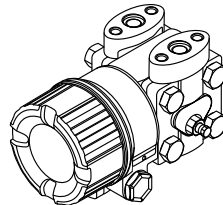
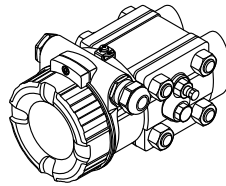


Brief Operating Instructions

Deltabar M

PMD55

Differential pressure 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
- Smart phone/tablet: *Endress+Hauser Operations App*

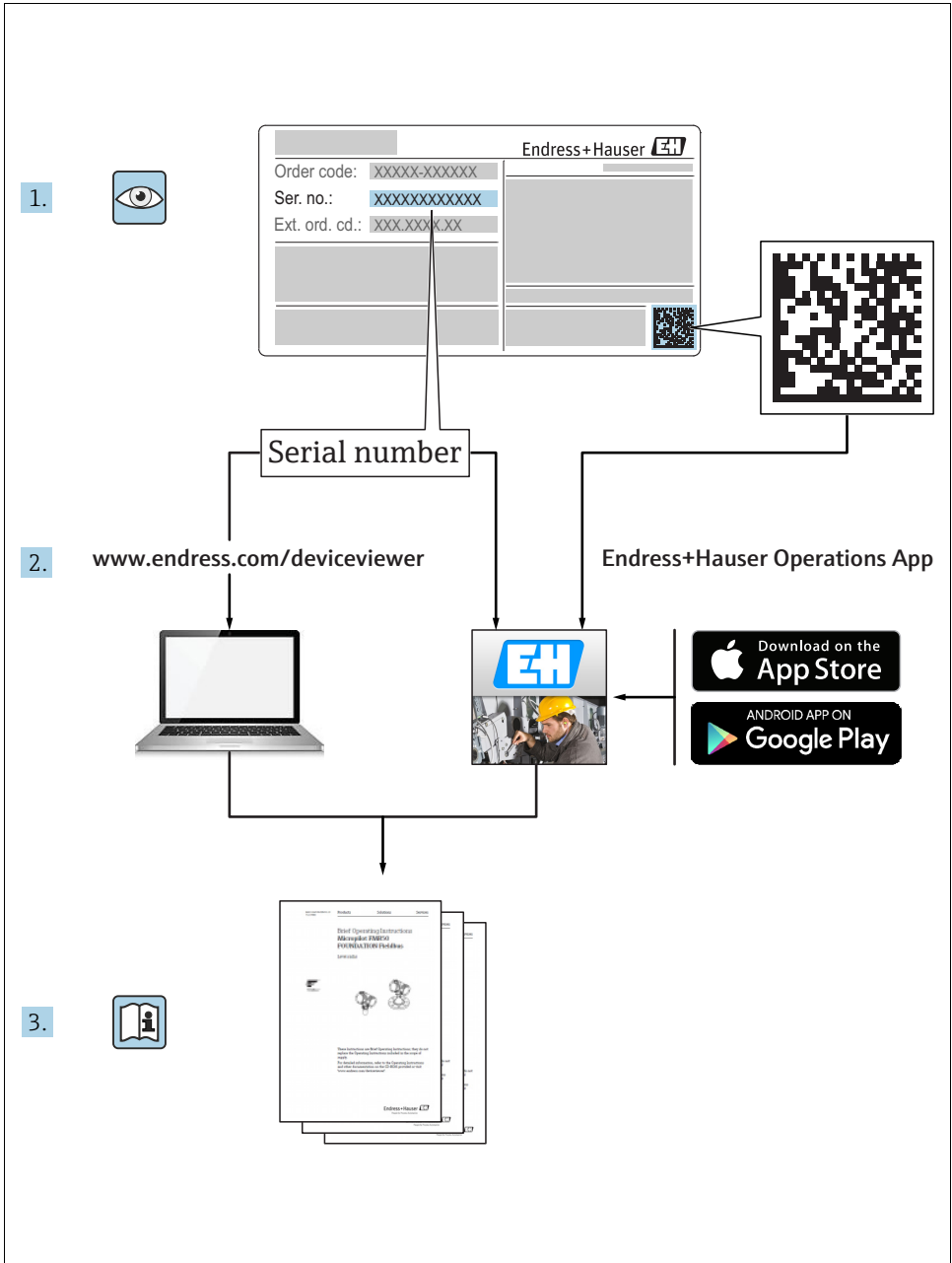


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1 Document information

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	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-DE	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-DE	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-DE	NOTICE! 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		Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Protective ground connection A terminal which must be connected to ground prior to establishing any other connections.		Equipotential connection A connection that has to be connected to the plant grounding system. This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

1.2.3 Tool symbols

Symbol	Meaning
 A0011221	Allen key
 A0011222	Hexagon wrench


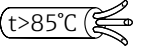
1.2.4 Symbols for certain types of information

Symbol	Meaning
 A0011182	Permitted Indicates procedures, processes or actions that are permitted.
 A0011184	Forbidden 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 sequence of actions
 A0015502	Visual inspection

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
	Safety instructions Observe the safety instructions contained in the associated Operating Instructions.
	Connecting cable immunity to temperature change 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

HART[®]

Registered trademark of the FieldComm Group, Austin, USA

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

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.

2.7 Functional Safety SIL (optional)

If using devices for applications with safety integrity, the Functional Safety Manual (SD00347P/00/EN) must be observed thoroughly.

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): 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).

3.2 Scope of delivery

The scope of delivery comprises:

- Device
- Optional accessories

Documentation supplied:

- Operating Instruction BA00382P is available on the Internet.
→ See: www.endress.com → Download

- Brief Operating Instruction: KAO1027P Deltabar 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 Deltabar M TI00434P.

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 Deltabar M TI00434P, "Mechanical construction" section.

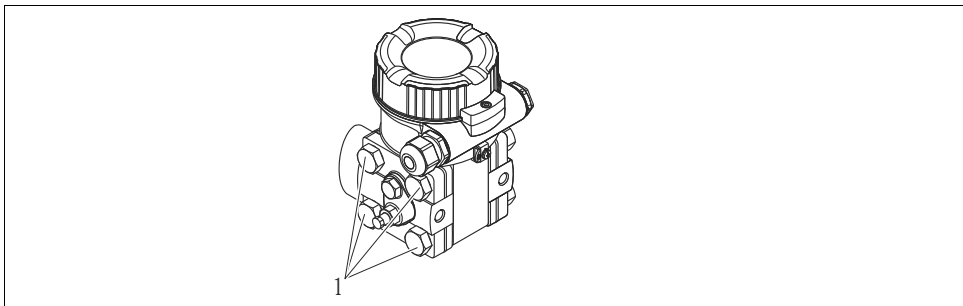
4.4 Installing

NOTICE

Incorrect handling!

Damage of the device!

- ▶ Disassembly of the screws with item number (1) is not permissible under any circumstances and will result in loss of warranty.



4.4.1 Installation position

- Due to the orientation of the Deltabar M, there may be a shift in the measured value, 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 (→ 25, "Function of the operating elements")
 - via the operating menu (→ 40, "Position 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 (→ 13, "Wall and pipe-mounting (option)").

Installation position for flow measurement



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

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

Flow measurement in gases

- 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

- 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 measurement in liquids

- Mount the Deltabar M below the measuring point so that the impulse 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.

Installation position for level measurement

Level measurement in an open container

- Mount the Deltabar M below the lower measuring connection so that the impulse 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

- Mount the Deltabar M below the lower measuring connection so that the impulse 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

- Mount the Deltabar M below the lower measuring connection so that the impulse 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*

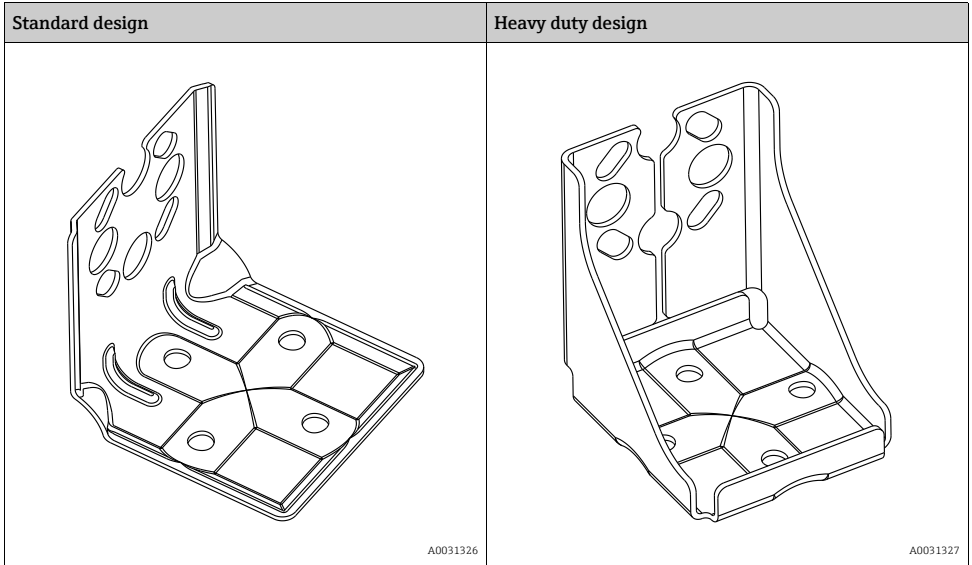
- Mount the Deltabar M above the measuring point so that the condensate which may be present, can run off into the process piping.

Differential pressure measurement in liquids

- Mount the Deltabar M below the measuring point so that the impulse 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.

4.4.2 Wall and pipe-mounting (option)

Endress+Hauser offers the following mounting brackets for installing the device on pipes or walls:



When using a valve block, the block's dimensions must be taken into account. Bracket for wall and pipe mounting including retaining bracket for pipe mounting and two nuts. material of the screws used to secure the device depend on the order code. Technical data (e.g. dimensions or order numbers for screws) see accessory document SD01553P/00/EN.

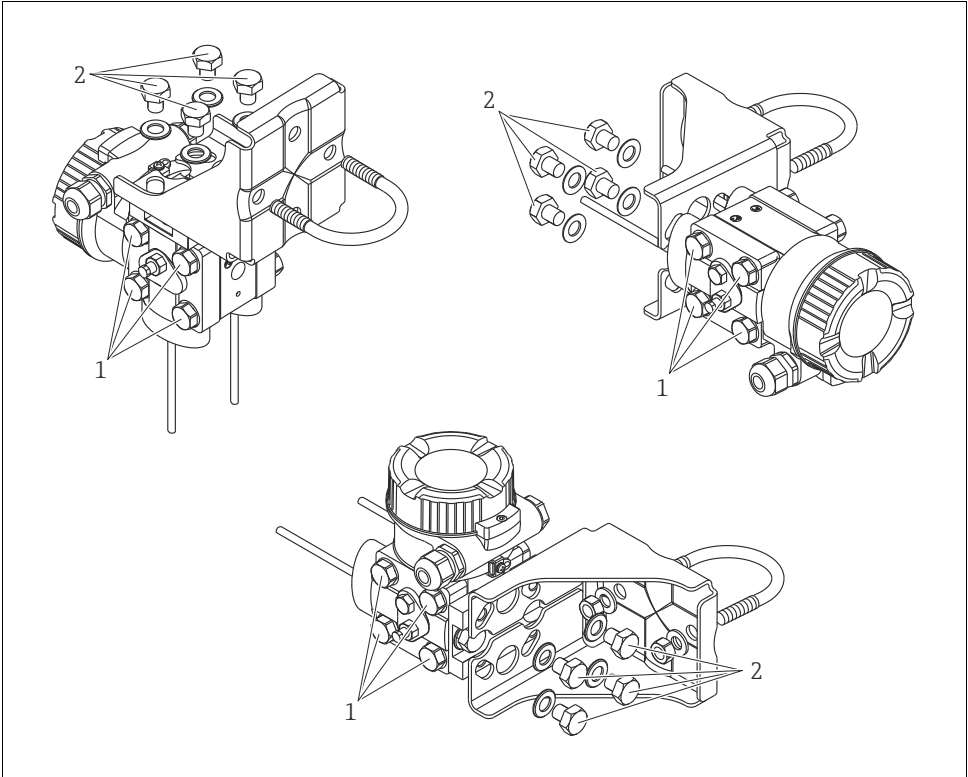
Please note the following when mounting:

- To prevent the mounting screws from scoring, lubricate them with a multi-purpose grease prior to mounting.
- In the case of pipe mounting, the nuts on the bracket 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!**

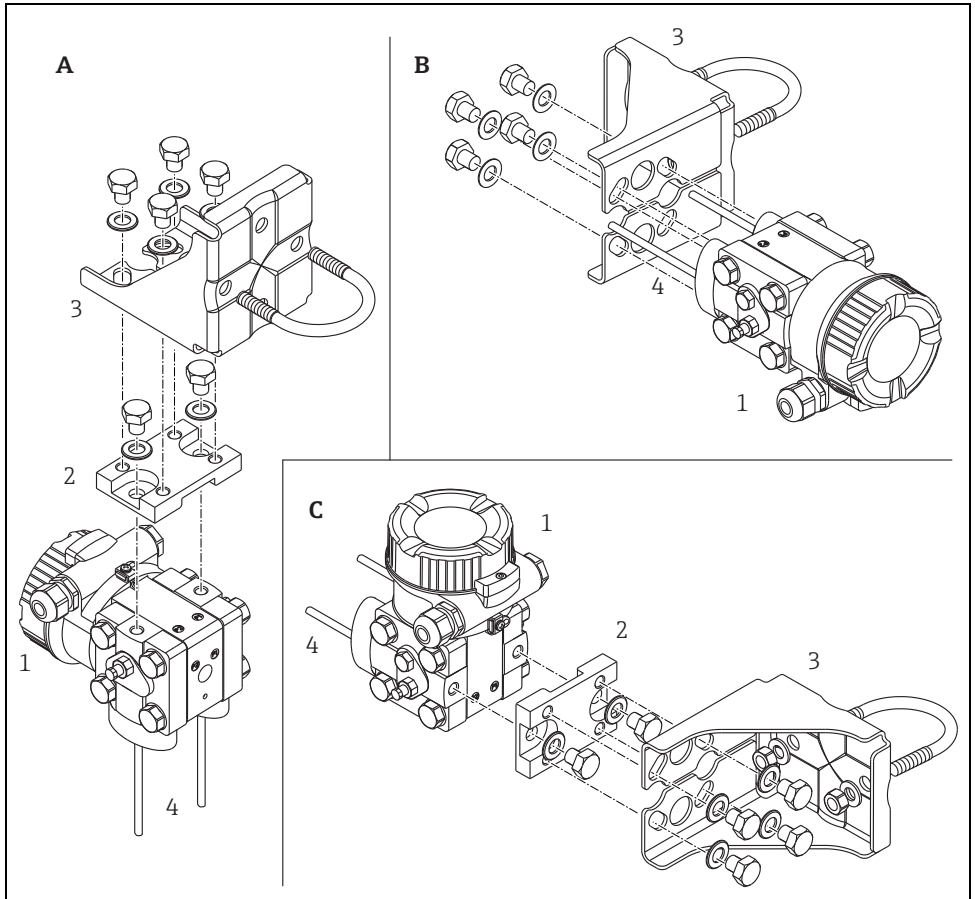
Damage of the device!

- ▶ Disassembly of the screws with item number (1) is not permissible under any circumstances and will result in loss of warranty.



A0024167.eps

Typical installation arrangements



A0023109

Fig. 1:

- A Impulse line vertical, version V1, alignment 90°
- B Impulse line horizontal, version H1, alignment 180°
- C Impulse line horizontal, version H2, alignment 90°
- 1 Deltabar M
- 2 Adapter plate
- 3 Mounting bracket
- 4 Pressure line

4.5 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.

4.6 Post-installation check

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

5 Electrical connection

5.1 Connecting the device

WARNING

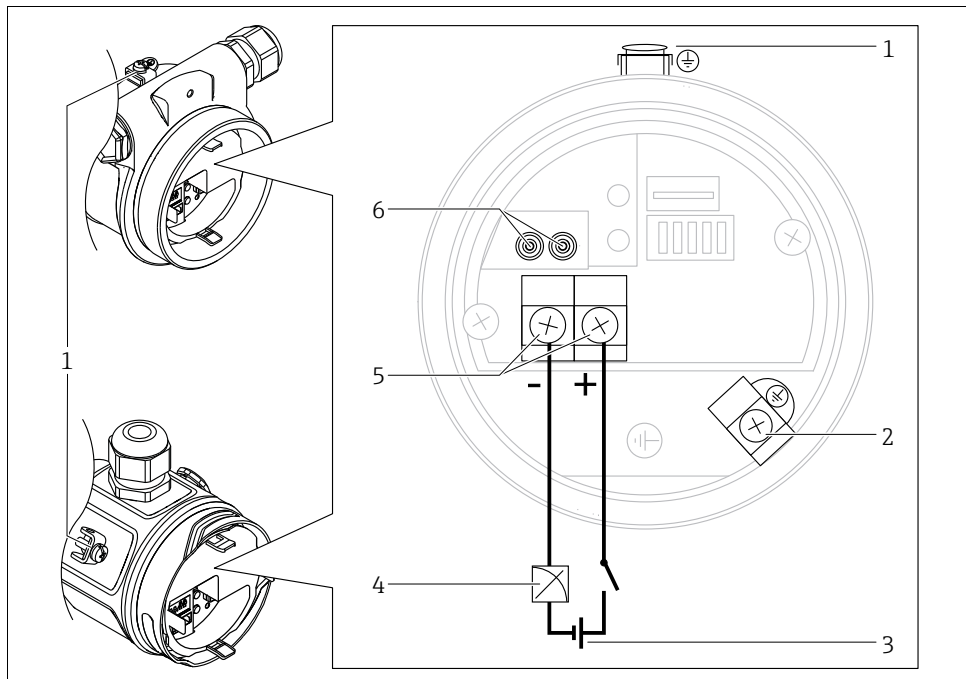
Supply voltage might be connected!

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.



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Electrical connection 4...20 mA HART

- 1 External ground terminal
- 2 Grounding terminal
- 3 Supply voltage: 11,5 ... 45 VDC (versions with plug connectors: 35 V DC)
- 4 4 to 20 mA
- 5 Terminals for supply voltage and signal
- 6 Test terminals

5.1.1 Connecting devices with a Harting connector Han7D

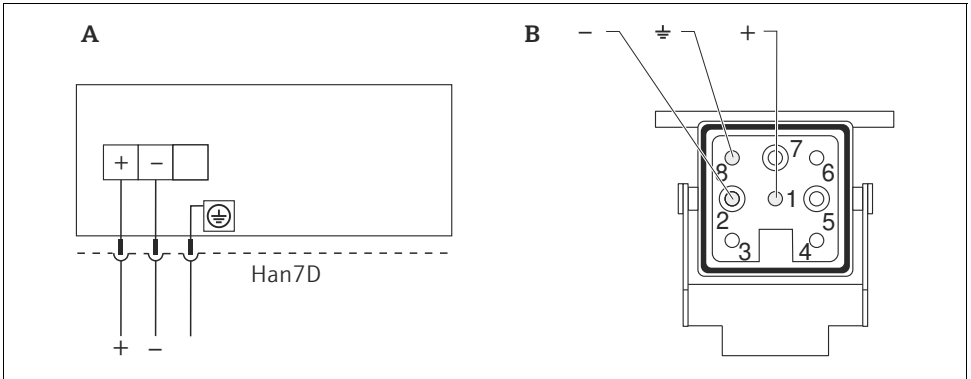


Fig. 2:

- A Electrical connection for devices with Harting plug Han7D
- B View of the connection on the device

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

5.1.2 Connecting devices with an M12 connector

PIN assignment for M12 connector

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

5.1.3 Devices with valve connector

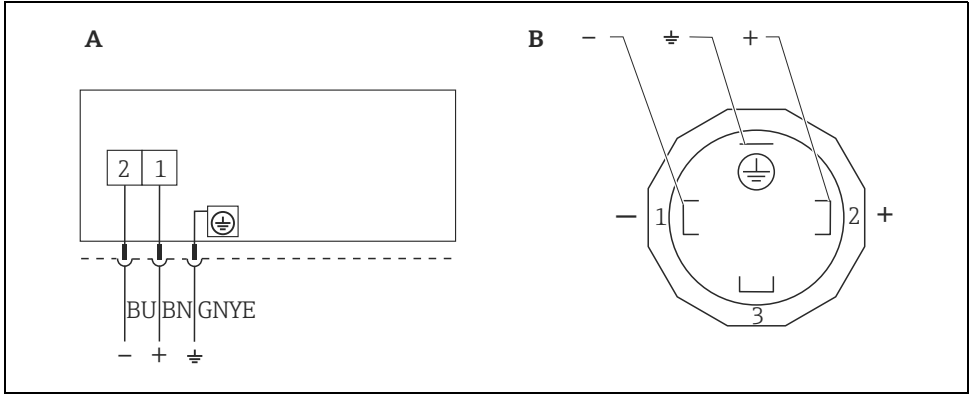


Fig. 3: BN = brown, BU = blue, GNYE = green/yellow

- 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, for non-hazardous areas	11.5 to 45 V DC (versions with plug-in connector 35 V DC)

Taking 4 to 20 mA test signal

A 4 to 20 mA test signal may be measured via the test terminals without interrupting the measurement. To keep the corresponding measured error below 0.1%, the current measuring device 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

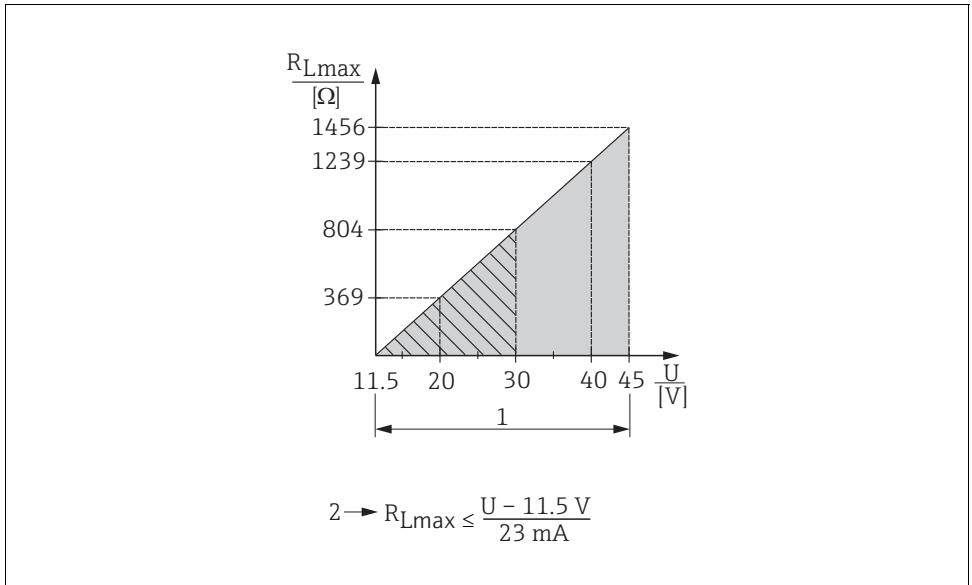


Fig. 4: Load diagram

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- 1 Supply voltage 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 R_{Lmax} Maximum load resistance
- U Supply voltage



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

5.2.5 Shielding/potential equalization

- A normal device cable suffices if only the analog signal is used. A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- 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

See operating instructions.

5.2.7 Connecting Commubox FXA195

See operating instructions.

5.3 Overvoltage protection (optional)

See operating instructions.

5.4 Post-connection check

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

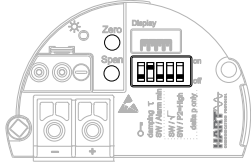
- Does the supply voltage match the specifications on the nameplate?
- Is the device properly connected?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

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


6 Operation

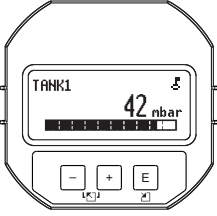

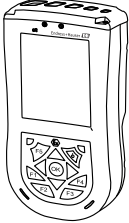

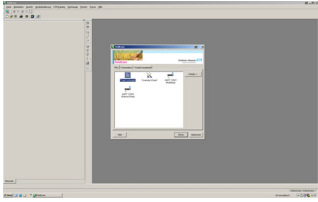

6.1 Operating options

6.1.1 Operation without operating menu

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

6.1.2 Operation with operating menu

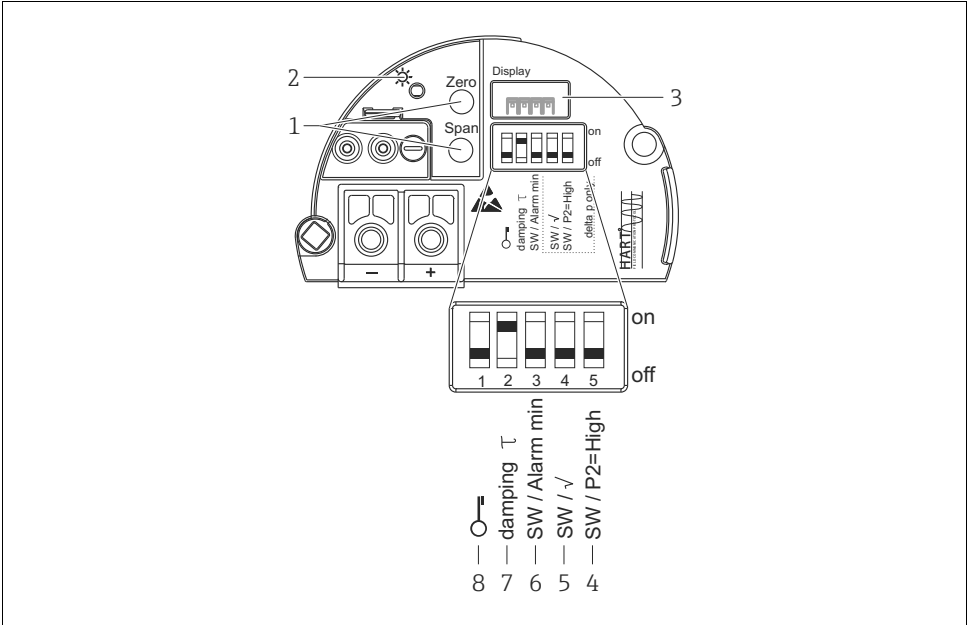
Operation with an operating menu is based on an operation concept with "user roles" →  27.

Operating options	Explanation	Graphic illustration	Description
<p>Local operation with device display</p>	<p>The device is operated using the operating keys on the device display.</p>		<p>→  29</p>
<p>Remote operation via HART handheld terminal</p>	<p>The device is operated using the HART handheld terminal (e.g. SFX100).</p>		<p>→  33</p>
<p>Remote operation via FieldCare</p>	<p>The device is operated using the FieldCare operating tool.</p>		<p>→  33</p>

6.2 Operation without operating menu

6.2.1 Position of operating elements

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




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Fig. 5: 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 local display
- 4+5 DIP switch only for Deltabar M
Switch 5: "SW/Square root"; used to control 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 switching damping on/off
- 8 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 τ	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 τ . ¹⁾
3	SW/Alarm min	The alarm current is defined by the setting in the operating menu. ("Setup" -> "Extended setup" -> "Curr. output" -> "Output fail mode")	The alarm current is 3.6 mA regardless of the setting in the operating menu.
4	SW/ $\sqrt{\quad}$	The output characteristics is defined by the setting in the operating menu. <ul style="list-style-type: none"> ▪ "Setup" -> "Measuring mode" ▪ "Setup" -> "Extended Setup" -> "Current output" -> "Linear/Sqroot" 	The measuring mode is "flow" and the output characteristics is "Square root" regardless of the settings in the operating menu.
5	SW/P2= High	The high-pressure side is defined by the setting in the operating menu. ("Setup" -> "High Press. Side")	The high-pressure side is allocated to the P2 pressure connection regardless of the setting in the operating menu.

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

Function of the operating elements

Operating key(s)	Meaning
"Zero" pressed for at least 3 seconds	<p>Get LRV</p> <ul style="list-style-type: none"> ▪ "Pressure" measuring mode The pressure present is accepted as the lower range value (LRV). ▪ "Level" measuring mode, "In pressure" level selection, "Wet" calibration mode The pressure present is assigned to the lower level value ("Empty calibration"). <p></p> <p>No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry"</p> <ul style="list-style-type: none"> ▪ "Flow" measuring mode There is no function allocated to the "Zero" key.

Operating key(s)	Meaning
"Span" pressed for at least 3 seconds	<p>Get URV</p> <ul style="list-style-type: none"> ▪ "Pressure" measuring mode The pressure present is accepted as the upper range value (URV). ▪ "Level" measuring mode, "In pressure" level selection, "Wet" calibration mode The pressure present is assigned to the upper level value ("Full calibration"). <p></p> <p>No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry"</p> <ul style="list-style-type: none"> ▪ "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	<p>Position adjustment</p> <p>The sensor characteristic curve is shifted such that the pressure present becomes the zero value.</p>
"Zero" and "Span" pressed simultaneously for at least 12 seconds	<p>Reset</p> <p>All parameters are reset to the order configuration.</p>

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.
Operator	Display/operat.	Contains parameters that are needed to configure the measured value display (selecting the values displayed, display format, display contrast, 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"> ■ 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.

User role	Submenu	Meaning/use
Service engineer/technician	Diagnosis	<p>Contains all the parameters that are needed to detect and analyze operating errors. This submenu has the following structure:</p> <ul style="list-style-type: none"> ▪ 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
Expert	Expert	<p>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:</p> <ul style="list-style-type: none"> ▪ 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: see operating instructions.

Direct access to parameters

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

Parameter name	Description
<p>Direct access (119) Entry</p> <p>Menu path: Expert → Direct access</p>	<p>Enter the direct access code to go directly to a parameter.</p> <p>Options:</p> <ul style="list-style-type: none"> ▪ Enter the desired parameter code. <p>Factory setting: 0</p> <p>Note: For direct access, it is not necessary to enter leading zeros.</p>

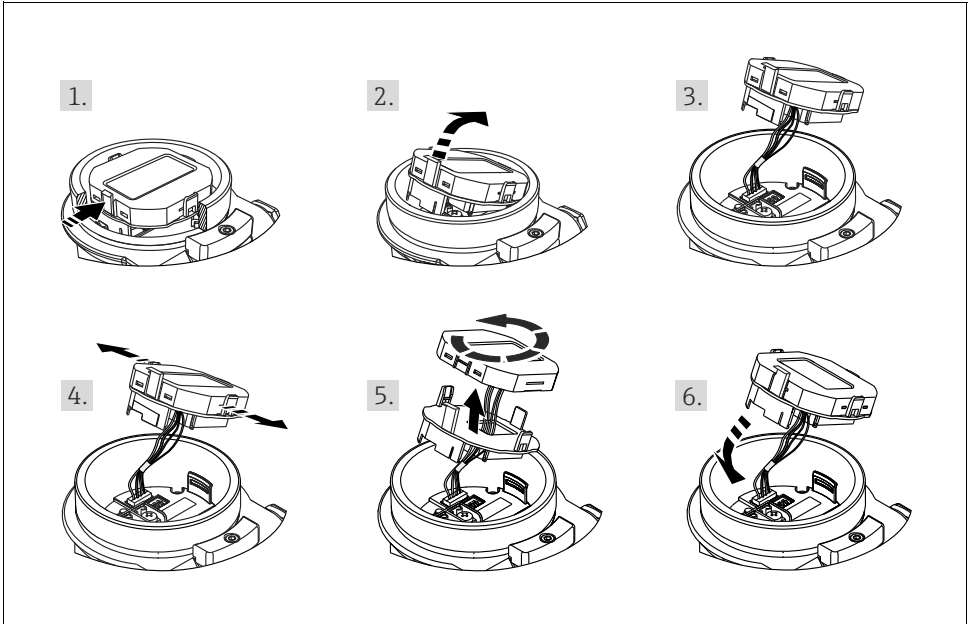
6.3.3 Operation with a device display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The local 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).

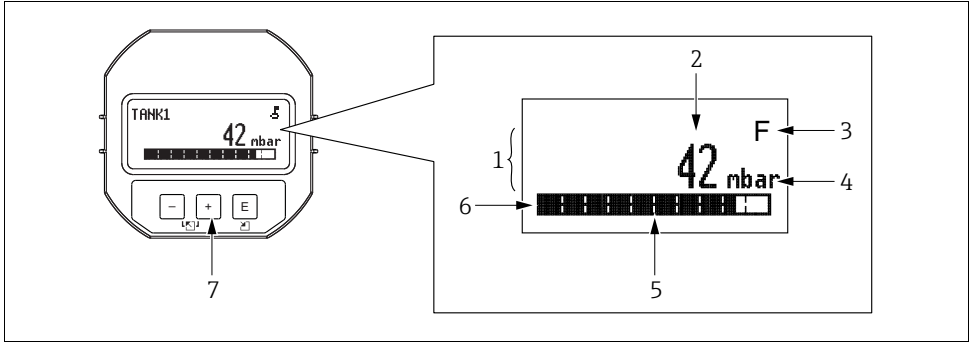
Depending on the orientation of the device, this makes it easy to operate the device and read the measured values.



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Functions:

- 8-digit measured value display including sign and decimal point, bargraph for 4 to 20 mA HART as current display
- 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, contrast setting, display of other measured values such as sensor temperature etc.
- Comprehensive diagnostic functions (fault and warning message etc.)



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Fig. 6: 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 local display. Four symbols can occur at one time.

Symbol	Meaning
	Lock symbol The operation of the device is locked. To unlock the device, → 33, Locking/unlocking operation.
	Communication symbol Data transfer via communication
	Square root symbol Active measuring mode "Flow measurement" The root flow signal is used for the current output.
	Error message "Out of specification" The device is being operated outside its technical specifications (e.g. during warmup or cleaning processes).
	Error message "Service mode" The device is in the service mode (during a simulation, for example).

Symbol	Meaning
M	Error message "Maintenance required" Maintenance is required. The measured value remains 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
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="+"/>	<ul style="list-style-type: none"> - Navigate downwards in the picklist - Edit the numerical values and characters within a function
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="-"/>	<ul style="list-style-type: none"> - Navigate upwards in the picklist - Edit the numerical values and characters within a function
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="E"/>	<ul style="list-style-type: none"> - Confirm entry - Jump to the next item - Selection of a menu item and activation of the editing mode
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="+"/> and <input style="border: 1px solid black; padding: 2px 5px;" type="button" value="E"/>	Contrast setting of local display: darker
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="-"/> and <input style="border: 1px solid black; padding: 2px 5px;" type="button" value="E"/>	Contrast setting of local display: brighter
<input style="border: 1px solid black; padding: 2px 5px;" type="button" value="+"/> and <input style="border: 1px solid black; padding: 2px 5px;" type="button" value="-"/>	ESC functions: <ul style="list-style-type: none"> - Exit the edit mode for a parameter without saving the changed value. - You are in a 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


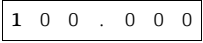
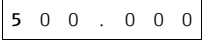
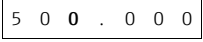
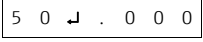
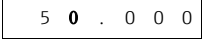
Example: selecting "Deutsch" as the language of the menu.

	Language	000	Operation
1	<input checked="" type="checkbox"/> English <input type="checkbox"/> Deutsch		"English" is set as the menu language (default value). A <input checked="" type="checkbox"/> in front of the menu text indicates the active option.
2	<input type="checkbox"/> Deutsch <input checked="" type="checkbox"/> English		Select "Deutsch" with <input style="border: 1px solid black; padding: 2px 5px;" type="button" value="↑"/> or <input style="border: 1px solid black; padding: 2px 5px;" type="button" value="↓"/> .

	Language	000	Operation
3	✓ Deutsch English		<ol style="list-style-type: none"> 1. Confirm your choice with \square. A ✓ in front of the menu text indicates the active option ("Deutsch" is now selected as the menu language). 2. Exit the edit mode for the parameter with \square.

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"> 1. Press \square or \square to get to the editing mode. 2. The first digit is highlighted in black.
3	 mbar		<ol style="list-style-type: none"> 1. Use \square to change "1" to "5". 2. Confirm "5" with \square. The cursor jumps to the next position (highlighted in black). 3. Confirm "0" with \square (second position).
4	 mbar		The third position is highlighted in black and can now be edited.
5	 mbar		<ol style="list-style-type: none"> 1. Switch to the "." symbol with the \square key. 2. Use \square to save the new value and exit the editing mode. → See next graphic.
6	 mbar		<p>The new value for the upper range value is 50.0 mbar (0.75 psi).</p> <ul style="list-style-type: none"> - You exit the edit mode for the parameter with \square. - You can get back to the editing mode with \square or \square.

Operating example: Accepting the pressure present

Example: setting position adjustment

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

6.3.4 Operation via SFX100

See operating instructions.

6.3.5 Operation via FieldCare

See operating instructions.

6.3.6 Locking/unlocking operation

See operating instructions.

6.3.7 Resetting to factory settings (reset)

See operating instructions.

7 Integrating transmitter using HART® protocol

See operating instructions.

8 Commissioning

The device is configured at the factory for the Pressure 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 → Chap. 4.6
- "Post-connection check" checklist → Chap. 5.4



8.2 Commissioning without an operating menu

8.2.1 Pressure measuring mode

If no local display is connected, the following functions are possible by means of the keys on the electronic insert:

- Position adjustment (zero point correction)
- Setting lower range value and upper range value
- Device reset →  25



- Operation must be unlocked. →  33, "Locking/unlocking operation"
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. →  39, "Measuring mode selection"
- 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 djustment. ¹⁾		Setting lower range value.		Setting upper range value.	
Pressure is present at device.		Desired pressure for lower range value is present at device.		Desired pressure for upper range value 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.	Applied pressure for position adjustment has not been accepted. Observe the input limits.	Applied pressure for lower range value has been accepted.	Applied pressure for lower range value has not been accepted. Observe the input limits.	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 (→  34)

8.2.2 Level measuring mode

The following functions are possible by means of 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 →  25




- The "Zero" and "Span" keys only have a function with the following setting:

– "Level selection" = "In pressure", "Calibration mode" = "Wet"

The keys have no function in other settings.

- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. →  39, "Measuring mode selection"

The following parameters are set to the following values at 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. →  33, "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 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

Carrying out position adjustment. ¹⁾		Setting lower pressure value.		Setting upper pressure value.	
↓	↓	↓	↓	↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure 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 (→  34)

8.2.3 Flow measuring mode

The following functions are possible by means of 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 →  25



- The operation must be unlocked. →  26, "Locking/unlocking operation".
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. →  38, "Selecting the language, measuring mode and pressure unit".
- 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!







Carry out position adjustment. ¹⁾	Setting maximum pressure value.
Pressure is present at device.	Desired pressure for the maximum pressure value ("Max. Press. Flow") is present at device.
↓	↓

Carry out position adjustment. ¹⁾		Setting maximum pressure value.	
Press the "Zero" and "Span" keys simultaneously 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?	
Yes	No	Yes	No
↓	↓	↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.	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 concerning the commissioning (page →  34).

8.3 Commissioning with an operating menu

Commissioning comprises the following steps:

1. Function check (→  34)
2. Selecting the language, measuring mode and pressure unit (→  38)
3. Position adjustment (→  40)
4. Configuring measurement:
 - Pressure measurement (→  41)
 - Level measurement (→  49)
 - Flow measurement (→  46)

8.3.1 Selecting the language, measuring mode and pressure unit

Language selection

Parameter name	Description
Language (000) Selection Menu path: Main menu → Language	Select the menu language for the local display. Options: <ul style="list-style-type: none"> ▪ English ▪ Another language (as selected when ordering the device) ▪ Possibly a third language (language of the manufacturing plant) Factory setting: English

Measuring mode selection


Parameter name	Description
Measuring mode (005) Selection Menu path: Setup → Measuring mode	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. <div style="background-color: #ff9900; color: white; padding: 2px; display: inline-block;">⚠ WARNING</div> 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: <ul style="list-style-type: none"> ■ Pressure ■ Level ■ Flow Factory setting: Pressure

Pressure unit selection

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: <ul style="list-style-type: none"> ■ mbar, bar ■ mmH₂O, mH₂O, inH₂O ■ ftH₂O ■ Pa, kPa, MPa ■ psi ■ mmHg, inHg ■ kgf/cm² Factory setting: mbar or bar depending on the sensor nominal measuring range, or as per order specifications

8.4 Position zero adjustment

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

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) Selection Menu path: Setup → Pos. zero adjust	Position zero adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. Example: <ul style="list-style-type: none"> – 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 assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. Options <ul style="list-style-type: none"> ▪ Confirm ▪ Abort Factory setting: Abort

8.5 Pressure measurement

8.5.1 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 → 40.

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 "Set LRV" parameter. Menu path: Setup → Set LRV
	Enter the value for the "Set LRV" parameter (here 0 mbar) and confirm. This pressure value is assigned to the lower current value (4 mA).
4	Select the "Set URV" parameter. 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. 7: Calibration without reference pressure

A See Table, Step 3.
B See Table, Step 4.

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8.5.2 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 operating instructions "Description of parameters".

Description	
1	Perform position adjustment → 40.
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.
	Select the "Get LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the lower current value (4 mA).

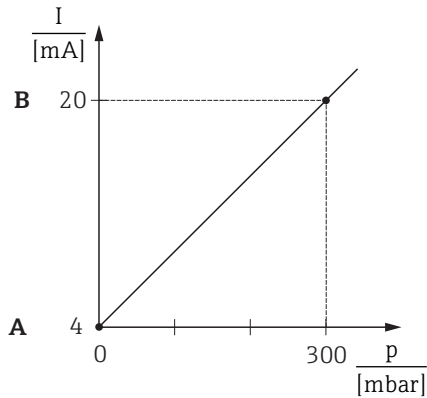


Fig. 8: Calibration with reference pressure

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A See Table, Step 4.
B See Table, Step 5.

Description	
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 "Get URV" parameter. Menu path: Setup → Extended setup → Current output → Get URV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the upper current value (20 mA).
6	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).

8.6 Differential pressure measurement

8.6.1 Preparatory steps





Before calibrating the device, the impulse piping must be cleaned and filled with fluid. → See the following table.

	Valves	Meaning	Preferred installation
1	Close 3.		<p>Above: preferred installation for gases Below: preferred installation for liquids</p> <p>I Deltabar M II Three-valve manifold III Separator 1, 5 Drain valves 2, 4 Inlet valves 3 Equalising valve 6, 7 Vent valves on Deltabar M A, B Shut-off valve</p>
2	Fill measuring system with fluid.		
	Open A, B, 2, 4.	Fluid flows in.	
3	Clean impulse piping if necessary: 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 fluid.	
	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 fluid and remove air.	
5	Set measuring point in 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 open (if present).		
6	Carry out calibration if necessary. → See also page 45, section 6.6.2.		

1) for arrangement with 5 valves

8.6.2 Setup menu for Pressure measuring mode

Parameter name	Description
Measuring mode (005) Selection	Select the "Pressure" measuring mode.
Switch P1/P2 (163) Display	Indicates whether the "SW/P2High" DIP switch (DIP switch 5) is switched on.
High pressure side (006) (183) Selection/Display	<p>Determines, which pressure input corresponds to the high-pressure side.</p>  <p>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.</p>
Press. eng. unit (125) Selection	<p>Select the pressure unit.</p> <p>If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit.</p>
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.
Pos. zero adjust (007) Selection	<p>Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known.</p> <p>Example:</p> <ul style="list-style-type: none"> - 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 assign the value 0.0 to the pressure present. - Measured value (after pos. zero adjust) = 0.0 mbar - The current value is also corrected.
Set LRV (056) Entry	Set the pressure value for the lower current value (4 mA).
Set URV (057) Entry	Set the pressure value for the upper current value (20 mA).
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.
Damping value (017) Entry/Display	<p>Enter damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure.</p>  <p>The damping is only active if DIP switch 2 ("damping τ") is in the ON position.</p>
Pressure after damping (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.

8.7 Flow measurement

8.7.1 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 is equipped with two totalizers as standard. The totalizers add up 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) totalises the flow from commissioning onwards and cannot be reset.



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

8.7.2 Preparatory steps



Before calibrating the Deltabar M, the impulse piping must be cleaned and filled with fluid. → See the following table.

	Valves	Meaning	Preferred installation
1	Close 3.		<p style="text-align: center;">I</p> <p style="text-align: center;">II</p> <p style="text-align: center;">+</p> <p style="text-align: center;">-</p> <p style="text-align: center;">A</p> <p style="text-align: center;">B</p> <p style="text-align: center;">6</p> <p style="text-align: center;">7</p> <p style="text-align: center;">P1 P2</p> <p style="text-align: center;">+</p> <p style="text-align: center;">-</p> <p style="text-align: center;">3</p> <p style="text-align: center;">2</p> <p style="text-align: center;">4</p> <p style="text-align: center;">1</p> <p style="text-align: center;">5</p>
2	Fill measuring system with fluid.		
	Open A, B, 2, 4.	Fluid flows in.	
3	Clean impulse piping if necessary 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 fluid.	
	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 fluid and remove air.	
5	Carry out position zero adjustment (→ 40) 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.		<p style="text-align: center;">I</p> <p style="text-align: center;">II</p> <p style="text-align: center;">III</p> <p style="text-align: center;">+</p> <p style="text-align: center;">-</p> <p style="text-align: center;">A</p> <p style="text-align: center;">B</p> <p style="text-align: center;">6</p> <p style="text-align: center;">7</p> <p style="text-align: center;">P1 P2</p> <p style="text-align: center;">+</p> <p style="text-align: center;">-</p> <p style="text-align: center;">3</p> <p style="text-align: center;">2</p> <p style="text-align: center;">4</p> <p style="text-align: center;">1</p> <p style="text-align: center;">5</p>
6	Set measuring point in 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 open (if present).		
7	Carry out position zero adjustment (→ 40) if the flow can be blocked off. In this case, step 5 is not applicable.		
8	Carry out calibration. → See page 48, → Chap. 8.7.3.		



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

A0030036

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

1) for arrangement with 5 valves

8.7.3 Setup menu for the "Flow" measuring mode

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.
Measuring mode (005) Selection	Select the "Flow" measuring mode.
Pressure side switch (163) Display	Indicates whether the "SW/P2High" DIP switch (DIP switch 5) is switched on.
High pressure side (006) (183) Selection	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.
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.
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.
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 assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected.
Max. flow (009) Entry	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.
Max. pressure flow (010) Entry	Enter maximum pressure of primary element. → See layout sheet of primary element. This pressure is assigned to the flow defined in the "Max. flow" (009) parameter.
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.
Damping value (017) Entry/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.
Flow (018) Display	Displays the present flow value.
Pressure after damping (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.

8.8 Level measurement

8.8.1 Preparatory steps

Open container



Before calibrating the device, the impulse piping must be cleaned and filled with fluid. → See the following table.

	Valves	Meaning	Installation
1	Fill container to a level above the lower tap.		<p><i>Open container</i></p> <p><i>I Deltabar M</i> <i>II Separator</i> <i>6 Vent valves on Deltabar M</i> <i>A Shut-off valve</i> <i>B Drain valve</i></p> <p style="text-align: right;">A009003B</p>
2	Fill measuring system with fluid.		
	Open A.	Open shut-off valve.	
3	Vent device.		
	Open 6 briefly, then close it again.	Fill device completely with fluid and remove air.	
4	Set measuring point in operation.		
	Now		
	- B and 6 are closed.		
	- A is open.		
5	Carry out calibration according to one of the following methods:		
	<ul style="list-style-type: none"> ■ "in pressure" - with reference pressure (→ 53) ■ "in pressure" - without reference pressure (→ 54) ■ "in height" - with reference pressure (→ 58) ■ "in height" - without reference pressure (→ 58) 		

Closed container



Before calibrating the device, the impulse piping must be cleaned and filled with fluid. → See the following table.

	Valves	Meaning	Installation
1	Fill container to a level above the lower tap.		<p style="text-align: right;">A0030039</p>
2	Fill measuring system with fluid.		
	Close 3.	Shut off high-pressure side from low-pressure side.	
	Open A and B.	Open shut-off valves.	
3	Vent high-pressure side (empty low-pressure side if necessary).		
	Open 2 and 4.	Introduce fluid on high-pressure side.	
	Open 6 and 7 briefly, then close them again.	Fill high-pressure side completely with fluid and remove air.	
4	Set measuring point in 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: <ul style="list-style-type: none"> ▪ "in pressure" - with reference pressure (→ 53) ▪ "in pressure" - without reference pressure (→ 54) ▪ "in height" - with reference pressure (→ 58) ▪ "in height" - without reference pressure (→ 58) 		

Closed container

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

Closed container with superimposed steam



Before calibrating the device, the impulse piping must be cleaned and filled with fluid. → See the following table.

	Valves	Meaning	Installation
1		Fill container to a level above the lower tap.	
2		Fill measuring system with fluid.	
	Open A and B.	Open shut-off valves.	
		Fill the negative impulse piping to the level of the condensate trap.	
3		Vent device.	
	Open 2 and 4.	Introduce fluid.	
	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 fluid and remove air.	
4		Set measuring point in 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:	<p><i>A0030040</i></p> <p><i>Closed container with superimposed steam</i></p> <ul style="list-style-type: none"> <i>I Deltabar M</i> <i>II Three-valve manifold</i> <i>III Separator</i> <i>I, 5 Drain valves</i> <i>2, 4 Inlet valves</i> <i>3 Equalising valve</i> <i>6, 7 Vent valves on Deltabar M</i> <i>A, B Shut-off valves</i>
		<ul style="list-style-type: none"> ■ "in pressure" - with reference pressure (→ 53) ■ "in pressure" - without reference pressure (→ 54) ■ "in height" - with reference pressure (→ 58) ■ "in height" - without reference pressure (→ 58) 	

8.8.2 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 output, if the values are too close together.

8.8.3 Overview of level measurement

Measuring task	Level selection	Measured variable options	Description	Measured value display
Calibration takes place by entering two pressure/level value pairs.	"In pressure"	Via the "Unit before lin" parameter: %, level, volume or mass units.	<ul style="list-style-type: none"> ■ Calibration with reference pressure (wet calibration), → 53 ■ Calibration without reference pressure (dry calibration) → 54 	The measured value display and the "Level before lin" parameter display the measured value.
Calibration takes place by entering the density and two height/level value pairs.	"In height"		<ul style="list-style-type: none"> ■ Calibration with reference pressure (wet calibration), → 58 ■ Calibration without reference pressure (dry calibration) → 56 	

8.8.4 Level selection "in pressure" 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 and 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 output, if the values are too close together. Other 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.

	Description
1	Perform "position zero adjustment" → 40.
2	Select the "Level" measuring mode via the " Measuring mode (005) " 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	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
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

Description	
7	<p>a. The pressure for the lower calibration point is present at the device, here "0 mbar" for example.</p> <p>b. Select the "Empty calib." parameter.</p> <p>c. Enter the level value, here "0 m" for example. Confirming the value means you assign the pressure value present to the lower level value.</p> <p>Menu path: Setup → Extended setup → Level → Empty calib.</p>
8	<p>a. The pressure for the upper calibration point is present at the device, here "300 mbar" (4.5 psi) for example.</p> <p>b. Select the "Full calib." parameter.</p> <p>c. Enter the level value, here "3 m" for example. Confirming the value means you assign the pressure value present to the upper level value.</p> <p>Menu path: Setup → Extended setup → Level → Full calib.</p>
9	<p>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.</p>

Calibration with reference pressure (wet calibration)

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

A0017658

8.8.5 Level selection "in pressure"

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 US gal) corresponds to a pressure of 400 mbar (6 psi). The minimum volume of 0 liters corresponds to a pressure of 0 mbar.

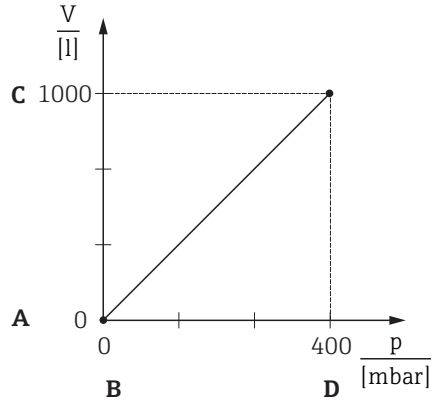
Prerequisite:

- 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 output, if the values are too close together. Other 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.

Description	
1	Perform "position zero adjustment" → 40.
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter (→ 39). Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press eng. unit" parameter (→ 39), here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
5	Select a level unit via the "Unit before lin" parameter, here "l" for example. Menu path: Setup → Extended setup → Level → Unit before lin
6	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
7	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.
8	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, 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, here "1000 liter" (264 US 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, 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 US 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) A0030043

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

8.8.6 Level selection "in height"

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 US 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 medium is 1 g/cm³ (1 SGU).

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 output, if the values are too close together. Other 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.

	Description
1	Perform "position zero adjustment" → 40.
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter (→ 39). Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press eng. unit" parameter (→ 39), here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
5	Select a level unit via the "Unit before lin" parameter, here "l" for example. Menu path: Setup → Extended setup → Level → Unit before lin
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

	Description	
8	Enter the height value for the lower calibration point via the "Empty height" parameter, here "0 m" for example. Menu path: Setup → Extended setup → Level → Empty height	<p style="text-align: center;">$h = \frac{p}{\rho \cdot g}$</p> <p style="text-align: center;">$\rho = 1 \frac{\text{g}}{\text{cm}^3}$</p> <p style="text-align: center;">$h = \frac{p}{\rho \cdot g}$</p>
9	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liter" (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.	
10	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here "0 liter" for example. Menu path: Setup → Extended setup → Level → Empty calib.	
11	Enter the height value for the upper calibration point via the "Full height" parameter, 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, 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 US gal). 0 l corresponds to an output current of 4 mA. 1000 l (264 US gal) corresponds to an output current of 20 mA.	<p style="text-align: right;">A0030051</p> <p>Calibration without reference pressure (dry calibration)</p> <p>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.</p>

8.8.7 Level selection "in height" 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 US 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 medium is 1 g/cm³ (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./Full calib." and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message output, if the values are too close together. Other 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.

	Description
1	Perform "position zero adjustment" → 40.
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter (→ 39). Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press eng. unit" parameter (→ 39), here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
5	Select a level unit via the "Unit before lin" parameter, here "l" for example. Menu path: Setup → Extended setup → Level → Unit before lin
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

Description	
8	<p>a. The pressure for the lower calibration point is present at the device, here "0 mbar" for example.</p> <p>b. Select the "Empty calib." parameter.</p> <p>c. Enter the volume value, here "0 l" for example.</p> <p>Menu path: Setup → Extended setup → Level → Empty calib.</p>
9	<p>a. The pressure for the upper calibration point is present at the device, here "400 mbar" (6 psi) for example.</p> <p>b. Select the "Full calib." parameter.</p> <p>c. Enter the volume value, here "1000 l" (264 US gal) for example.</p> <p>Menu path: Setup → Extended setup → Level → Full calib.</p>
10	<p>Enter the density of the medium, using the "Adjust density" parameter, here 1 g/cm³ (1 SGU) for example.</p> <p>Menu path: Setup → Extended setup → Level → Adjust density</p>
11	<p>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.</p> <p>Menu path: Setup → Extended Setup → Level → Density process</p>
12	<p>Result: The measuring range is set for 0 to 1000 l (264 US gal). 0 l corresponds to an output current of 4 mA. 1000 l (264 US gal) corresponds to an output current of 20 mA.</p>

$h = \frac{p}{\rho \cdot g}$

$\rho = 1 \frac{\text{g}}{\text{cm}^3}$

C V
[l]

B h
[m]

$h = \frac{p}{\rho \cdot g}$

Calibration with reference pressure (wet calibration) A0030052

A See table, Step 8.

B See table, Step 9.



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