing any other connections.		**Equipotential connection** A connection that has to be connected to the plant's grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

1.2.3 Tool symbols

Symbol	Meaning
 A0011221	Allen key
 A0011222	Open-ended wrench

1.2.4 Symbols for certain types of Information

Symbol	Meaning
A0011182	**Permitted** Indicates procedures, processes or actions that are allowed.
A0011184	**Not permitted** Indicates procedures, processes or actions that are forbidden.
A0011193	**Tip** Indicates additional information.
A0015482	Reference to documentation
A0015484	Reference to page.
A0015487	Reference to graphic
1. , 2. , …	Series of steps
A0018343	Result of a series of actions
A0015502	Visual inspection

1.2.5 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4 etc.	Numbering of main items
1. , 2. , …	Series of steps
A, **B**, **C**, **D** etc.	Views

1.2.6 Symbols on the device

Symbol	Meaning
A0019159	**Safety notice** Observe the safety instructions contained in the associated operating instructions.
t>85°C	**Temperature resistance of the connection cables** Indicates that the connecting cables must be able to withstand temperatures of at least 85 °C.

1.2.7 Registered Trademarks

KALREZ®
Registered label of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®
Registered label of Ladish & Co., Inc., Kenosha, USA

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

GORE-TEX®
Trademark of W.L. Gore & Associates, Inc., USA

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel responsible for installation, commissioning, diagnostics and maintenance must fulfil the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task
- They must be authorized by the plant operator
- They must be familiar with 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)
- They must follow instructions and comply with basic conditions

The operating personnel must fulfil the following requirements:
- They must be instructed and authorized according to the requirements of the task by the plant operator
- They must follow the instructions in these Operating Instructions

2.2 Intended use

The **Cerabar M** is a pressure transmitter for measuring level and pressure.
The **Deltabar M** is a differential pressure transmitter for measuring differential pressure, flow and level.
The **Deltapilot M** is a hydrostatic pressure sensor for measuring level and pressure.

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or unintended use.
Clarification for borderline cases:
In the case of special fluids and fluids used for cleaning, Endress+Hauser is glad to provide assistance in clarifying the corrosion resistance of 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 as per 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 ensuring that the device is in good working order.
- ▶ Only disassemble the device in unpressurized condition!

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.

2.5 Hazardous area

To eliminate danger to persons or the installation when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):

- Check the nameplate to verify if the device ordered can be put to its intended use in the hazardous area.
- Comply with the instructions in the separate supplementary documentation, which is an integral part of this manual.

2.6 Product safety

This measuring instrument 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 conforms to the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

2.7 Functional Safety SIL (optional)

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

3 Identification

3.1 Product identification

The measuring instrument can be identified in the following ways:
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial number from the nameplates in W@M Device Viewer (www.endress.com/deviceviewer): All the information about the measuring instrument is displayed.

For an overview of the technical documentation provided, enter the serial number from the nameplates in W@M Device Viewer (www.endress.com/deviceviewer).

3.1.1 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany
Address of the manufacturing plant: See nameplate

3.2 Device designation

3.2.1 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.

3.2.2 Identification of sensor type

In the case of gauge pressure sensors, the "Pos. zero adjust" parameter appears in the operating menu ("Setup" -> "Pos. zero adjust").
In the case of absolute pressure sensors, the "Calib. offset" parameter appears in the operating menu ("Setup" -> "Calib. offset").

3.3 Scope of delivery

The scope of delivery comprises:
- Measuring instrument
- Optional accessories

Documentation supplied:
- Operating Instructions BA00382P is available on the Internet.
  → See: www.de.endress.com → Download
- Brief Operating Instructions : KA01030P Cerabar M/KA01027P Deltabar M/KA01033P Deltapilot M
- Final inspection report
- Additional Safety Instructions with ATEX, IECEx and NEPSI devices
- Optional: factory calibration certificate, test certificates

3.4 CE mark, Declaration of Conformity

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

4 Installation

4.1 Incoming acceptance

- Check the packaging and contents for any signs of damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

4.2 Storage and transport

4.2.1 Storage

The measuring instrument must be stored in a dry, clean area and protected against damage from impact (EN 837-2).
Storage temperature range:
See Technical Information Cerabar M TI00436P/Deltabar M TI00434P/Deltapilot M TI00437P.

4.2.2 Transport

⚠ WARNING

Incorrect transportation

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

- ▶ Transport the measuring instrument to the measuring point in its original packaging or by the process connection.
- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.6 lbs).
- ▶ Do not use capillaries as a carrying aid for the diaphragm seals.

4.3 Installation requirements

4.3.1 Installation dimensions

→ For dimensions, refer to the Technical Information for Cerabar M TI00436P / Deltabar M TI00434P/Deltapilot M TI00437P, section "Structural design".

4.4 General installation instructions

- Devices with a G 1 1/2 thread:
  When screwing the device into the tank, the flat seal has to be positioned on the sealing surface of the process connection. To avoid additional strain on the process membrane, the thread should never be sealed with hemp or similar materials.
- Devices with NPT threads:
  - Wrap Teflon tape around the thread to seal it.
  - Tighten the device at the hexagonal bolt only. Do not turn at the housing.
  - Do not overtighten the thread when screwing in the screw. Max. torque: 20 to 30 Nm (14.75 to 22.13 lbf ft)
- For the following process connections a tightening torque of max. 40 Nm (29.50 lbf ft) is required:
  - Thread ISO228 G1/2 (Order option "GRC" or "GRJ" or "G0J")
  - Thread DIN13 M20 x 1.5 (Order option "G7J" or "G8J")

4.4.1 Mounting sensor modules with PVDF thread

⚠ WARNING

Risk of damage to process connection!

Risk of injury!

▶ Sensor modules with PVDF process connections with threaded connection must be installed with the mounting bracket provided!

⚠ WARNING

Material fatigue from pressure and temperature!

Risk of injury due to bursting of parts! The thread can become loose if exposed to high pressure and temperature loads.

▶ The integrity of the thread must be checked regularly and the thread may need to be re-tightened with the maximum tightening torque of 7 Nm (5.16 lbf ft). Teflon tape is recommended for sealing the ½" NPT thread.

4.5 Installing the Cerabar M

- Due to the orientation of the Cerabar M, there may be a shift in the zero point, i.e. when the container is empty, the measured value does not display zero. You can correct this zero point shift → 🗎 43, Kap. "Function of operating elements".
- For PMP55, please refer to Kap. 4.5.2 "Installation instructions for devices with diaphragm seals – PMP55", → 🗎 15.
- Endress+Hauser offers a mounting bracket for installations on pipes or walls. → 🗎 16, Kap. 4.5.5 "Wall and pipe mounting (optional)".

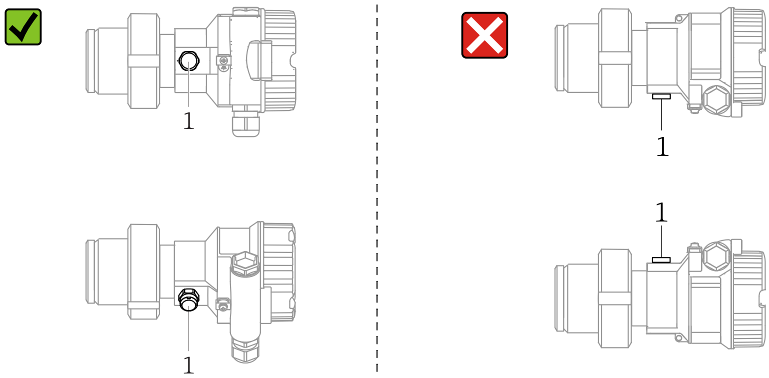
4.5.1 Installation instructions for devices without diaphragm seals – PMP51, PMC51

NOTICE

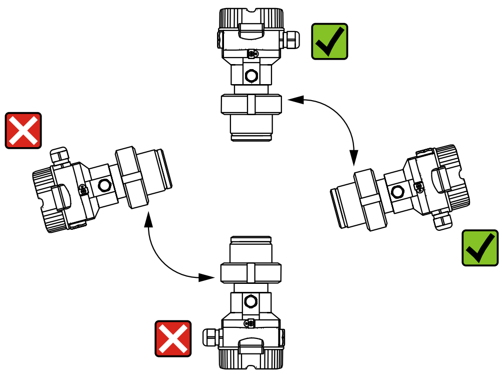
Damage to the device!

If a heated Cerabar M is cooled during the cleaning process (e.g. by cold water), a vacuum develops for a short time, and as a result, moisture can enter the sensor through the pressure compensation (1).

▶ Mount the device as follows.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contaminations.
- Cerabar M transmitters without diaphragm seals are mounted as per the norms for a manometer (DIN EN 837-2). We recommend the use of shutoff devices and siphons. The orientation depends on the measuring application.
- Do not clean or touch process membranes with hard or pointed objects.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



Pressure measurement in gases

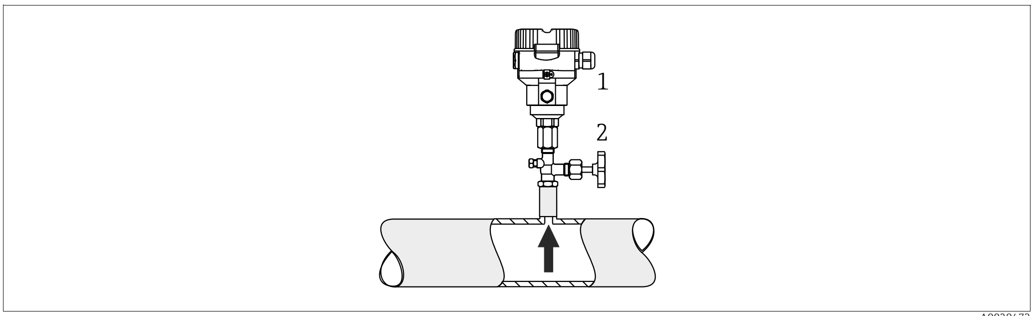


Fig. 1: Measuring arrangement for pressure measurement in gases

1 Cerabar M
2 Shutoff device

Mount CerabarM with shutoff device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steam

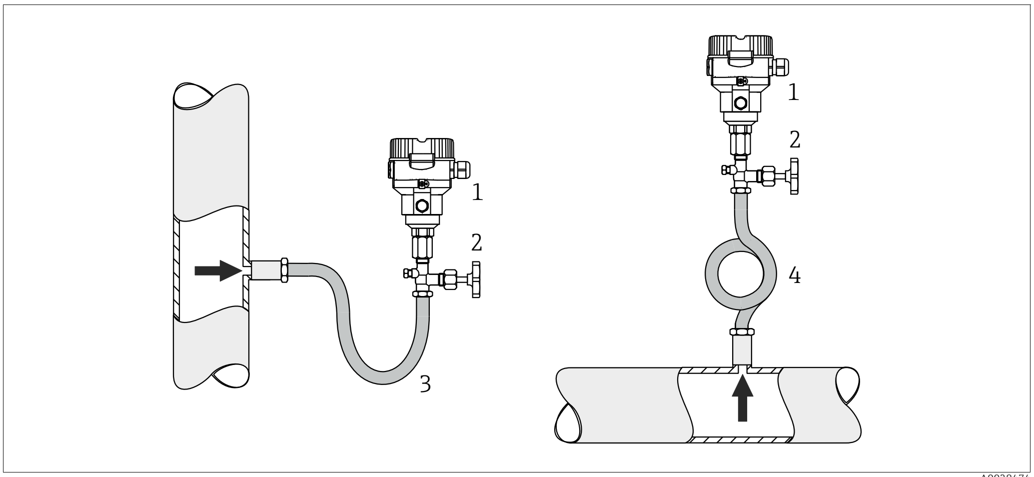


Fig. 2: Measuring arrangement for pressure measurement in steams

1 Cerabar M
2 Shutoff device
3 U-shaped siphon
4 Circular siphon

Observe the maximum permitted ambient temperature of the transmitter!

Installation:
- Preferably mount the device with an O-shaped siphon below the tapping point. The device may also be mounted above the tapping point
- Fill the siphon with liquid before commissioning

Advantages of using siphons:
- Protection of the measuring instrument from hot, pressurised media by forming and accumulating condensate
- Damping of pressure shocks
- The defined water column only causes minimal (negligible) measurement errors and minimal (negligible) thermal effects on the device.

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

Pressure measurement in liquids

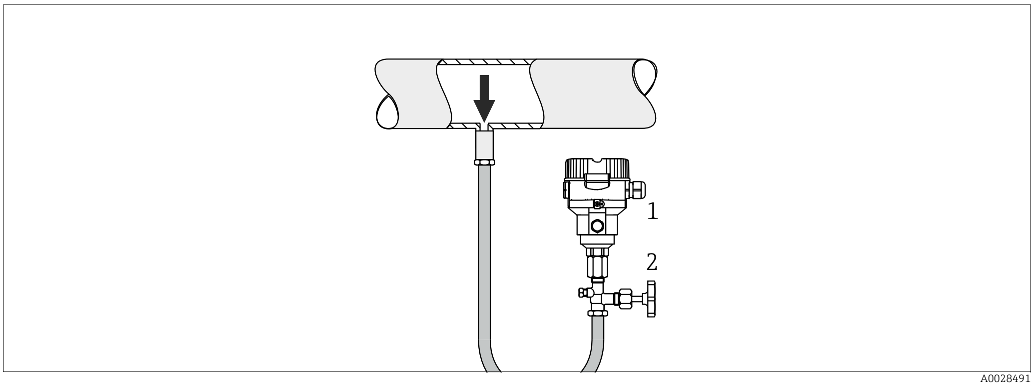


Fig. 3: Measuring arrangement for pressure measurement in liquids

1 Cerabar M
2 Shutoff device

- Mount the Cerabar M with the shutoff device below or at the same level as the tapping point.

Level measurement

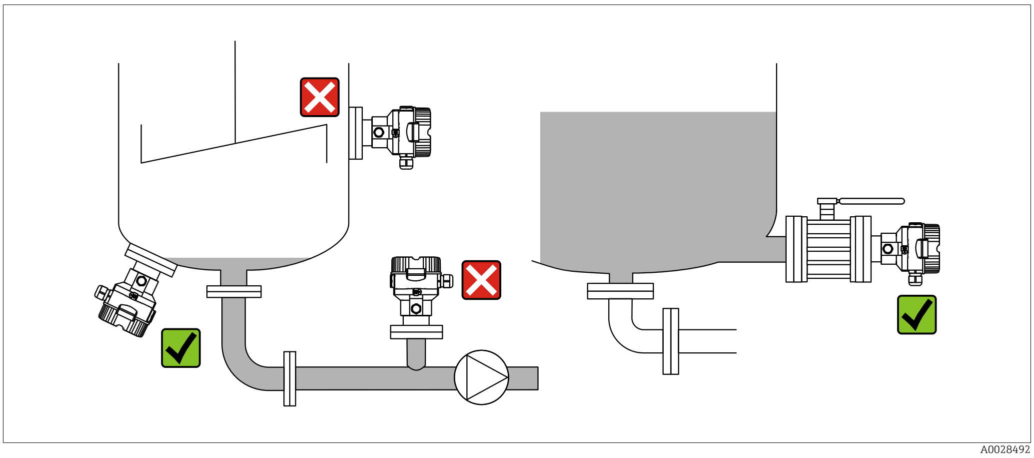


Fig. 4: Measuring arrangement for level

- Always install the Cerabar M below the lowest measuring point.
- Do not mount the device at the following positions: in the fill flow, in the tank outlet or at a point in the container which could be affected by pressure pulses from an agitator.
- Do not mount the device in the suction area of a pump.
- The adjustment and functional test can be carried out more easily if you mount the device downstream from a shutoff device.

4.5.2 Installation instructions for devices with diaphragm seals – PMP55

- Cerabar M devices with diaphragm seals are screwed in, flanged or clamped, depending on the type of diaphragm seal.
- Please note that the hydrostatic pressure of the liquid columns in the capillaries can cause zero point shift. The zero point shift can be corrected.
- Do not clean or touch the process membrane of the diaphragm seal with hard or pointed objects.
- Do not remove the protection on the process membrane until just before installation.

NOTICE

Incorrect handling!

Damage to the device!

- ▶ The diaphragm seal and the pressure transmitter together form a closed, calibrated system which is filled with filling fluid through a hole in the upper part. This hole is sealed and not to be opened.
- ▶ When using a mounting bracket, sufficient strain relief must be ensured for the capillaries in order to prevent the capillary bending down (bending radius ≥ 100 mm (3.94 in)).
- ▶ Please observe the application limits of the diaphragm seal fill fluid as detailed in the Technical Information for Cerabar M TI00436P, "Planning instructions for diaphragm seal systems" section.

NOTICE

In order to obtain more precise measurement results and to avoid a defect in the device:

- ▶ Mount capillaries vibration-free (in order to avoid additional pressure fluctuations)
- ▶ Do not mount in the vicinity of heating or cooling lines
- ▶ Insulate the capillaries if the ambient temperature is below or above the reference temperature
- ▶ With a bending radius of≥ 100 μμ (3.94 ιν)
- ▶ Do not use the capillaries as a carrying aid for the diaphragm seals!

Vacuum application

See Technical Information.

Mounting with temperature isolator

See Technical Information.

4.5.3 Seal for flange mounting

NOTICE

Incorrect measurement results

The seal is not allowed to press against the process membrane as this could affect the measurement result.

▶ Ensure that the seal is not touching the process membrane.

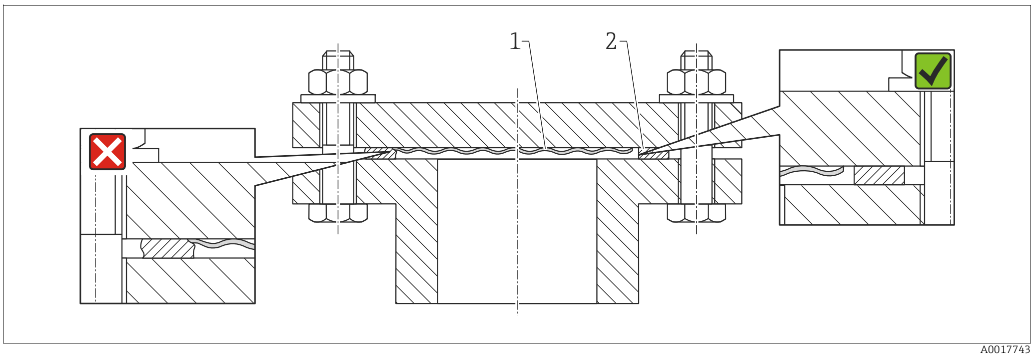


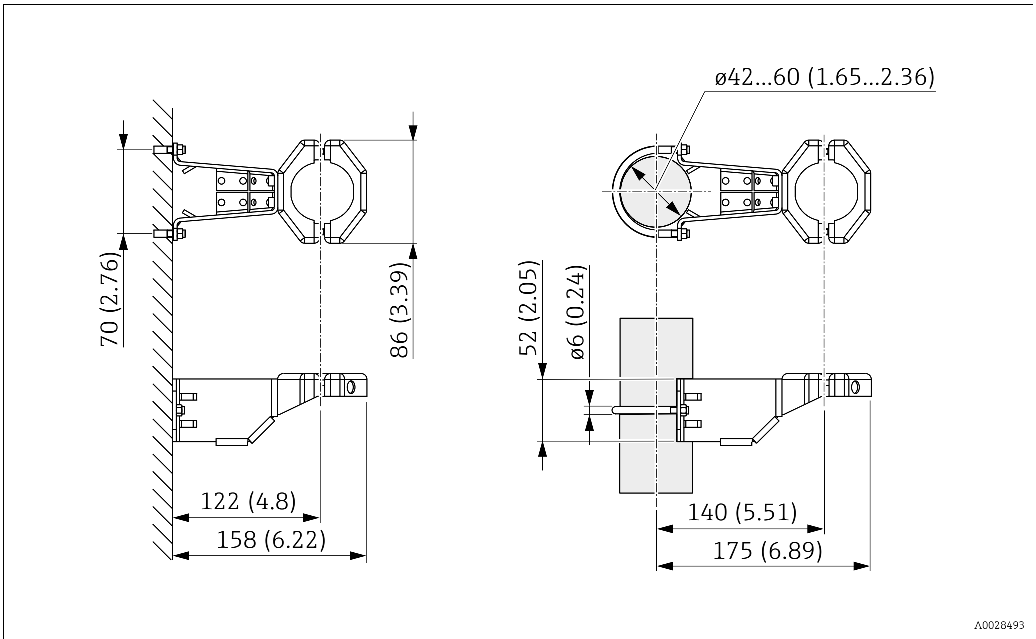
Fig. 5:
1 Process membrane
2 Seal

4.5.4 Thermal insulation – PMP55

See Technical Information.

4.5.5 Wall and pipe mounting (optional)

Endress+Hauser offers a mounting bracket for installation on pipes or walls (for pipe diameters from 1 ¼" to 2").



Unit mm (in)

Please note the following when mounting:

- Devices with capillary tubes: mount capillaries with a bending radius ≥ 100 mm (3.94 in).
- When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbs ft).

4.5.6 Assembling and mounting the "separate housing" version

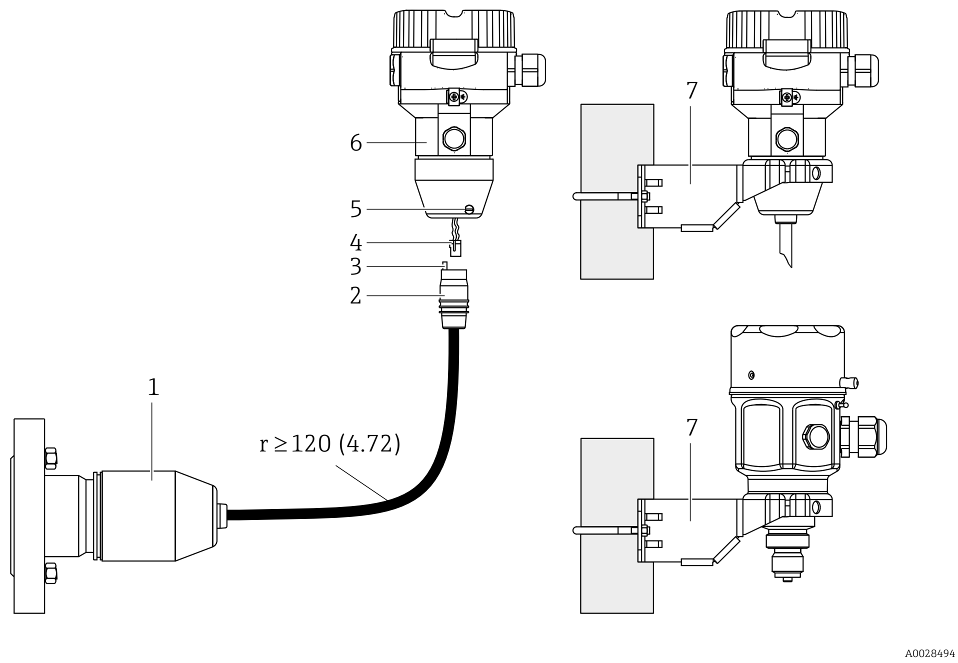


Fig. 6: "Separate housing" version

1 *In the "separate housing" version, the sensor is supplied with process connection and cable fitted.*
2 *Cable with connection jack*
3 *Pressure compensation*
4 *Plug*
5 *Locking screw*
6 *Housing mounted with housing adapter, included*
7 *Mounting bracket provided, suitable for pipe and wall mounting (for pipe diameters from 1 ¼" up to 2")*

Unit mm (in)

Assembly and mounting

1. Connect plug (item 4) into the corresponding connection jack of the cable (item 2).
2. Plug the cable into the housing adapter (item 6).
3. Tighten the locking screw (item 5).
4. Mount the housing on a wall or pipe using the mounting bracket (item 7).
   When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbs ft).
   Mount the cable with a bending radius (r) ≥120 μμ (4.72 in).

Routing the cable (e.g. through a pipe)

You require the cable shortening kit.
Order number: 71093286
For details on mounting, see SD00553P/00/A6.

4.5.7 PMP51, version prepared for diaphragm seal mount – welding recommendation

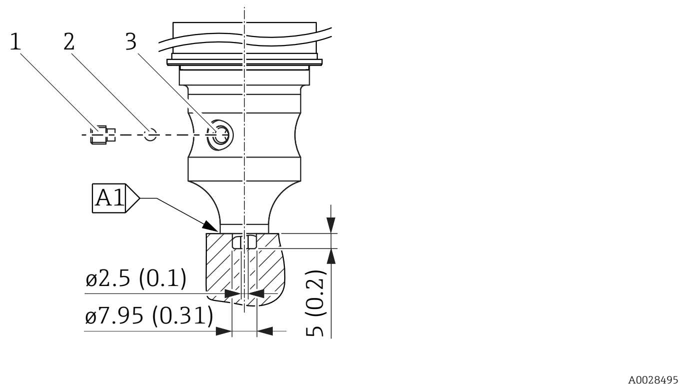
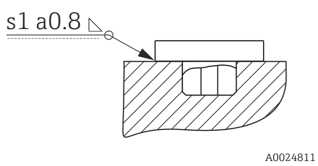


Fig. 7: Version XSJ: prepared for diaphragm seal mount

1 Hole for filling fluid
2 Bearing
3 Threaded pin
A1 See the following "Welding recommendation" table

Unit mm (in)

Endress+Hauser recommends welding on the diaphragm seal as follows for the "XSJ - Vorbereitet für Druckmittleranbau" version in feature 110 "Prozessanschluss" in the order code up to, and including, 40 bar (600 psi) sensors: the total welding depth of the fillet weld is 1 mm (0.04 in) with an outer diameter of 16 mm (0.63 in). Welding is performed according to the WIG method.

Consecutive seam no.	Sketch/welding groove shape, dimension as per DIN 8551	Base material matching	Welding method DIN EN ISO 24063	Welding position	Inert gas, additives
A1 for sensors ≤ 40 bar (600 psi)		Adapter made of AISI 316L (1.4435) to be welded to diaphragm seal made of AISI 316L (1.4435 or 1.4404)	141	PB	Inert gas Ar/H 95/5 Additive: ER 316L Si (1.4430)

Information on filling

The diaphragm seal must be filled as soon as it has been welded on.

- After welded into the process connection, the sensor assembly must be properly filled with a fill fluid and sealed gas-tight with a sealing ball and lock screw.
  Once the diaphragm seal has been filled, at the zero point the device display should not exceed 10% of the full scale value of the cell measuring range. The internal pressure of the diaphragm seal must be corrected accordingly.
- Adjustment / calibration:
  - The device is operational once it has been fully assembled.
  - Perform a reset. The device must then be calibrated to the process measuring range as described in the Operating Instructions.

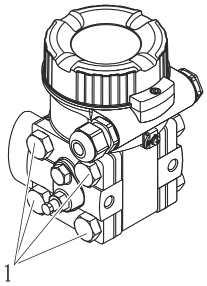
4.6 Installing the Deltabar M

NOTICE

Incorrect handling!

Damage to the device!

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



4.6.1 Orientation

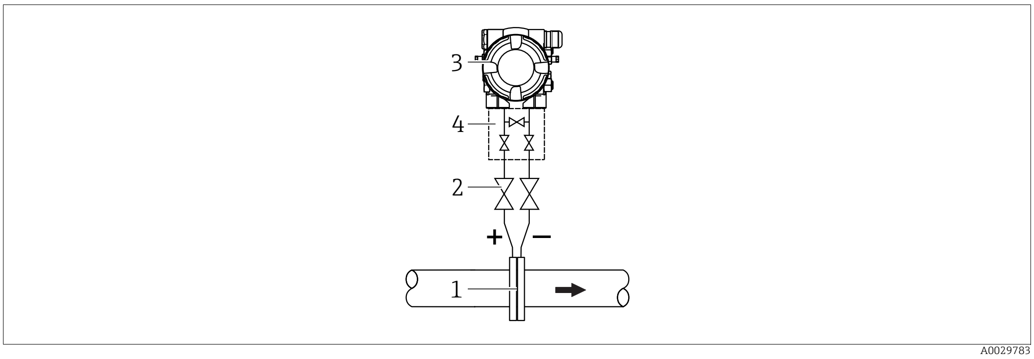
- Due to the orientation of the Deltabar M, there may be a shift in the zero point, i.e. when the container is empty, the measured value does not display zero. You may correct this zero point shift by a position adjustment in one of the following ways:
  - via the operation keys on the electronics module (→ 🗎 43, "Function of operating elements")
  - via the operating menu (→ 🗎 60, "Zero adjustment")
- General recommendations for routing the impulse piping can be found in DIN 19210 "Methods for measurement of fluid flow; differential piping for flow measurement devices" or the corresponding national or international standards.
- Using a three-valve or five-valve manifold allows for easy commissioning, installation and maintenance without interrupting the process.
- When routing the impulse piping outdoors, ensure that sufficient anti-freeze protection is used, e.g. by using pipe heat tracing.
- Install the impulse piping with a monotonic gradient of at least 10 %.
- Endress+Hauser offers a mounting bracket for installing on pipes or walls (→ 🗎 24, "Wall and pipe mounting (optional)").

Installation position for flow measurement

For more information about differential pressure flow measurement refer to following documents:

- Differential pressure flow measurement with orifices: Technical Information TI00422P
- Differential pressure flow measurement with Pitot tubes: Technical Information TI00425P

Flow measurement in gases

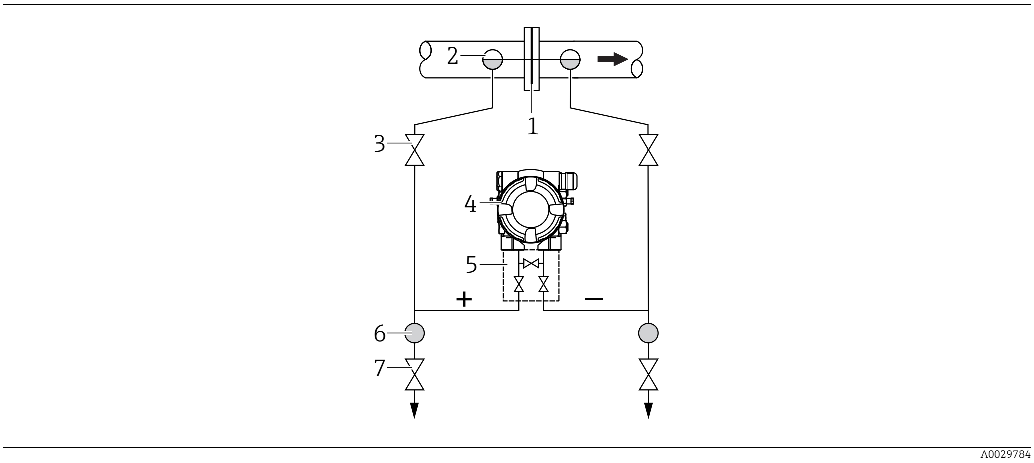


Measuring layout for flow measurement in gases

1 *Orifice plate or pitot tube*
2 *Shutoff valves*
3 *Deltabar M*
4 *Three-valve manifold*

- Mount the Deltabar M above the measuring point so that the condensate which may be present, can run off into the process piping.

Flow measurement in steam

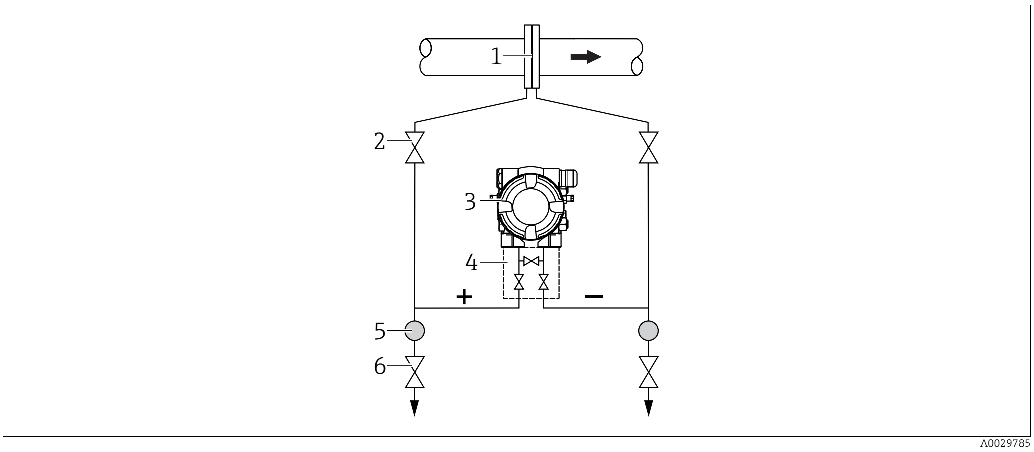


Measuring layout for flow measurement in steam

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

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

Flow measurements in liquids



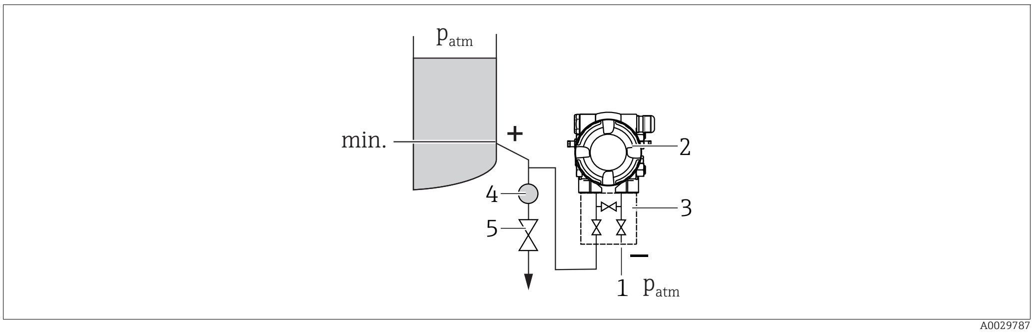
Measuring layout for flow measurement in liquids

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

- Mount the Deltabar M below the measuring point so that the piping is always filled with liquid and gas bubbles can run 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.

Orientation for level measurement

Level measurement in an open container

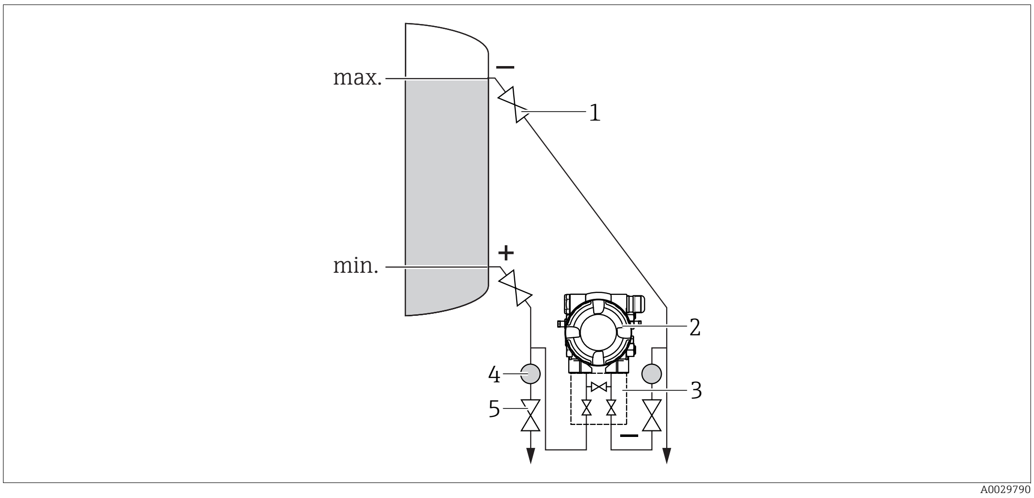


Measuring layout for level measurement in an open container

1 *The low-pressure side is open to atmospheric pressure*
2 *Deltabar M*
3 *Three-valve manifold*
4 *Separator*
5 *Drain valve*

- Mount the Deltabar M below the lower measuring connection so that the piping is 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 container

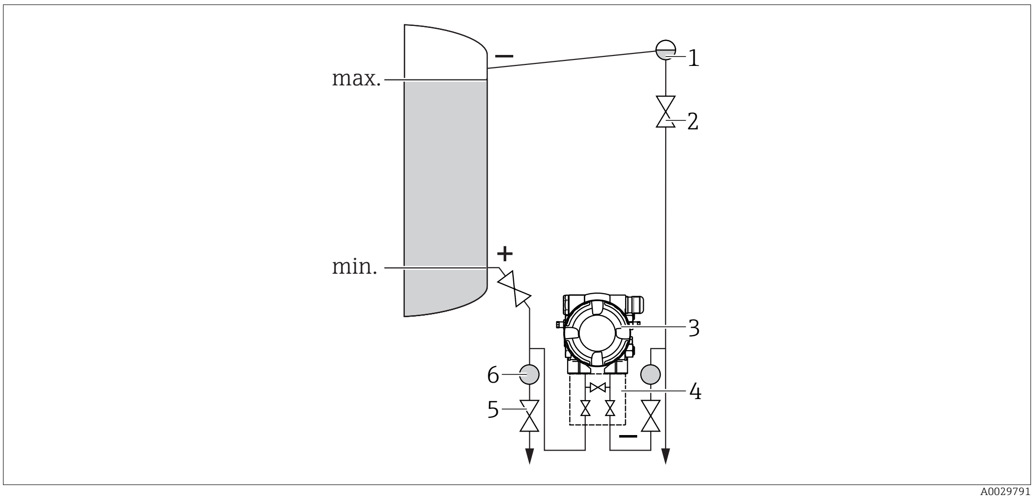


Measuring layout for level measurement in a closed container

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

- Mount the Deltabar M below the lower measuring connection so that the piping is 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 container with superimposed steam



Measuring layout for level measurement in a container with superimposed steam

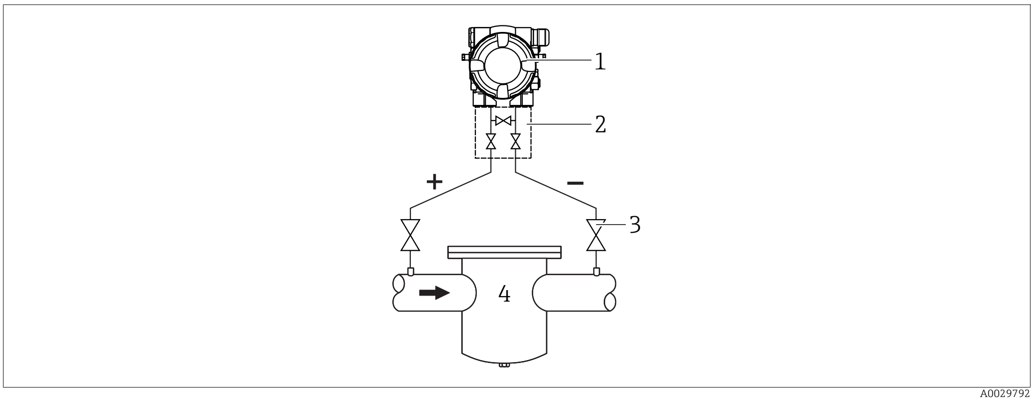
1 *Condensate trap*
2 *Shutoff valves*
3 *Deltabar M*
4 *Three-valve manifold*
5 *Drain valves*
6 *Separator*

- Mount the Deltabar M below the lower measuring connection so that the piping is always filled with liquid.
- Always connect the low-pressure side above the maximum level.
- A 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.

Installation position for differential pressure measurement

Differential pressure measurement in gases and steam

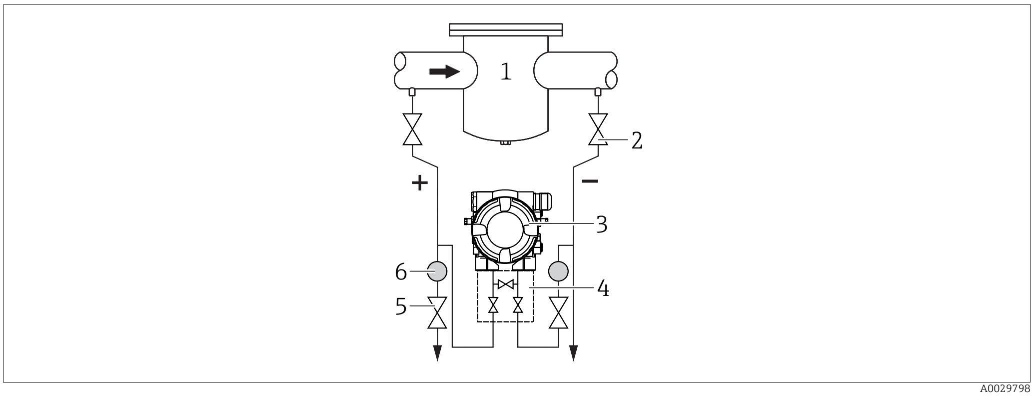


Measuring layout for differential pressure measurement in gases and steam

1 *Deltabar M*
2 *Three-valve manifold*
3 *Shutoff valves*
4 *e.g. filter*

- Mount the Deltabar M above the measuring point so that the condensate which may be present, can run off into the process piping.

Differential pressure measurement in liquids



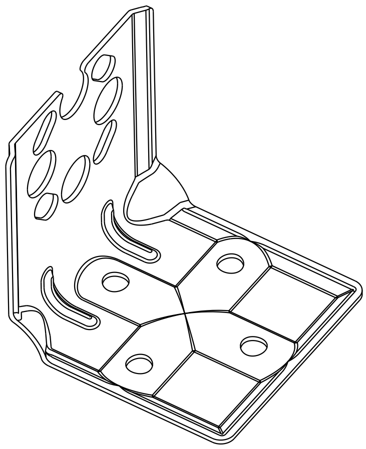
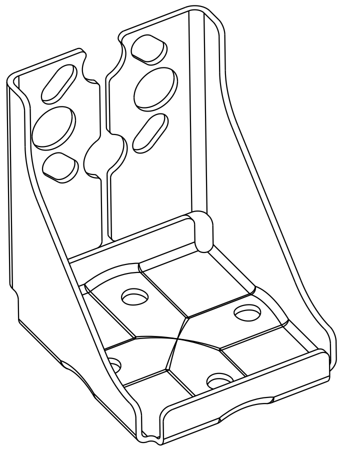
Measuring layout for differential pressure measurement in liquids

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

- Mount the Deltabar M below the measuring point so that the piping is always filled with liquid and gas bubbles can run 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.

4.6.2 Wall and pipe mounting (optional)

Endress+Hauser offers the following mounting brackets to install the device on pipes or walls:

Standard version	Reinforced version
	

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 depend on the order code.
For the technical data (such as the dimensions or order numbers for screws), see the accessories document SD01553P/00/EN.

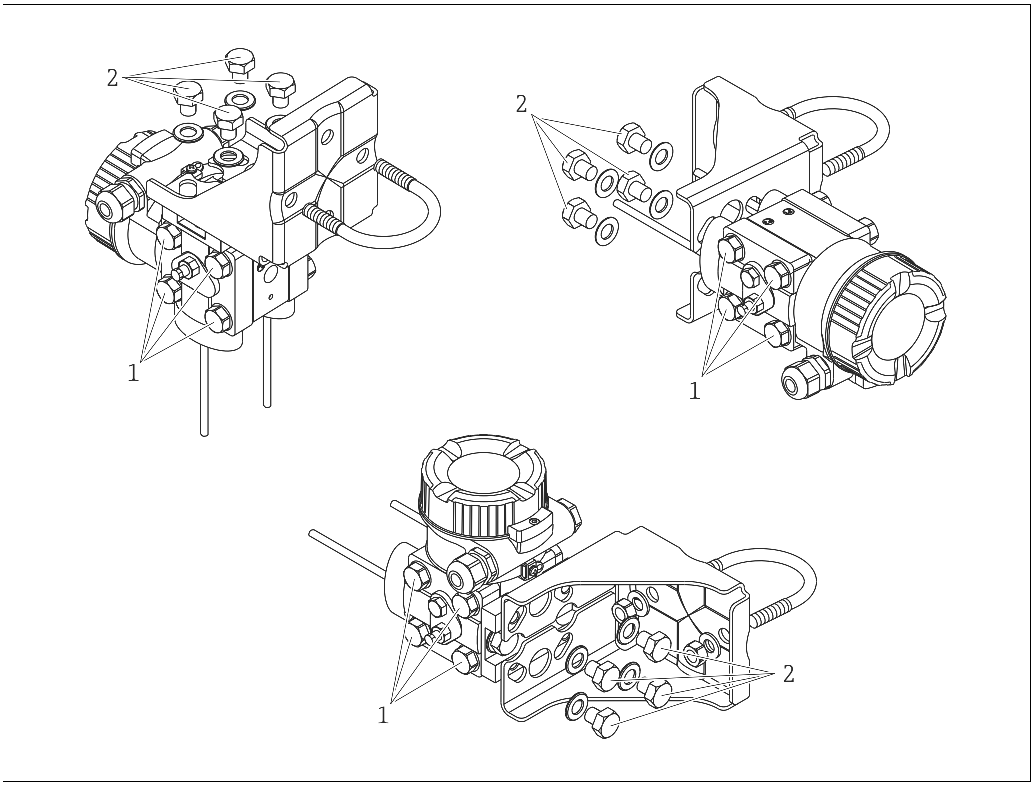
Please note the following when mounting:
- To prevent the mounting screws from scoring, they must be lubricated with a multi-purpose grease before mounting.
- For pipe mounting, the nuts on the retainer must be tightened uniformly with a torque of at least 30 Nm (22.13 lbf ft).
- For installation purposes, only use the screws with item number (2) (see the following diagram).

NOTICE

Incorrect handling!

Damage to the device!

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



A0024167.eps

Typical installation arrangements

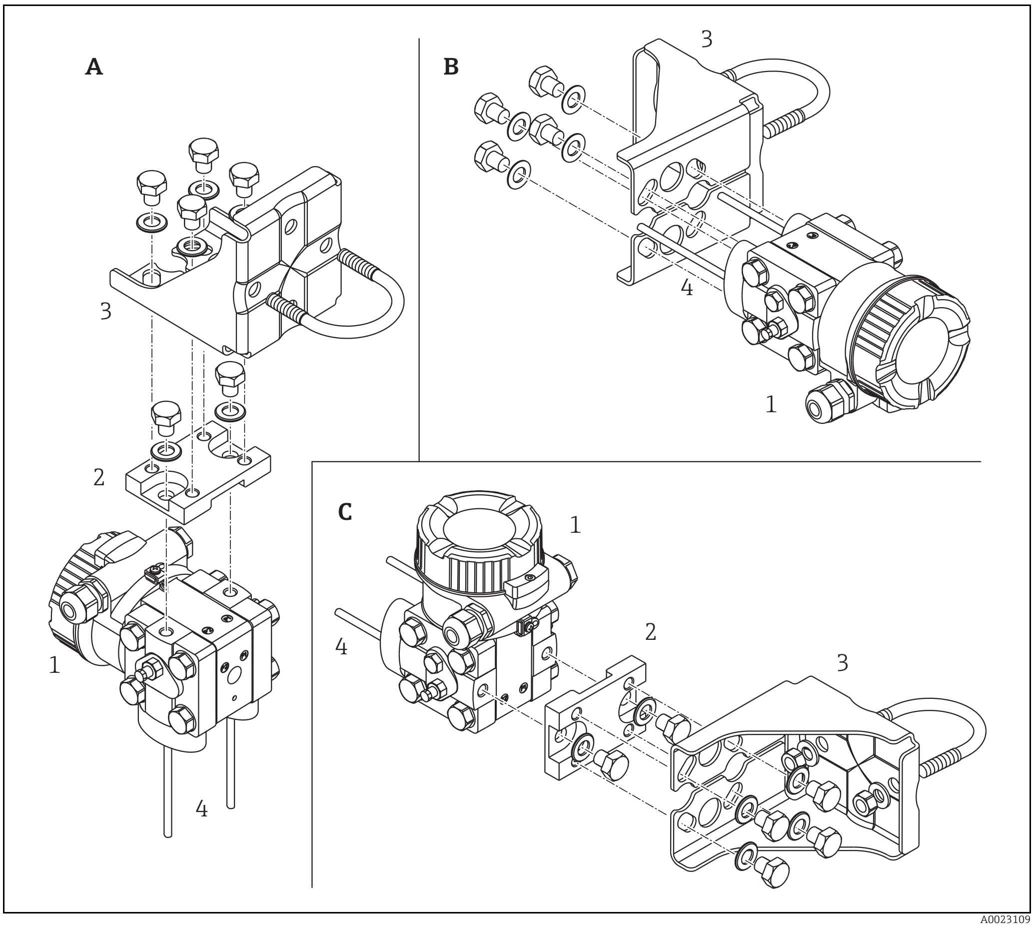


Fig. 8:

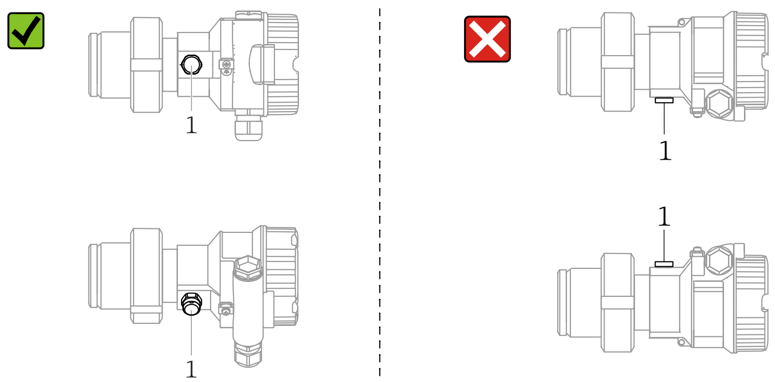
A	Vertical impulse line, V1 version, 90° alignment
B	Horizontal impulse line, H1 version, 180° alignment
C	Horizontal impulse line, H2 version, 90° alignment
1	Deltabar M
2	Adapter board
3	Mounting bracket
4	Impulse line

4.7 Installing the Deltapilot M

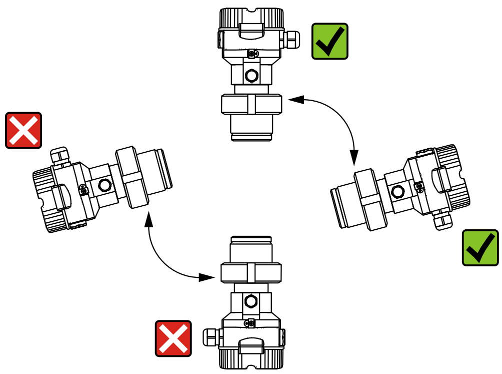
- Due to the orientation of the Deltapilot M, a shift in zero point may occur, i.e. when the container is empty, the measured value does not display zero. You can correct this zero point shift → 🗎 43, Kap. "Function of operating elements" or → 🗎 60, Kap. 8.4 "Zero adjustment".
- The onsite display can be rotated in 90° stages.
- Endress+Hauser offers a mounting bracket for installing on pipes or walls. → 🗎 16, Kap. 4.5.5 "Wall and pipe mounting (optional)".

4.7.1 General installation instructions

- Do not clean or touch process isolating diaphragms with hard or pointed objects.
- The process membrane in the rod and cable version is protected against mechanical damage by a plastic cap.
- If a heated Deltapilot M is cooled during the cleaning process (e.g. by cold water), a vacuum develops for a short time, and as a result, moisture can enter the sensor through the pressure compensation (1).
  Mount the device as follows.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contamination.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



4.7.2 FMB50

Level measurement

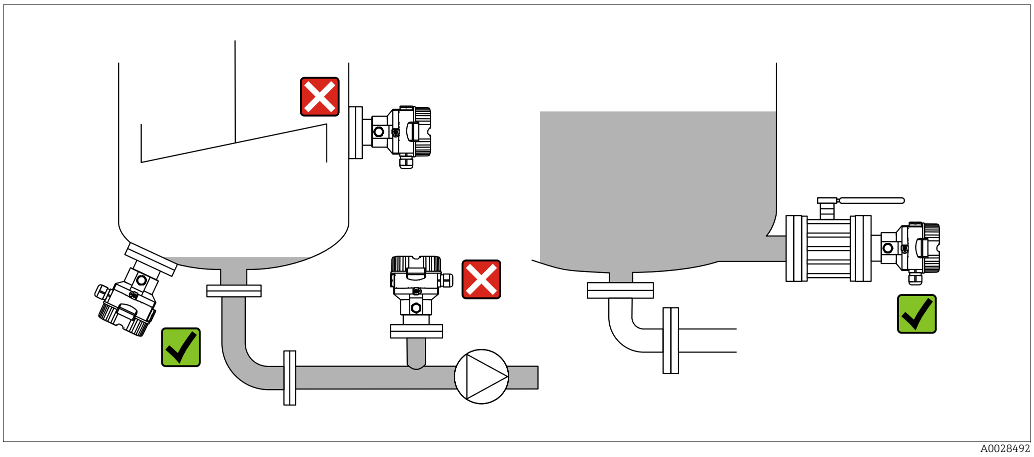


Fig. 9: Measuring arrangement for level

- Always install the device below the lowest measuring point.
- Do not install the device at the following positions:
  - in the filling curtain
  - in the tank outlet
  - in the suction area of a pump
  - or at a point in the tank which could be affected by pressure pulses from the agitator.
- The adjustment and functional test can be carried out more easily if you mount the device downstream from a shutoff device.
- The Deltapilot M must also be insulated in the case of media that can harden when cold.

Pressure measurement in gases

- Mount Deltapilot M with shutoff device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steam

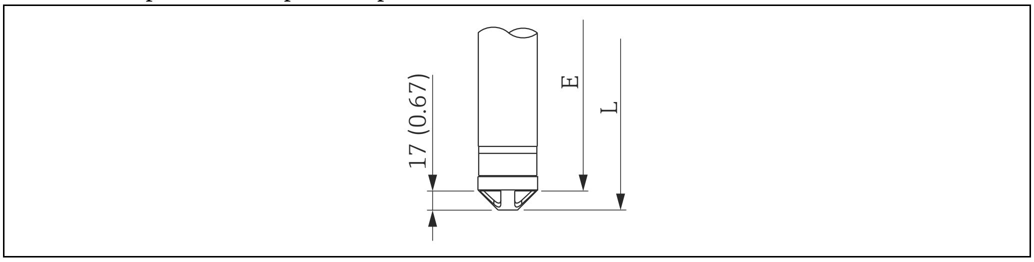
- Mount the Deltapilot M with the siphon above the tapping point.
- Fill the siphon with liquid before commissioning.
  The siphon reduces the temperature to almost ambient temperature.

Pressure measurement in liquids

- Mount the Deltapilot M with the shutoff device below or at the same level as the tapping point.

4.7.3 FMB51/FMB52/FMB53

- When mounting rod and cable versions, make sure that the probe head is located at a point as free as possible from flow. To protect the probe from impact resulting from lateral movement, mount the probe in a guide tube (preferably made of plastic) or secure it with a clamping fixture.
- In the case of devices for hazardous areas, comply strictly with the safety instructions when the housing cover is open.
- The length of the extension cable or the probe rod is based on the planned level zero point. The height of the protective cap must be taken into consideration when designing the layout of the measuring point. The level zero point (E) corresponds to the position of the process isolating diaphragm.
  Level zero point = E; top of the probe = L.



4.7.4 Mounting the FMB53 with a suspension clamp

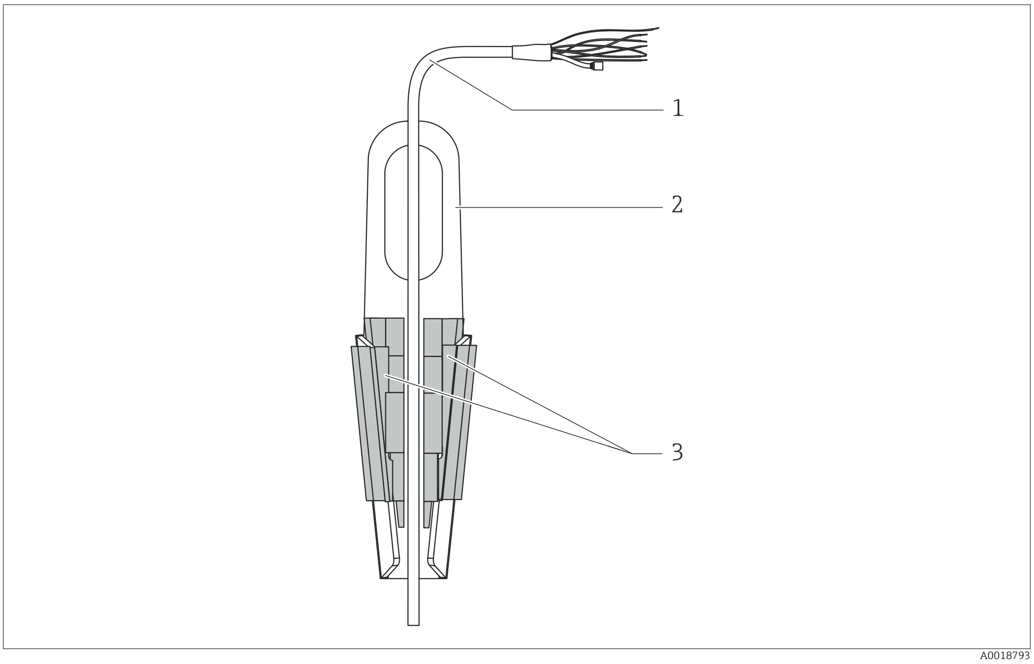


Fig. 10: Mounting with a mounting clamp

1 Extension cable
2 Suspension clamp
3 Clamping jaws

Mounting the suspension clamp:

1. Mount the suspension clamp (item 2). Take the weight of the extension cable (item 1) and the device into account when selecting the fastening point.
2. Push up the clamping jaws (item 3). Place the extension cable (item 1) between the clamping jaws as shown in the graphic.
3. Hold the extension cable (item 1) in position and push the clamping jaws (item 3) back down.
   Tap the clamping jaws gently from above to fix them in place.

4.7.5 Seal for flange mounting

NOTICE

Incorrect measurement results

The seal must not be allowed to press against the process membrane as this could affect the measurement result.

▶ Ensure that the seal is not touching the process membrane.

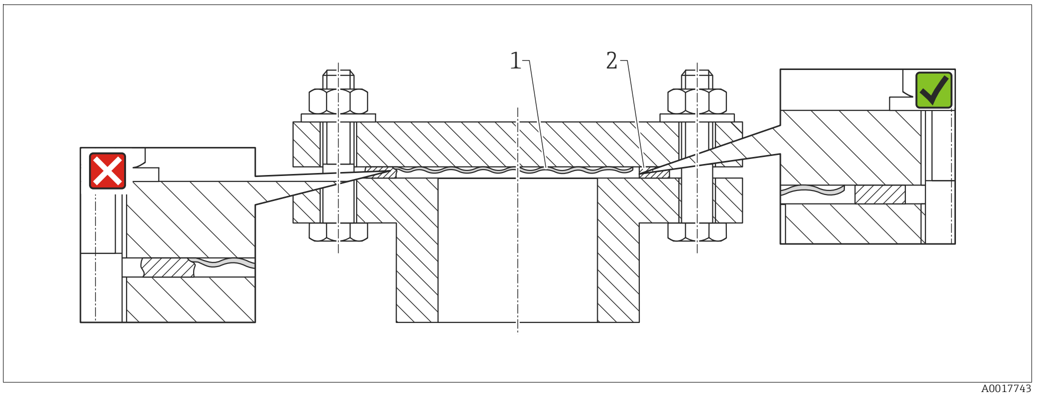
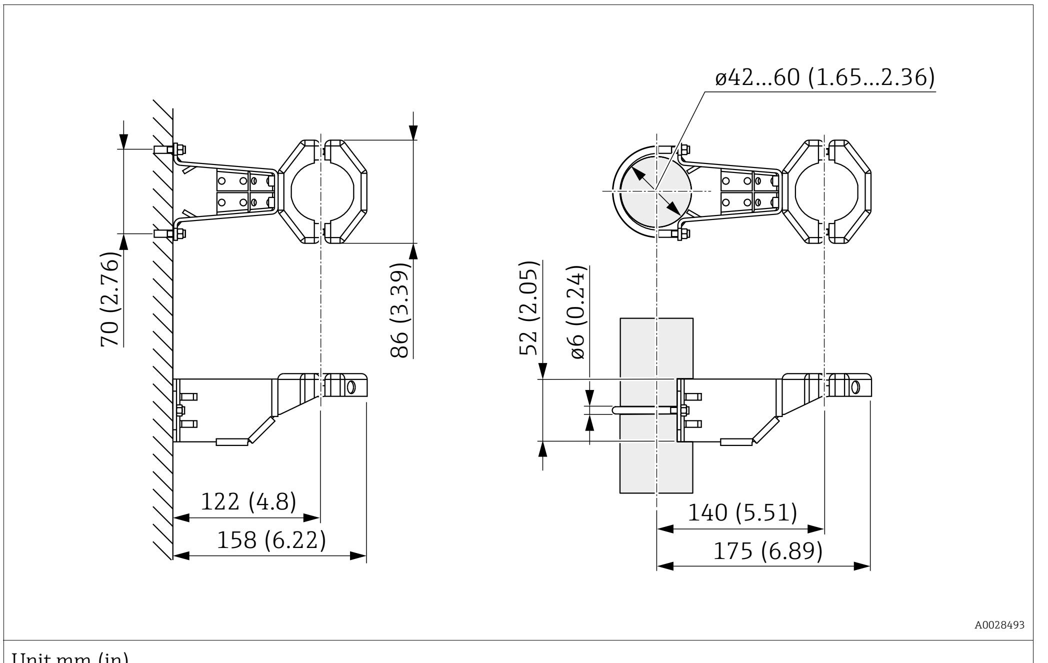


Fig. 11:
1 Process membrane
2 Seal

4.7.6 Wall and pipe mounting (optional)

Mounting bracket

Endress+Hauser offers a mounting bracket for installation on pipes or walls (for pipe diameters from 1 ¼" to 2").



Unit mm (in)

When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft).

4.7.7 Assembling and mounting the "separate housing" version

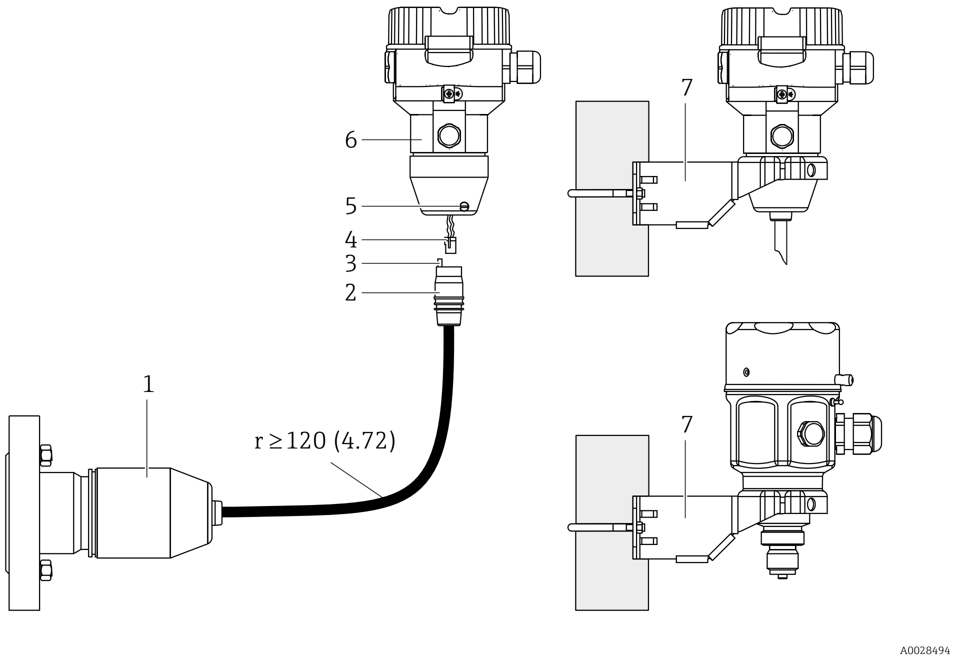


Fig. 12: "Separate housing" version

1 In the "separate housing" version, the sensor is supplied with process connection and cable fitted.
2 Cable with connection jack
3 Pressure compensation
4 Plug
5 Locking screw
6 Housing mounted with housing adapter, included
7 Mounting bracket provided, suitable for pipe and wall mounting (for pipe diameters from 1 ¼" up to 2")

Unit mm (in)

Assembly and mounting

1. Connect plug (item 4) into the corresponding connection jack of the cable (item 2).
2. Plug the cable into the housing adapter (item 6).
3. Tighten the locking screw (item 5).
4. Mount the housing on a wall or pipe using the mounting bracket (item 7).
   When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft).
   Mount the cable with a bending radius (r) ≥120 mm (4.72 in).

Routing the cable (e.g. through a pipe)

You require the cable shortening kit.
Order number: 71093286
For details on mounting, see SD00553P/00/A6.

4.7.8 Additional installation instructions

Sealing the probe housing

- No moisture must be allowed to enter the housing when installing or operating the device, or when establishing the electrical connection.
- Always firmly tighten the housing cover and the cable entries.

4.8 Mounting of the profile seal for universal process adapter

For details on mounting, see KA00096F/00/A3.

4.9 Closing the housing covers

NOTICE

Devices with EPDM cover seal - leaking transmitter!
Mineral-, animal- or plant-based lubricants cause the EPDM cover seal to swell and the transmitter to leak as a result.

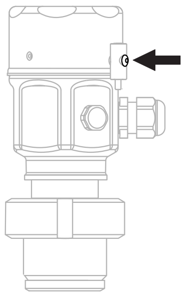
- ▶ It is not necessary to grease the thread due to the coating applied to the thread at the factory.

NOTICE

The housing cover can no longer be closed.
Damaged thread!

- ▶ When closing the housing cover, please ensure that the thread of the cover and housing are free from dirt, e.g. sand. If you encounter resistance when closing the covers, then check the threads again for dirt or fouling.

4.9.1 Closing the cover on the stainless steel housing



A0028497

Fig. 13: Closing the cover

The cover for the electronics compartment is tightened by hand at the housing until the stop. The screw serves as DustEx protection (only on devices with DustEx approval).

4.10 Post-installation check

O	Is the device undamaged (visual inspection)?
O	Does the device comply with the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure ▪ Ambient temperature ▪ Measuring range
O	Are the measuring point identification (tag) and labeling correct (visual inspection)?
O	Is the device adequately protected from precipitation and direct sunlight?
O	Are the securing screw and securing clamp tightened securely?

5 Electrical connection

5.1 Connecting the device

⚠ WARNING

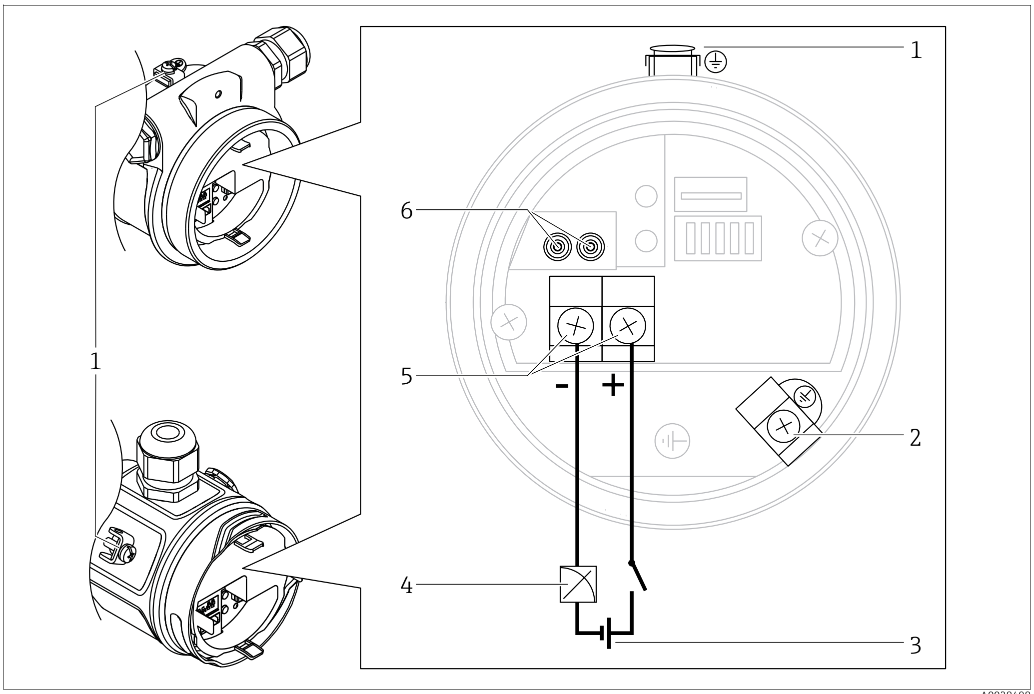
Supply voltage might be connected!

Risk of electric shock and/or explosion!

- ▶ Ensure that no uncontrolled processes are activated at the plant.
- ▶ Switch off the supply voltage before connecting the device.
- ▶ When using the measuring instrument in hazardous areas, installation must also comply with the applicable national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- ▶ A suitable circuit breaker must be provided for the device in accordance with IEC/EN 61010.
- ▶ Devices with integrated overvoltage protection must be grounded.
- ▶ Protective circuits against reverse polarity, HF influences, and overvoltage peaks are integrated.

Connect the device in the following order:

1. Check whether the supply voltage matches the supply voltage indicated on the nameplate.
2. Switch off the supply voltage before connecting the device.
3. Remove the housing cover.
4. Guide cable through the gland. Preferably use twisted, shielded two-wire cable. 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 SW24/25 (8 Nm (5.9 lbf ft) for the M20 cable gland.
5. Connect the device as indicated in the following diagram.
6. Screw down housing cover.
7. Switch on the supply voltage.



Electrical connection 4 to 20 mA

1 External grounding terminal
2 Internal grounding terminal
3 Supply voltage: 11.5 to 45 VDC (versions with plug-in connectors 35 V DC)
4 4 to 20 mA
5 Terminals for supply and signal
6 Test terminals

5.1.1 Devices with a Harting plug Han7D

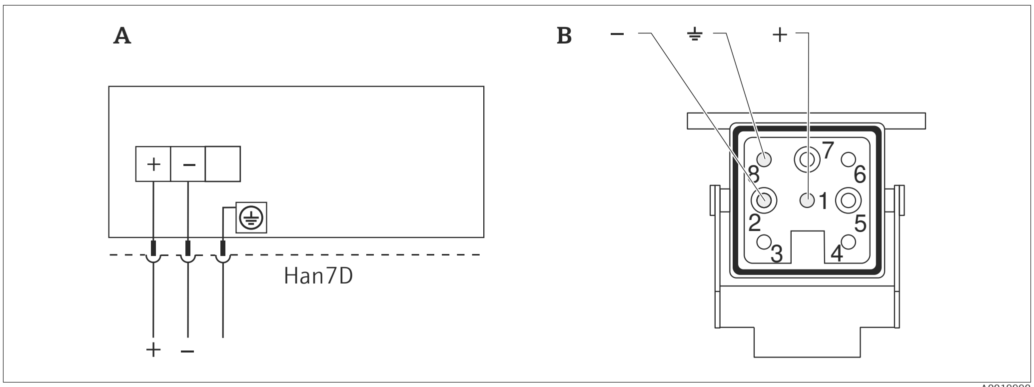
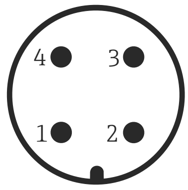


Fig. 14:

A Electrical connection for devices with Harting plug Han7D
B View of the connection on the device
- Brown
) Green/yellow
+ Blue

Material: CuZn, gold-plated contacts of the plug-in jack and plug

5.1.2 Devices with M12 plug

PIN assignment for M12 plug	PIN	Meaning
 A0011175	1	Signal +
	2	Not assigned
	3	Signal –
	4	Ground

5.1.3 Devices with valve plug

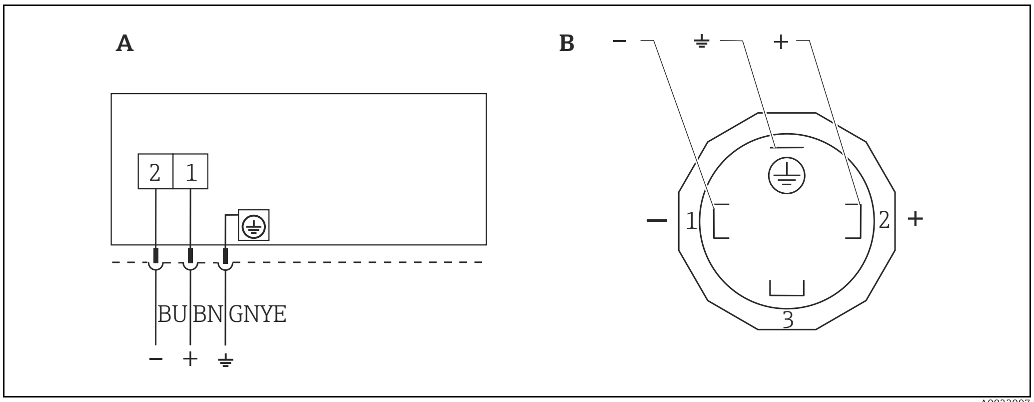


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Fig. 15: BN = brown, BU = blue, GNYE = green

A Electrical connection for devices with valve connector
B View of the connection on the device

Material: PA 6.6

5.2 Connecting the measuring unit

5.2.1 Supply voltage

Electronic version	
4 to 20 mA HART, version for non-hazardous areas	11.5 to 45 V DC (Versions with 35 V DC plug-in connector)

Tap the 4 to 20 mA test signal.

A 4 to 20 mA test signal may be tapped via the test terminals without interrupting the measurement. To keep the corresponding measured error below 0.1%, the current measuring instrument should exhibit an internal resistance of < 0.7 Ω.

5.2.2 Terminals

- Supply voltage and internal ground terminal: 0.5 to 2.5 mm² (20 to 14 AWG)
- External ground terminal: 0.5 to 4 mm² (20 to 12 AWG)

5.2.3 Cable specification

- Endress+Hauser recommends using twisted, shielded two-wire cables.
- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in) depends on the used cable gland (see technical information)

5.2.4 Load

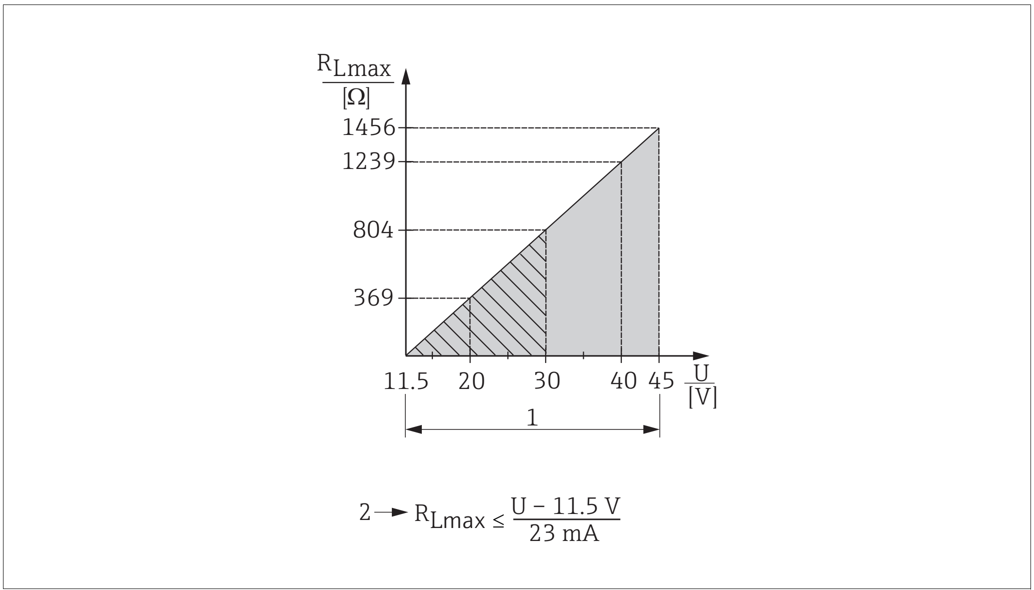


Fig. 16: Load diagram

1 Power supply 11.5 to 45 V DC (versions with plug-in connector 35 V DC) for other types of protection and for uncertified device versions
2 RLmax Maximum load resistance
U Supply voltage

When operating via a handheld terminal or via PC with an operating program, a minimum communication resistance of 250 Ω must be taken into account.

5.2.5 Shielding/potential equalization

- A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant. A normal device cable suffices if only the analog signal is used.
- When using in hazardous areas, you must observe the applicable regulations.
  Separate Ex documentation with additional technical data and instructions is included with all Ex systems as standard. Connect all devices to the local potential equalization.

5.2.6 Connecting Field Xpert SFX100

Compact, flexible and robust industrial handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA).
For details refer to Operating Instructions BA00060S/04/EN.

5.2.7 Commubox FXA195 connection

The Commubox FXA195 connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using Endress+Hauser's FieldCare operating program. Power is supplied to the Commubox via the USB port. The Commubox is also suitable for connecting to intrinsically safe circuits. → See Technical Information TI00404F for further information.

5.3 Overvoltage protection (optional)

Devices with the option "NA" in feature 610 "Zubehör montiert" in the order code are equipped with an overvoltage protection (see Technical Information, section on "Ordering information"). The overvoltage protection is factory-mounted on the housing thread for the cable gland and is approx. 70 mm (2.76 in) long (take the additional length into account during installation).
The device is connected as illustrated in the following graphic. For details refer to TI001013KEN, XA01003KA3 and BA00304KA2.

5.3.1 Wiring

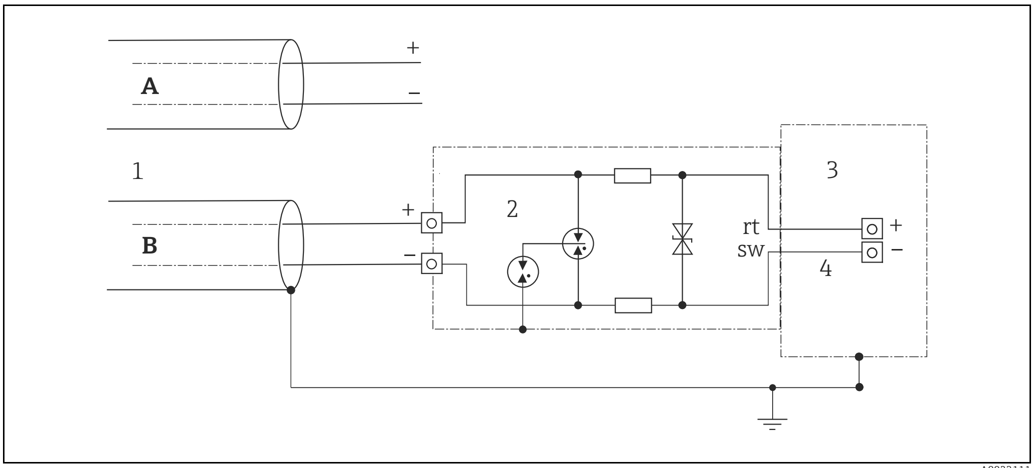


Fig. 17:

- *A* *Without direct shield grounding*
- *B* *With direct shield grounding*
- *1* *Incoming connection cable*
- *2* *HAW569-DA2B*
- *3* *Unit to be protected*
- *4* *Connection cable*

5.3.2 Installation

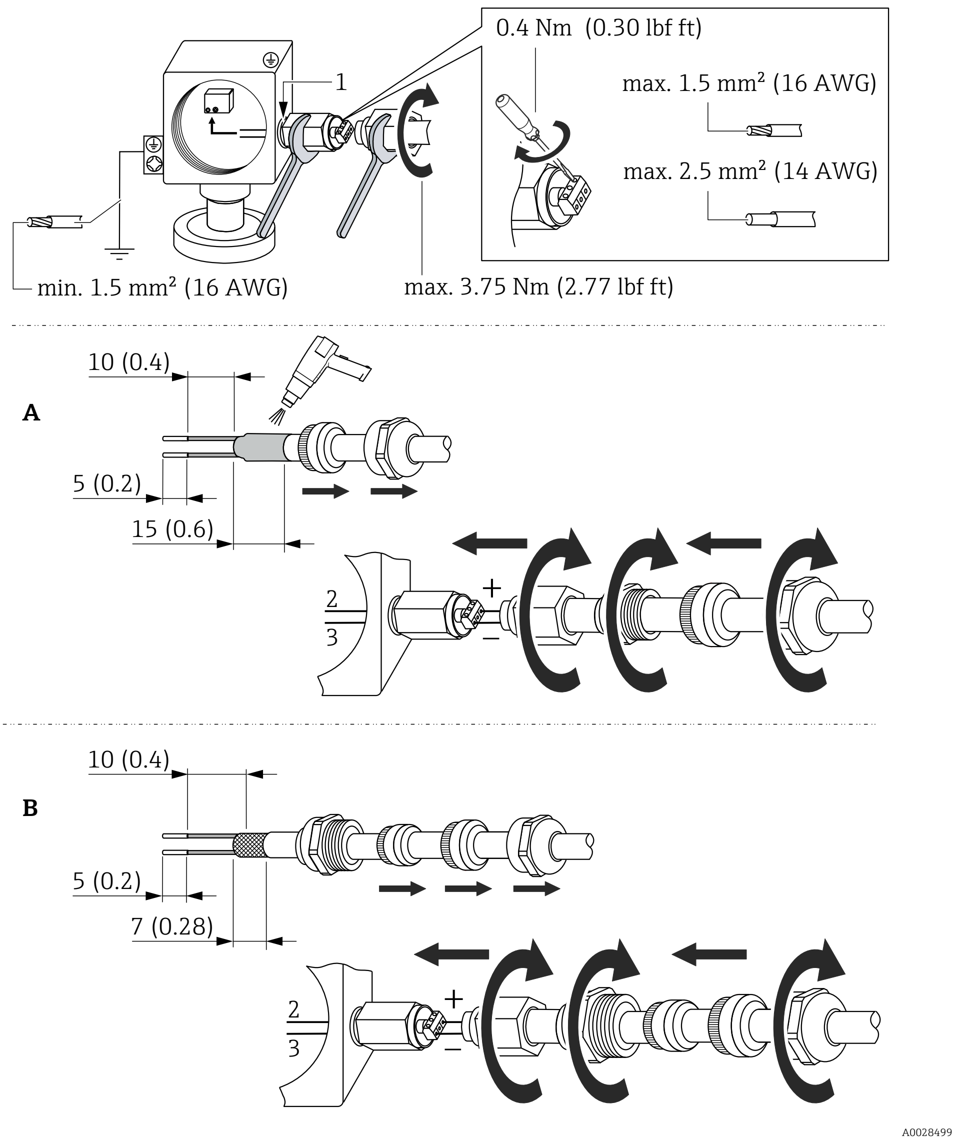


Fig. 18:

A Without shield grounding
B With shield grounding
1 See NOTICE below
2 Red
3 Black

Unit mm (in)

NOTICE

Screw connection glued at factory!

Damage to the device and/or surge arrester!

- ▶ When releasing/tightening the coupling nut, use a wrench to hold the screw steady so it does not turn.

5.4 Post-connection check

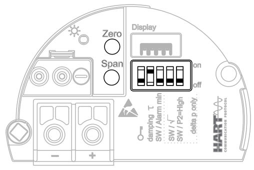
Perform the following checks after completing the electrical installation of the device:
- Does the supply voltage match the specification on the nameplate?
- Is the device properly connected?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

As soon as voltage is applied to the device, the green LED on the electronic insert lights up for a few seconds or the connected onsite display lights up.

6 Operation

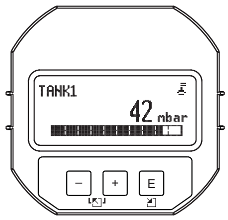
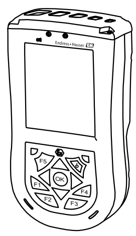
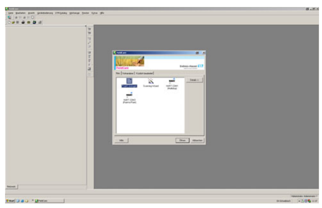
6.1 Operation methods

6.1.1 Operation without an operating menu

Operation methods	Explanation	Graphic illustration	Description
Local operation without device display	The device is operated using the operating keys and DIP switches on the electronic insert.		→ 42

6.1.2 Operation with an operating menu

Operation with an operating menu is based on an operation concept with "user roles" → 44.

Operation methods	Explanation	Graphic illustration	Description
Local operation with device display	The device is operated using the operating keys on the device display.		→ 46
Remote operation via handheld terminal	The device is operated using the HART handheld terminal (e.g. SFX100).		→ 50
Remote operation via FieldCare	The device is operated using the FieldCare operating tool.		→ 50

6.2 Operation without an operating menu

6.2.1 Position of operating elements

The operating key and DIP switches are located on the electronic insert in the device.

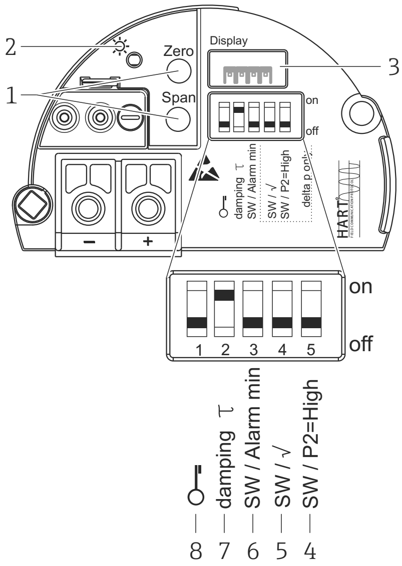


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Fig. 19: HART electronic insert

1 Operating keys for lower range value (zero) and upper range value (span)
2 Green LED to indicate successful operation
3 Slot for optional onsite display
4+5 DIP switch only for Deltabar M
Switch 5: "SW/Square root" used to determine the output characteristics
Switch 4: "SW/P2 High" used to determine the high-pressure side
6 DIP switch for alarm current SW/Alarm Min (3.6 mA)
7 DIP switch for damping on/off
8 DIP switch for locking/unlocking parameters relevant to the measured value

Function of the DIP switches

Switch	Symbol/ label	Switching position	
		"off"	"on"
1		The device is unlocked. Parameters relevant to the measured value can be modified.	The device is locked. Parameters relevant to the measured value cannot be modified.
2	damping τ	The damping is switched off. The output signal follows measured value changes without any delay.	The damping is switched on. The output signal follows measured value changes with the latency τ.[1)]
3	SW/Alarm min	The alarm current is defined via the setting in the operating menu. ("Setup" -> "Extended setup" -> "Curr. output" -> "Output fail mode")	The alarm current is 3.6 mA irrespective of the setting in the operating menu.
The following switches only for Deltabar M:			
4	SW/√	The measuring mode and output characteristics is defined by the setting in the operating menu. ▪ "Setup" -> "Measuring mode" ▪ "Setup" -> "Extended setup" -> "Curr. output" -> "Linear/Sqroot"	The measuring mode is "Flow" and the output characteristics is "Square root" regardless of the settings in the operating menu.

Switch	Symbol/ label	Switching position	
		"off"	"on"
5	SW/P2= High	The high-pressure side (+/HP) is defined by the setting in the operating menu. ("Setup" -> "High Press. Side")	The high pressure side is allocated to the P2 pressure connection, irrespective of the setting in the operating menu.

1) The value for the delay time (latency) can be configured via the operating menu ("Setup" -> "Damping"). Factory setting: τ = 2 s or as per order specifications.

Function of operating elements

Operating key(s)	Meaning
"Zero" pressed for at least 3 seconds	**Get LRV** ▪ **"Pressure" measuring mode** The pressure present is accepted as the lower range value (LRV). ▪ **"Level" measuring mode, level selection "In pressure", calibration mode "Wet"** The applied pressure is assigned to the lower level value ("Empty Calib."). For level selection = "at height" and/or calibration mode = "Dry", the key does not have a function. ▪ **"Flow" measuring mode** There is no function allocated to the "Zero" key.
"Span" pressed for at least 3 seconds	**Get upper range value** ▪ **"Pressure" measuring mode** The pressure present is accepted as the upper range value (URV). ▪ **"Level" measuring mode, level selection "In pressure", calibration mode "Wet"** The applied pressure is assigned to the upper level value ("Full Calib."). For level selection = "at height" and/or calibration mode = "Dry", the key does not have a function. ▪ **"Flow" measuring mode** The pressure present is accepted as the maximum pressure ("Max. pressure flow") and allocated to the maximum flow ("max. flow").
"Zero" and **"Span"** pressed simultaneously for at least 3 seconds	**Position adjustment** The sensor characteristic is shifted in parallel so that the pressure present becomes the zero value.
"Zero" and **"Span"** pressed simultaneously for at least 12 seconds	**Reset** All the parameters are reset to the order configuration.

6.2.2 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access.

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

Locking/unlocking via DIP switches

DIP switch 1 on the electronic insert is used to lock/unlock operation.
→ 42, "Function of the DIP switches".

6.3 Operation with an operating menu

6.3.1 Operation concept

The operating concept makes a distinction between the following user roles:

User role	Meaning
Operator	Operators are responsible for the devices during normal "operation". This is usually limited to reading process values either directly at the device or in a control room. If the work with the devices goes beyond reading, it concerns simple, application-specific functions that are used in operation. If an error occurs, these users simply forward the information on the errors but do not intervene themselves.
Service engineer/ technician	Service engineers usually work with the devices in the phases following device commissioning. They are primarily involved in maintenance and troubleshooting activities for which simple settings have to be made on the device. Technicians work with the devices over the entire life cycle of the product. Thus, commissioning and advanced settings and configurations are some of the tasks they have to carry out.
Expert	Experts work with the devices over the entire life cycle of the device, but, at times, have high device requirements. Individual parameters/functions from the overall functionality of the devices are required for this purpose time and again. In addition to technical, process-oriented tasks, experts can also perform administrative tasks (e.g. user administration). "Experts" can avail of the entire parameter set.

6.3.2 Structure of the operating menu

User role	Submenu	Meaning/use
Operator	Language	Only consists of the "Language" parameter (000) where the operating language for the device is specified. The language can always be changed even if the device is locked.
Operator	Display/Operation	Contains parameters that are needed to configure the measured value display (selecting the values displayed, display format, etc.). With this submenu, users can change the measured value display without affecting the actual measurement.
Service engineer/ technician	Setup	Contains all the parameters that are needed to commission measuring operations. This submenu has the following structure: ▪ **Standard setup parameters** A wide range of parameters, which can be used to configure a typical application, is available at the start. The measuring mode selected determines which parameters are available. After making settings for all these parameters, the measuring operation should be completely configured in the majority of cases. ▪ **"Extended setup" submenu** The "Setup" submenu contains additional parameters for more in-depth configuration of the measurement operation to convert the measured value and to scale the output signal. This menu is split into additional submenus depending on the measuring mode selected.
Service engineer/ technician	Diagnostic	Contains all the parameters required to detect and analyze operating errors. This submenu has the following structure: ▪ **Diagnostic list** Contains up to 10 error messages currently pending. ▪ **Event logbook** Contains the last 10 error messages (no longer pending). ▪ **Instrument info** Contains information on the device identification. ▪ **Measured values** Contains all the current measured values ▪ **Simulation** Is used to simulate pressure, level, flow, current and alarm/warning. ▪ **Reset**

User role	Submenu	Meaning/use
Expert	Expert	Contains all the parameters of the device (including those already in one of the other submenus). The "Expert" submenu is structured by the function blocks of the device. It thus contains the following submenus: ▪ **System** Contains all the device parameters that neither affect measurement nor integration into a distributed control system. ▪ **Measurement** Contains all the parameters for configuring the measurement. ▪ **Output** Contains all the parameters for configuring the current output. ▪ **Communication** Contains all the parameters for configuring the HART interface. ▪ **Application** Contains all the parameters for configuring the functions that go beyond the actual measurement (e.g. totalizer). ▪ **Diagnosis** Contains all the parameters that are needed to detect and analyze operating errors.

For an overview of the entire operating menu: → 🗎 103 ff.

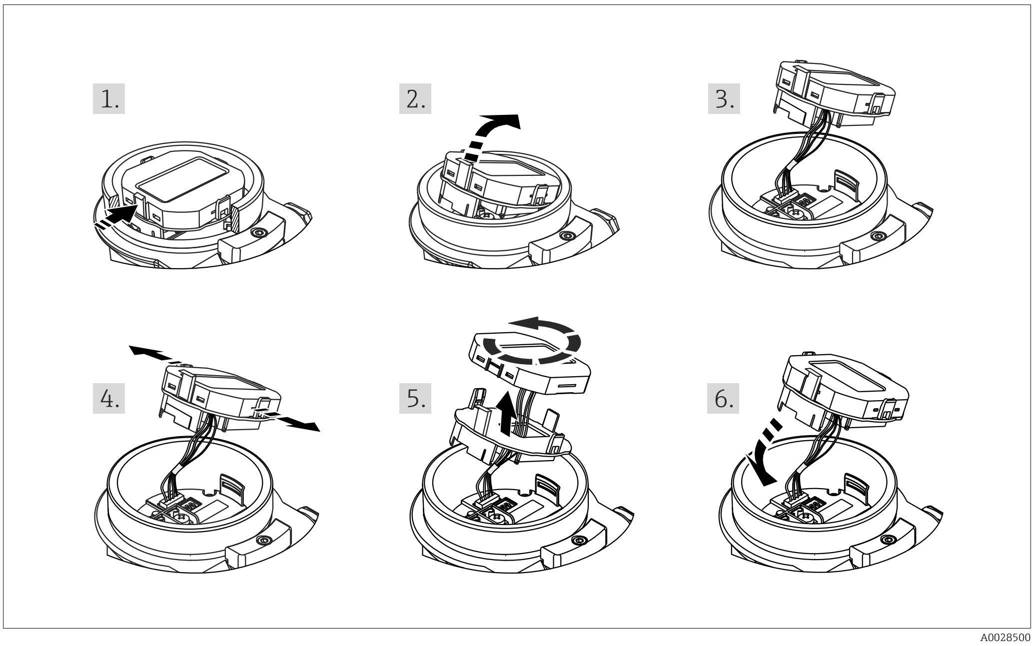
Direct access to parameters

The parameters can only be accessed directly via the "Expert" user role.

Parameter name	Description
Direct access (119) User input Menu path: Expert → Direct access	Enter the direct access code to go directly to a parameter. **Options:** ▪ Enter the desired parameter code. **Factory setting:** 0 **Note:** For direct access, it is not necessary to enter leading zeros.

6.3.3 Operation with a device display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The onsite display shows measured values, dialog texts, fault messages and notice messages.
For easy operation the display can be taken out of the housing (see figure steps 1 to 3). It is connected to the device via a 90 mm (3.54 in) long cable.
The display of the device can be turned in 90° stages (see figure steps 4 to 6).
Depending on the orientation of the device, this makes it easy to operate the device and read the measured values.



Functions:
- 8-digit measured value display incl. sign and decimal point, bar graph for 4 to 20 mA HART as current display.
- Three keys for operation
- Simple and complete menu guidance due to breakdown of parameters into several levels and groups
- Each parameter is given a 3-digit parameter code for easy navigation.
- Possibility of configuring the display to suit individual requirements and preferences, such as language, alternating display, display of other measured values such as sensor temperature, contrast setting.
- Comprehensive diagnostic functions (fault and warning message etc.).

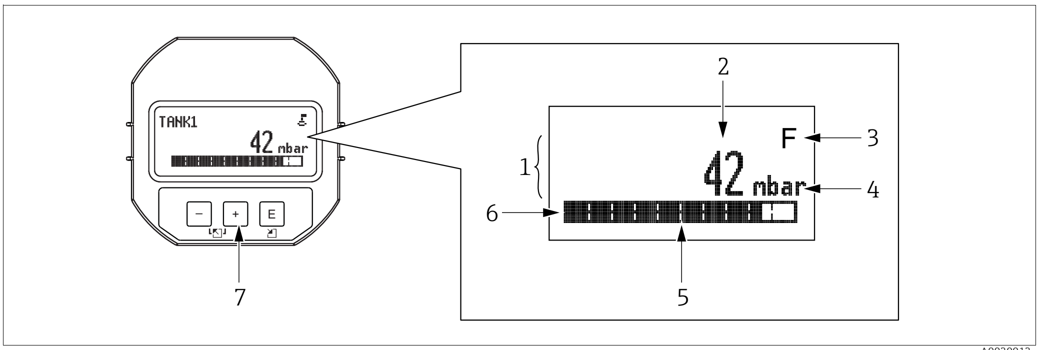
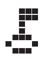
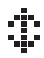
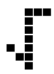


Fig. 20: Display

1 Main line
2 Value
3 Symbol
4 Unit
5 Bar graph
6 Information line
7 Operating keys

The following table illustrates the symbols that can appear on the onsite display. Four symbols may appear at the same time.

Symbol	Meaning
	**Lock symbol** The operation of the device is locked. To unlock the device, → 51, Locking/ unlocking operation.
	**Communication symbol** Data transfer via communication
	**Root symbol (Deltabar M only)** Active measuring mode "Flow measurement" The root flow signal is used for the current output.
S	**Error message "Out of specification"** The device is being operated outside its technical specifications (e.g. during warm-up or cleaning).
C	**Error message "Service mode"** The device is in the service mode (during a simulation, for example).
M	**Error message "Maintenance required"** Maintenance is required. The measured value is still valid.
F	**Error message "Failure detected"** An operating error has occurred. The measured value is no longer valid.

Operating keys on the display and operating module

Operating key(s)	Meaning
+	– Navigate downwards in the picklist – Edit the numerical values or characters within a function
–	– Navigate upwards in the picklist – Edit the numerical values or characters within a function
E	– Confirm entry – Jump to the next item – Select a menu item and activate edit mode
+ and E	Contrast setting of onsite display: darker
– and E	Contrast setting of onsite display: brighter
+ and –	ESC functions: – Exit the edit mode for a parameter without saving the changed value – You are in the menu at a selection level: each time you press the keys simultaneously, you go up a level in the menu.

Operating example: Parameters with a picklist

Example: selecting "Deutsch" as the language of the menu.

	Language 000	Operation
1	✔ English Deutsch	"English" is set as the menu language (default value). A ✔ in front of the menu text indicates the option that is currently active.
2	Deutsch ✔ English	Select "Deutsch" with ⊞ or ⊟.
3	✔ Deutsch English	1. Select Ⓔ to confirm. A ✔ in front of the menu text indicates the option that is currently active ("Deutsch" is the language selected). 2. Use Ⓔ to exit the edit mode for the parameter.

Operating example: User-definable parameters

Example: setting "Set URV" parameter from 100 mbar (1.5 psi) to 50 mbar (0.75 psi).

	Set URV 014		Operation
1	1 0 0 . 0 0 0	mbar	The onsite display shows the parameter to be changed. The value highlighted in black can be changed. The "mbar" unit is defined in another parameter and cannot be changed here.
2	1 0 0 . 0 0 0	mbar	1. Press ⊞ or ⊟ to enter the editing mode. 2. The first digit is highlighted in black.
3	5 0 0 . 0 0 0	mbar	1. Use the ⊞ key to change "1" to "5". 2. Press the Ⓔkey to confirm "5". The cursor jumps to the next position (highlighted in black). 3. Confirm "0" with Ⓔ(second position).
4	5 0 0 . 0 0 0	mbar	The third digit is highlighted in black and can now be edited.
5	5 0 ↵ . 0 0 0	mbar	1. Use the ⊟key to change to the "↵" symbol. 2. Use Ⓔ to save the new value and exit editing mode. → See next graphic.
6	5 0 . 0 0 0	mbar	The new value for the upper range value is 50.0 mbar (0.75 psi). – Use Ⓔ to exit the edit mode for the parameter. – Use ⊞ or ⊟ to return to the edit mode.

Operating example: Accepting the pressure present

Example: setting position adjustment

	Pos. zero adjust 007	Operation
1	✔ Cancel Confirm	The pressure for position adjustment is present at the device.
2	Confirm ✔ Cancel	Use ⊞ or ⊟ to switch to the "Confirm" option. The active selection is highlighted in black.
3	Compensation accepted!	Use the Ⓔ key to accept the applied pressure for pos. zero adjustment. The device confirms the adjustment and goes back to the "Pos. zero adjust" parameter.
4	✔ Cancel Confirm	Use Ⓔ to exit the edit mode for the parameter.

6.3.4 Operation via SFX100

Compact, flexible and robust industrial handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA).
For details refer to Operating Instructions BA00060S/04/EN.

6.3.5 Operation via FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. You can find hardware and software requirements on the Internet: www.de.endress.com → Search: FieldCare → FieldCare → Technical Data.

FieldCare supports the following functions:
- Configuration of transmitters in online/offline mode
- Loading and saving of device data (upload/download)
- Documenting the measuring point
- Offline parametrization of transmitters

Connection options:
- HART via Commubox FXA195 and the USB port of a computer
- HART via Fieldgate FXA520

- → 37, Kap. 5.2.7 "Commubox FXA195 connection".
- In "Level expert" measuring mode, the configuration data which were generated by FDT upload cannot be saved back again (FDT download); they are used solely to document the configuration.
- As not all internal device dependencies can be mapped in offline operation, the consistency of the parameters must be checked before the parameters are transmitted to the device.
- Further information on FieldCare can be found on the Internet (http://www.endress.com, Download, → Search for: FieldCare).

6.3.6 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access.
Locked operation is indicated as follows:
- By the symbol on the onsite display
- In FieldCare and the HART handheld terminal, the parameters are grayed out (not editable). Indicated in the corresponding "Locking" parameter.

Parameters which refer to how the display appears, e.g. "Language ", can still be altered.

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

The "Operator code" parameter is used to lock and unlock the device.

Parameter name	Description
Operator code (021) User input Menu path: Setup → Extended setup → User code	Use this function to enter a code to lock or unlock operation. **User input:** ▪ To lock: Enter a number the release code (value range: 1 to 9999). ▪ To unlock: Enter the release code. The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code can be visible by entering the number "5864". **Factory setting:** 0

The release code is defined in the "Code Definition" parameter.

Parameter name	Description
Code Definition (023) User input Menu path: Setup → Extended setup → Code definition	Use this function to enter a release code that allows you to unlock the device. **User input:** ▪ A number from 0 to 999 **Factory setting:** 0

6.3.7 Resetting to factory settings (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings[1]. Enter the code via the "Reset" parameter (menu path: "Diagnosis" → "Reset" → "Reset").
There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation must be unlocked to reset parameters (→ 🗎 51).

Any customer-specific configuration carried out at the factory remains intact even after a reset. If you want to change the customer-specific configuration carried out at the factory, please contact Endress+Hauser Service.
As no separate service level is provided, the order code and serial number may be changed without a specific access code (e.g. after replacing the electronics).

Reset code[1]	Description and effect
62	**PowerUp reset (warm start)** ▶ The device is restarted. ▶ Data are read back anew from the EEPROM (processor is initialized again). ▶ Any simulation running is terminated.
333	**User reset** ▶ This code resets all the parameters apart from: – Device tag (022) – Linearization table – Operating hours (162) – Event logbook – Current trim 4mA (135) – Current trim 20mA (136) – Lo Trim Sensor (131) – Hi Trim Sensor (132) ▶ Any simulation running is terminated. ▶ The device is restarted.
7864	**Total reset** ▶ This code resets all the parameters apart from: – Operating hours (162) – Event logbook – Lo Trim Sensor (131) – Hi Trim Sensor (132) ▶ Any simulation running is terminated. ▶ The device is restarted.

1) To be entered in "Expert" → "Diagnosis" → "Reset" → "Reset" (124)

After a "Total reset" in FieldCare you have to press the "refresh" button in order to ensure that the measuring units are also reset.

1) The default value for the individual parameters is indicated in the parameter description (→ 🗎 111 ff)

7 Integrating transmitter using HART® protocol

Version data for the device

Firmware Version	01.00.zz	▪ On the title page of the manual ▪ On the nameplate ▪ **Firmware Version** parameter Diagnostics Instrument info Firmware version
Manufacturer ID	17 (0x11)	**Manufacturer ID** parameter Diagnostics Instrument info Manufacturer ID
Device type code	Cerabar M: 25 (0x19) Deltabar M: 33 (0x21) Deltapilot M: 35 (0x23)	**Device ID** parameter Diagnostics Instrument info Device ID
HART protocol revision	6.0	---
Device revision	1	▪ On the transmitter nameplate ▪ **Devision revision** parameter Diagnostics Instrument info Device revision

Below is a list of the appropriate device description files (DD) with sources for the individual operating tools.

Operating tools

Operating tool	Reference sources for device descriptions (DD and DTM)
FieldCare	▪ www.endress.com → Download area ▪ CD–ROM (contact Endress+Hauser) ▪ DVD (contact Endress+Hauser)
AMS Device Manager (Emerson Process Management)	www.endress.com → Download area
SIMATIC PDM (Siemens)	www.endress.com → Download area
Field Communicator 375, 475 (Emerson Process Management)	Use update function of handheld terminal

7.1 HART process variables and measured values

The following numbers are assigned to the process variables in the factory:

Process variable	Pressure	Flow (Deltabar only)		Level	
		Linear	Square root	Linear	Table active
First process variable (Primary Variable)	0 - Meas. pressure	0 - Meas. pressure	5 - Flow	8 - Level before lin.	9- Tank content
Second process variable (Secondary Variable)	2 - Corrected press.	5 - Flow	0 - Meas. pressure	0 - Meas. pressure	8 - Level before lin.
Third process variable (Tertiary Variable)	3 - Sensor pressure	6 - Totalizer 1	6 - Totalizer 1	2 - Corrected press.	0 - Meas. pressure
Fourth process variable (Quaternary Variable)	Deltabar M: 251 - None Apart from Deltabar M: Sensor temp.				

The assignment of the device variables to the process variable is displayed in the **Expert** → **Communication** → **HART output** menu.
The assignment of the device variables to the process variable can be changed using HART command 51.
An overview of the possible device variables can be found in the following section.

7.2 Device variables and measured values

The following measured values are assigned to the individual device variables:

Device variable code	Device variable	Measurement value	Measuring mode	Devices
0	PRESSURE_1_FINAL_VALUE	Meas. pressure	All	All
1	PRESSURE_1_AFTER_DAMPING	Pressure af.damp	All	All
2	PRESSURE_1_AFTER_CALIBRATION	Corrected press.	All	All
3	PRESSURE_1_AFTER_SENSOR	Sensor pressure	All	All
4	MEASURED_TEMPERATURE_1	Sensor temp.	All	Not Deltabar M
5	FLOW_AFTER_SUPPRESSION	Flow	Flow only	Only Deltabar M
6	TOTALIZER_1_FLOAT	Totalizer 1	Flow only	Only Deltabar M
7	TOTALIZER_2_FLOAT	Totalizer 2	Flow only	Only Deltabar M
8	MEASURED_LEVEL_AFTER_ SIMULATION	Level before lin.	Level only	all [1)]
9	MEASURED_TANK_CONTENT_AFTER_ SIMULATION	Tank content	Level only	all [1)]
10	CORRECTED_MEASUREMENT_ DENSITY	Process density	Level only	all [1)]
11	MEASURED_TEMPERATURE_3	Temp.electronics	all	Only Deltabar M
12	HART_INPUT_VALUE	HART input value	Not selectable as output	
251	None (no device variable is mapped)		all (but only allowed for Quaternary)	

1) Cerabar M: with level measurement option

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

8 Commissioning

The device is configured for the "Pressure" measuring mode (Cerabar, Deltabar) or "Level" measuring mode (Deltapilot) as standard. The measuring range and the unit in which the measured value is transmitted correspond to the data on the nameplate.

⚠ WARNING

The permitted process pressure is exceeded!

Risk of injury due to bursting of parts! Warning messages are generated if 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, the following messages are output in succession (depending on the setting in the "Alarm behavior P" (050) parameter):
"S140 Working range P" or "F140 Working range P"
"S841 Sensor range" or "F841 Sensor range"
"S971 Adjustment"
Only operate the device within the sensor range limits!

NOTICE

Pressure is below the permitted working pressure!

Messages are displayed if the pressure is too low.

▶ If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession (depending on the setting in the "Alarm behavior P" (050) parameter):
"S140 Working range P" or "F140 Working range P"
"S841 Sensor range" or "F841 Sensor range"
"S971 Adjustment"
Only operate the device within the sensor range limits!

8.1 Function check

Carry out a post-installation and a post-connection check as per the checklist before commissioning the device.

- Checklist for "Post-installation check" → 📄 32
- Checklist for "Post-connection check" → 📄 40

8.2 Commissioning without an operating menu

8.2.1 Pressure measuring mode

The following functions can be performed using the keys on the electronic insert:
- Position adjustment (zero point correction)
- Setting the lower range value and upper range value
- Device reset → 🗎 43

- Operation must be unlocked. → 🗎 51, "Locking/unlocking operation"
- The device is configured for the "Pressure" measuring mode as standard. You can change the measuring mode via the "Measuring Mode" parameter. → 🗎 59, "Selecting the measuring mode".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

⚠ WARNING

Changing the measuring mode affects the span (URV)!

This situation can result in product overflow.
- ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!

Carrying out position adjustment[1]	
Pressure is present at the device.	
↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Pressure present for position adjustment has not been accepted. Observe the input limits.

Setting lower range value	
The desired pressure for the lower range value is present at the device.	
↓	
Press the "Zero" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for lower range value has been accepted.	Applied pressure for lower range value has not been accepted. Observe the input limits.

Setting upper range value	
The desired pressure for the upper range value is present at the device.	
↓	
Press the "Span" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for upper range value has been accepted.	Applied pressure for upper range value has not been accepted. Observe the input limits.

1) Observe warning on commissioning (→ 🗎 55)

8.2.2 Level measuring mode

The following functions can be performed using the keys on the electronic insert:
- Position adjustment (zero point correction)
- Setting the lower and upper pressure value and assigning to the lower and upper level value
- Device reset → 43

- The "Zero" and "Span" keys only have a function with the following setting:
  – "Level selection" = "In pressure", "Calibration mode" = "Wet"
  In other settings, the keys do not have a function.
- The device is configured for the "Pressure" measuring mode as standard. You can change the measuring mode via the "Measuring Mode" parameter. → 59, "Selecting the measuring mode"
  The following parameters are set to the following values in the factory:
  – "Level selection" = "In pressure"
  – "Calibration mode": Wet
  – "Unit before lin": %
  – "Empty calib.": 0.0
  – "Full calib.": 100.0
  – "Set LRV": 0.0 (corresponds to 4 mA value)
  – "Set URV": 100.0 (corresponds to 20 mA value)
- Operation must be unlocked. → 51, "Locking/unlocking operation".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

⚠ WARNING

Changing the measuring mode affects the span (URV)!

This situation can result in product overflow.

▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!

Carrying out position adjustment[1]		**Setting lower pressure value**		**Setting upper pressure value**	
Pressure is present at the device.		Desired pressure for lower pressure value ("empty pressure") is present at device.		Desired pressure for upper pressure value ("full pressure") is present at device.	
↓		↓		↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.		Press the "Zero" key for at least 3 s.		Press the "Span" key for at least 3 s.	
↓		↓		↓	
Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?	
Yes	No	Yes	No	Yes	No
↓	↓	↓	↓	↓	↓
Applied pressure for position adjustment has been accepted.	Pressure present for position adjustment has not been accepted. Observe the input limits.	The pressure present was saved as the lower pressure value ("empty pressure") and assigned to the lower level value ("empty calibration").	The pressure present was not saved as the lower pressure value. Observe the input limits.	The pressure present was saved as the upper pressure value ("full pressure") and assigned to the upper level value ("full calibration").	The pressure present was not saved as the upper pressure value. Observe the input limits.

1) Observe warning on commissioning (→ 55)

8.2.3 Flow measuring mode (Deltabar M only)

The following functions can be performed using the keys on the electronic insert:
- Position adjustment (zero point correction)
- Set the maximum pressure value and assign it to the maximum flow value
- Device reset → 📄 43

- Operation must be unlocked. → 📄 51, "Locking/unlocking operation"
- The device is configured for the "Pressure" measuring mode as standard. You can change the measuring mode via the "Measuring Mode" parameter. → 📄 59, "Selecting the measuring mode".
- DIP switch 4 (SW/√) on the electronics insert can be used to switch to the "Flow" measuring mode. In this case, the "Measuring mode" parameter is adjusted automatically.
- The "Zero"- key does not have any function in the "Flow" measuring mode.
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

⚠ WARNING

Changing the measuring mode affects the span (URV)!
This situation can result in product overflow.
- ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!

Carrying out position adjustment[1)]	
Pressure is present at the device.	
↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Pressure present for position adjustment has not been accepted. Observe the input limits.

Setting maximum pressure value.	
Desired pressure for the maximum pressure value ("Max. Press. Flow") is present at device.	
↓	
Press the "Span" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
The pressure present was saved as the maximum pressure value ("Max. Press. Flow") and assigned to the maximum flow value ("Max. Flow").	The pressure present was not saved as the maximum pressure value. Observe the input limits.

1) Observe warning on commissioning (→ 📄 55)

8.3 Commissioning with an operating menu

Commissioning comprises the following steps:

1. Function check (→ 🗎 55)
2. Selecting the language, measuring mode and pressure unit (→ 🗎 59)
3. Position adjustment (→ 🗎 60)
4. Configuring measurement:
   – Pressure measurement (→ 🗎 75 ff)
   – Level measurement (→ 🗎 61 ff)
   – Flow measurement (→ 🗎 61 ff)

8.3.1 Selecting the language, measuring mode and pressure unit

Select the language

Parameter name	Description
Language (000) Selection Menu path: Main menu → Language	Select the menu language for the onsite display. **Options:** ▪ English ▪ Another language (as selected when ordering the device) ▪ Possibly a third language (language of the manufacturing plant) **Factory setting**: English

Selecting the measuring mode

Parameter name	Description
Measuring mode (005) Selection Menu path: Setup → Measuring mode	Select the measuring mode. The operating menu is structured according to the selected measuring mode. ⚠ **WARNING** **Changing the measuring mode affects the span (URV)!** This situation can result in product overflow. ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured! **Options:** ▪ Pressure ▪ Level ▪ Flow **Factory setting:** Pressure

Selecting the pressure unit.

Parameter name	Description
Press. eng. unit (125) Selection Menu path: Setup → Press. eng. unit	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. **Options:** ▪ mbar, bar ▪ mmH2O, mH2O ▪ in H2O, ftH2O ▪ Pa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ kgf/cm^2 **Factory setting:** mbar or bar depending on the nominal measuring range of the sensor, or as per order specifications

8.4 Zero adjustment

A pressure shift resulting from the orientation of the device can be corrected by the position adjustment.

Parameter name	Description
Corrected press. (172) Display Menu path: Setup → Corrected press.	Displays the measured pressure after sensor trim and position adjustment. If this value is not equal to "0", it can be corrected to "0" by the position adjustment.
Pos. zero adjust (007) (Deltabar M and gauge pressure measuring cells) Eingabe Menu path: Setup → Pos. zero adjust	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. Zero Adjust" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. **Selection** ▪ Confirm ▪ Cancel **Factory setting:** Cancel
Calib. offset (192) / (008) (absolute pressure sensors) User input	Position adjustment – the pressure difference between the set point and the measured pressure must be known. **Example:** – Measured value = 982.2 mbar (14.73 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Calib. Offset" parameter. This means that you are assigning the value 980.0 (14.7 psi) to the pressure present. – Measured value (after calib. offset) = 980.0 mbar (14.7 psi) – The current value is also corrected. **Factory setting:** 0.0

8.5 Level measurement (Cerabar M and Deltapilot M)

8.5.1 Information on level measurement

- The limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- There is no unit conversion.
- The values entered for "Empty Calib./Full Calib.", "Empty Pressure/Full Pressure", "Empty Height/Full Height", and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together.

You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.

8.5.2 Overview of level measurement

Measuring task	Level selection	Measured variable options	Description	Measured value display
Calibration is performed by entering two pressure/level value pairs.	"In pressure"	Using the "Unit before lin" parameter: %, level, volume or mass units.	– Calibration with reference pressure (wet calibration), see → 62 – Calibration without reference pressure (dry calibration), see → 64	The measured value display and the "Level before Lin." parameter display the measured value.
Calibration is performed by entering the density and two height/level value pairs.	"In height"		– Calibration with reference pressure (wet calibration), see → 66 – Calibration without reference pressure (dry calibration), see → 68	

8.5.3 "In pressure" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the level in a tank should be measured in "m". The maximum level is 3 m (9.8 ft). The pressure range is set to 0 to 300 mbar (4.5 psi).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled or emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description
1	Perform "Position adjustment" → 🗎 60.
2	Using the "**Measuring mode (005)**" parameter, select the "Level" measuring mode. Menu path: Setup → Measuring mode
3	Select the "In pressure" level mode via the "Level Selection" parameter. Menu path: Setup → Extended setup → Level → Level selection.
4	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup Press. eng. unit

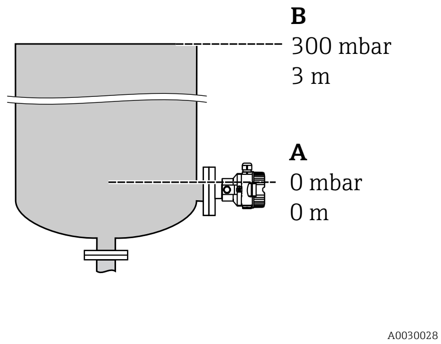


Fig. 21: Calibration with reference pressure – wet calibration

A See table, step 8.
A See table, step 9.

	Description
5	Select a level unit via the "Unit before lin" parameter, here "m" for example. Menu path: Setup →Extended setup →Level → Unit before Lin
6	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode.
7	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in "Adjust Density". Menu path: Setup → Extended setup → Level → Adjust density
8	The pressure for the lower calibration point is present at the device, here "0 mbar" for example.
	Select the "Empty Calib." parameter. Menu path: Setup → Extended setup → Level → Empty calib.
	Enter the level value, here "0 m" for example. The pressure value present is assigned to the lower level value by confirming the value.
9	The pressure for the upper calibration point is present at the device, here 300 mbar (4.5 psi) for example.
	Select the "Full Calib." parameter. Menu path: Setup → Extended setup → Level → Full calib.
	Enter the level value, here 3 m (9.8 ft) for example. The pressure value present is assigned to the upper level value by confirming the value.
10	Set the level value for the lower current value (4 mA) via "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV
11	Set the level value for the upper current value (20 mA) via "Set URV". Menu path: Setup → Extended setup → Current output → Set URV
12	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process Density" parameter. Menu path: Setup → Extended setup → Level → Process density
13	Result: The measuring range is set for 0 to 3 m (9.8 ft).

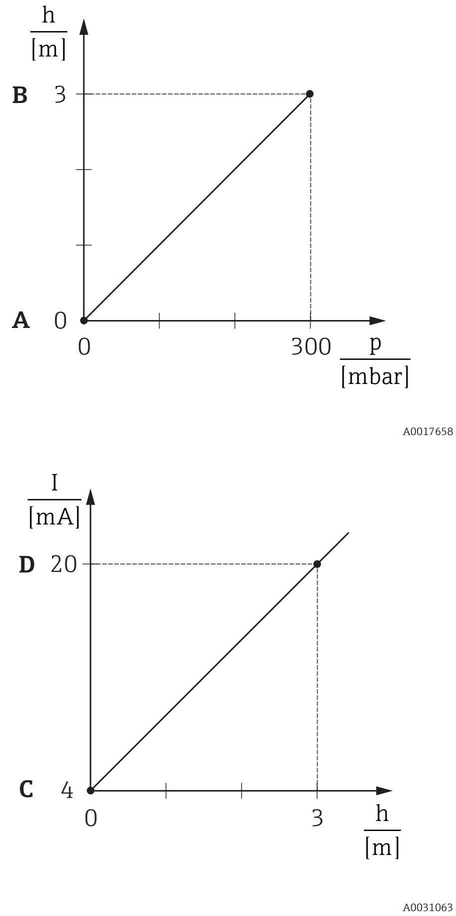


Fig. 22: Calibration with reference pressure – wet calibration

A See table, step 8.
A See table, step 9.
C See table, step 10.
D See table, step 11.

The measured variables %, level, volume and mass are available for this level mode. See → 118 "**Unit before lin (025)**".

8.5.4 "In pressure" level selection Calibration without reference pressure (dry calibration)

Example:

In this example, the volume in a tank should be measured in liters . The maximum volume of 1000 liters (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) since the device is mounted below the start of the level measuring range.

Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the pressure and volume values for the lower and upper calibration point must be known.

- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 60, "Zero adjustment".

	Description
1	Select the "Level" measuring mode via the "Measuring Mode" parameter. Menu path: Setup → Measuring mode
2	Select the "In pressure" level mode via the "Level Selection" parameter. Menu path: Setup → Extended setup → Level → Level selection.
3	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup Press. eng. unit
4	Select a volume unit via the "Unit before lin", here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin

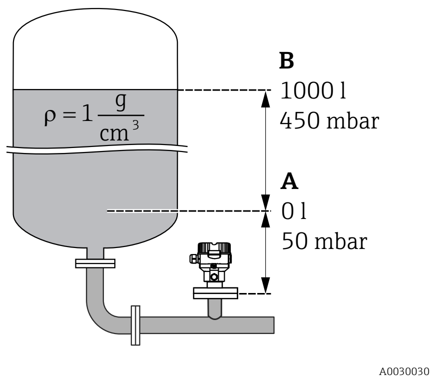
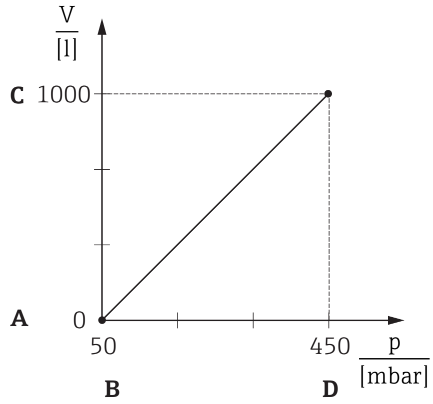


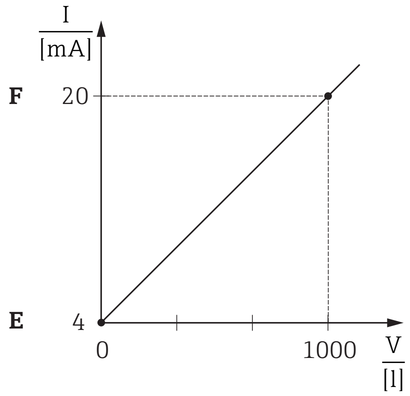
Fig. 23: Calibration without reference pressure – dry calibration

A See table, steps 6 and 7.
B See table, steps 8 and 9.

	Description
5	Select the "Dry" option using the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode.
6	Enter the volume value for the lower calibration point via the "Empty Calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.
7	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, here 50 mbar (0.75 psi) for example. Menu path: Setup → Extended setup → Level → Empty pressure
8	Enter the volume value for the upper calibration point via the "Full Calib." parameter, here 1000 liters (264 gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
9	Enter the pressure value for the upper calibration point via the "Full pressure" parameter, here 450 mbar (6.75 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure
10	"Adjust Density" contains the factory setting 1.0, but this value can be changed if required. The value pairs subsequently entered must correspond to this density. Menu path: Setup → Extended setup → Level → Adjust density
11	Set the volume value for the lower current value (4 mA) using the parameter "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) using the parameter "Set URV". Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process Density" parameter. Menu path: Setup → Extended setup → Level → Process density
14	Result: The measuring range is set for 0 to 1000 l (264 gal).



A0031028



A0031064

Fig. 24: Calibration with reference pressure – wet calibration

A See table, step 6.
B See table, step 7.
C See table, step 8.
D See table, step 9.
E See table, step 11.
F See table, step 12.

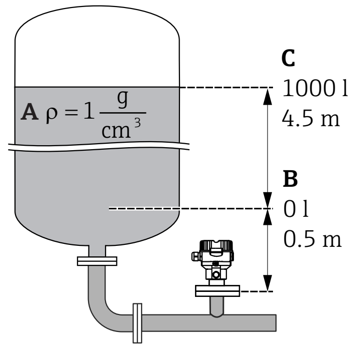
The measured variables %, level, volume and mass are available for this level mode. See → 118 "**Unit before lin (025)**".

8.5.5 "In height" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.
The density of the fluid is 1 g/cm^3 (1 SGU).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled or emptied.

The values entered for "Empty Calib./Full Calib.", "Set LRV/Set URV", and the applied pressure values must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description	
1	Perform position adjustment. Refer to → 📄 60.	 *Fig. 25: Calibration with reference pressure – wet calibration* *A See table, step 10.* *B See table, step 8.* *C See table, step 9.*
2	Select the "Level" measuring mode via the "Measuring Mode" parameter. Menu path: Setup → Measuring mode	
3	Select the "in height" level mode via the "Level Selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
4	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
5	Select a volume unit via the "Unit before lin", here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin	

	Description
6	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit
7	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode.
8	The pressure for the lower calibration point is present at the device, here "50 mbar" (0.75 psi) for example.
	Enter the volume value for the lower calibration point via the "Empty Calib." parameter, here 0 liters for example. (The pressure currently measured is displayed as the height, here 0.5 m (1.6 ft) for example.) Menu path: Setup → Extended setup → Level → Empty calib.
9	The pressure for the upper calibration point is present at the device, here "450 mbar" (6.75 psi) for example.
	Enter the volume value for the upper calibration point via the "Full Calib." parameter, here "1000 liters" (264 gal) for example. The pressure currently measured is displayed as the height, here "4.5 m" (15 ft) for example. Menu path: Setup → Extended setup → Level → Full calib.
10	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter, here "1 g/cm ^{3} (1 SGU). Menu path: Setup → Extended setup → Level → Adjust density
11	Set the volume value for the lower current value (4 mA) using the parameter "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) using the parameter "Set URV". Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process Density" parameter. Menu path: Setup → Extended setup → Level → Process density
14	Result: The measuring range is set for 0 to 1000 l (264 gal).

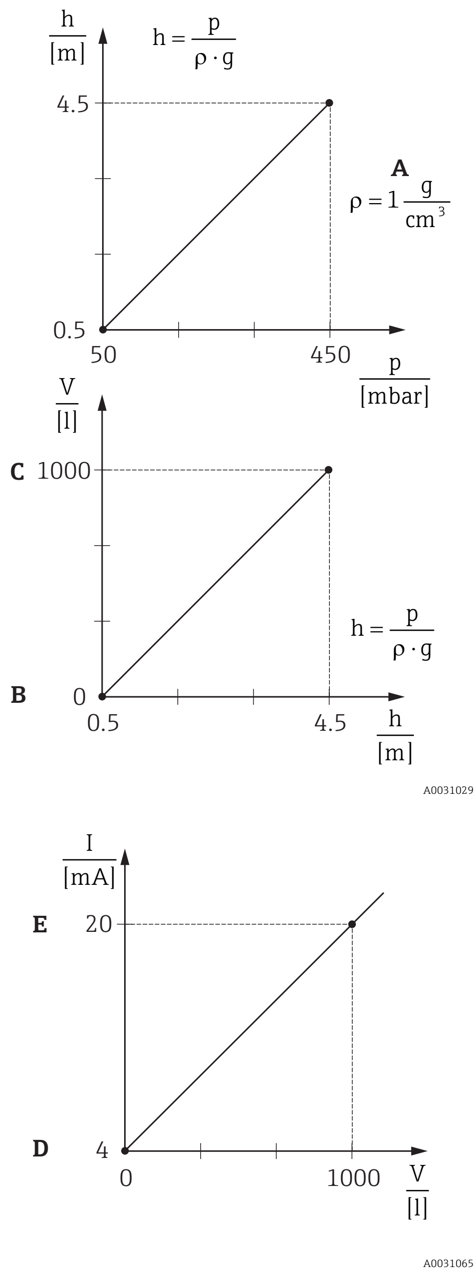


Fig. 26: Calibration with reference pressure – wet calibration

A See table, step 10.
B See table, step 8.
C See table, step 9.
D See table, step 11.
E See table, step 12.

The measured variables %, level, volume and mass are available for this level mode → 118 "**Unit before lin (025)**".

8.5.6 "In height" level selection Calibration without reference pressure (dry calibration)

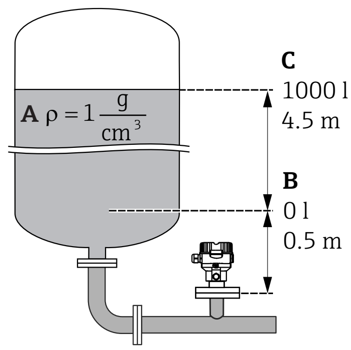
Example:

In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.

Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the height and volume values for the lower and upper calibration point must be known.

- The values entered for "Empty calib./Full calib.", "Empty height/Full height" and" Set LRV/ Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 60, "Zero adjustment".

	Description	
1	Select the "Level" measuring mode via the "Measuring Mode" parameter. Menu path: Setup → Measuring mode	 A0031027 *Fig. 27: Calibration without reference pressure – dry calibration* *A See table, step 11.* *B See table, steps 7 and 8.* *C See table, steps 9 and 10.*
2	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
3	Select the "In height" level mode via the "Level Selection" parameter. Menu path: Setup → Extended setup → Level → Level selection	
4	Select a volume unit via the "Unit before lin", here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin	
5	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit	
6	Select the "Dry" option using the "Calibration Mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	

	Description
7	Enter the volume value for the lower calibration point via the "Empty Calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.
8	Enter the height value for the lower calibration point via the "Empty height" parameter, here 0.5 m (1.6 ft) for example. Menu path: Setup → Extended setup → Level → Empty height
9	Enter the volume value for the upper calibration point via the "Full Calib." parameter, here 1000 liters (264 gal), for example. Menu path: Setup → Extended setup → Level → Full calib.
10	Enter the height value for the upper calibration point via the "Full height" parameter, here 4.5 m (15 ft) for example. Menu path: Setup → Extended setup → Level → Full height
11	Enter the density of the medium via the "Adjust density" parameter, here "1 g/cm^3" (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density
12	Set the volume value for the lower current value (4 mA) using the parameter "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV
13	Set the volume value for the upper current value (20 mA) using the parameter "Set URV". Menu path: Setup → Extended setup → Current output → Set URV
14	If the process uses a medium other than that on which the calibration was based, the new density must be specified in the "Process Density" parameter. Menu path: Setup → Extended setup → Level → Process density
15	Result: The measuring range is set for 0 to 1000 l (264 gal).

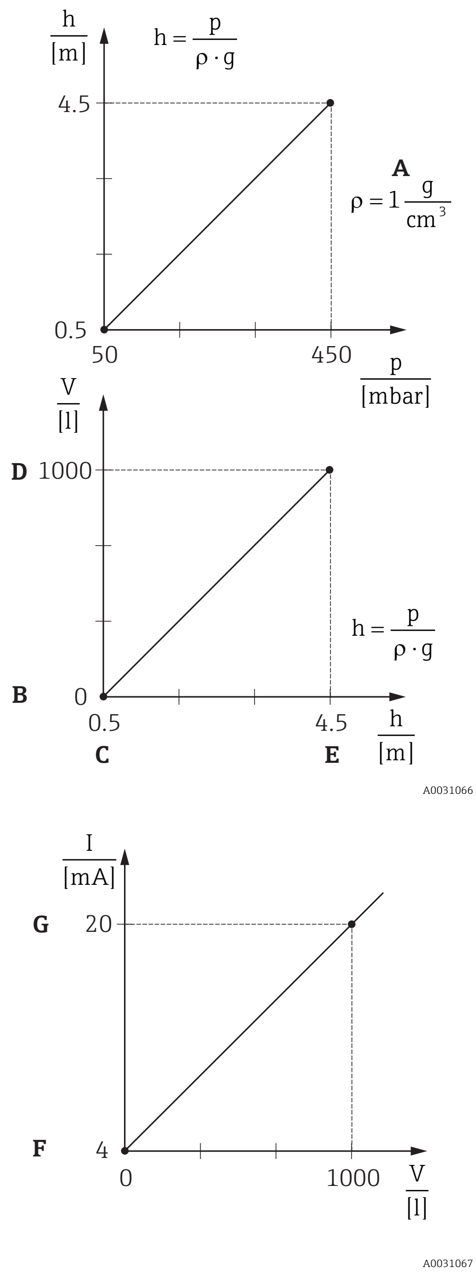


Fig. 28: Calibration with reference pressure – wet calibration

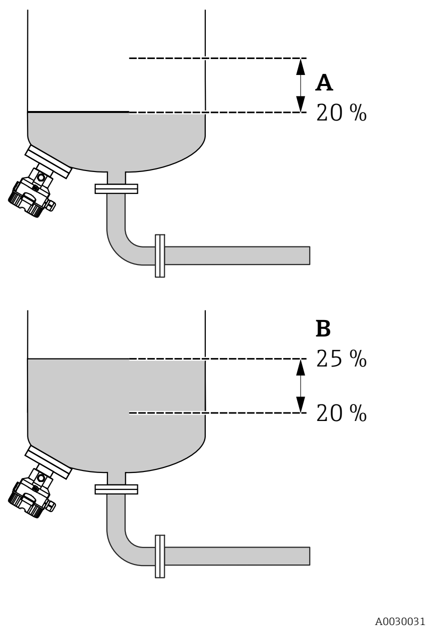
A See table, step 11.
B See table, step 7.
C See table, step 8.
D See table, step 9.
E See table, step 10.
F See table, step 12.
G See table, step 13.

The measured variables %, level, volume and mass are available for this level mode → 118 "**Unit before lin (025)**".

8.5.7 Calibration with partially filled container (wet calibration)

Example:
This example explains a wet calibration for situations in which it is not possible to empty the container and then fill it to 100%. During this wet calibration, a level of 20% is used as the calibration point for "Empty" and a level of "25%" is used as the calibration point for "Full". The calibration is then extended to 0% to 100% and the lower range value (LRV)/upper range value (URV) are adapted accordingly.

Prerequisite:
The default value in level mode for the calibration mode is "Wet".
This value can be configured: Setup → Extended Setup → Level → Calibration mode

	Description	
1	Using the "**Measuring mode (005)**" parameter, select the "Level" measuring mode. Menu path: Setup → **Measuring mode (005)**	 *Fig. 29: Calibration with partially-filled tank* *A See table, step 2.* *B See table, step 3.*
2	Configure the value for "Empty Calib." with the differential pressure for level, e.g. 20%. Menu path: Setup → Extended setup → Level → Empty calib.	
3	Set the value for "Full calib." with the differential pressure for the level, e.g. 25 %. Menu path: Setup → Extended setup → Level → Full calib.	
4	The values for full and empty pressure are measured automatically during tuning. Because the transmitter automatically configures the pressure value best suited for an "Empty Calib." and a "Full Calib." to the minimum and maximum pressure through which the output current is triggered, the correct upper-range value (URV) and the correct lower range-value (LRV) must be configured.	

It is also possible to use different liquids (e.g. water) for the adjustment. In this case, you have to enter the various densities via the following menu path:
- Setup → Extended setup → Level→ **Adjust density (034)** (e.g. 1.0 kg/l for water)
- Setup → Extended setup → Level → **Process density (035)** (e.g. 0.8 kg/l for oil)

8.6 Linearization

8.6.1 Manual entry of the linearization table

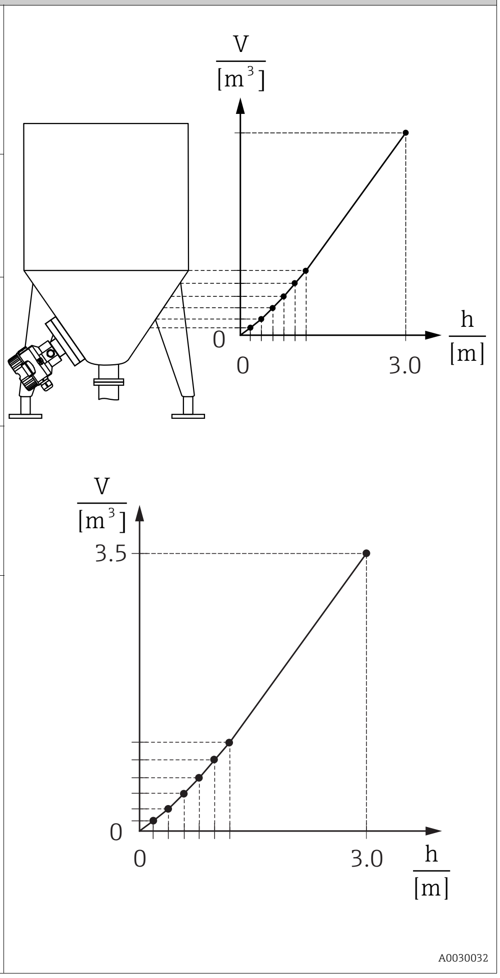
Example:
In this example, the volume in a tank with a conical outlet should be measured in m^3.

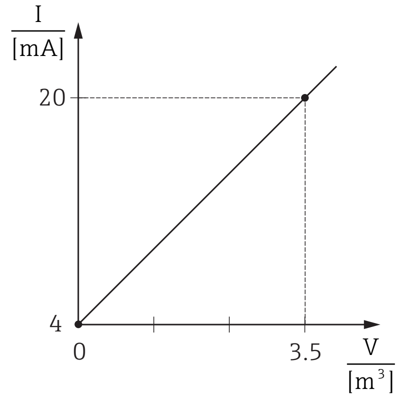
Prerequisite:

- This is a theoretical calibration, i.e. the points for the linearization table are known.
- A level calibration has been performed.

For a description of the parameters mentioned, → Kap. 12.2 "Parameter description".

	Description
1	Select the option "Manual entry" using the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
2	Select using the "Unit before lin." parameter, e.g. m^3. Menu path: Setup → Extended setup → Linearization → Unit after lin.
3	Using the "Line-numb" parameter, enter the number of the item in the table. Menu path: Setup → Extended setup → Linearization → Line numb.
	The level is entered via the "X-val." parameter, here 0 m for example. Confirm your entry. Menu path: Setup → Extended setup → Linearization → X-value
	Using the "Y-value" parameter, enter the associated volume value, here 0 m^3 for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value



	Description	
4	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 3. Menu path: Setup → Extended setup → Linearization → Edit table	 *Fig. 30: Manual entry of the linearization table*
5	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
6	Result: The measured value after linearization is displayed.	

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the smallest point in the table.
   The 100% value (= 20 mA) is defined by the biggest point in the table.
3. Using the parameters "Set LRV" and "Set URV", you can change the allocation of the volume/mass values to the current values.

8.6.2 Manual entry of the linearization table via the operating tool

Using an operating tool based on FDT technology (e.g. FieldCare), you can enter the linearization with a module specially designed for this purpose. This provides you with an overview of the selected linearization, even during entry. Additionally, it is possible to call up pre-programmed tank shapes.

The linearization table may also be entered manually point by point in the operating tool menu (see → Kap. 8.6.1, "Manual entry of the linearization table".

8.6.3 Semiautomatic entry of the linearization table

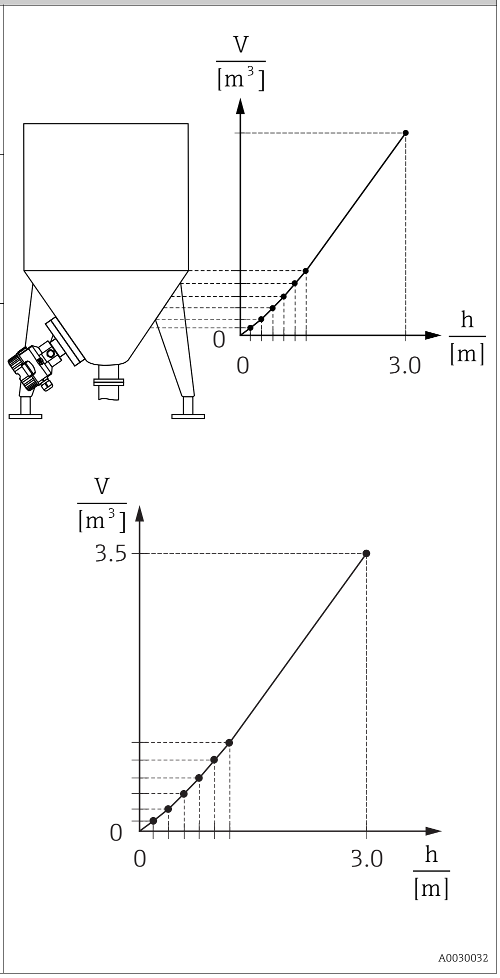
Example:
In this example, the volume in a tank with a conical outlet should be measured in m^3.

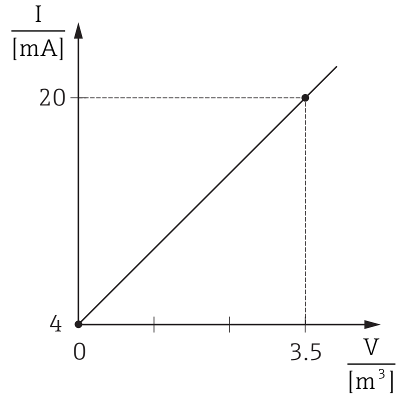
Prerequisite:

- The tank can be filled or emptied. The linearization characteristic must rise continuously.
- A level calibration has been performed.

For a description of the parameters mentioned → Kap. 12.2 "Parameter description".

	Description
1	Select the option "Semiautom. entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
2	Select the volume unit/mass unit via the "Unit after lin." parameter, e.g. m^3. Menu path: Setup → Extended setup → Linearization → Unit after lin.
3	Fill the tank to the height of the 1st point.



	Description	
4	Using the "Line-numb" parameter, enter the number of the item in the table. Menu path: Setup → Extended setup → Linearization → Line numb.	 *Fig. 31: Semiautomatic entry of the linearization table*
	The level at the current time is displayed using the "X-val." parameter. Menu path: Setup → Extended setup → Linearization → X-value	
	Using the "Y-value" parameter, enter the associated volume value, here 0 m^3 for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value	
5	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 4. Menu path: Setup → Extended setup → Linearization → Edit table	
6	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode	
7	Result: The measured value after linearization is displayed.	

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0% value (= 4 mA) is defined by the smallest point in the table.
   The 100% value (= 20 mA) is defined by the biggest point in the table.
3. Using the parameters "Set LRV" and "Set URV", you can change the allocation of the volume/mass values to the current values.

8.7 Pressure measurement

8.7.1 Calibration without reference pressure (dry calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
This is a theoretical calibration, i.e. the pressure values for the lower and upper range are known.

Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. the measured value is not zero in a pressureless condition. For information on how to perform position adjustment, see → 60.

	Description
1	Select the "Pressure" measuring mode via the "Measuring Mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the parameter "Set LRV". Menu path: Setup → Set LRV
	Enter and confirm the value (here, 0 mbar) for the parameter "Set LRV". This pressure value is assigned to the lower current value (4 mA).
4	Select the parameter "Set URV". Menu path: Setup → Set URV
	Enter the value for the "Set URV" parameter (here 300 mbar (4.5 psi)) and confirm. This pressure value is assigned to the upper current value (20 mA).
5	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).

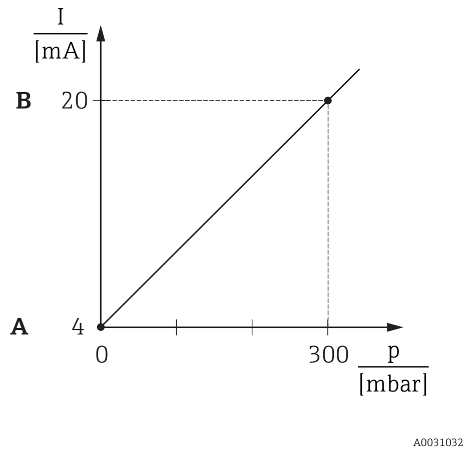


Fig. 32: Calibration without reference pressure

A See table, step 3.
B See table, step 4.

8.7.2 Calibration with reference pressure (wet calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
The pressure values 0 mbar and 300 mbar (4.5 psi) can be specified. The device is already mounted, for example.

For a description of the parameters mentioned, see Kap. 12.2 "Parameter description".

	Description
1	Perform position adjustment → 60.
2	Select the "Pressure" measuring mode via the "Measuring Mode" parameter. Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	The pressure for the lower range value (4 mA value) is present at the device, here 0 mbar for example.
	Set the "GET LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV
	Confirm the value present by selecting "Confirm". The present pressure value is assigned to the lower current value (4 mA).
5	The pressure for the upper range value (20 mA value) is present at the device, here 300 mbar (4.5 psi) for example.
	Select the parameter "Get URV". Menu path: Setup → Extended setup → Current output → Get URV
	Confirm the value present by selecting "Confirm". The present pressure value is assigned to the upper current value (20 mA).
6	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).

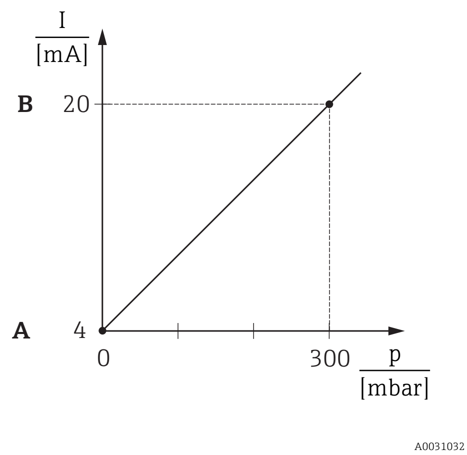


Fig. 33: Calibration with reference pressure

A See table, step 4.
B See table, step 5.

8.8 Electrical differential pressure measurement with gauge pressure sensors (Cerabar M or Deltapilot M)

Example:
In the example given, two Cerabar M or Deltapilot M devices (each with a gauge pressure measuring cell) are interconnected. The pressure difference can thus be measured using two independent Cerabar M or Deltapilot M devices.

For a description of the parameters mentioned → Kap. 12.2 "Parameter description".

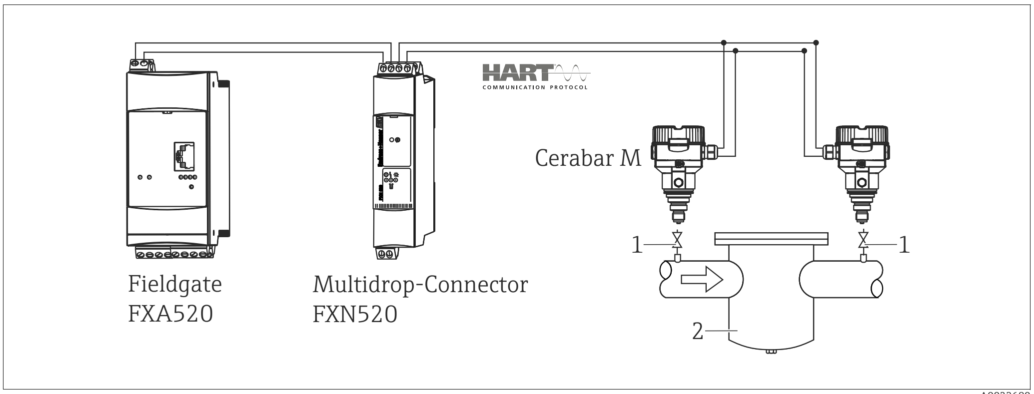


Fig. 34:

1 Shutoff valves
2 e.g. filter

	Description Adjustment of the Cerabar M/Deltapilot M on the high pressure side
1	Select the "Pressure" measuring mode via the "Measuring Mode" parameter. ⚠ WARNING **Changing the measuring mode affects the span (URV)!** This situation can result in product overflow. ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured! Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The Cerabar M/Deltapilot M is unpressurized. Perform position adjustment; see → 📄 60.
4	Switch on burst mode via the "Burst mode" parameter Menu path: Expert → Communication → HART config
5	Set the output current to "Fixed" 4.0 mA via the "Current Mode" parameter. Menu path: Expert → Communication → HART config
6	Via the "Bus address" parameter, configure an address ≠ 0, e.g. bus adress = 1. (HART 5.0 master: range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART config

	Description **Adjustment of the Cerabar M/Deltapilot M on the low-pressure side (the differential is generated in this device)**
1	Select the "Pressure" measuring mode via the "Measuring Mode" parameter. ⚠ WARNING **Changing the measuring mode affects the span (URV)!** This situation can result in product overflow. ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured! Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press. eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The Cerabar M/Deltapilot M is unpressurized. Perform position adjustment; see → 🗎 60.
4	Set the output current to "Fixed" 4.0 mA via the "Current Mode" parameter. Menu path: Expert → Communication → HART config
5	Via "Bus address" parameter, configure an address ≠ 0, e.g. bus address = 2. (HART 5.0 master: range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART config
6	Activate the reading of a value sent externally in burst mode via the "Electr. Delta P" parameter. Menu path: Expert → Application
7	Result: The measured value output by the Cerabar M/Deltapilot M on the low-pressure side equals the differential: high pressure - low pressure, and can be read out by means of a HART - request of the address of the Cerabar M/Deltapilot M on the low-pressure side.

⚠ WARNING

Settings can result in non-permitted use of the "Electr. Delta P" function.

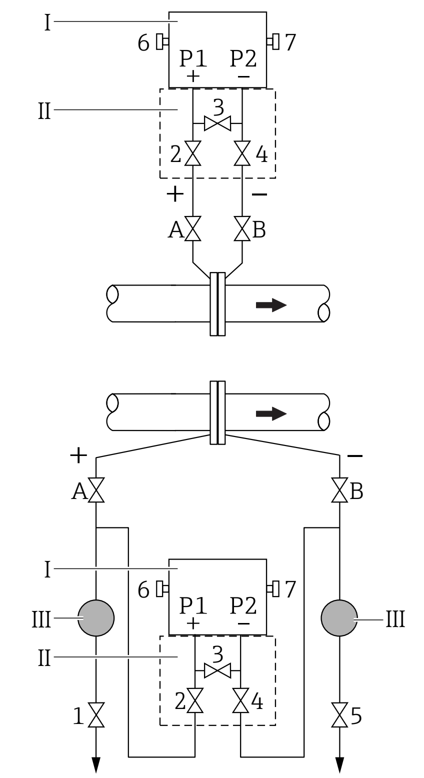
The measured value of the transmitting device (via burst) must always be greater than the measured value of the receiving device (via the "Electr. Delta P" function).
Adjustments that result in an offset of the pressure values (e.g. position adjustment, trim) must always be performed in accordance with the individual sensor and its orientation, irrespective of the "Electr. Delta P" application. Other settings result in non-permitted use of the "Electr. Delta P" function and can lead to incorrect measured values.

▶ It is not permissible to reverse the assignment of the measuring points to the direction of communication.

8.9 Differential pressure measurement (Deltabar M)

8.9.1 Preparatory steps

Before calibrating the device, ensure that the impulse piping has been cleaned and filled with medium. → See the following table.

	Valves	Meaning	Preferred installation
1	Close 3.		 A0030036
2	Fill the measuring system with medium.		
	Open A, B, 2, 4.	Medium flows in.	
3	If necessary, clean impulse piping:[1)] – by blowing out with compressed air in the case of gases – by rinsing out in the case of liquids.		
	Close 2 and 4.	Block off device.	
	Open 1 and 5.[1]	Blow out/rinse out impulse piping.	
	Close 1 and 5.[1]	Close valves after cleaning.	
4	Vent device.		
	Open 2 and 4.	Introduce medium.	
	Close 4.	Close low-pressure side.	
	Open 3.	Balance positive and low-pressure side.	
	Open 6 and 7 briefly, then close them again.	Fill device completely with medium and remove air.	
5	Set measuring point to operation.		
	Close 3.	Shut off high-pressure side from low-pressure side.	
	Open 4.	Connect low-pressure side.	
	Now – 1[1], 3, 5[1], 6 and 7 are closed. – 2 and 4 are open. – A and B are open (if present).		*Above: preferred installation for gases* *Below: preferred installation for liquids*
6	If necessary, carry out calibration. → See also page 80.		*I Deltabar M* *II Three-valve manifold* *III Separator* *1, 5 Drain valves* *2, 4 Inlet valves* *3 Equalizing valve* *6, 7 Vent valves on Deltabar M* *A, B Shutoff valve*

1) for arrangement with 5 valves

8.9.2 Setup menu for Pressure measuring mode

Parameter name	Description	See page
Measuring mode (005) Selection	Select the "Pressure" measuring mode.	113
Switch P1/P2 (163) Display	Indicates whether the "SW/P2 High" DIP switch (DIP switch 5) is switched on.	115
High pressure side (006) (183) Selection/Display	Determines which pressure input corresponds to the high-pressure side This setting is only valid if the "SW/P2High" DIP switch is in the OFF position (see the **"Pressure side switch" (163)** parameter). Otherwise P2 corresponds to the high-pressure side in any case.	115
Press. eng. unit (125) Selection	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.	114
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.	117
Pos. zero adjust (007) Selection	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. Zero Adjust" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected.	114
Set LRV (056) User input	Set the pressure value for the lower current value (4 mA).	125
Set URV (057) User input	Set the pressure value for the upper current value (20 mA).	126
Damping switch (164) Display	Displays the status of DIP switch 2 "damping τ", which is used to switch the damping of the output signal on and off.	114
Damping value (017) (184) User input/display	Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure. The damping is only active if DIP switch 2 ("damping τ") is in the ON position.	114
Pressure af. damp (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.	117

8.10 Flow measurement (Deltabar M)

8.10.1 Information on flow measurement

In the "Flow" measuring mode, the device determines a volume or mass flow value from the differential pressure measured. The differential pressure is generated by means of primary elements such as pitot tubes or orifice plates and depends on the volume or mass flow. Four flow types are available: volume flow, norm volume flow (European norm conditions), standard volume flow (American standard conditions), mass flow and flow in %.

In addition, the Deltabar M software provides two totalizers as standard. The totalizers integrates the volume or the mass flow. The counting function and the unit can be set separately for both totalizers. The first totalizer (totalizer 1) can be reset to zero at any time while the second (totalizer 2) totalizes the flow from commissioning onwards and cannot be reset.

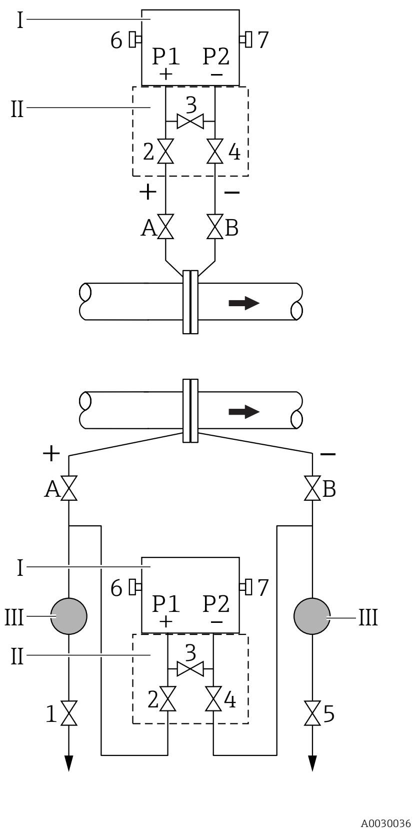
The totalizers are not available for the "Flow in %" flow type.

8.10.2 Preparatory steps

Before calibrating the Deltabar M, ensure that the impulse piping has been cleaned and filled with medium. → See the following table.

	Valves	Meaning
1	Close 3.	
2	Fill the measuring system with medium.	
	Open A, B, 2, 4.	Medium flows in.
3	If necessary, clean the impulse piping[1)]: – by blowing out with compressed air in the case of gases – by rinsing out in the case of liquids.	
	Close 2 and 4.	Block off device.
	Open 1 and 5.[1]	Blow out/rinse out impulse piping.
	Close 1 and 5.[1]	Close valves after cleaning.
4	Vent device.	
	Open 2 and 4.	Introduce medium.
	Close 4.	Close low-pressure side.
	Open 3.	Balance positive and low-pressure side.
	Open 6 and 7 briefly, then close them again.	Fill device completely with medium and remove air.
5	Carry out position zero adjustment (→ 60) if the following conditions are met. If the conditions are not met, then do not carry out the pos. zero adjustment until after step 6. Conditions: – The process cannot be blocked off. – The tapping points (A and B) are at the same geodetic height.	
6	Set measuring point to operation.	
	Close 3.	Shut off high-pressure side from low-pressure side.
	Open 4.	Connect low-pressure side.
	Now – 1[1], 3, 5[1], 6 and 7 are closed. – 2 and 4 are open. – A and B are open (if present).	
7	Carry out position zero adjustment (→ 60) if the flow can be blocked off. In this case, step 5 is not applicable.	
8	Carry out calibration. → See Page 83, → Kap. 8.10.3.	

Preferred installation



Above: preferred installation for gases
Below: preferred installation for liquids

I	*Deltabar M*
II	*Three-valve manifold*
III	*Separator*
1, 5	*Drain valves*
2, 4	*Inlet valves*
3	*Equalizing valve*
6, 7	*Vent valves on Deltabar M*
A, B	*Shutoff valves*

1) for arrangement with 5 valves

8.10.3 Setup menu for the "Flow" measuring mode

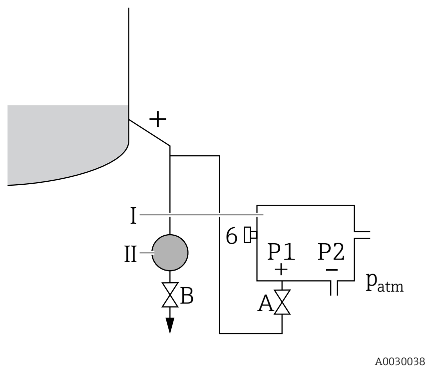
Parameter name	Description	See page
Lin./SQRT switch (133) Display	Displays the status of DIP switch 4 on the electronic insert, which is used to define the output characteristics of the current output.	125
Measuring mode (005) Selection	Select the "Flow" measuring mode.	113
Switch P1/P2 (163) Display	Indicates whether the "SW/P2 High" DIP switch (DIP switch 5) is switched on.	115
High pressure side (006) (183) Selection/Display	Determines which pressure input corresponds to the high-pressure side This setting is only valid if the "SW/P2 High" DIP switch is in the OFF position (see the **"Pressure side switch" (163)** parameter). Otherwise P2 corresponds to the high-pressure side in any case.	115
Press. eng. unit (125) Selection	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.	114
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.	117
Pos. zero adjust (007) Selection	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. Zero Adjust" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected.	114
Max. flow (009) User input	Enter maximum flow of primary element. See also layout sheet of primary element. The maximum flow is assigned to the maximum pressure which you enter via the "Max. pressure flow" (010) parameter.	123
Max. pressure flow (010) User input	Enter maximum pressure of primary element. → See layout sheet of primary element. This value is assigned to the maximum flow value (→ See **"Max. flow" (009)**).	123
Damping switch (164) Display	Displays the status of DIP switch 2 "damping τ", which is used to switch the damping of the output signal on and off.	114
Damping value (017) (184) User input/display	Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure. The damping is only active if DIP switch 2 ("damping τ") is in the ON position.	114
Flow (018) Display	Displays the present flow value.	123
Pressure af. damp (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.	117

8.11 Level measurement (Deltabar M)

8.11.1 Preparatory steps

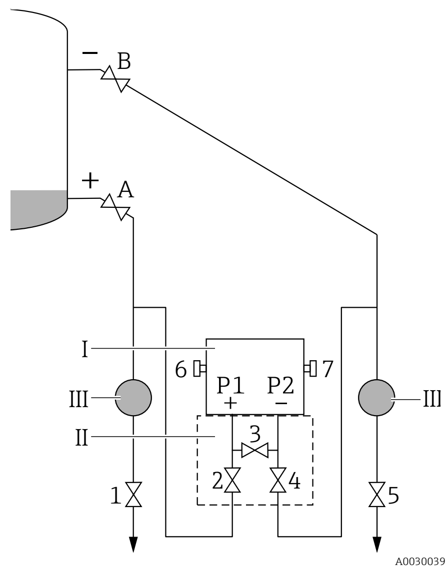
Open container

Before calibrating the device, ensure that the impulse piping has been cleaned and filled with medium. → See the following table.

	Valves	Meaning	Installation
1	Fill the container to a level above the lower tap.		
2	Fill the measuring system with medium.		
	Open A.	Open shutoff valve.	
3	Vent device.		
	Open 6 briefly, then close again.	Fill device completely with medium and remove air.	
4	Set measuring point to operation.		
	Now: – B and 6 are closed. – A is open.		
5	Carry out calibration according to one of the following methods: ▪ "in pressure" - with reference pressure (→ 88) ▪ "in pressure" - without reference pressure (→ 90) ▪ "in height" - with reference pressure (→ 94) ▪ "in height" - without reference pressure (→ 92)		*Open container* *I Deltabar M* *II Separator* *6 Vent valves on Deltabar M* *A Shutoff valve* *B Drain valve*

Closed container

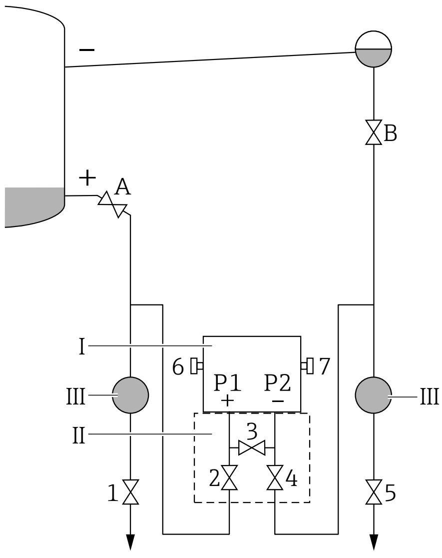
Before calibrating the device, ensure that the impulse piping has been cleaned and filled with medium. → See the following table.

	Valves	Meaning	Installation
1	Fill the container to a level above the lower tap.		 *Closed container* *I Deltabar M* *II Three-valve manifold* *III Separator* *1, 5 Drain valves* *2, 4 Inlet valves* *3 Equalizing valve* *6, 7 Vent valves on Deltabar M* *A, B Shutoff valve*
2	Fill the measuring system with medium.		
	Close 3.	Shut off high-pressure side from low-pressure side.	
	Open A and B.	Open shutoff valves.	
3	Vent high-pressure side (empty low-pressure side if necessary).		
	Open 2 and 4.	Introduce medium on high-pressure side.	
	Open 6 and 7 briefly, then close them again.	Fill high-pressure side completely with medium and remove air.	
4	Set measuring point to operation.		
	Now: – 3, 6 and 7 are closed. – 2, 4, A and B are open.		
5	Carry out calibration according to one of the following methods: ▪ "in pressure" - with reference pressure (→ 🗎 88) ▪ "in pressure" - without reference pressure (→ 🗎 90) ▪ "in height" - with reference pressure (→ 🗎 94) ▪ "in height" - without reference pressure (→ 🗎 92)		

Closed container with superimposed steam

Before calibrating the device, ensure that the impulse piping has been cleaned and filled with medium. → See the following table.

	Valves	Meaning	Installation
1	Fill the container to a level above the lower tap.		See figure below
2	Fill the measuring system with medium.		
	Open A and B.	Open shutoff valves.	
	Fill the negative impulse piping to the level of the condensate trap.		
3	Vent device.		
	Open 2 and 4.	Introduce medium.	
	Close 4.	Close low-pressure side.	
	Open 3.	Balance positive and low-pressure side.	
	Open 6 and 7 briefly, then close them again.	Fill device completely with medium and remove air.	
4	Set measuring point to operation.		
	Close 3.	Shut off high-pressure side from low-pressure side.	
	Open 4.	Connect low-pressure side.	
	Now: – 3, 6 and 7 are closed. – 2, 4, A and B are open.		
5	Carry out calibration according to one of the following methods: ▪ "in pressure" - with reference pressure (→ 88) ▪ "in pressure" - without reference pressure (→ 90) ▪ "in height" - with reference pressure (→ 94) ▪ "in height" - without reference pressure (→ 92)		



Closed container with superimposed steam

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

8.11.2 Information on level measurement

You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.
- The limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together.

8.11.3 Overview of level measurement

Measuring task	Level selection	Measured variable options	Description	Measured value display
Calibration is performed by entering two pressure/level value pairs.	"In pressure"	Via the "Unit before lin" parameter: %, level, volume or mass units.	▪ Calibration with reference pressure (wet calibration), → 88 ▪ Calibration without reference pressure (dry calibration) → 90	The measured value display and the "Level before lin." zeigen den Messwert an.
Calibration is performed by entering the density and two height/level value pairs.	"In height"		▪ Calibration with reference pressure (wet calibration), → 94 ▪ Calibration without reference pressure (dry calibration) → 92	

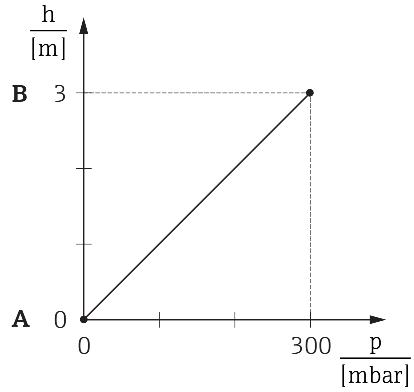
8.11.4 "In pressure" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the level in a tank should be measured in m. The maximum level is 3 m (9.8 ft). The pressure range is set to 0 to 300 mbar (4.5 psi).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled or emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description	
1	Perform "position zero adjustment" → 60.	
2	Select the "Level" measuring mode via the "→ 113" parameter (). Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter (→ 114), here "mbar" for example. Menu path: Setup Press. eng. unit	
4	Select the "In pressure" level mode via the "Level selection" parameter (→ 118). Menu path: Setup → Extended setup → Level → Level selection.	
5	Select a level unit via the "Unit before lin" parameter (→ 118), here "m" for example. Menu path: Setup → Extended setup → Level → Unit before lin	
6	Select the "Wet" option via the "Calibration mode" parameter (→ 118). Menu path: Setup →Extended setup → Level → Calibration mode.	

	Description	
7	a. The pressure for the lower calibration point is present at the device, here "0 mbar" for example. b. Select the "Empty calib." parameter (→ 🗎 119). c. Enter the level value, here "0 m" for example. By confirming the value, you assign the pressure value present to the lower level value. Menu path: Setup → Extended setup → Level → Empty calib.	 A0017658 *Calibration with reference pressure (wet calibration)* *A See table, step 7.* *B See table, step 8.*
8	a. The pressure for the upper calibration point is present at the device, here "300 mbar" (4.5 psi) for example. b. Select the "Full calib." parameter (→ 🗎 119). c. Enter the level value, here 3 m (9.8 ft) for example. By confirming the value, you assign the pressure value present to the upper level value. Menu path: Setup → Extended setup → Level → Full calib.	
9	Result: The measuring range is set for 0 to 3 m (9.8 ft). 0 m corresponds to an output current of 4 mA. 3 m (9.8 ft) corresponds to an output current of 20 mA.	

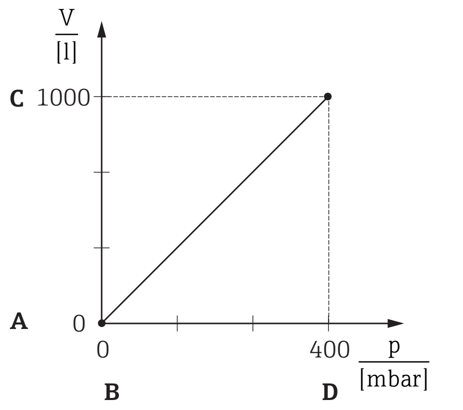
8.11.5 "In pressure" level selection Calibration without reference pressure (dry calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 gal) corresponds to a pressure of 400 mbar (6 psi). The minimum volume of 0 liters corresponds to a pressure of 0 mbar.

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the pressure and volume values for the lower and upper calibration point must be known.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description	
1	Perform "position zero adjustment" → 🗎 60.	
2	Select the "Level" measuring mode via the "→ 🗎 113" parameter (). Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter (→ 🗎 114), here "mbar" for example. Menu path: Setup Press. eng. unit	
4	Select the "In pressure" level mode via the "Level selection" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Level selection.	
5	Select a volume unit via the "Unit before lin" (→ 🗎 118), here "l" (liters), for example. Menu path: Setup → Extended setup → Level → Unit before lin	
6	Select the "Dry" option via the "Calibration mode" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Calibration mode.	

	Description	
7	Enter the volume value for the lower calibration point via the "Empty calib." parameter (→ 🗎 119), here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.	 *Calibration without reference pressure (dry calibration)* *A See table, step 7.* *B See table, step 8.* *C See table, step 9.* *D See table, step 10.*
8	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter (→ 🗎 119), here "0 mbar" for example. Menu path: Setup → Extended setup → Level → Empty pressure	
9	Enter the volume value for the upper calibration point via the "Full calib." parameter (→ 🗎 119), here "1000 liter" (264 gal) for example. Menu path: Setup → Extended setup → Level → Full calib.	
10	Enter the pressure value for the upper calibration point via the "Full pressure" parameter (→ 🗎 119), here "400 mbar" (6 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure	
11	Result: The measuring range is set for 0 to 1000 l (264 gal). 0 l corresponds to an output current of 4 mA. 1000 l (264 US gal) corresponds to an output current of 20 mA.	

8.11.6 "In height" level selection Calibration without reference pressure (dry calibration)

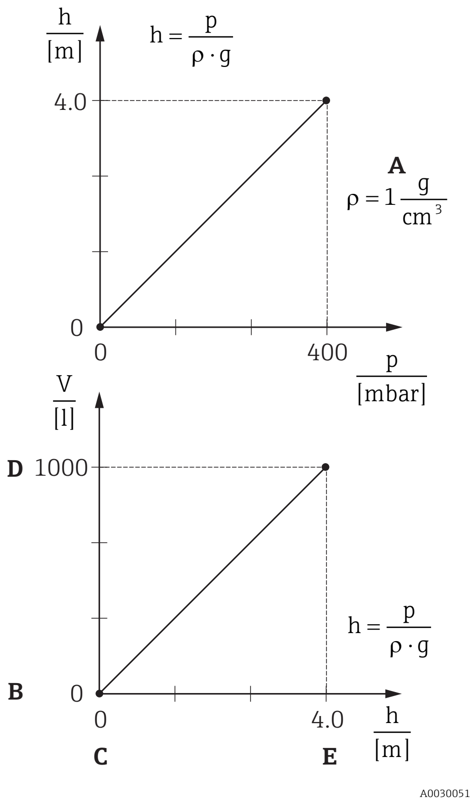
Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m. The density of the fluid is 1 g/cm^3 (1 SGU).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the height and volume values for the lower and upper calibration point must be known.

The values entered for "Empty calib./Full calib." and " Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description	
1	Perform "position zero adjustment" → 🗎 60.	
2	Select the "Level" measuring mode via the "→ 🗎 113" parameter (). Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter (→ 🗎 114), here "mbar" for example. Menu path: Setup Press. eng. unit	
4	Select the "In height" level mode via the "Level selection" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Level selection.	
5	Select a volume unit via the "Unit before lin" (→ 🗎 118), here "l" (liters), for example. Menu path: Setup → Extended setup → Level → Unit before lin	
6	Select a level unit via the "Height unit" parameter (→ 🗎 118), here "m" for example. Menu path: Setup → Extended setup → Level → Height unit	
7	Select the "Dry" option via the "Calibration mode" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Calibration mode.	

	Description
8	Enter the volume value for the lower calibration point via the "Empty calib." parameter (→ 🗎 119), here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.
9	Enter the volume value for the lower calibration point via the "Empty calib." parameter (→ 🗎 119), here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty height
10	Enter the volume value for the upper calibration point via the "Full calib." parameter (→ 🗎 119), here "1000 liter" (264 gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
11	Enter the height value for the upper calibration point via the "Full height" parameter (→ 🗎 119), here "4 m" (13 ft) for example. Menu path: Setup → Extended setup → Level → Full height
12	Enter the density of the medium, using the "Adjust density" parameter (→ 🗎 120), here 1 g/cm^3 (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density
13	Result: The measuring range is set for 0 to 1000 l (264 gal). 0 l corresponds to an output current of 4 mA. 1000 l (264 US gal) corresponds to an output current of 20 mA.



Calibration without reference pressure (dry calibration)

A See table, step 12.
B See table, step 8.
C See table, step 9.
D See table, step 10.
E See table, step 11.

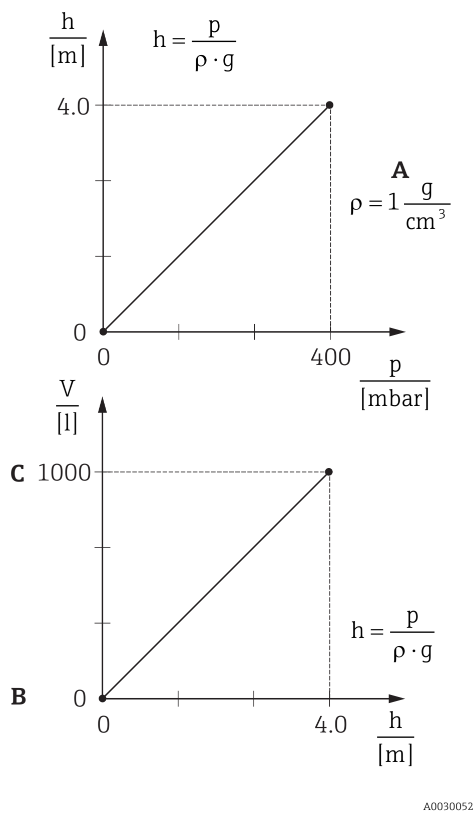
8.11.7 "In height" level selection Calibration with reference pressure (wet calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 gal) corresponds to a level of 4 m (13 ft). The minimum volume of 0 liters corresponds to a level of 0 m. The density of the fluid is 1 g/cm^3 (1 SGU).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled or emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring instrument can measure correctly.

	Description	
1	Perform "position zero adjustment" → 🗎 60.	
2	Select the "Level" measuring mode via the "→ 🗎 113" parameter (). Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter (→ 🗎 114), here "mbar" for example. Menu path: Setup Press. eng. unit	
4	Select the "In height" level mode via the "Level selection" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Level selection.	
5	Select a level unit via the "Unit before. lin" parameter (→ 🗎 118), here "l" for example. Menu path: Setup → Extended setup → Level → Unit before. lin	
6	Select a level unit via the "Height unit" parameter (→ 🗎 118), here "m" for example. Menu path: Setup → Extended setup → Level → Height unit	
7	Select the "Wet" option via the "Calibration mode" parameter (→ 🗎 118). Menu path: Setup → Extended setup → Level → Calibration mode	

	Description	
8	a. The pressure for the lower calibration point is present at the device, here "0 mbar" for example. b. Select the "Empty calib." parameter (→ 🗎 119). c. Enter the volume value, here "0 l" for example. Menu path: Setup → Extended setup → Level → Empty calib	
9	a. The pressure for the upper calibration point is present at the device, here "400 mbar" (6 psi) for example. b. Select the "Full calib." parameter (→ 🗎 119). c. Enter the associated volume value, here 1000 l (264 gal), for example. Menu path: Setup → Extended setup → Level → Full calib	
10	Enter the density of the medium, using the "Adjust density" parameter (→ 🗎 120), here 1 g/cm^3 (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density	
11	If the process uses a medium other than the medium on which the calibration was based, the new density must be specified in the "Process density" parameter (→ 🗎 120). Menu path: Setup → Extended setup → Level → Process density	
12	Result: The measuring range is set for 0 to 1000 l (264 gal). 0 l corresponds to an output current of 4 mA. 1000 l (264 US gal) corresponds to an output current of 20 mA.	*Calibration with reference pressure (wet calibration)* *A See table, step 8.* *B See table, step 9.* *p Pressure* *v Volume*

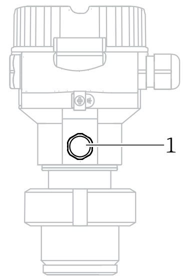
8.12 Backing up or duplicating the device data

The device does not have a memory module. With an operating tool based on FDT technology (e.g. FieldCare), the following options are, however, available :

- Save/recover configuration data
- Duplicate device configurations
- Transfer of all relevant parameters when replacing electronic inserts.

9 Maintenance

Deltabar M requires no maintenance.
In the case of Cerabar M and Deltapilot M, keep the pressure compensation and GORE-TEX® filter (1) free from contamination.



A0028502

9.1 Cleaning instructions

Endress+Hauser provides flushing rings as an accessory to enable cleaning of the process membrane without removing the transmitter from the process.
For further information, please contact your local Endress+Hauser Sales Center.

9.1.1 Cerabar M PMP55

We recommend you perform CIP (cleaning in place (hot water)) before SIP (sterilization in place (steam)) for inline seals. Frequent use of SIP cleaning increases the stress and strain on the process membrane. Under unfavorable conditions, frequent changes of temperature can lead to process membrane material fatigue and potentially leaks over the long term.

9.2 Exterior cleaning

Please note the following points when cleaning the measuring instrument:
- The cleaning agents used should not corrode the surface and the seals.
- Mechanical damage to the membrane, e.g. due to pointed objects, must be avoided.
- Observe the degree of protection of the device. See the nameplate if necessary (→ 🗎 8 ff).

10 Troubleshooting

10.1 Messages

The following table lists the messages that can occur. The Diagnostic code parameter show the message with the highest priority. The device has four different status information codes according to NE107:

- F = failure
- M (warning) = maintenance required
- C (warning) = function check
- S (warning) = out of specification (deviations from the permitted ambient or process conditions determined by the device with the self-monitoring function, or errors in the device itself indicate that the measuring uncertainty is greater than what would be expected under normal operating conditions).

Diagnostic code	Error message	Cause	Measure
0	No error	–	–
C412	Backup in progress	– Downloading.	Wait for download to complete
C482	Simul. output	– Current output simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C484	Error simul	– Fault state simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C485	Measure simul	– Simulation is switched on, i.e. the device is not measuring at present.	End the simulation
C824	Process pressure	– Overpressure or low pressure present. – Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Check the pressure value 2. Restart the device 3. Perform a reset
F002	Sens. unknown	– Sensor does not suit the device (electronic sensor nameplate).	Contact Endress+Hauser Service
F062	Sensor conn.	– Cable connection between sensor and main electronics disconnected. – Sensor defective. – Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Check sensor cable 2. Replace electronics 3. Contact Endress+Hauser Service 4. Replace the sensor (snap-on version)
F081	Initialization	– Cable connection between sensor and main electronics disconnected. – Sensor defective. – Electromagnetic effects are greater than the specifications in the technical data. This message normally only appears briefly.	1. Perform a reset 2. Check sensor cable 3. Contact Endress+Hauser Service
F083	Permanent mem	– Sensor defective. – Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Restart device 2. Contact Endress+Hauser Service
F140	Working range P	– Overpressure or low pressure present. – Electromagnetic effects are greater than specifications in the technical data. – Sensor defective.	1. Check the process pressure 2. Check the sensor range
F261	Electronics	– Main electronics defective. – Fault in the main electronics.	1. Restart device 2. Replace electronics
F282	Data memory	– Fault in the main electronics. – Main electronics defective.	1. Restart device 2. Replace electronics

Diagnostic code	Error message	Cause	Measure
F283	Permanent mem	– Main electronics defective. – Electromagnetic effects are greater than the specifications in the technical data. – The supply voltage is disconnected when writing. – An error occurred when writing.	1. Perform a reset 2. Replace electronics
F411	Up-/Download	– The file is corrupt. – During the download, the data are not correctly transmitted to the processor, e.g. because of open cable connections, spikes (ripple) on the supply voltage or electromagnetic effects.	1. Repeat download 2. Use other file 3. Perform a reset
F510	Linearization	– The linearization table is being edited.	1. Conclude entries 2. Select "linear"
F511	Linearization	– The linearization table consists of less than 2 points.	1. Table too small 2. Corr. table 3. Accept the table
F512	Linearization	– The linearization table is not increasing or decreasing monotonically.	1. Tab. not monotonic 2. Corr. table 3. Accept the table
F841	Sensor range	– Overpressure or low pressure present. – Sensor defective.	1. Check the pressure value. 2. Contact Endress+Hauser Service.
F882	Input signal	– External measured value is not received or displays a failure status.	1. Check the bus. 2. Check source device. 3. Check the setting.
M002	Sens. unknown	– Sensor does not suit the device (electronic sensor nameplate). Device continues measuring.	Contact Endress+Hauser Service.
M283	Permanent mem.	– Cause as indicated for F283 – Correct measurement can continue as long as you do not need the peak hold indicator function.	1. Perform a reset. 2. Replace electronics.
M431	Adjustment	– The calibration carried out would cause the sensor nominal range to be exceeded or undershot.	1. Check the measuring range. 2. Check position adjustment. 3. Check the setting.
M434	Scaling	– Values for calibration (e.g. lower range value and upper range value) are too close together. – Lower range value and/or upper range value exceed or fall below the sensor range limits. – The sensor was replaced and the customer-specific configuration does not suit the sensor. – Unsuitable download carried out.	1. Check the measuring range. 2. Check the setting. 3. Contact Endress+Hauser Service.
M438	Dataset	– The supply voltage is disconnected when writing. – An error occurred when writing.	1. Check setting. 2. Restart the device. 3. Replace electr.
M515	Configuration flow	– Max. flow out of nominal range of sensor	1. Recalibrate the device 2. Restart the device
M882	Input signal	– External measured value displays a warning status.	1. Check the bus. 2. Check source device. 3. Check the setting.
S110	Operational range T	– Excess temperature or low temperature present. – Electromagnetic effects are greater than specifications in the technical data. – Sensor defective.	1. Check proc. temp. 2. Check temperature range.
S140	Working range P	– Overpressure or low pressure present – Electromagnetic effects are greater than specifications in the technical data. – Sensor defective.	1. Check the process pressure. 2. Check the sensor range.
S822	Process temp.	– The temperature measured in the sensor is higher than the upper nominal temperature of the sensor. – The temperature measured in the sensor is less than the lower nominal temperature of the sensor.	1. Check the temperature. 2. Check the setting.

Diagnostic code	Error message	Cause	Measure
S841	Sensor range	– Gauge pressure or low pressure present. – Sensor defective.	1. Check the pressure value. 2. Contact Endress+Hauser Service.
S971	Adjustment	– The current is outside the permitted range from 3.8 to 20.5 mA. – The pressure value is outside the configured measuring range (but may be within the sensor range).	1. Check the pressure value. 2. Check the measuring range. 3. Check the setting.

10.2 Response of output to errors

The behavior of the current output in the event of errors is defined in the following parameters:
- "Alarm behavior" (050) → 🗎 124
- "Output fail mode (190) → 🗎 125
- "High alarm current" (052) → 🗎 125

10.3 Repair

The Endress+Hauser repair concept provides for measuring instruments to have a modular design and that the customer can also carry out repairs (see → 🗎 100, Kap. 10.5 "Spare parts").

- For certified devices, please consult the "Repair of Ex-certified devices" section.
-

  For more information on service and spare parts, contact the Endress+Hauser Service.
  → See www.endress.com/worldwide.

10.4 Repair of Ex-certified devices

⚠ WARNING

Incorrect repair can compromise electrical safety!
Explosion hazard!

When repairing Ex-certified devices, please note the following:
- Repairs to Ex-certified devices must be carried out by Endress+Hauser Service or by specialist personnel according to national regulations.
- Relevant standards, national hazardous area regulations and Safety Instructions and Certificates must be observed.
- Only genuine Endress+Hauser spare parts may be used.
- When ordering spare parts, please check the device designation on the nameplate. Only replace parts with identical parts.
- Electronic inserts or sensors already in use in a standard instrument may not be used as spare parts for a certified device.
- Carry out repairs according to the instructions. After repairs, the device must fulfill the requirements of the specified individual tests.
- A certified device may only be converted into another certified variant by Endress+Hauser.

10.5 Spare parts

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

Measuring instrument serial number:
- Located on the device and spare part nameplate.
- Can be read out via the "Serial number" parameter in the "Instrument info" submenu.

10.6 Return

The measuring instrument must be returned if it is in need of repair or a factory calibration, or if the wrong measuring instrument has been delivered or ordered. Due to legal specifications, and as an ISO-certified company, Endress+Hauser is obliged to follow certain procedures when handling all returned products that are in contact with medium.
To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material.

10.7 Disposal

When disposing, ensure that the materials of the device components are separated and processed accordingly.

10.8 Software history

Device	Date	Software version	Changes to the software
Cerabar	08.2009	01.00.zz	Original software Compatible with: – FieldCare version 2.02.00 and higher – Field Communicator DXR375 with Device Rev.: 1, DD Rev.: 1

Device	Date	Software version	Changes to the software
Deltabar	03.2009	01.00.zz	Original software Compatible with: – FieldCare version 2.02.00 and higher – Field Communicator DXR375 with Device Rev.: 1, DD Rev.: 1

Device	Date	Software version	Changes to the software
Deltapilot	10.2009	01.00.zz	Original software Compatible with: – FieldCare version 2.02.00 and higher – Field Communicator DXR375 with Device Rev.: 1, DD Rev.: 1

11 Technical data

For the technical data, please refer to the Technical Information for Cerabar M TI436P/ Deltabar M TI434P/Deltapilot M TI437P.

12 Appendix

12.1 Overview of the operating menu

All the parameters and the direct access codes are listed in the following table. The page reference indicates where a description of the parameter can be found in the manual.

Level 1	Level 2	Level 3	Level 4	Direct access	Page
Parameters in italics cannot be edited (read-only parameters). Specific settings, such as the measuring mode, dry or wet calibration, or hardware locking, determine whether these parameters are displayed.					
Language				000	112
Display/Operation	Display mode			001	112
	Add. disp. value			002	112
	Format 1st value			004	113
Setup	Lin./SQRT switch (Deltabar)			133	113
	Measuring mode *Measuring mode (read only)*			005 *182*	113
	Switch P1/P2 (Deltabar)			163	115
	High pressure side (Deltabar) *High pressure side (read only)*			006 *183*	115
	Pressure unit			125	114
	Corrected press.			172	117
	Pos. zero adjust (Deltabar and gauge pressure sensors) Calib. offset (absolute pressure sensors)			007 192	114 114
	Max. flow ("Flow" measuring mode) (Deltabar)			009	123
	Max. pressure flow ("Flow" measuring mode) (Deltabar)			010	123
	Empty calib. (Level measuring mode and "Calibration mode" = wet)			011	119
	Full calib. (Level measuring mode and "Calibration mode" = wet)			012	119
	Set LRV (Pressure measuring mode and flow linear)			013	125
	Set URV (Pressure measuring mode and flow linear)			014	126
	Damping switch (read only)			164	114
	Damping value *Damping (read only)*			017 *184*	114
	Flow ("Flow" measuring mode) (Deltabar)			018	123
	Level before lin ("Level" measuring mode)			019	120
	Pressure af. damp			111	117
	Extended Setup	Code definition		023	111
		Device tag		022	112
		Operator code		021	111
		Level ("Level" measuring mode)	Level selection	024	118
			Unit before lin	025	118
			Height unit	026	118
			Calibration mode	027	118
			Empty calib. *Empty calib.*	028 011	119
...	...	...	Empty pressure *Empty pressure (read only)*	029 *185*	119

Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Setup	**... Extended Setup**	**... Level ("Level" measuring mode)**	Empty height *Empty height (read only)*	030 *186*	119
			Full calib. *Full calib.*	031 012	119
			Full pressure *Full pressure (read only)*	032 *187*	119
			Full height *Full height (read only)*	033 *188*	119
			Adjust density	034	120
			Process density	035	120
			Level before lin.	019	120
		Linearization	Lin. mode	037	120
			Unit after lin.	038	120
			Line-numb.:	039	121
			X-value:	040	121
			Y-value:	041	121
			Edit table	042	121
			Tank description	173	121
			Tank content	043	121
		Flow ("Flow" measuring mode) (Deltabar)	Flow type	044	121
			Mass flow unit	045	122
			Norm. flow unit	046	122
			Std. flow unit	047	122
			Flow unit	048	122
			Max. flow	009	123
			Max. press. flow	010	123
			Set low-flow cut-off	049	123
			Flow	018	123
		Current output	Alarm behav. P	050	124
			Alarm cur.switch	165	124
			Output fail mode	190	125
			High alarm curr.	052	125
			Set min. current	053	125
			Output current	054	124
			Linear/Sqroot (Deltabar) *Linear/Sqroot (read only)*	055 *191*	125
			Get LRV (only "Pressure")	015	125
			Set LRV	013	125
			Get URV (only "Pressure")	016	126
			Set URV	014	126
		Totalizer 1 (Deltabar)	Eng. unit totalizer 1	058 059 060 061	131
			Totalizer 1 mode	175	131
...	...	...	Totalizer 1 failsafe	176	131

Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Setup	**... Extended Setup**	**... Totalizer 1** (Deltabar)	Reset totalizer 1	062	131
			Totalizer 1	063	131
			Totalizer 1 overflow	064	131
		Totalizer 2 (Deltabar)	Eng. unit totalizer 2	065 066 067 068	132
			Totalizer 2 mode	177	132
			Totalizer 2 failsafe	178	132
			Totalizer 2	069	132
			Totalizer 2 overflow	070	132
Diagnostic	Diagnostic code			071	133
	Last diag. code			072	133
	Min. meas. press.			073	133
	Max. meas. press.			074	133
	Diagnostic list	Diagnostic 1		075	133
		Diagnostic 2		076	133
		Diagnostic 3		077	133
		Diagnostic 4		078	133
		Diagnostic 5		079	133
		Diagnostic 6		080	133
		Diagnostic 7		081	133
		Diagnostic 8		082	133
		Diagnostic 9		083	133
		Diagnostic 10		084	133
	Event logbook	Last diag. 1		085	134
		Last diag. 2		086	134
		Last diag. 3		087	134
		Last diag. 4		088	134
		Last diag. 5		089	134
		Last diag. 6		090	134
		Last diag. 7		091	134
		Last diag. 8		092	134
		Last diag. 9		093	134
		Last diag. 10		094	134
	Instrument info	Firmware version		095	112
		Serial number		096	112
		Ext. order code		097	112
		Order identifier		098	112
		Cust. tag number		254	112
		Device tag		022	112
		ENP version		099	112
		Config. counter		100	133
...	...	LRL sensor		101	124

Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Diagnosis	**... Instrument Info**	URL sensor		102	124
		Manufacturer ID		103	127
		Device ID		105	127
		Device revision		108	127
	Measured values	Flow (Deltabar)		018	123
		Level before lin.		019	120
		Tank content		043	121
		Meas. pressure		020	116
		Sensor pressure		109	117
		Corrected press.		172	117
		Sensor temp. (Cerabar/Deltapilot)		110	115
		Pressure af. damp		111	117
	Simulation	Simulation mode		112	134
		Sim. pressure		113	135
		Sim. flow (Deltabar)		114	135
		Sim. level		115	135
		Sim. tank cont.		116	135
		Sim. current		117	135
		Sim. error no.		118	135
	Reset	Reset		124	113
Expert	Direct access			119	111
	System	Code definition		023	111
		Lock switch		120	111
		Operator code		021	111
		Instrument info	Cust. tag number	254	112
			Device tag	022	112
			Serial number	096	112
			Firmware version	095	112
			Ext. order code	097	112
			Order identifier	098	112
			ENP version	099	112
			Electr. serial no.	121	112
			Sensor serial no.	122	112
		Display	Language	000	112
			Display mode	001	112
			Add. disp. value	002	112
			Format 1st value	004	113
		Management	Reset	124	113
	Measurement	Lin./SQRT switch (Deltabar)		133	113
		Measuring mode *Measuring mode (read only)*		005 *182*	113

Level 1	Level 2	Level 3	Level 4	Direct access	Page
 ...	 ...	**Basic setup** ...	Pos. zero adjust (Deltabar and gauge pressure sensors) Calib. offset (absolute pressure sensors)	007 008	114
... Expert	**... Measurement**	**... Basic Setup**	Damping switch (read only)	164	114
			Damping value *Damping (read only)*	017 *184*	114
			Pressure unit	125	114
			Temp. eng. unit (Cerabar/ Deltapilot)	126	115
			Sensor temp. (Cerabar/ Deltapilot)	110	115
		Pressure	Switch P1/P2 (Deltabar)	163	115
			High pressure side (Deltabar) *High pressure side (read only)*	006 *183*	115
			Set LRV	013	125
			Set URV	014	126
			Meas. pressure	020	116
			Sensor pressure	109	117
			Corrected press.	172	117
			Pressure af. damp	111	117
		Level	Level selection	024	118
			Unit before lin	025	118
			Height unit	026	118
			Calibration mode	027	118
			Empty calib. *Empty calib.*	028 011	119
			Empty pressure *Empty pressure (read only)*	029 *185*	119
			Empty height *Empty height (read only)*	030 *186*	119
			Full calib. *Full calib.*	031 012	119
			Full pressure *Full pressure (read only)*	032 *187*	119
			Full height *Full height (read only)*	033 *188*	119
			Density unit	127	120
			Adjust density *Adjust density (read only)*	034 *189*	120
			Process density *Process density (read only)*	035 *181*	120
			Level before lin.	019	120
		Linearization	Lin. mode	037	120
			Unit after lin.	038	120
			Line-numb.:	039	121
			X-value:	040	121
			Y-value:	041	121

Level 1	Level 2	Level 3	Level 4	Direct access	Page
			Edit table	042	121
			Tank description	173	121
			Tank content	043	121
...	...	**Flow** (Deltabar)	Flow type	044	121
... Expert	**... Measurement**	**... Flow** (Deltabar)	Mass flow unit	045	122
			Norm. flow unit	046	122
			Std. flow unit	047	122
			Flow unit	048	122
			Max. flow	009	123
			Max. press. flow	010	123
			Set low-flow cut-off	049	123
			Flow	018	123
		Sensor limits	LRL sensor	101	124
			URL sensor	102	124
		Sensor trim	Lo trim measured	129	124
			Hi trim measured	130	124
			Lo trim sensor	131	124
			Hi trim sensor	132	124
	Output	**Current output**	Output current (read only)	054	124
			Alarm behav. P	050	124
			Alarm cur.switch (read only)	165	124
			Output fail mode *Output fail mode (read only)*	190 *051*	125
			High alarm curr.	052	125
			Set min. current	053	125
			Lin./SQRT switch (Deltabar)	133	125
			Linear/Sqroot (Deltabar)	055	125
			Get LRV (only "Pressure")	015	125
			Set LRV	056 013 166 168	125
			Get URV (only "Pressure")	016	126
			Set URV	057 014 067 169	126
			Start current	134	126
			Curr. trim 4mA	135	126
			Curr. trim 20mA	136	126
			Offset trim 4 mA	137	126
			Offset trim 20 mA	138	126
	Communication	**HART config**	Burst mode	142	127
			Burst option	143	127
			Current mode	144	127

Level 1	Level 2	Level 3	Level 4	Direct access	Page
			Bus address	145	127
			Preamble number	146	127
		HART info	Device ID	105	127
…	…	…	Device revision	108	127
… Expert	**… Communication**	**… HART info**	Manufacturer ID	103	127
			HART version	180	127
			Description	139	128
			HART message	140	128
			HART date	141	128
		HART output	Primary value Is	147	128
			Primary value	148	128
			Secondary value Is	149	128
			Secondary value	150	128
			Third value is	151	128
			Third value	152	128
			4th value Is	153	128
			4th value	154	128
		HART input	HART input value	155	128
			HART input stat.	179	128
			HART input unit	156	129
			HART input form.	157	129
	Application	Electr. delta P (Cerabar/Deltapilot)		158	130
		Fixed ext. value (Cerabar/Deltapilot)		174	130
		Totalizer 1 (Deltabar)	Eng. unit totalizer 1	058 059 060 061	131
			Totalizer 1 mode	175	131
			Totalizer 1 failsafe	176	131
			Reset totalizer 1	062	131
			Totalizer 1	063	131
			Totalizer 1 overflow	064	131
		Totalizer 2 (Deltabar)	Eng. unit totalizer 2	065 066 067 068	132
			Totalizer 2 mode	177	132
			Totalizer 2 failsafe	178	132
			Totalizer 2	069	132
			Totalizer 2 overflow	070	132
	Diagnostic	Diagnostic code			133
		Last diag. code			133
		Reset logbook		159	133
		Min. meas. press.		073	133
		Max. meas. press.		074	133

Level 1	Level 2	Level 3	Level 4	Direct access	Page
		Reset peakhold		161	133
		Operating hours		162	133
		Config. counter		100	133
...	**...**	**Diagnostic list**	Diagnostic 1	075	133
... Expert	**... Diagnosis**	**... Diagnostic list**	Diagnostic 2	076	133
			Diagnostic 3	077	133
			Diagnostic 4	078	133
			Diagnostic 5	079	133
			Diagnostic 6	080	133
			Diagnostic 7	081	133
			Diagnostic 8	082	133
			Diagnostic 9	083	133
			Diagnostic 10	084	133
		Event logbook	Last diag. 1	085	134
			Last diag. 2	086	134
			Last diag. 3	087	134
			Last diag. 4	088	134
			Last diag. 5	089	134
			Last diag. 6	090	134
			Last diag. 7	091	134
			Last diag. 8	092	134
			Last diag. 9	093	134
			Last diag. 10	094	134
		Simulation	Simulation mode	112	134
			Sim. pressure	113	135
			Sim. flow (Deltabar)	114	135
			Sim. level	115	135
			Sim. tank cont.	116	135
			Sim. current	117	135
			Sim. error no.	118	135

12.2 Parameter description

This section describes the parameters in the order they are arranged in the "Expert" operating menu.

Expert

Parameter name	Description
Direct access (119) User input	Enter the direct access code to go directly to a parameter. **Options:** ▪ A number between 0 and 999 (only valid entries are recognized) **Factory setting:** 0 **Note:** For direct access, it is not necessary to enter leading zeros.

12.2.1 System

Expert → System

Parameter name	Description
Code definition (023) User input	Use this function to enter a release code that allows you to unlock the device. **Options:** ▪ A number from 0 to 9999 **Factory setting:** 0
Lock switch (120) Display	Displays the status of DIP switch 1 on the electronic insert. You can lock or unlock parameters relevant to the measured value with DIP switch 1. If operation is locked by means of the **"Operator code" (021)** parameter, you can only unlock operation again by means of this parameter. **Display:** ▪ On (locking switched on) ▪ Off (locking switched off) **Factory setting:** Off (locking switched off)
Operator code (021) User input	Use this function to enter a code to lock or unlock operation. **Options:** ▪ To lock: Enter a number ≠ the release code. ▪ To unlock: Enter the release code. The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, it can be made visible again by entering the number sequence "5864". **Factory setting:** 0

Expert → System → Instrument info

Parameter name	Description
Cust. tag number (254) User input	Enter device tag e.g. TAG number (max. 8 alphanumeric characters). **Factory setting:** No entry or according to order specifications
Device tag (022) User input	Enter device tag e.g. TAG number (max. 32 alphanumeric characters). **Factory setting:** No entry or according to order specifications
Serial number (096) Display	Displays the serial number of the device (11 alphanumeric characters).
Firmware version (095) Display	Displays the firmware version.
Ext. order code (097) Display	Enter the extended order code. **Factory setting** As per order specifications
Order code (098) User input	Enter the order identifier. **Factory setting** As per order specifications
ENP version (099) Display	Displays the ENP version (ENP = electronic nameplate)
Electr. serial no (121) Display	Displays the serial number of the main electronics (11 alphanumeric characters).
Ser.no. sensor (122) Display	Displays the serial number of the sensor (11 alphanumeric characters).

Expert → System → Display

Parameter name	Description
Language (000) Options	Select the menu language for the onsite display. **Options:** ▪ English ▪ Possibly another language (as selected when ordering the device) ▪ One further language (language of the manufacturing plant) **Factory setting**: English
Display mode (001) Options	Specify the display mode for the onsite display during operation. **Options:** ▪ Main value only ▪ External value ▪ All alternating **Factory setting:** Primary value (PV)
Add. display value (002) Options	Specify the contents for the second value in the alternating display mode of the onsite display in measuring mode. **Options:** ▪ No value ▪ Pressure ▪ Main value(%) ▪ Current ▪ Totalizer 1 ▪ Totalizer 2 The options depend on the measuring mode chosen. **Factory setting:** No value

Parameter name	Description
Format 1st value (004) Options	Specifies the number of places after the decimal point for the value displayed in the main line. **Options:** ▪ Auto ▪ x ▪ x.x ▪ x.xx ▪ x.xxx ▪ x.xxxx ▪ x.xxxxx **Factory setting:** Auto

Expert → System → Management

Parameter name	Description
Enter reset code (124) User input	Reset parameters completely or partially to the factory values or order configuration, → 📄 52, "Resetting to factory settings (reset)". **Factory setting:** 0

12.2.2 Measurement

Expert → Measurement

Parameter name	Description
Lin./SQRT switch (133) Display	Displays the status of DIP switch 4 on the electronic insert, which is used to define the output characteristics of the current output. **Display:** ▪ SW setting The output characteristics is defined by the "Linear/Sqroot" (055) parameter. ▪ Square root The square root signal is used, independent of the setting in the "Linear/Sqroot" (055) parameter. **Factory setting** SW setting
Measuring mode (005) Options	Select the measuring mode. The operating menu is structured according to the selected measuring mode. **⚠ WARNING** **Changing the measuring mode affects the span (URV)!** This situation can result in product overflow. ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured! **Options:** ▪ Pressure ▪ Level ▪ Flow (Deltabar M only) **Factory setting** Pressure or according to order specifications

Expert → Measurement → Basic setup

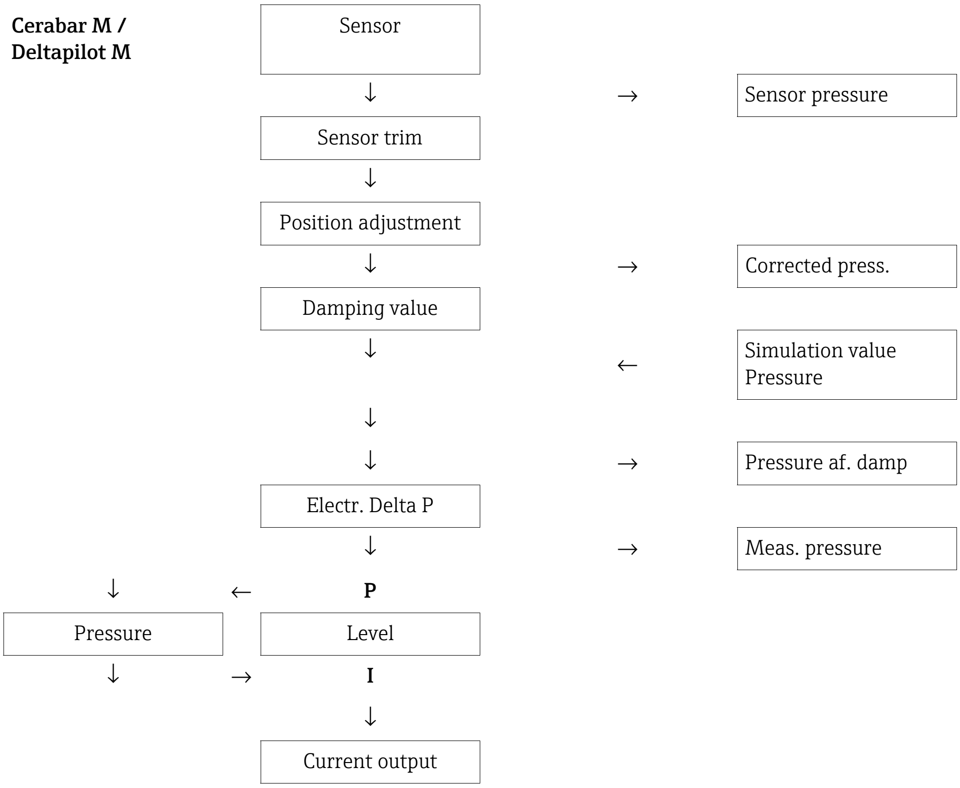
Parameter name	Description
Pos. zero adjust (007) (Deltabar M and gauge pressure measuring cells) Options	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. **Options** ▪ Confirm ▪ Cancel **Factory setting:** Cancel
Calib. offset (192) / (008) (absolute pressure sensors) Options	Position adjustment – the pressure difference between the set point and the measured pressure must be known. **Example:** – Measured value = 982.2 mbar (14.73 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Calib. Offset" parameter. This means that you are assigning the value 980.0 (14.7 psi) to the pressure present. – Measured value (after pos. zero adjust) = 980.0 mbar (14.7 psi) – The current value is also corrected. **Factory setting:** 0.0
Damping switch (164) Display	Displays the switch position of DIP switch 2 which is used to switch the damping of the output signal on and off. **Display:** ▪ Off The output signal is not damped. ▪ On The output signal is damped. The attenuation constant is specified in the "Damping value" (017) (184) parameter. **Factory setting** On
Damping value (017) User input	Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure. **Input range:** 0.0 to 999.0 s **Factory setting:** 2.0 sec. or as per order specifications
Press. eng. unit (125) Options	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. **Options:** ▪ mbar, bar ▪ mmH2O, mH2O ▪ in, H2O, ftH2O ▪ Pa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ kgf/cm^2 **Factory setting:** mbar or bar depending on the nominal measuring range of the sensor, or as per order specifications

Parameter name	Description
Temp. eng. unit (126) (only Cerabar M and Deltapilot M) Options	Select the unit for the temperature measured values. The setting affects the unit for the "Sensor temp." parameter. **Options:** ▪ °C ▪ °F ▪ K **Factory setting:** °C
Sensor temp. (110) (only Cerabar M and Deltapilot M) Display	Displays the temperature currently measured in the sensor. This can deviate from the process temperature.

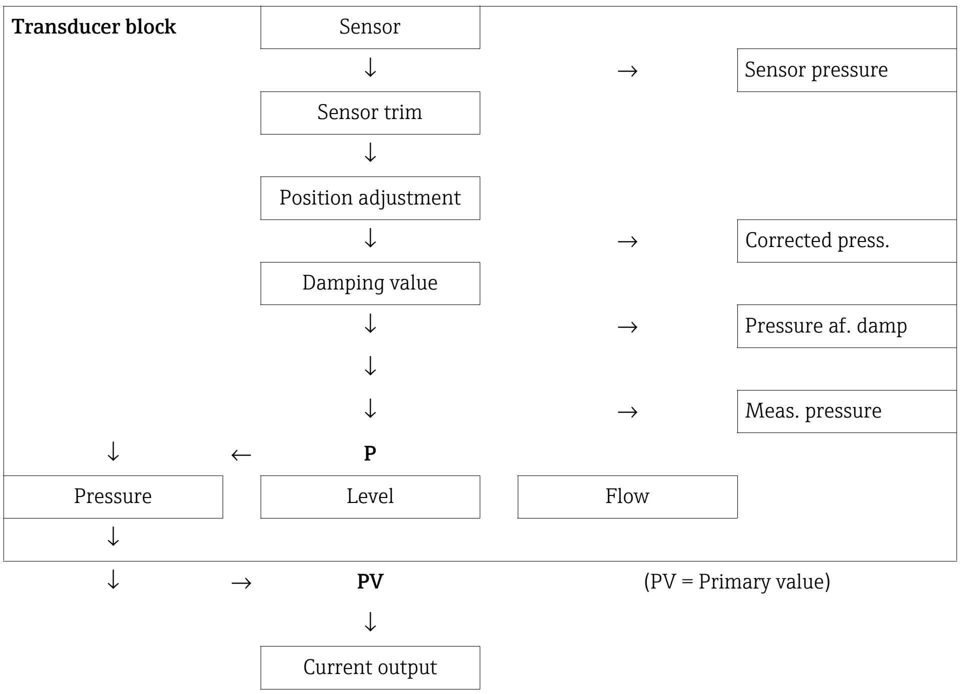
Expert → Measurement → Pressure

Parameter name	Description
Switch P1/P2 (163) Display	Indicates whether the "SW/P2 High" DIP switch (DIP switch 5) is switched on. The "SW/P2 High" DIP switch determines which pressure input corresponds to the high-pressure side. **Display:** ▪ SW setting "SW/P2 High" is switched off: The **"High pressure side" (183)** parameter determines which pressure input corresponds to the high-pressure side. ▪ P2 High "SW/P2 High" is switched on: Pressure input P2 corresponds to the high-pressure side, independent of the setting in the **"High pressure side" (183)** parameter. **Factory setting:** SW setting
High pressure side (006) (183) Options	Determines which pressure input corresponds to the high-pressure side. This setting is only valid if the "SW/P2 High" DIP switch is in the OFF position (see the **"Pressure side switch" parameter (163)** parameter). Otherwise P2 corresponds to the high-pressure side in any case. **Options:** ▪ P1 High Pressure input P1 is the high-pressure side. ▪ P2 High Pressure input P2 is the high-pressure side. **Factory setting** P1 High
Set LRV (013) Display	Set the lower-range value – without reference pressure. Enter pressure value for the lower current value (4 mA). **Factory setting:** 0.0 or as per order specifications
Set URV (014) Display	Set the upper-range value – without reference pressure. Enter pressure value for the upper current value (20 mA). **Factory setting:** Upper range limit or as per order specifications.

Parameter name	Description
Meas. pressure (020) Display	Displays the measured pressure after sensor trim, position adjustment and damping.



Deltabar M



Parameter name	Description
Sensor pressure (109) Display	Displays the measured pressure before sensor trim and position adjustment.
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.
Pressure af. damp (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.

Expert → Measurement → Level

Parameter name	Description
Level selection (024) Options	Select the method for calculating the level **Options:** ▪ In pressure If this option is selected, specify two pressure/level value pairs. The level value is displayed directly in the unit that you select via the parameter "Unit before lin". ▪ In height If this option is selected, specify two height/level value pairs. From the measured pressure, the device first calculates the height using the density. This information is then used to calculate the level in the "Unit before lin." selected using the two value pairs specified. **Factory setting:** In pressure
Unit before lin (025) Options	Select the unit for the measured value display for the level before linearization. The selected unit is used only to describe the measured value. This means that the measured value is not converted when a new output unit is selected. **Example:** ▪ Current measured value: 0.3 ft ▪ New output unit: m ▪ New measured value: 0.3 m **Options** ▪ % ▪ mm, cm, dm, m ▪ ft, in ▪ m^3, in^3 ▪ l, hl ▪ ft^3 ▪ gal, Igal ▪ kg, t ▪ lb **Factory setting:** %
Height unit (026) Options	Select height unit. The measured pressure is converted to the selected height unit using the "Adjust Density" parameter. **Prerequisite** "Level selection" = "In height" **Options** ▪ mm. ▪ m ▪ in ▪ ft **Factory setting:** m
Calibration mode (027) Options	Select calibration mode. **Options:** ▪ Wet Wet calibration is performed by filling and emptying the container. In the case of two different levels, the level, volume, mass or percentage value entered is assigned to the pressure measured at this point in time ("Empty Calib." and "Full Calib." parameters). ▪ Dry Dry calibration is a theoretical calibration. For this calibration, you specify two pressure-level value pairs via the following parameters: "Empty Calib.", "Empty Pressure", "Full Calib.", "Full Pressure". **Factory setting:** Wet

Parameter name	Description
Empty calib. (028) **Empty calib. (011)** User input	Enter the output value for the lower calibration point (container empty). The unit defined in "Unit before lin" must be used. ▪ In the case of wet calibration, the level (container empty) must actually be available. The associated pressure is then automatically recorded by the device. ▪ In the case of dry calibration, the level (container empty) does not have to be available. For the level section "in pressure", the associated pressure in the "**Empty pressure (029)**" parameter must be entered. The associated height has to be entered in the "Empty Height" (030) parameter for the "In height" level selection. **Factory setting:** 0.0
Empty pressure (029) User input/display	Enter the pressure value for the lower calibration point (container empty). → See also "**Empty calib. (028)**". **Prerequisite** ▪ "Level selection" = In pressure ▪ "Calibration mode" = Dry -> entry ▪ "Calibration mode" = Wet -> display **Factory setting:** 0.0
Empty height (030) User input/display	Enter the height value for the lower calibration point (container empty). Select the unit via the "**Height unit (026)**" parameter. **Prerequisite:** ▪ "Level selection" = "In height" ▪ "Calibration mode" = Dry -> entry ▪ "Calibration mode" = Wet -> display **Factory setting:** 0.0
Full calib. (031) **Full calib. (012)** User input	Enter the output value for the upper calibration point (container full). The unit defined in "Unit before lin" must be used. ▪ In the case of wet calibration, the level (container full) must actually be available. The associated pressure is then automatically recorded by the device. ▪ In the case of dry calibration, the level (container full) does not have to be available. The associated pressure has to be entered in the "Full Pressure" parameter for the "In pressure" level selection. The associated height has to be entered in the "Full height" parameter for the "In height" level selection. **Factory setting:** 100.0
Full pressure (032) User input/display	Enter pressure value for the upper calibration point (container full). → See also "Full calib.". **Prerequisite** ▪ "Level selection" = In pressure ▪ "Calibration mode" = Dry -> entry ▪ "Calibration mode" = Wet -> display **Factory setting:** Upper-range limit (URL) of the sensor
Full height (033) User input/display	Enter height value for the upper calibration point (container full). The unit is selected via the "Height unit" parameter. **Prerequisite:** ▪ "Level selection" = "In height" ▪ "Calibration mode" = Dry -> entry ▪ "Calibration mode" = Wet -> display **Factory setting:** Upper range limit (URL) is converted to a level unit

Parameter name	Description
Density unit (127) Options	Select density unit. The measured pressure is converted to a height using the "Height unit" and "Adjust Density" parameters. **Factory setting:** ▪ g/cm³
Adjust density (034) User input	Enter the density of the medium. The measured pressure is converted to a height using the "Height unit" and "Adjust Density" parameters. **Factory setting:** 1.0
Process density (035) User input	Enter a new density value for density correction. The calibration was carried out with water as the medium, for example. Now the container is to be used for another medium with another density. The calibration is corrected appropriately by entering the new density value in the "Process density" parameter. If you change to dry calibration after completing a wet calibration using the "Calibration mode" parameter, the density for the "Adjust Density" and "Process Density" parameters must be entered correctly before changing the calibration mode. **Factory setting:** 1.0
Level before lin. (019) Display	Displays the level value prior to linearization.

Expert → Measurement → Linearization

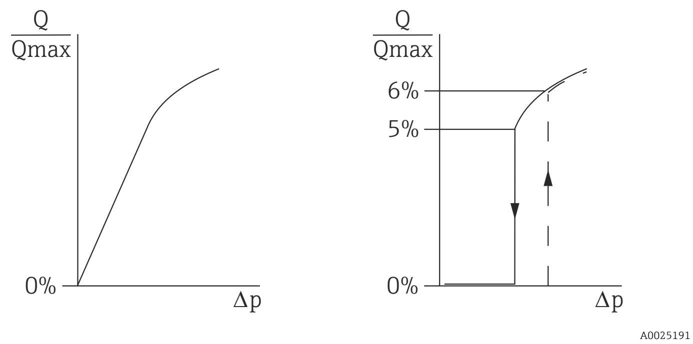
Parameter name	Description
Lin. mode (037) Options	Select the linearization mode. **Options:** ▪ Linear: The level is output without being converted beforehand. "Level before lin." is output. ▪ Erase table: The existing linearization table is cleared. ▪ Manual entry (sets the table to edit mode; an alarm is output): The value pairs of the table (**X-value (193/040)** and **Y-val (041)**) are entered manually. ▪ Semiautomatic entry (sets the table to the edit mode, an alarm is output): The container is emptied or filled in stages in this entry mode. The device automatically records the level value (**X-value (193/040)**). The associated volume, mass or %-value is entered manually (**Y-val (041)**). ▪ Activate table The table entered is activated and checked with this option. The device shows the level after linearization. **Factory setting:** Linear
Unit after lin. (038) Options	Select the volume unit (unit of the Y-value). **Options:** ▪ % ▪ cm, dm, m, mm ▪ hl ▪ in³, ft³, m³ ▪ l ▪ in, ft ▪ kg, t ▪ lb ▪ gal ▪ Igal **Factory setting:** %

Parameter name	Description
Line-numb (039) User input	Enter the number of the current point in the table. The subsequent entries in "X-val." and "Y-val." refer to this point. **Input range:** ▪ 1 to 32
X-value (193/040) Display/user input	Enter the X-value (level before linearization) for the specific point in the table and confirm. ▪ If "Lin. mode" = "Manual", the level value must be entered. ▪ If "Lin. mode" = "Semiautomatic", the level value is displayed and has to be confirmed by entering the paired Y-val.
Y-val (041) User input	Enter the Y-value (value after linearization) for the specific point in the table. The unit is determined by "Unit after lin." The linearization table must be monotonic (increasing or decreasing).
Edit table (042) Options	Select the function for entering the table. **Options:** ▪ Next point: Enter the next point. ▪ Current point: stay on the current point to correct a mistake for example. ▪ Previous point: skip back to the previous point to correct a mistake for example. ▪ Insert point: insert an additional point (see example below). ▪ Delete point: Delete the current point (see example below).. **Example:** Add a point - in this case between the 4th and 5th point for example – Select point 5 via the "Line-numb." parameter. – Select the "Insert point" option via the "Edit table" parameter. – Point 5 is displayed for the "Line-numb" parameter. Enter new values for the "X-val." and "Y-val." parameters. **Example:** Delete a point - in this case the 5th point for example – Select point 5 via the "Line-numb." parameter. – Select the "Delete point" option via the "Edit table" parameter. – The 5th point is deleted. All of the subsequent points are moved up one number i.e. following deletion, the 6th point becomes Point 5. **Factory setting:** Current point
Tank description (173) User input	Enter the tank description (max. 32 alphanumeric characters)
Tank content (043) Display	Displays the level value after linearization.

Expert → Measurement → Flow (Deltabar M)

Parameter name	Description
Flow type (044) Options	Select the flow type. **Options:** ▪ Volume process cond. (volume under operating conditions) ▪ Volume norm. cond. (norm volume under norm conditions in Europe: 1013.25 mbar and 273.15 K (0 °C)) ▪ Volume std. cond. (standard volume under standard conditions in the USA: 1013.25 mbar (14.7 psi) and 288.15 K (15 °C/59 °F)) ▪ Mass ▪ Flow in % **Factory setting:** Volume operat. conditions

Parameter name	Description
Mass flow unit (045) Options	Select mass flow unit. When a new flow unit is selected, all flow-specific parameters are converted and displayed with the new unit within a flow type. When the flow mode is changed, conversion is not possible. **Prerequisite:** ▪ "Flow type" (044) = Mass **Options:** ▪ g/s, kg/s, kg/min, kg/h ▪ t/s, t/min, t/h, t/d ▪ oz/s, oz/min ▪ lb/s, lb/min, lb/h ▪ ton/s, ton/min, ton/h, ton/d **Factory setting:** kg/s
Norm. flow unit (046) Options	Select norm flow unit. When a new flow unit is selected, all flow-specific parameters are converted and displayed with the new unit within a flow type. When the flow mode is changed, conversion is not possible. **Prerequisite:** ▪ "Flow type" (044) = Volume norm. cond. **Options:** ▪ Nm^3/s, Nm^3/min, Nm^3/h, Nm^3/d **Factory setting:** Nm^3/s
Std. flow unit (047) Options	Select standard flow unit. When a new flow unit is selected, all flow-specific parameters are converted and displayed with the new unit within a flow type. When the flow mode is changed, conversion is not possible. **Prerequisite:** ▪ "Flow type" (044) = Volume std. cond. **Options:** ▪ Sm^3/s, Sm^3/min, Sm^3/h, Sm^3/d ▪ SCFS, SCFM, SCFH, SCFD **Factory setting:** Sm^3/s
Flow unit (048) Options	Select volume flow unit. When a new flow unit is selected, all flow-specific parameters are converted and displayed with the new unit within a flow type. When the flow mode is changed, conversion is not possible. **Prerequisite:** ▪ "Flow type" (044) = Volume process cond. **Options:** ▪ dm^3/s, dm^3/min, dm^3/h ▪ m^3/s, m^3/min, m^3/h, m^3/d ▪ l/s, l/min, l/h ▪ hl/s, hl/min, hl/d ▪ ft^3/s, ft^3/min, ft^3/h, ft^3/d ▪ ACFS, ACFM, ACFH, ACFD ▪ ozf/s, ozf/min ▪ Gal/s, Gal/min, Gal/h, Gal/d, MGal/d ▪ I gal/s, I gal/min, I gal/h ▪ bbl/s, bbl/min, bbl/h, bbl/d **Factory setting:** m^3/h

Parameter name	Description
Max. flow (009) User input	Enter maximum flow of primary element. See also layout sheet of primary element. The maximum flow is assigned to the maximum pressure which you enter via the "Max. pressure flow" (010) parameter. Use the "**Linear/Sqroot" (055)** parameter to specify the current signal for the "Flow" measuring mode. The following applies for the "square root" setting: If you enter a new value for "**Max. flow" (009)**, the value for "**Set URV" (057)** is also changed. Use the "**Set URV" (057)** parameter to assign a flow to the upper current value. If you want to assign the upper current value a value other than that for "**Max. flow" (009)**, you must enter the desired value for "**Set URV" (057)**. **Factory setting:** 100.0
Max. pressure flow (010) User input	Enter maximum pressure of primary element. → See layout sheet of primary element. This value is assigned to the maximum flow value (→ See **"Max. flow" (009)**). Use the "**Linear/Sqroot" (055)** parameter to specify the current signal for the "Flow" measuring mode. The following applies for the "linear" setting: If you enter a new value for "**Max. pressure flow" (010)**, the value for "**Set URV" (014)** is also changed. Use the "**Set URV" (014)** parameter to assign a pressure value to the upper current value. If you want to assign the upper current value a value other than that for "Max. press. flow" (010), you must enter the desired value for "**Set URV" (014)**. **Factory setting:** Upper-range limit (URL) of the sensor
Set low-flow cut-off (049) User input	Enter switch-on point of the flow-flow cut-off. The hysteresis between the switch-on point and the switch-off point is always 1% of the maximum flow value. **Input range:** 0...50 % of the end flow value t (**"Max. flow" (009)**).  **Factory setting:** 5 % (of the maximum flow value)
Flow (018) Display	Displays the present flow value.

Expert → Measurement → Sensor limits

Parameter name	Description
LRL sensor (101) Display	Displays the lower-range limit of the sensor
URL sensor (102) Display	Displays the upper-range limit of the sensor

Expert → Measurement → Sensor trim

Parameter name	Description
Lo trim measured (129) Display	Displays the reference pressure present to be accepted for the lower calibration point.
Hi trim measured (130) Display	Displays the reference pressure present to be accepted for the upper calibration point.
Lo trim sensor (131) Display	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the lower calibration point.
Hi trim sensor (132) Display	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the upper calibration point.

12.2.3 Output

Expert → Output → Current output

Parameter name	Description
Output current (054) Display	Displays the current current value
Alarm behav. P (050) Options	Configure the current output for when the sensor limits are undershot or overshot. **Options:** ▪ Warning The device continues to measure. An error message is displayed. ▪ Alarm The output signal assumes a value that can be defined by the "Output fail mode" function. ▪ NAMUR – The lower sensor limit is undershot: current output = 3.6 mA – Exceeding the upper sensor limit: Current output assumes a value from 21 - 23 mA, depending on the setting of the "**High alarm curr." (052) parameter** . **Factory setting:** Warning
Alarm cur.switch (165)	Displays the switching state of DIP switch 3 "SW/Alarm min." **Display** ▪ SW The alarm current has the value defined in **"Output fail mode" (190)**. ▪ Alarm min. The alarm current is 3.6 mA, regardless of the software setting.

Parameter name	Description
Output fail mode (190) Options	Select the current value in the event of an alarm. In the event of an alarm, the current and the bar graph assume the current value specified with this parameter. **Options:** ▪ Max alarm: can be set from 21 to 23 mA ▪ Hold measured value: last measured value is held. ▪ Min. alarm: 3.6 mA **Factory setting:** Max. alarm (22 mA)
Max. alarm current (052) User input	Enter current value for maximum alarm current. → See also "Output fail mode". **Input range:** 21 to 23 mA **Factory setting:** 22 mA
Set min. current (053) User input	Enter the lower current limiting value. Some switching units do not accept current values lower than 4.0 mA. **Options:** ▪ 3.8 mA ▪ 4.0 mA **Factory setting:** 3.8 mA
Lin./SQRT switch (133) Display	Displays the state of DIP switch 4 "SW/SQRT". **Display** ▪ SW The output characteristics is defined in the "Linear/Sqroot" (055) parameter ▪ Square root The output characteristics follows a square root function, independent of the software setting. This characteristics is needed for differential pressure flow measurement.
Linear/Sqroot (055) Options	Specify current signal for the "Flow" measuring mode. See also **"Set LRV" (056)** and **"Set URV" (057)**. **Prerequisite:** ▪ "Measuring mode" (005) = Flow **Options:** ▪ Linear The linear pressure signal is used for the current output. The flow must be calculated in the evaluation unit. Deviating from the bar graph (current output), the digital value on the display continues to show the square root value. ▪ Square root The root flow signal is used for the current output. The "Flow (square root)" current signal is indicated on the onsite display with a root symbol. **Factory setting:** Square root
Get LRV (015) User input	Set lower range value – reference pressure is present at device. The pressure for the lower current value (4 mA) is present at the device. Use the "Confirm" option to assign the applied pressure value to the lower current value. **Prerequisite:** Pressure measuring mode **Options:** ▪ Cancel ▪ Confirm **Factory setting:** Cancel
Set LRV (056, 013, 166, 168) User input	Set the pressure value for the lower current value (4 mA). **Factory setting:** 0.0 % in the level measuring mode; 0.0 or in accordance with ordering specifications in the pressure measuring mode 0.0 m^3/h in the flow measureing mode

Parameter name	Description
Get URV (016) User input	Set upper range value – reference pressure is present at device. The pressure for the upper current value (20 mA) is present at device. With the "Confirm" option, you assign the upper current value to the pressure value present. **Prerequisite:** Pressure measuring mode **Options:** ▪ Cancel ▪ Confirm **Factory setting:** Cancel
Set URV (057, 014, 167, 169) User input	Set the pressure value for the upper current value (20 mA). **Factory setting:** 100.0 % in the level measuring mode; URL sensor or in accordance with ordering information in the pressure measuring mode; 3600 m^3/h in the flow measuring mode
Start current (134) User input	Use this function to enter the start current. This setting also applies in the HART Multidropmode. **Options:** ▪ 12 mA ▪ Max alarm (22 mA, cannot be adjusted) **Factory setting:** 12 mA
Curr. trim 4mA (135) User input	Enter the pressure value for the lower point (4 mA) of the current partial regression lines. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 20mA". Carry out the current trim for the lower point as follows: 1. In the "Simulation Mode" parameter, select the "Current" option. 2. Set the 4mA value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 4 mA" parameter. **Input range:** Measured current ±0.2 mA **Factory setting:** 4 mA
Curr. trim 20mA (136) User input	Enter the pressure value for the upper point (20 mA) of the current partial regression lines. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 4mA". Carry out the current trim for the lower point as follows: 1. In the "Simulation Mode" parameter, select the "Current" option. 2. In the "Sim current" parameter, enter the value "20 mA". 3. Enter the current value measured using the switching unit in the "Curr. trim 20 mA" parameter. **Input range:** Measured current ±1 mA **Factory setting:** 20 mA
Offset trim 4mA (137) Display/user input	Display/enter the difference between 4 mA and the value entered for the "Curr. trim 4 mA" parameter. **Factory setting:** 0
Offset trim 20mA (138) Display/user input	Display/enter the difference between 20 mA and the value entered for the "Curr. trim 20 mA" parameter. **Factory setting:** 0

12.2.4 Communication

Expert → Communication → HART config

Parameter name	Description
Burst mode (142) Options	Switch the burst mode on and off. **Options:** ▪ On ▪ Off **Factory setting:** Off
Burst option (143) User input	You can use this parameter to define which command is sent to the master. **Options:** ▪ 1 (HART command 1) ▪ 2 (HART command 2) ▪ 3 (HART command 3) ▪ 9 (HART command 9) ▪ 33 (HART command 33) **Factory setting:** 1 (HART command 1)
Current mode (144) Options	Configure current mode for HART communication. **Options:** ▪ Signaling Measured value transmission by the current value ▪ Fixed Fixed current 4.0 mA (Multidrop mode) (measured value only transmitted via HART digital communication) **Factory setting** Signaling
Bus address (145) User input	Use this function to enter the address via which a data exchange is to take place via HART protocol. (HART 5.0 master: range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) **Factory setting:** 0
Preamble number (146) User input	Enter the number of preambles in the HART protocol. (Synchronization of the modem components along a transmission path, each modem component could "swallow" one byte, at least 2 bytes must be the preamble.) **Input range:** 2 to 20 **Factory setting:** 5

Expert → Communication → HART info

Parameter name	Description
Device type code (105) Display	Display of the numerical ID of the device for Deltabar M: 33 for Deltapilot M: 35 for Cerabar M: 25
Device revision (108) Display	Display of Device Revision (e.g. 1)
Manufacturer ID (103) Display	Displays the manufacturer number in decimal numerical format. Here: 17
Hart version (180) Display	Displays the HART version

Parameter name	Description
Description (139) User input	Enter the tag description (max. 16 alphanumeric characters).
HART message (140) User input	Enter a message (max. 32 alphanumeric characters). Upon request from the master, this message is sent via the HART protocol.
HART date (141) User input	Enter the date of the last configuration change. **Factory setting:** DD/MM/YY (date of the final test)

Expert → Communication → HART output

Parameter name	Description
1. Primary value is (147) Display	Indicates which measured variable is transmitted via the HART protocol as the primary process value. The display depends on the selected "Measuring Mode": – "Pressure" measuring mode: "Meas. pressure" – "Level" measuring mode, Lin. mode "Linear": "Level before lin." – "Level" measuring mode, Lin. mode "Activate table": "Tank content" – "Flow" measuring mode: "Flow"
Primary value (148) Display	The primary value is displayed.
Secondary value is (149) Display	Indicates which measured variable is transmitted via the HART protocol as the secondary process value. Depending on the selected measuring mode, the following measured values can be displayed: – "Meas. pressure" – "Sensor pressure" – "Corrected press." – "Pressure af. damp" – "Sensor temp." – "Level before lin." – "Tank content" – "Tank content" – Totalizer 1 – Totalizer 2
Secondary value (150) Display	Display of the secondary value
Third value is (151) Display	Indicates which measured variable is transmitted via the HART protocol as the third process value. The value displayed depends on the selected measuring mode. See also "Secondary val. is"
Third value (152) Display	Displays the third process value.
4th value is (153) Display	Indicates which measured variable is transmitted via the HART protocol as the fourth process value. The value displayed depends on the selected measuring mode. See also "Secondary val. is"
4th value (154) Display	Display of the fourth value

Expert → Communication → HART input

Parameter name	Description
HART input value (155) Display	Display of the HART input value
HART input stat. (179) Display	Display of the HART input status Bad / Uncertain / Good

Parameter name	Description
HART input unit (156) Options	Select the unit of the HART input value. **Options:** ▪ unknown ▪ mbar, bar ▪ mmH2O, ftH2O, inH2O ▪ Pa, hPa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ Torr ▪ g/cm², kg/cm² ▪ lb/ft² ▪ atm ▪ °C, °F, K, R **Factory setting:** unknown
HART input form. (157) Options	Specify the format for displaying the HART input value. **Options:** ▪ x.x (default) ▪ x.xx ▪ x.xxx ▪ x.xxxx ▪ x.xxxxx **Factory setting:** x.x

12.2.5 Application

Expert → Application (Cerabar M and Deltapilot M)

Parameter name	Description
Electr. delta P (158) User input	For switching the electr. delta P application on or off with an external or constant value. **Options:** Off External value Constant **Factory setting:** Off
Fixed ext. value (174) User input	Use this function to enter the constant value. The value refers to "HART input unit". **Factory setting:** 0.0

Expert → Application → Totalizer 1 (Deltabar M)

With the "Flow in %" flow type setting, the totalizer is not active and is not displayed at this position.

Parameter name	Description
Eng. unit totalizer 1 (058) (059) (060) (061) Options	Select unit for totalizer 1. **Options** Depending on the setting in the **"Flow-meas. type" (044)** parameter (→ Page 121) this parameter offers a list of volume, norm volume, standard volume and mass units. When a new volume or mass unit is selected, totalizer-specific parameters are converted and displayed with the new unit within a unit group. When the flow mode is changed, the totalizer value is not converted. The Direct Access Code depends on the selection in the **"Flow meas. type" (044)** parameter: – (058): Flow. meas. type "Mass" – (059): Flow. meas. type "Volume norm. cond." – (060): Flow. meas. type "Volume std. cond." – (061): Flow. meas. type "Volume process cond." **Factory setting:** m^3
Totalizer 1 mode (175) Options	Define the behavior of the totalizer. **Options:** ▪ Balanced: Integration of all measured flows (positive and negative) ▪ Pos. flow only: only positive flows are integrated. ▪ Neg. flow only: only negative flows are integrated. ▪ Hold: The flow counter is stopped. **Factory setting:** Pos. flow only
Totalizer 1 failsafe (176)	Define the behavior of the totalizer in the case of an error. **Options:** ▪ Run: The current flow value continues to be integrated. ▪ Hold: The flow counter is stopped. **Factory setting:** Run
Reset Totalizer 1 (062) Options	You reset totalizer 1 to zero with this parameter. **Options:** ▪ Abort (do not reset) ▪ Reset **Factory setting:** Cancel
Totalizer 1 (063) Display	Displays the total flow value of totalizer 1. You can reset the value with the **"Reset totalizer 1" (062)** parameter. The **"Totalizer 1 overflow" (064)** parameter displays the overflow. **Example:** The value 123456789 m^3 is displayed as follows: – Totalizer 1: 3456789 m^3 – Totalizer 1 overflow: 12 E7 m^3
Totalizer 1 overflow (064) Display	Displays the overflow value of totalizer 1. → See also **"Totalizer 1" (063)**.

Expert → Application → Totalizer 2 (Deltabar M)

With the "Flow in %" flow type setting, the totalizer is not active and is not displayed at this position.

Parameter name	Description
Eng. unit totalizer 2 (065) (066) (067) (068) Options	Select unit for totalizer 2. → See also TOTAL 1. ENG. UNIT. The Direct Access Code depends on the selection in the **"Flow meas. type" (044)** parameter: – (065): Flow. meas. type "Mass" – (066): Flow. meas. type "Gas norm. cond." – (067): Flow. meas. type "Gas. std. cond." – (068): Flow. meas. type "Volume process cond." **Factory setting:** m^3
Totalizer 2 mode (177)	Define the behavior of the totalizer. **Options:** ▪ Balanced: Integration of all measured flows (positive and negative) ▪ Pos. flow only: only positive flows are integrated. ▪ Neg. flow only: only negative flows are integrated. ▪ Hold: The flow counter is stopped. **Factory setting:** Pos. flow only
Totalizer 2 failsafe (178)	Define the behavior of the totalizer in the case of an error. **Options:** ▪ Run: The current flow value continues to be integrated. ▪ Hold: The flow counter is stopped. **Factory setting:** Run
Totalizer 2 (069) Display	Displays the total flow value of totalizer 2. The **"Totalizer 2 overflow" (070)** parameter displays the overflow. → See also the example for "Totalizer 1".
Totalizer 2 overflow (070) Display	Displays the overflow value of totalizer 2. → See also **"Totalizer 2" (069)** and example for Totalizer 1.

12.2.6 Diagnostic

Expert → Diagnosis

Parameter name	Description
Diagnostic code (071) Display	Displays the diagnostic message with the highest priority currently present.
Last diag. code (072) Display	Displays the last diagnostic message that occurred and was rectified. ▪ Digital communication: the last message is displayed. ▪ Use the "Reset logbook" parameter to clear the messages listed in the parameter "Last diag. code".
Reset logbook (159) Options	Use this parameter to reset all messages of the parameter "Last diag. code" and the event logbook "Last diag. 1" to "Last diag. 10". **Options:** ▪ Cancel ▪ Confirm **Factory setting:** Cancel
Min. meas. press. (073) Display	Displays the smallest measured pressure value (peak hold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Max. meas. press. (074) Display	Displays the largest measured pressure value (peak hold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Reset peakhold (161) Options	You can reset the "Min. meas. press." and "Max. meas. press." indicators with this parameter. **Options:** ▪ Cancel ▪ Confirm **Factory setting:** Cancel
Operating hours (162) Display	Displays the hours of operation. This parameter cannot be reset.
Config. counter (100) Display	Displays the configuration counter. This counter is increased by one with each change to a parameter or group. The counter counts to 65535 and then starts again at zero.

Expert → Diagnosis → Diagnostic list

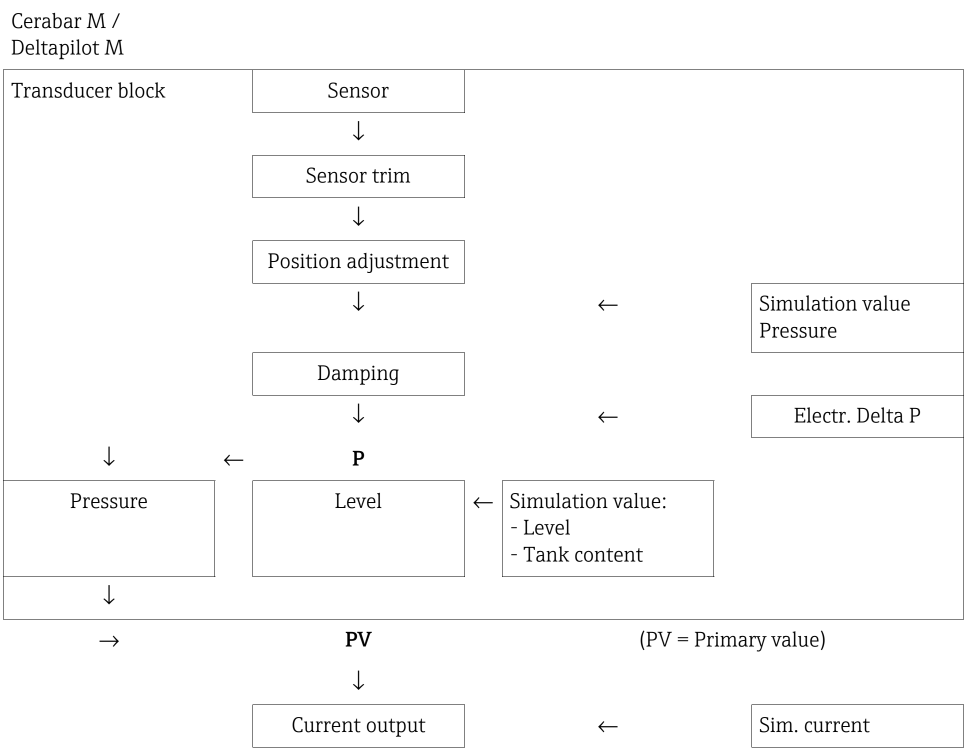
Parameter name	Description
Diagnostic 1 (075) Diagnostic 2 (076) Diagnostic 3 (077) Diagnostic 4 (078) Diagnostic 5 (079) Diagnostic 6 (080) Diagnostic 7 (081) Diagnostic 8 (082) Diagnostic 9 (083) Diagnostic 10 (084)	These parameters contain up to ten diagnosis messages that are currently pending, arranged in order of priority.

Expert → Diagnosis → Event logbook

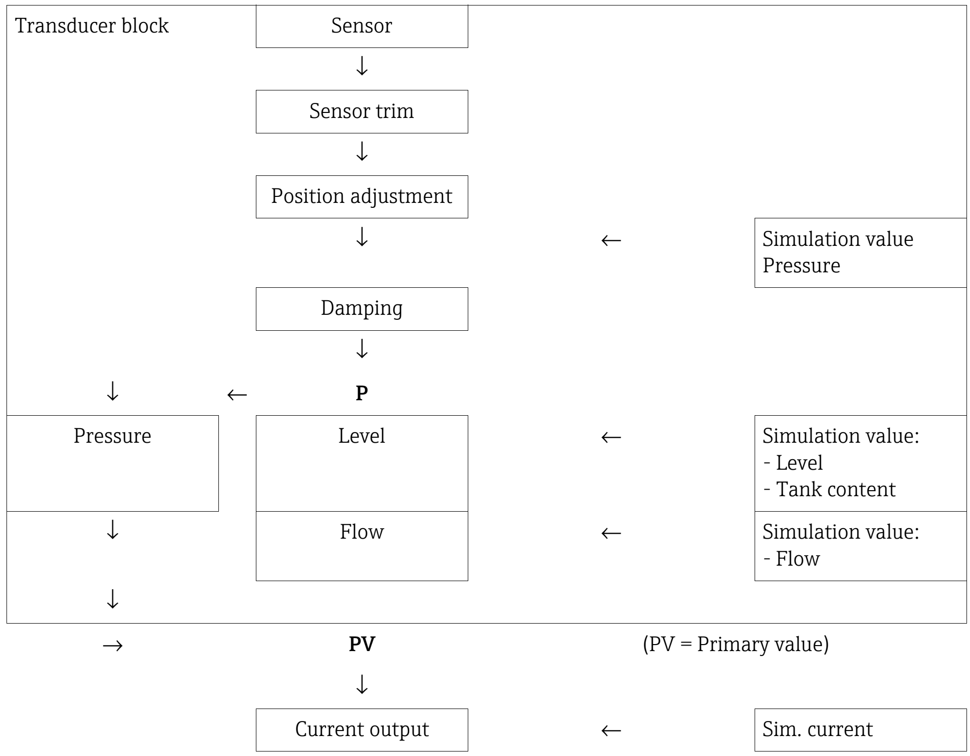
Parameter name	Description
Last diag. 1 (085) Last diag. 2 (086) Last diag. 3 (087) Last diag. 4 (088) Last diag. 5 (089) Last diag. 6 (090) Last diag. 7 (091) Last diag. 8 (092) Last diag. 9 (093) Last diag. 10 (094)	These parameters contain the last 10 diagnosis messages to occur and be rectified. They can be reset using the "Reset logbook" parameter. Errors which have occurred multiple times are displayed once only.

Expert → Diagnosis → Simulation

Parameter name	Description
Simulation mode (112) Options	Switch on simulation and select simulation type. When changing the measuring mode or the level type (Lin. mode (037)), any simulation running is switched off. **Options**: ▪ None ▪ Pressure, → see also this table, "Sim. pressure" parameter ▪ Level, → see this table, "Sim. level" parameter ▪ Flow, → see this table, "Sim. flow" parameter ▪ Tank content → see this table, "Sim. tank cont." parameter ▪ Current, → see this table, "Sim. current" parameter ▪ Alarm/warning, → see this table, "Sim. error no." parameter **Factory setting:** None



Parameter name	Description
Deltabar M	



Parameter name	Description
Sim. pressure (113) User input	Enter simulation value. → See also "Simulation mode". **Prerequisite:** ▪ "Simulation mode" = Pressure **Value at switch-on:** Current pressure measured value
Sim. flow (114) User input	Enter simulation value. → See also "Simulation mode". **Prerequisite:** ▪ "Meas. mode" = Flow and "Simulation Mode" = Flow
Sim. level (115) User input	Enter simulation value. → See also "Simulation mode". **Prerequisite:** ▪ "Measuring mode" = Level and "Simulation mode" = Level
Sim. tank cont. (116) User input	Enter simulation value. → See also "Simulation mode". **Prerequisites:** ▪ "Measuring mode" = Level, "Activate table" lin. mode and "Simulation mode" = Tank content.
Sim. current (117) User input	Enter simulation value. → See also "Simulation mode". **Prerequisite:** ▪ "Simulation mode"= Current value **Factory setting:** Actual current value
Sim. error no. (118) User input	Enter the diagnostic message number. → See also "Simulation mode". **Prerequisite:** ▪ "Simulation mode"= Alarm/warning **Value at switch-on:** 484 (simulation active)

Index

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