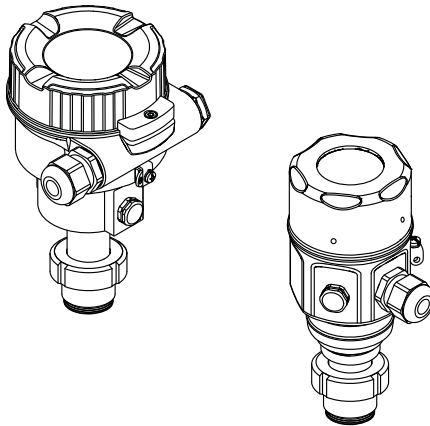


# Brief Operating Instructions **Deltapilot M FMB50, FMB51, FMB52, FMB53**

Hydrostatic level measurement

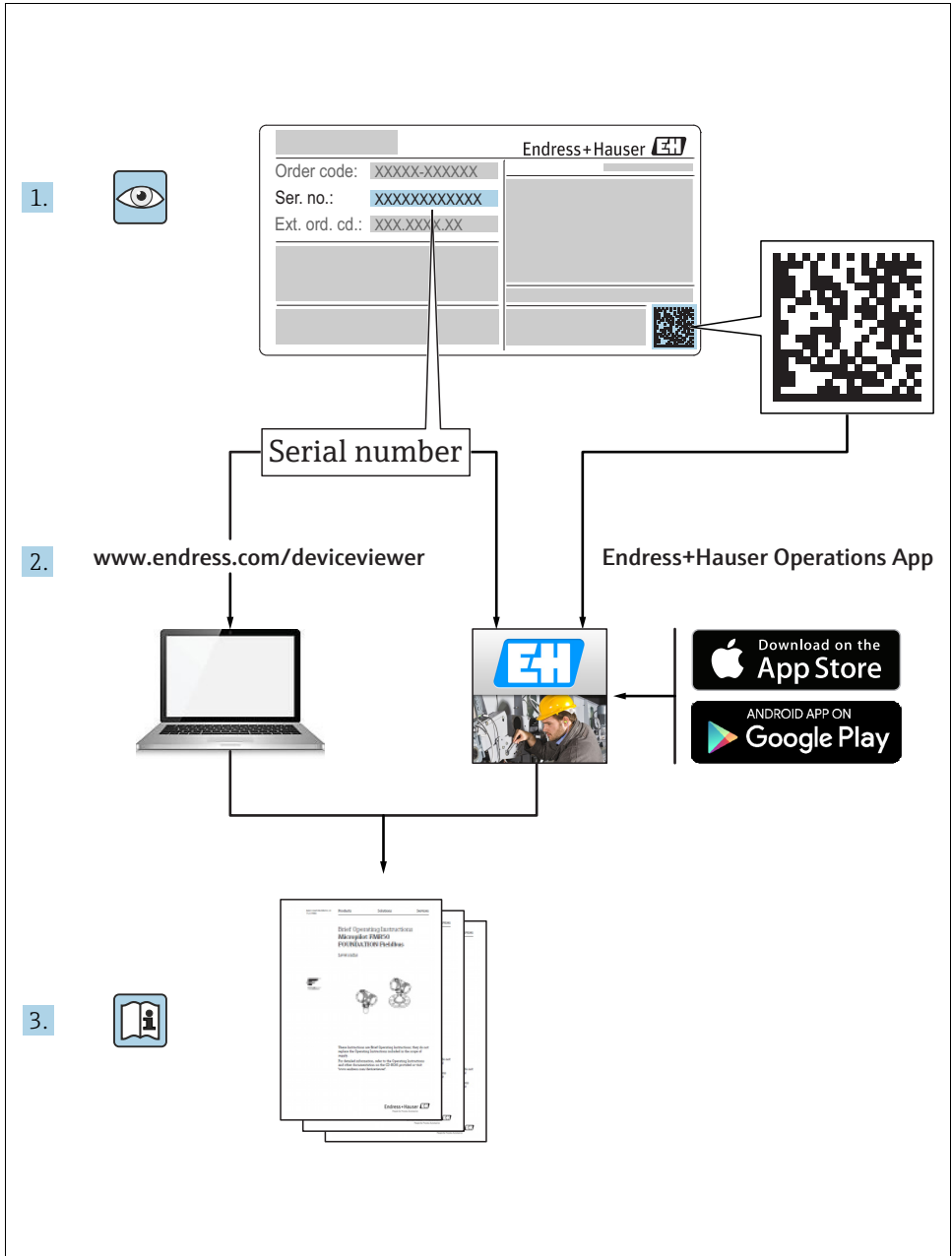


These Instructions are Brief Operating Instructions; they are not a substitute for the Operating Instructions pertaining to the device.

Detailed information about the device can be found in the Operating Instructions and the other documentation:

Available for all device versions via:

- Internet: [www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)
- Smart phone/tablet: *Endress+Hauser Operations App*



A0023555

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# 1 Document information

## 1.1 Document function







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

## 1.2 Symbols used



### 1.2.1 Safety symbols

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










### 1.2.2 Electrical symbols


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

### 1.2.3 Tool symbols

Symbol	Meaning
 A0011221	Allen key
 A0011222	Hexagon wrench

### 1.2.4 Symbols for certain types of information

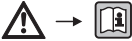
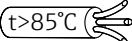
Symbol	Meaning
 A0011182	<b>Permitted</b> Indicates procedures, processes or actions that are permitted.
 A0011184	<b>Forbidden</b> Indicates procedures, processes or actions that are forbidden.
 A0011193	<b>Tip</b> Indicates additional information.
 A0015482	Reference to documentation
 A0015484	Reference to page
 A0015487	Reference to graphic
1., 2., ...	Series of steps
 A0018343	Result of a sequence of actions
 A0015502	Visual inspection
 A0015502	Indicates how to navigate to the parameter using the display and operating module

 A0015502	Indicates how to navigate to the parameter using operating tools (e.g. FieldCare)
---	---

1.2.5 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
1., 2., ...	Series of steps
A, B, C, D, ...	Views

1.2.6 Symbols at the device

Symbol	Meaning
 A0019159	<b>Safety instructions</b> Observe the safety instructions contained in the associated Operating Instructions.
	<b>Connecting cable immunity to temperature change</b> Indicates that the connecting cables have to withstand a temperature of 85°C at least.

1.2.7 Registered trademarks

- KALREZ®, VITON®, TEFLON®  
Registered label of E.I. Du Pont de Nemours & Co., Wilmington, USA
- TRI-CLAMP®  
Registered label of Ladish & Co., Inc., Kenosha, USA
- PROFIBUS PA®  
Trademark of the PROFIBUS User Organization, Karlsruhe, Germany
- GORE-TEX®  
Registered label of W.L. Gore & Associates, Inc., USA

## 2 Basic safety instructions

### 2.1 Requirements concerning the staff

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

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

The operating personnel must fulfill the following requirements:

- Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- Following the instructions in these Operating Instructions

### 2.2 Designated use

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 non-designated use.

Verification for borderline cases:

For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability.

### 2.3 Workplace safety

For work on and with the device:

- Wear the required personal protective equipment according to federal/national regulations.
- Switch off the supply voltage before connecting the device.

### 2.4 Operational safety

Risk of injury!

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

### **Conversions to the device**

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

- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

### **Repair**

To ensure continued operational safety and reliability,

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

## **2.5 Hazardous area**

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

- Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
- Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

## **2.6 Product safety**

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate. It fulfills general safety requirements and legal requirements. It also conforms to the EC directives listed in the device-specific EC declaration of conformity. Endress+Hauser confirms this fact by applying the CE mark.



## 3 Identification

### 3.1 Product identification

The following options are available for identification of the measuring device:

- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter serial numbers from nameplates in W@M Device Viewer ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): All information about the measuring device is displayed.

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

### 3.2 Scope of delivery

The scope of delivery comprises:

- Device
- Optional accessories

Documentation supplied:

- The Operating Instructions BA00383P is available on the Internet.  
→ See: [www.endress.com](http://www.endress.com) → Download
- Brief Operating Instructions: KA01034P Deltapilot M
- Final inspection report
- Additional Safety Instructions for ATEX, IECEx and NEPSI devices
- Optional: factory calibration form, test certificates

### 3.3 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 devices comply with the applicable standards and regulations as listed in the EC Declaration of Conformity and thus comply with the statutory requirements of the EC Directives. Endress+Hauser confirms the conformity of the device by affixing to it the CE mark.

## 4 Installation

### 4.1 Incoming acceptance

- Check the packaging and the contents for 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 device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:

See Technical Information for Deltapilot M TI00437P.

### 4.2.2 Transport

#### **WARNING**

##### **Incorrect transportation**

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

- ▶ Transport the measuring device 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 conditions

### 4.3.1 Dimensions

→ For dimensions, please refer to the Technical Information for Deltapilot M TI00437P, "Mechanical construction" section.

## 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 isolating diaphragm, 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. Max. torque: 20 to 30 Nm (14.75 to 22.13 lbf ft)

### 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 if parts burst! The thread can become loose if exposed to high pressure and temperatures.

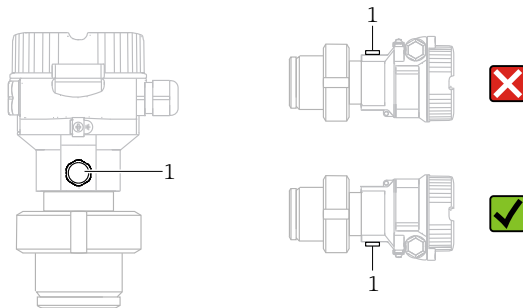
- The integrity of the thread must be checked regularly and the thread may need to be re-tightened with the maximum tightening torque of 7 Nm (5.16 lbf ft). Teflon tape is recommended for sealing the ½" NPT thread.

## 4.5 Installing

- Due to the orientation of the Deltapilot M, there may be a shift in the zero point, i.e. when the container is empty or partially full, the measured value does not display zero. You can correct this zero point shift → 26, Section "Function of the operating elements" or → 39, Section 8.3 "Position zero adjustment".
- The local display can be rotated in 90° stages.
- Endress+Hauser offers a mounting bracket for installing on pipes or walls.  
→ 15, Section 4.5.6 "Wall and pipe mounting (optional)".

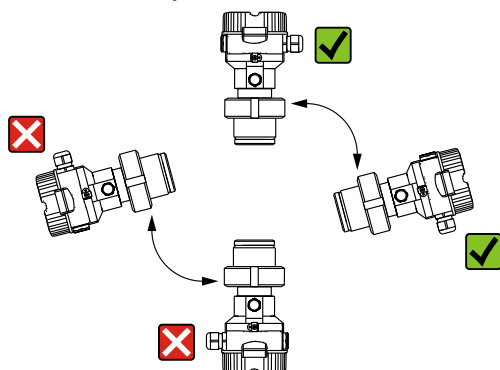
### 4.5.1 General installation instructions

- Do not clean or touch process isolating diaphragms with hard or pointed objects.
- The process isolating diaphragm 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, whereby moisture can penetrate the sensor through the pressure compensation (1). If this is the case, mount the Deltapilot M with the pressure compensation (1) pointing downwards.



- 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).:



#### 4.5.2 FMB50

##### Level measurement

- 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 outflow
  - in the suction area of a pump
  - or at a point in the tank that can be affected by pressure pulses from the agitator
- The calibration and functional test can be carried out more easily if you mount the device downstream of a shutoff device.
- Deltapilot M must be included in the insulation for 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 steams

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

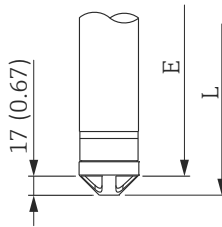
##### Pressure measurement in liquids

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

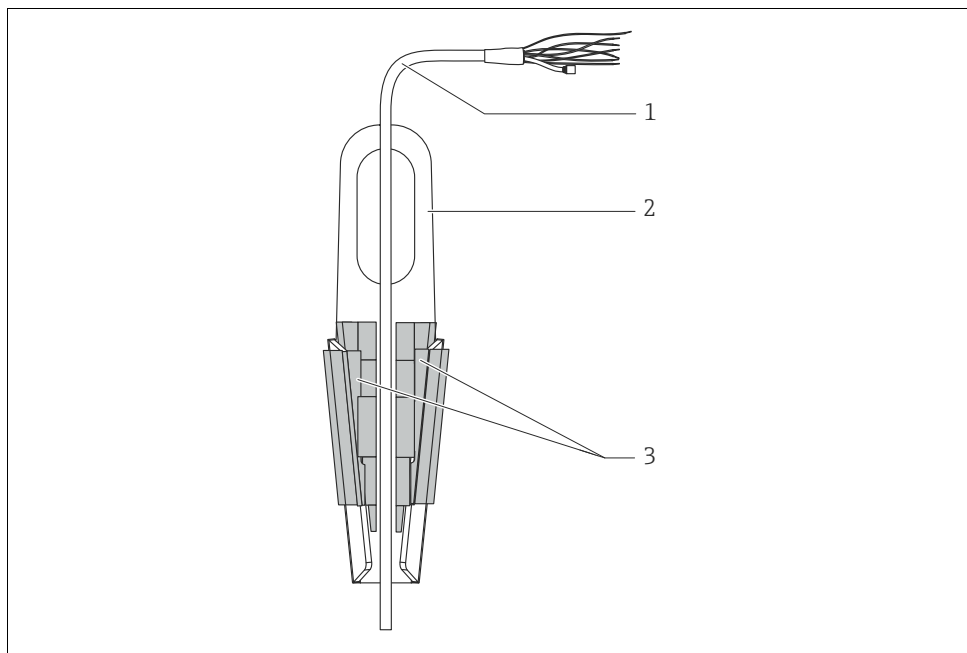
### 4.5.3 FMB51/FMB52/FMB53

- 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.



#### 4.5.4 Mounting the FMB53 with a suspension clamp



A0018793

Fig. 1: Mounting with a suspension clamp

- 1 Extension cable
- 2 Suspension clamp
- 3 Clamping jaws

#### Mounting the suspension clamp:

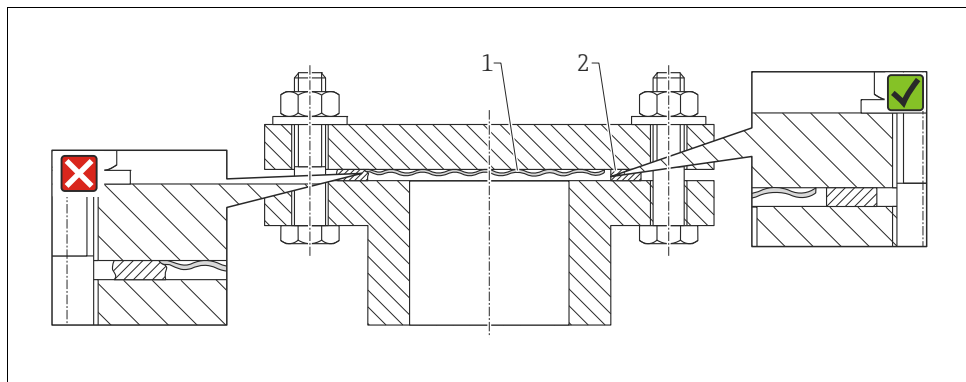
1. Mount the suspension clamp (item 2). When selecting the place to fix the unit, take the weight of the extension cable (item 1) and the device into account.
2. Raise the clamping jaws (item 3). Position the extension cable (item 1) between the clamping jaws as illustrated in Figure.
3. Hold the extension cable in position (item 1) and push the clamping jaws (item 3) back down.  
Tap the clamping jaws gently from above to fix them in place.

#### 4.5.5 Seal for flange mounting

**NOTICE****Distorted measurement results.**

The seal is not allowed to press on the process isolating diaphragm as this could affect the measurement result.

- Ensure that the seal is not touching the process isolating diaphragm.



A0017743

Fig. 2:

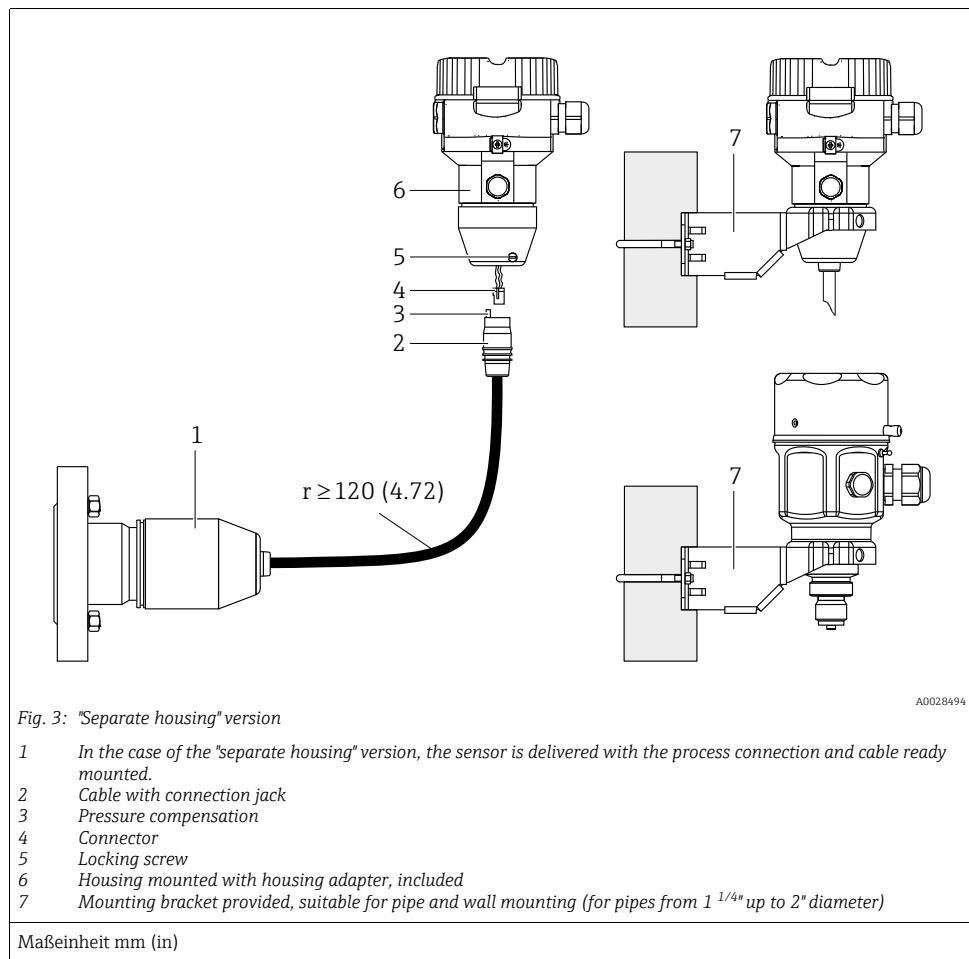
- 1 Process isolating diaphragm
- 2 Seal

#### 4.5.6 Wall and pipe mounting (optional)

**Mounting bracket**

See operating instructions.

### 4.5.7 Assembling and mounting the "separate housing" version



### Assembly and mounting

1. Insert the connector (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 ( $r$ )  $\geq 120$  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.

#### 4.5.8 Supplementary installation instructions

##### Sealing the probe housing

- Moisture must not penetrate the housing when mounting the device, establishing the electrical connection and during operation.
- Always firmly tighten the housing cover and the cable entries.

### 4.6 Mounting of the profile seal for universal process mounting adapter

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

### 4.7 Closing the housing cover

#### NOTICE

##### Devices with EPDM cover seal - transmitter leakiness!

Mineral-based, animal-based or vegetable-based lubricants cause the EPDM cover seal to swell and the transmitter to become leaky.

- The thread is coated at the factory and therefore does not require any lubrication.

#### 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 feel any resistance when closing the cover, check the thread on both again to ensure that they are free from dirt.

4.7.1 Closing the cover on the stainless steel housing

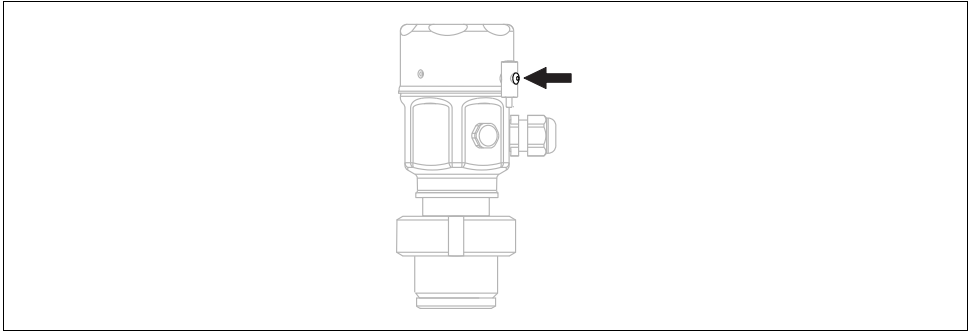


Fig. 4: Closing the cover

A0028497

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

4.8 Post-installation check

O	Is the device undamaged (visual inspection)?
O	Does the device comply with the measuring point specifications? For example: <ul style="list-style-type: none"><li>■ Process temperature</li><li>■ Process pressure</li><li>■ Ambient temperature range</li><li>■ Measuring range</li></ul>
O	Are the measuring point identification and labeling correct (visual inspection)?
O	Is the device adequately protected against precipitation and direct sunlight?
O	Are the securing screw and securing clamp tightened securely?

## 5 Electrical connection

### 5.1 Connecting the device

#### **WARNING**

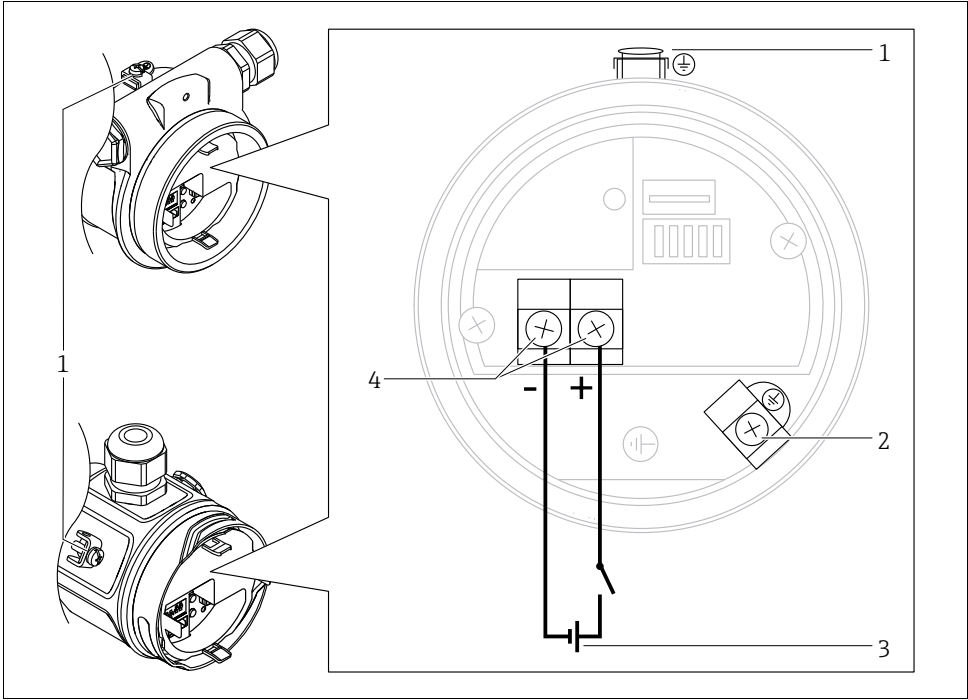
##### **Supply voltage might be connected!**

Risk of electric shock and/or explosion!

- ▶ Ensure that no uncontrolled processes are activated in the system.
- ▶ Switch off the supply voltage before connecting the device.
- ▶ When using the measuring device in hazardous areas, installation must comply with the corresponding 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/EN61010.
- ▶ 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 that the supply voltage corresponds to the supply voltage indicated on the nameplate.
2. Switch off the supply voltage before connecting the device.
3. Remove housing cover.
4. Guide the cable through the gland. Preferably use a twisted, shielded two-wire cable.
5. Connect the device in accordance with the following diagram.
6. Screw down the housing cover.
7. Switch on the supply voltage.



PROFIBUS PA electrical connection

A0029967

- 1 External ground terminal
- 2 Grounding terminal
- 3 Supply voltage: 9 to 32 VDC (Segment coupler)
- 4 Terminals for supply voltage and signal

5.1.1 Devices with M12 connector

PIN assignment for M12 connector	PIN	Meaning
	1	Signal +
	2	Not assigned
	3	Signal -
	4	Earth

A0011175

## 5.2 Connecting the measuring unit



For further information on the network structure and grounding and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA00034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and the PNO Guideline.

### 5.2.1 Supply voltage

Electronic version	
PROFIBUS PA, version for non-hazardous areas	9 to 32 V DC

### 5.2.2 Current consumption

11 mA ±1 mA, switch-on current corresponds to IEC 61158-2, Clause 21.

### 5.2.3 Terminals

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

### 5.2.4 Cable specification

- Use a twisted, shielded two-wire cable, preferably cable type A.
- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in)



For further information on the cable specifications, see Operating Instructions BA00034S "PROFIBUS DP/PA: Guidelines for planning and commissioning", the PNO Guideline 2.092 "PROFIBUS PA User and Installation Guideline" and IEC 61158-2 (MBP).

### 5.2.5 Shielding/potential equalization

- You achieve optimum shielding against disturbances if the shielding is connected on both sides (in the cabinet and on the device). If potential equalization currents are expected in the plant, only ground shielding on one side, preferably at the transmitter.
- 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.

## 5.3 Potential equalization

Hazardous area applications: Connect all devices to the local potential equalization. Observe the applicable regulations.

## 5.4 Overvoltage protection (optional)

See operating instructions.

## 5.5 Post-connection check

Perform the following checks after completing electrical installation of the device:

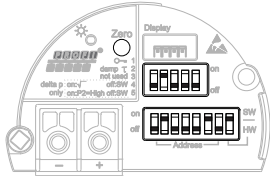
- Does the supply voltage match the specifications on the nameplate?
- Is the device properly connected?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

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

## 6 Operation

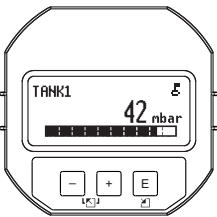
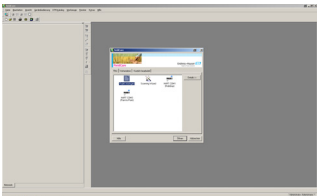
### 6.1 Operating options

#### 6.1.1 Operation without an operating menu

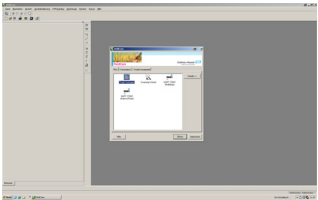

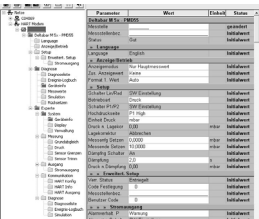

Operating options	Explanation	Graphic illustration	Description
Local operation without device display	The device is operated using the operating key and DIP switches on the electronic insert.		→ 24

#### 6.1.2 Operation with an operating menu

Operation with an operating menu is based on an operation concept with "user roles" → 27.

Operating options	Explanation	Graphic illustration	Description
Local operation with device display	The device is operated using the operating keys on the device display.		→ 29
Remote operation via FieldCare	The device is operated using the FieldCare operating tool.		→ 33

6.1.3 Operation via PA communication protocol

Operating options	Explanation	Graphic illustration	Description
Remote operation via FieldCare	The device is operated using the FieldCare operating tool.		→  34
Remote operation via PDM	The device is operated using the PDM tool.		→  34

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.



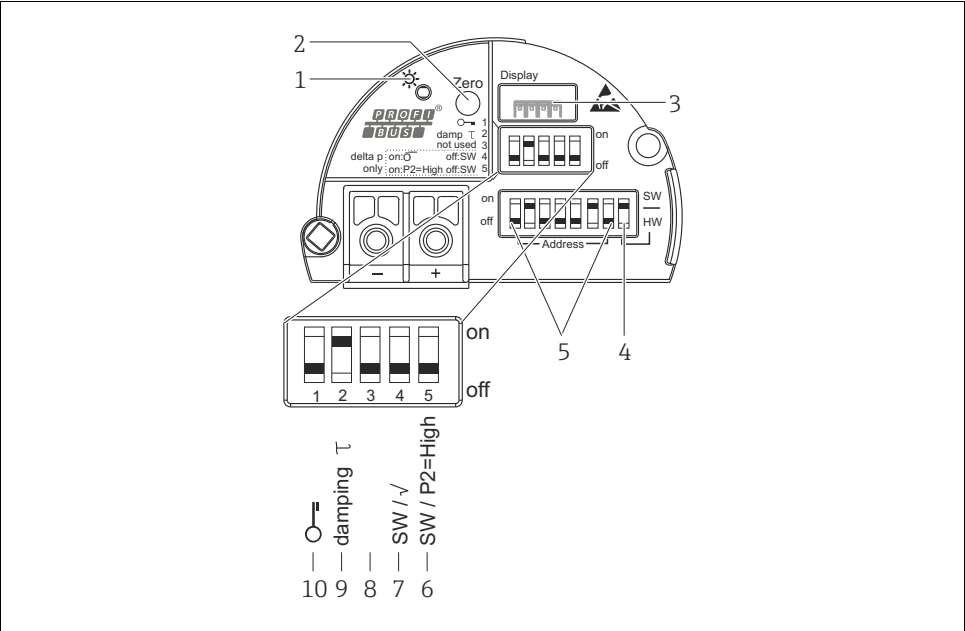


Fig. 5: PROFIBUS PA electronic insert

A0023126

- 1 Green LED to indicate successful operation
- 2 Operating key for position zero adjustment (Zero) or reset
- 3 Slot for optional local display
- 4 DIP-switch for bus address SW / HW
- 5 DIP-switch for hardware address
- 6+7 DIP switch only for Deltabar M
- 8 Not used
- 9 DIP switch for switching damping on/off
- 10 DIP switch for locking/unlocking parameters relevant to the measured value

Function of the DIP switches

Switches	Symbol/ labeling	Switch 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 $\tau$	Damping is switched off. The output signal follows measured value changes without any delay.	Damping is switched on. The output signal follows measured value changes with the delay time $\tau$ . <sup>1)</sup>

Switches	Symbol/ labeling	Switch position	
		"off"	"on"
4 (Deltabar)	SW/√		
5 (Deltabar)	SW/P2= High		
6	Address	Set the device address using switches 1-7	
7	SW / HW	Hardware addressing	Software addressing

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

## Function of the operating elements

Operating key(s)	Meaning
"Zero" pressed for at least 3 seconds	<b>Position adjustment (zero point correction)</b> Press key for at least 3 seconds. The LED on the electronic insert lights up briefly if the pressure applied has been accepted for position adjustment. → See also the following Section "Performing position adjustment on site."
"Zero" pressed for at least 12 seconds	<b>Reset</b> All parameters are reset to the order configuration.

## Performing position adjustment on site

- Operation must be unlocked. → 33, Section 6.3.5 "Locking/unlocking operation".
- The device is configured at the factory for the Level measuring mode.
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

Perform position adjustment:

1. Pressure is present at device.
2. Press key for at least 3 seconds.
3. If the LED on the electronic insert lights up briefly, the pressure applied has been accepted for position adjustment.  
If the LED does not light up, the pressure applied was not accepted. Observe the input limits. For error messages, see operating instructions.

## 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.

→ 25, "Function of the DIP switches".

## 6.3 Operation with an operating menu

### 6.3.1 Operation concept

The operation 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 extends beyond value read-off tasks, the tasks involve simple, application-specific functions that are used in operation. Should an error occur, 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 at 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 product life cycle, but their device requirements are often extremely high. 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.


User role	Submenu	Meaning/use
Operator	Display/operat.	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: <ul style="list-style-type: none"> <li>▪ <b>Standard setup parameters</b> 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.</li> <li>▪ <b>"Extended setup" submenu</b> The "Extended 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.</li> </ul>
Service engineer/technician	Diagnosis	Contains all the parameters that are needed to detect and analyze operating errors. This submenu has the following structure: <ul style="list-style-type: none"> <li>▪ <b>Diagnostic list</b> Contains up to 10 error messages currently pending.</li> <li>▪ <b>Event logbook</b> Contains the last 10 error messages (no longer pending).</li> <li>▪ <b>Instrument info</b> Contains information on the device identification.</li> <li>▪ <b>Measured values</b> Contains all the current measured values</li> <li>▪ <b>Simulation</b> Is used to simulate pressure, level and alarm/warning.</li> <li>▪ <b>Reset</b></li> </ul>
Expert	Expert	Contains all the parameters of the device (including those in one of the submenus). The "Expert" submenu is structured by the function blocks of the device. It thus contains the following submenus: <ul style="list-style-type: none"> <li>▪ <b>System</b> Contains general device parameters that neither affect measurement nor integration into a distributed control system.</li> <li>▪ <b>Measurement</b> Contains all the parameters for configuring the measurement.</li> <li>▪ <b>Communication</b> Contains the parameters of the PROFIBUS PA interface.</li> <li>▪ <b>Application</b> Contains all the parameters for configuring the functions that go beyond the actual measurement (e.g. totalizer).</li> <li>▪ <b>Diagnosis</b> Contains all the parameters that are needed to detect and analyze operating errors.</li> </ul>



For an overview of the entire operating menu: see operating instructions.

## Direct access to parameters

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

Parameter name	Description
<b>Direct access (119)</b> Entry  Menu path: Expert → Direct access	Use this function to enter a parameter code for direct access.  <b>User input:</b> <ul style="list-style-type: none"> <li>Enter the desired parameter code.</li> </ul> <b>Factory setting:</b> 0

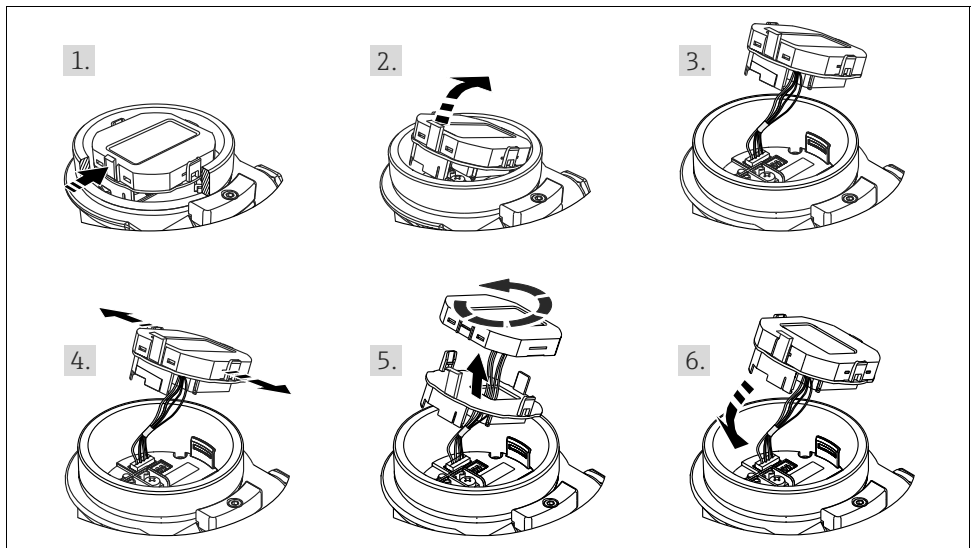
### 6.3.3 Operation with a device display (optional)

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 through a 90 mm (3.54 in) 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.



A0028500

Functions:

- 8-digit measured value display including sign and decimal point.
- Bar graph as graphic display of the standardized value of the Analog Input Block (→ see also operating instructions)
- Three keys for operation
- Simple and complete menu guidance as parameters are split 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.)

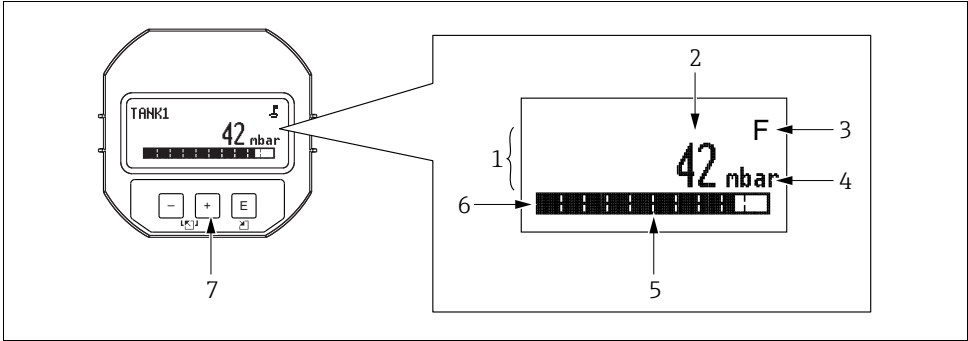


Fig. 6: Display

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

- 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 can occur at one time.

Symbol	Meaning
	<b>Lock symbol</b> The operation of the device is locked. To unlock the device, → 33, Locking/unlocking operation.
	<b>Communication symbol</b> Data transfer via communication





Symbol	Meaning
<b>S</b>	<b>Error message "Out of specification"</b> The device is being operated outside its technical specifications (e.g. during warmup or cleaning processes).
<b>C</b>	<b>Error message "Service mode"</b> The device is in the service mode (during a simulation, for example).
<b>M</b>	<b>Error message "Maintenance required"</b> Maintenance is required. The measured value remains valid.
<b>F</b>	<b>Error message "Failure detected"</b> An operating error has occurred. The measured value is no longer valid.

## Operating keys on the display and operating module

Operating key(s)	Meaning
	<ul style="list-style-type: none"> <li>– Navigate downwards in the picklist</li> <li>– Edit the numerical values and characters within a function</li> </ul>
	<ul style="list-style-type: none"> <li>– Navigate upwards in the picklist</li> <li>– Edit the numerical values and characters within a function</li> </ul>
	<ul style="list-style-type: none"> <li>– Confirm entry</li> <li>– Jump to the next item</li> <li>– Selection of a menu item and activation of the editing mode</li> </ul>
 and 	Contrast setting of onsite display: darker
 and 	Contrast setting of onsite display: brighter
 and 	ESC functions: <ul style="list-style-type: none"> <li>– Exit the edit mode for a parameter without saving the changed value.</li> <li>– You are in a menu at a selection level. Each time you press the keys simultaneously, you go up a level in the menu.</li> </ul>

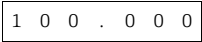
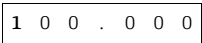


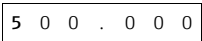



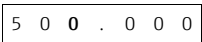
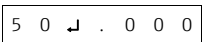


## Operating example: Parameters with a picklist

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 active option.
2	Deutsch  ✓ English		Select "Deutsch" with  or  .
3	✓ Deutsch  English		<ol style="list-style-type: none"><li>Confirm your choice with . A ✓ in front of the menu text indicates the active option ("Deutsch" is now selected as the menu language).</li><li>Exit the edit mode for the parameter with .</li></ol>

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	 mbar		The local display shows the parameter to be changed. The value highlighted in black can be changed. The "mbar" unit is specified in another parameter and cannot be modified here.
2	 mbar		<ol style="list-style-type: none"><li>Press  or  to get to the editing mode.</li><li>The first digit is highlighted in black.</li></ol>
3	 mbar		<ol style="list-style-type: none"><li>Use  to change "1" to "5".</li><li>Confirm "5" with . The cursor jumps to the next position (highlighted in black).</li><li>Confirm "0" with  (second position).</li></ol>
4	 mbar		The third position is highlighted in black and can now be edited.
5	 mbar		<ol style="list-style-type: none"><li>Switch to the "." symbol with the  key.</li><li>Use  to save the new value and exit the editing mode. → See next graphic.</li></ol>



	Set URV	014	Operation
6	<div><div>50.000</div>mbar</div>		The new value for the upper range value is 50.0 mbar (0.75 psi). <ul style="list-style-type: none"><li>- You exit the edit mode for the parameter with .</li><li>- You can get back to the editing mode with  or .</li></ul>

Operating example: Accepting the pressure present

Example: setting position adjustment

	Pos. zero adjust	007	Operation
1	<div><div><div>✓ Abort</div><div>Confirm</div></div></div>		The pressure for position adjustment is present at the device.
2	<div><div>Confirm</div><div><div>✓ Abort</div></div></div>		Use  or  to switch to the "Confirm" option. The active option is highlighted in black.
3	<div><div>Compensation accepted!</div></div>		Accept the pressure present as position adjustment with the  key. The device confirms the adjustment and goes back to the "Pos. zero adjust" parameter.
4	<div><div><div>✓ Abort</div><div>Confirm</div></div></div>		Exit the edit mode for the parameter with  .

6.3.4 Operation via FieldCare

See operating instructions.

6.3.5 Locking/unlocking operation

See operating instructions.

6.3.6 Resetting to factory settings (reset)

See operating instructions.

## 6.4 PROFIBUS PA communication protocol

### 6.4.1 Device identification and addressing

Please note the following:

- An address must be assigned to each PROFIBUS PA device. The control system/master can only recognize the device if the address is set correctly.
- Each address can only be assigned once in any PROFIBUS PA network.
- Device addresses in the range from 0 to 125 are valid.
- The address "126" configured at the factory can be used for functional device testing and to connect to a PROFIBUS PA network already in operation. This address must be changed subsequently to add additional devices.
- On leaving the factory, all devices are delivered with the default address 126 and software addressing.
- The FieldCare operating program is delivered with the default address 1.

There are two ways to assign the device address to a Deltapilot:

- Via an operating program of the DP Class 2 master, such as FieldCare or
- Onsite via DIP switches.

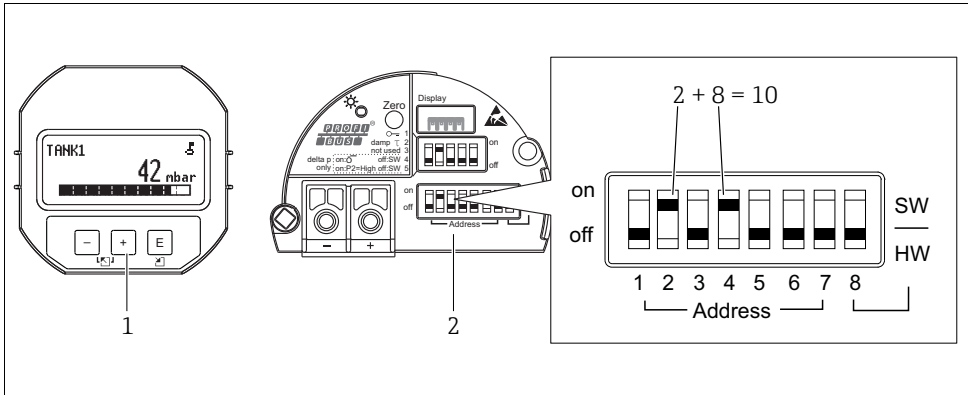


Fig. 7: Setting the device address via DIP switches

- 1 If necessary, remove onsite display (optional)
- 2 Set the hardware address via the DIP switches

### Hardware addressing

A hardware address is set as follows:

1. Set the DIP switch 8 (SW/HW) to "Off".
2. Set the address with DIP switches 1 to 7.
3. The change of address takes effect after 10 seconds. The device is restarted.

DIP switch	1	2	3	4	5	6	7
Value when set to "On"	1	2	4	8	16	32	64
Value when set to "Off"	0	0	0	0	0	0	0

## Software addressing

A software address is set as follows:

1. Set the DIP switch 8 (SW/HW) to "On" (factory setting).
2. The device is restarted.
3. The device reports its current address. Factory setting: 126
4. Set the address via the configuration program.  
See the next section for information on how to enter a new address via FieldCare.  
For other operating programs, see the corresponding operating manual.

## 7 Commissioning without an operating menu

The device is configured at the factory for the Level measuring mode. The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

### WARNING

#### Exceeding the maximum allowable working pressure!

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" (050) parameter):

"S140 Working range P" or "F140 Working range P"

"S841 Sensor range" or "F841 Sensor range"

"S971 Adjustment"

Use the device only within the sensor range limits.

### NOTICE

#### Shortfall of the allowable working pressure!

Output of messages if 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" (050) parameter):

"S140 Working range P" or "F140 Working range P"

"S841 Sensor range" or "F841 Sensor range"

"S971 Adjustment"  
Use the device only within the sensor range limits.

7.1 Function check

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

- "Post-installation check" checklist → 18
- "Post-connection check" checklist → 22

7.2 Position adjustment

The following functions are possible by means of the key on the electronic insert:

- Position adjustment (zero point correction)
- Device reset → 26 (total reset)



- Operation must be unlocked. → 33, "Locking/unlocking operation"
- The device is configured for the "Pressure" measuring mode as standard.
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

Carrying out position adjustment	
Pressure is present at 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 position adjustment has been accepted.	<sup>1)</sup> Applied pressure for position adjustment has not been accepted. Observe the input limits.

1) Observe warning on commissioning (→ 35)

## 8 Commissioning with an operating menu (onsite display/FieldCare)

The device is configured at the factory for the Level measuring mode. The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

### **WARNING**

#### **Exceeding the maximum allowable working pressure!**

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" (050) parameter):

"S140 Working range P" or "F140 Working range P"

"S841 Sensor range" or "F841 Sensor range"

"S971 Adjustment"

Use the device only within the sensor range limits.

### **NOTICE**

#### **Shortfall of the allowable working pressure!**

Output of messages if 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" (050) parameter):

"S140 Working range P" or "F140 Working range P"



"S841 Sensor range" or "F841 Sensor range"

"S971 Adjustment"

Use the device only 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.

- "Post-installation check" checklist →  18
- "Post-connection check" checklist →  22

## 8.2 Commissioning

Commissioning comprises the following steps:


- 1. Function check →  37
- 2. Selecting the language, measuring mode and pressure unit →  38
- 3. Position adjustment →  39
- 4. Configuring measurement:
  - Pressure measurement →  51 ff
  - Level measurement →  40 ff

### 8.2.1 Selecting the language, measuring mode and pressure unit

#### Language selection

Parameter name	Description
<b>Language (000)</b> Options  Menu path: Main menu → Language	Select the language for the onsite display.  <b>Options:</b> <ul style="list-style-type: none"><li>▪ English</li><li>▪ Possibly another language (as selected when ordering the device)</li><li>▪ One further language (language of the manufacturing plant)</li></ul> <b>Factory setting:</b> English

#### Measuring mode selection


Parameter name	Description
<b>Measuring mode (005)</b> Options  Menu path: Setup → Measuring mode (005)	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. <div> <b>WARNING</b></div> <b>Changing the measuring mode affects the span (URV)!</b> This situation can result in product overflow. <ul style="list-style-type: none"><li>▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!</li></ul> <b>Options:</b> <ul style="list-style-type: none"><li>▪ Pressure</li><li>▪ Level</li></ul> <b>Factory setting:</b> Pressure

## Pressure unit selection

Parameter name	Description
<b>Press. eng. unit (125)</b> Options  Menu path: Setup → Press. eng. unit (125)	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.  <b>Options:</b> <ul style="list-style-type: none"> <li>■ mbar, bar</li> <li>■ mmH<sub>2</sub>O, mH<sub>2</sub>O,</li> <li>■ inH<sub>2</sub>O, ftH<sub>2</sub>O</li> <li>■ Pa, kPa, MPa</li> <li>■ psi</li> <li>■ mmHg, inHg</li> <li>■ kgf/cm<sup>2</sup></li> </ul> <b>Factory setting:</b> mbar or bar depending on the sensor nominal measuring range, or as per order specifications

## 8.3 Position zero adjustment

The pressure resulting from the orientation of the device can be corrected here.

Parameter name	Description
<b>Corrected press. (172)</b> Display  Menu path: Setup → Corrected press. (172)	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.
<b>Pos. zero adjust (007)</b> <b>(Gauge pressure sensor)</b> Options  Menu path: Setup → Pos. zero adjust (007) (Gauge pressure sensor)	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known.  <b>Example:</b> <ul style="list-style-type: none"> <li>– Measured value = 2.2 mbar (0.032 psi)</li> <li>– Correct the measured value via the "Pos. zero adjust (007) (Gauge pressure sensor)" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present.</li> <li>– Measured value (after pos. zero adjust) = 0.0 mbar</li> </ul> <b>Options</b> <ul style="list-style-type: none"> <li>■ Confirm</li> <li>■ Abort</li> </ul> <b>Factory setting:</b> Abort

Parameter name	Description
<b>Calib. offset (192) (008)</b> <b>(absolute pressure sensor)</b> Entry  Menu path: Setup → Calib. offset (192)	Position adjustment – the pressure difference between the set point and the measured pressure must be known.  <b>Example:</b> <ul style="list-style-type: none"><li>– Measured value = 982.2 mbar (14.25 psi)</li><li>– You correct the measured value with the value entered (e.g. 2.2 mbar (0.032 psi)) via the "Calib. offset (192)" parameter. This means that you are assigning the value 980.0 (14.21 psi) to the pressure present.</li><li>– Measured value (after calib. offset) = 980.0 mbar (14.21 psi)</li></ul> <b>Factory setting:</b> 0.0

8.4 Level measurement

8.4.1 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. (028)/Full calib. (031)", "Empty pressure (029)/Full pressure (032)", "Empty height (030)/Full height (033)" must be at least 1 % apart. The value will be rejected, and a warning 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.

8.4.2 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"	Via the "Unit before lin (025)" parameter: %, level, volume or mass units.	<ul style="list-style-type: none"><li>– Calibration with reference pressure (wet calibration), see → 41</li><li>– Calibration without reference pressure (dry calibration), see → 42</li></ul>	The measured value display and the "Level before lin. (019)" parameter display the measured value.
Calibration is performed by entering the density and two height-level value pairs.	"In height"		<ul style="list-style-type: none"><li>– Calibration with reference pressure (wet calibration), see → 45</li><li>– Calibration without reference pressure (dry calibration), see → 47</li></ul>	



### 8.4.3 "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 due to the filling height and the density.

##### Prerequisite:

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



The values entered for "Empty calib. (028)/Full calib. (031)" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a warning 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 device can measure correctly.

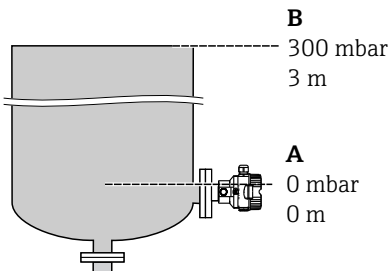
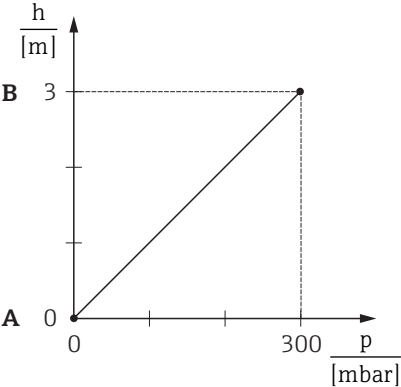
	Description	
1	Perform "position adjustment" → 39.	 <p><b>B</b> 300 mbar 3 m</p> <p><b>A</b> 0 mbar 0 m</p> <p><small>A0030028</small></p>
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter.  Menu path: Setup → Measuring mode (005)	
3	Select a pressure unit via the "Press. eng. unit (125)" parameter, here "mbar" for example.  Menu path: Setup → Press. eng. unit (125)	
4	Select the "in pressure" level mode by means of the "Level selection (024)" parameter.  Menu path: Setup → Extended Setup → Level → Level selection (024)	
5	Select a level unit by means of the "Unit before lin (025)" parameter, here "m" for example.  Menu path: Setup → Extended Setup → Level → Unit before lin (025)	
6	Select the "Wet" option by means of the "Calibration mode (027)" parameter.  Menu path: Setup → Extended Setup → Level → Calibration mode (027)	

Fig. 8: Calibration with reference pressure – wet calibration

A See Table, Step 7.

B See Table, Step 8.

	Description	
7	The pressure for the lower calibration point is present at the device, here 0 mbar for example.	
	Select the "Empty calib. (028)" parameter.	
	Menu path: Setup → Extended Setup → Level → Empty calib. (028)	
	Enter the level value, here 0 m for example. The pressure value present is assigned to the lower level value by confirming the value.	
8	The pressure for the upper calibration point is present at the device, here 300 mbar (4.35 psi) for example.	
	Select the "Full calib. (031)" parameter.	
	Menu path: Setup → Extended Setup → Level → Full calib. (031)	
	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.	
9	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in "Adjust density (034)".  Menu path: Setup → Extended Setup → Level → Adjust density (034)	
10	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density (035)" parameter.  Menu path: Setup → Extended setup → Level → Process density (035).	
11	Result: The measuring range is set for 0 to 3 m (9.8 ft).	



*Fig. 9: Calibration with reference pressure – wet calibration*

A See Table, Step 7.  
B See Table, Step 8.

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

8.4.4 "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 (6.53 psi). The minimum volume

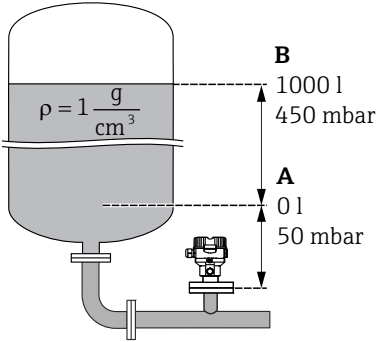
of 0 liters corresponds to a pressure of 50 mbar (0.72 psi) since the device is mounted below the start of the level measuring range.

### 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. (028)/Full calib. (031)", "Empty pressure (029)/Full pressure (032)" must be at least 1% apart. The value will be rejected, and a warning 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 device 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 → 39, "Position zero adjustment".

	Description	 <p>Fig. 10: Calibration without reference pressure – dry calibration</p> <p>A See Table, Steps 7 + 8. B See Table, Steps 9 + 10.</p>
1	Select the "Level" measuring mode via the "Measuring mode (005)" parameter.  Menu path: Setup → Measuring mode (005)	
2	Select a pressure unit via the "Press. eng. unit (125)" parameter, here "mbar" for example.  Menu path: Setup → Press. eng. unit (125)	
3	Select the "in pressure" level mode by means of the "Level selection (024)" parameter.  Menu path: Setup → Extended Setup → Level → Level selection (024)	
4	Select a volume unit via the "Unit before lin (025)" parameter, here "l" (liter) for example.  Menu path: Setup → Extended Setup → Level → Unit before lin (025)	

	Description	
5	Select the "Dry" option by means of the "Calibration mode (027)" parameter.  Menu path: Setup → Extended Setup → Level → Calibration mode (027)	<p>Fig. 11: Calibration with reference pressure – wet calibration</p> <p>A See Table, Step 7. B See Table, Step 8. C See Table, Step 9. D See Table, Step 10.</p>
6	"Adjust density (034)" contains the factory setting 1.0, but this value can be changed if required. The entered value pairs must correspond to this density.  Menu path: Setup → Extended Setup → Level → Adjust density (034)	
7	Enter the volume value for the lower calibration point via the "Empty calib. (028)" parameter, here 0 liters for example.  Menu path: Setup → Extended Setup → Level → Empty calib. (028)	
8	Enter the pressure value for the lower calibration point via the "Empty pressure (029)" parameter, here 50 mbar (0.72 psi) for example.  Menu path: Setup → Extended Setup → Level → Empty pressure (029)	
9	Enter the volume value for the upper calibration point via the "Full calib. (031)" parameter, here 1000 liters (264 gal) for example.  Menu path: Setup → Extended Setup → Level → Full calib. (031)	
10	Enter the pressure value for the upper calibration point via the "Full pressure (032)" parameter, here 450 mbar (6.53 psi) for example.  Menu path: Setup → Extended Setup → Level → Full pressure (032)	
11	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density (035)" parameter. Menu path: Setup → Extended setup → Level → Process density (035).	
12	Result: The measuring range is set for 0 to 1000 l (264 gal).	



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

### 8.4.5 "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 (14.8 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 medium is 1 g/cm<sup>3</sup> (1 SGU).

##### Prerequisite:

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



The values entered for "Empty calib. (028)/Full calib. (031)" and the pressure values present at the device must be at least 1% apart. The value will be rejected, and a warning 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 device can measure correctly.

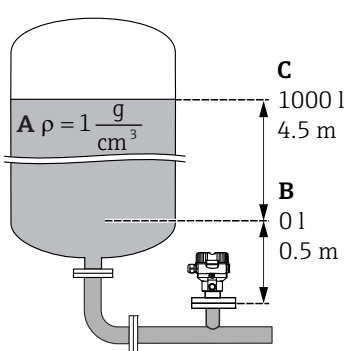
	Description	
1	Perform position adjustment. See → 39.	 <p>The diagram shows a vertical tank with a liquid level. A pressure sensor is mounted on the side of the tank, with its measurement point at a distance 'B' from the bottom. The total height of the tank is 'C', and the distance from the sensor to the bottom is 'B'. The liquid level is at height 'A' from the bottom. The density of the liquid is given as <math>\rho = 1 \frac{\text{g}}{\text{cm}^3}</math>. The sensor is labeled 'A'.</p>
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode (005)	
3	Select a pressure unit via the "Press. eng. unit (125)" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit (125)	
4	Select the "in height" level mode via the "Level selection (024)" parameter. Menu path: Setup → Extended Setup → Level → Level selection (024)	
5	Select a volume unit via the "Unit before lin (025)" parameter, here "l" (liter) for example. Menu path: Setup → Extended Setup → Level → Unit before lin (025)	

Fig. 12: Calibration with reference pressure – wet calibration

- A See Table, Step 8.  
B See Table, Step 9.  
B See Table, Step 9.

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	Description	
6	Select a level unit by means of the "Height unit (026)" parameter, here "m" for example.  Menu path: Setup → Extended Setup → Level → Height unit (026)	
7	Select the "Wet" option by means of the "Calibration mode (027)" parameter. Menu path: Setup → Extended Setup → Level → Calibration mode (027)	
8	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density (034)" parameter, here 1 g/cm³ (1 SGU) for example. Menu path: Setup → Extended Setup → Level → Adjust density (034)	
9	The pressure for the lower calibration point is present at the device, here 0.5 m covered / 49 mbar (0.71 psi) for example.  Enter the volume value for the lower calibration point via the "Empty calib. (028)" parameter, here 0 liters for example.  Menu path: Setup → Extended Setup → Level → Empty calib. (028)	
10	The pressure for the upper calibration point is present at the device, here 4.5 m covered / 441 mbar (6.4 psi) for example.  Enter the volume value for the upper calibration point via the "Full calib. (031)" parameter, here "1000 liters" (264 gal) for example.  Menu path: Setup → Extended Setup → Level → Full calib. (031)	
11	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density (035)" parameter.  Menu path: Setup → Extended Setup → Level → Process density (035)	<p>Fig. 13: Calibration with reference pressure – wet calibration</p> <p>A See Table, Step 8. B See Table, Step 9. C See Table, Step 10.</p>
12	Result: The measuring range is set for 0 to 1000 l (264 gal).	



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

### 8.4.6 "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 (14.8 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. (028)/Full calib. (031)", "Empty height (030)/Full height (033)" must be at least 1% apart. The value will be rejected, and a warning 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 device 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 → 39, "Position zero adjustment".

Description	
1	Select the "Level" measuring mode via the "Measuring mode (005)" parameter.  Menu path: Setup → Measuring mode (005)
2	Select a pressure unit via the "Press. eng. unit (125)" parameter, here "mbar" for example.  Menu path: Setup → Press. eng. unit (125)
3	Select the "In height" level mode via the "Level selection (024)" parameter. Menu path: Setup → Extended Setup → Level → Level selection (024)
4	Select a volume unit via the "Unit before lin (025)" parameter, here "l" (liter) for example.  Menu path: Setup → Extended Setup → Level → Unit before lin (025)
5	Select a level unit by means of the "Height unit (026)" parameter, here "m" for example.  Menu path: Setup → Extended Setup → Level → Height unit (026)
6	Select the "Dry" option by means of the "Calibration mode (027)" parameter.  Menu path: Setup → Extended Setup → Level → Calibration mode (027)
7	Enter the density of the medium via the "Adjust density (034)" parameter, here "1 g/cm³" (1 SGU) for example.  Menu path: Setup → Extended Setup → Level → Adjust density (034)

Fig. 14: Calibration without reference pressure – dry calibration

A See Table, Step 7.  
B See Table, Step 8 and 10.  
C See Table, Step 9 and 11.

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	Description	
8	Enter the volume value for the lower calibration point via the "Empty calib. (028)" parameter, here 0 liters for example.  Menu path: Setup → Extended Setup → Level → Empty calib. (028)	<p>The figure contains two graphs. The top graph has a vertical axis labeled <math>\frac{h}{[m]}</math> and a horizontal axis labeled <math>\frac{p}{[mbar]}</math>. It shows a line starting at point B (0.5, 0) and ending at point A (4.5, 4.5). The equation <math>h = \frac{p}{\rho \cdot g}</math> is shown. The density <math>\rho = 1 \frac{g}{cm^3}</math> is also indicated. The bottom graph has a vertical axis labeled <math>\frac{V}{[l]}</math> and a horizontal axis labeled <math>\frac{h}{[m]}</math>. It shows a line starting at point C (0.5, 0) and ending at point E (4.5, 1000). The equation <math>h = \frac{p}{\rho \cdot g}</math> is shown. The points A, B, C, D, and E are labeled on the graphs.</p>
9	Enter the height value for the lower calibration point via the "Empty height (030)" parameter, here 0.5 m (1.6 ft) for example.  Menu path: Setup → Extended Setup → Level → Empty height (030)	
10	Enter the volume value for the upper calibration point via the "Full calib. (031)" parameter, here 1000 liters (264 gal) for example.  Menu path: Setup → Extended Setup → Level → Full calib. (031)	
11	Enter the height value for the upper calibration point via the "Full height (033)" parameter, here 4.5 m (14.8 ft) for example.  Menu path: Setup → Extended Setup → Level → Full height (033)	
12	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 (035)" parameter.  Menu path: Setup → Extended setup → Level → Process density (035).	
13	Result: The measuring range is set for 0 to 1000 l (264 gal).	

Fig. 15: Calibration with reference pressure – wet calibration

- A See Table, Step 7.  
B See Table, Step 8.  
C See Table, Step 9.  
D See Table, Step 10.  
E See Table, Step 11.



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

8.4.7 Required parameters for Level measuring mode

Parameter name	Description
Level selection (024)	see operating instructions
Unit before lin (025)	see operating instructions
Height unit (026)	see operating instructions
Calibration mode (027)	see operating instructions
Empty calib. (028)	see operating instructions
Empty pressure (029)	see operating instructions
Empty height (030)	see operating instructions
Full calib. (031)	see operating instructions
Full pressure (032)	see operating instructions
Full height (033)	see operating instructions
Density unit (127)	see operating instructions
Adjust density (034)	see operating instructions
Process density (035)	see operating instructions
Level before lin. (019)	see operating instructions

8.5 Linearization

See operating instructions.

## 8.6 Pressure measurement

### 8.6.1 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 (4.35 psi) measuring range, i.e. 0 mbar and 300 mbar (4.35 psi) are assigned.

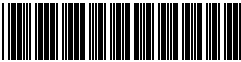
#### Prerequisite:

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 → 39. Calibration is possible only using FieldCare.

	Description
1	Select the "Pressure" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode (005)
2	Select a pressure unit via the "Press. eng. unit (125)" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit (125)
3	Where necessary scale the "Output value (Out Value)" of the Analog Input Block, see operating instructions, parameter descriptions for "Proc value scale" and "Output scale".
4	Result: The measuring range is configured for 0 to +300 mbar (4.35 psi).



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