



OPTIBAR DP 3050 Handbook

Compact differential pressure transmitter for measuring flow, level and differential pressure

2-wire 4...20 mA HART:
ER: from 1.01._

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1.1 Software history

For all GDC devices, the "Electronic Revision" (ER) is consulted to document the revision status of the electronics according to NE 53. It is easy to see from the ER whether troubleshooting or larger changes in the electronic equipment have taken place and how that has affected the compatibility.

Changes and effect on compatibility

1	Downwards compatible changes and fault repair with no effect on operation (e.g. spelling mistakes on display)	
2- _	Downwards compatible hardware and/or software change of interfaces:	
	H	HART®
	P	PROFIBUS
	F	Foundation Fieldbus
	M	Modbus
X	all interfaces	
3- _	Downwards compatible hardware and/or software change of inputs and outputs:	
	I	Current output
	F, P	Frequency / pulse output
	S	Status output
	C	Control input
	CI	Current input
X	All inputs and outputs	
4	Downwards compatible changes with new functions	
5	Incompatible changes, i.e. electronic equipment must be changed.	



INFORMATION!

In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.

Release date	SW version	HW version	Changes and compatibility	Documentation
2019-01-01	1.01.X_	1.00.X_	-	MA OPTIBAR DP 3050 R01

1.2 Intended use

**DANGER!**

For devices used in hazardous areas, additional safety notes apply.

**CAUTION!**

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

**INFORMATION!**

This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

**INFORMATION!**

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The OPTIBAR DP 3050 is a differential pressure transmitter suitable for measuring flow, level and differential pressure. The available measurement ranges and the respective permissible overloads are indicated on the nameplate. To observe the intended use, adhere to the following points:

- Observe the instructions in this document.
- Comply with the technical specifications (for further information refer to *Technical data* on page 48).
- Only suitably qualified personnel may install and operate the device.
- Observe the generally accepted standards of good practice.

**CAUTION!**

- *Any modification to the device, including drilling, sawing, trimming, welding and soldering of parts, or partially painting over or coating, is prohibited.*
- *Neither is it permitted to use the device as a climbing aid e.g. for installation purposes, as a holder for cables, pipes or other loads.*
- *The mounting or installation of parts is only permitted as described in this document, or insofar as it has been authorised by the manufacturer or a certified service partner.*

1.3 Technical limits

The device was constructed solely for use within the technical limits indicated on the nameplate and in the technical data. Applications outside of these limits are not permitted and could lead to significant risk of accident. For this reason, observe the following limits:

- Do not exceed the maximum working pressure (MWP).
- Do not exceed the indicated permissible operating temperature range.
- The permissible ambient temperatures given may not be exceeded or undershot.
- Check the materials used for the wetted parts (e.g. gasket, process connection, separating diaphragm etc.) for suitability as regards process compatibility.

1.4 Measured products

The device is designed to measure the pressure of vaporous, gaseous and liquid media. Prior to using any corrosive or abrasive products, the operator must check the resistance of all materials which are in contact with the product.

1.5 Manufacturer's declaration

CE marking



The device meets the essential requirements of the EU directives. The CE marking indicates the conformity of the product with the union legislation applying to the product and providing for CE marking.

For full information of the EU directives and standards and the approved certifications, please refer to the EU declaration on the KROHNE website.

1.6 Safety instructions from the manufacturer

1.6.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.6.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.6.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.6.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.6.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This warning refers to the immediate danger when working with electricity.



DANGER!

This warning refers to the immediate danger of burns caused by heat or hot surfaces.



DANGER!

This warning refers to the immediate danger when using this device in a hazardous atmosphere.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➔ **RESULT**

This symbol refers to all important consequences of the previous actions.

1.7 Safety instructions for the operator



WARNING!

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

2.1 Scope of delivery



INFORMATION!

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.



INFORMATION!

Do a check of the packing list to make sure that you have all the elements given in the order.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

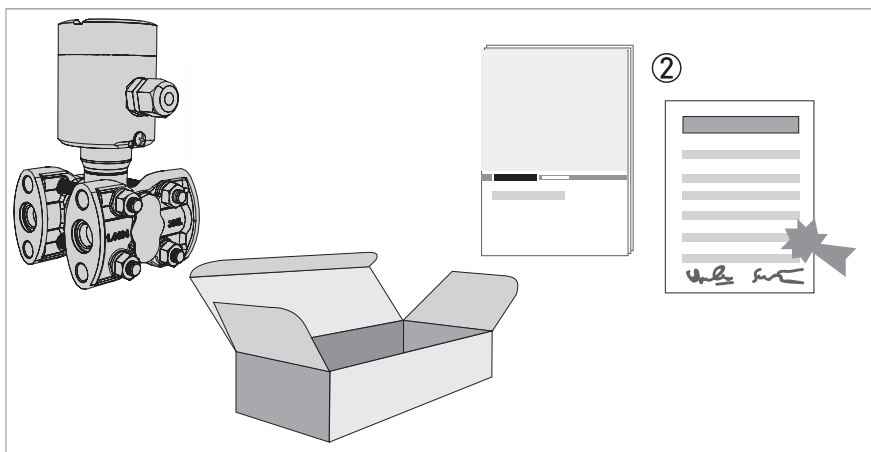


Figure 2-1: Scope of delivery

- ① Device in the version as ordered
- ② Documentation (test reports, factory and material certification (if ordered) and product documentation)

Optional accessories

- Oval flange adapter 1/2-14 NPT (female)
- Manifolds
- Sealings
- Mounting bracket



INFORMATION!

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

2.2 Device design

The following drawings show the basic components of the differential pressure transmitter.

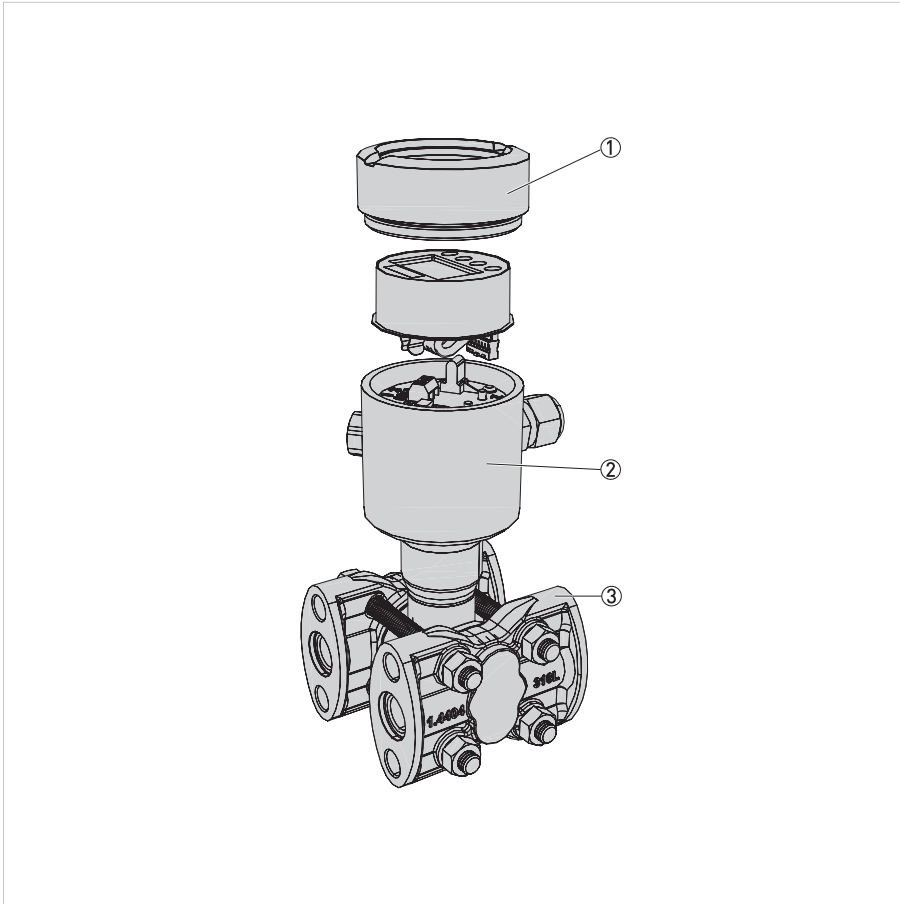


Figure 2-2: Basic components of single chamber pressure transmitter

- ① Housing cover, optional with display and adjustment module below
- ② Housing with electronics and cable entry (aligned parallel to process axis)
- ③ Process assembly with measuring cell

2.2.1 Connection variants

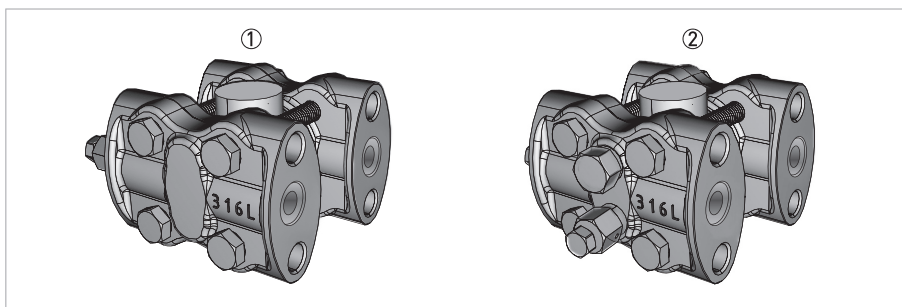


Figure 2-3: Process assembly

- ① Rear vent on process axis
- ② Side vent

Following connection variants are available:

- Process connection: 1/4-18 NPT (female) as well as IEC 61518 A
- Optional: Oval flange adapter 1/2-14 NPT (female)
- Mounting thread: 7/16 UNF, optional M10

The optional venting and drain valves on the device must be chosen according to the installation situation.

2.3 Nameplates



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

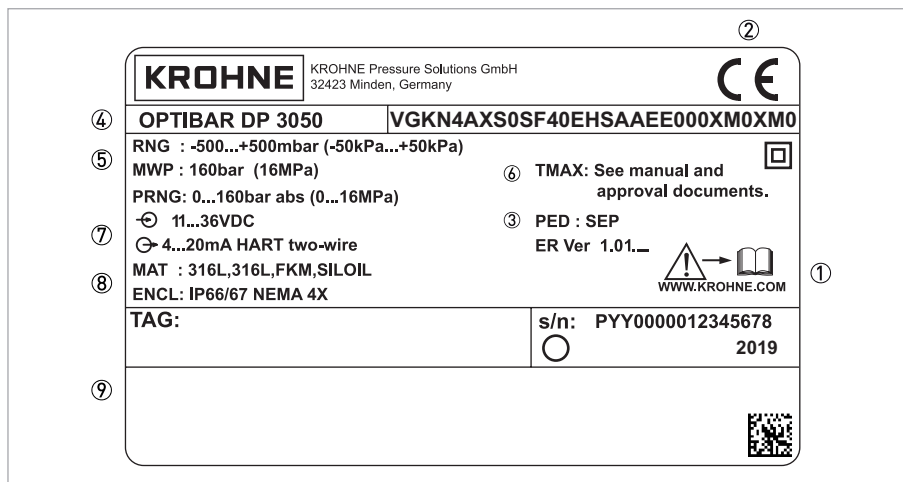


Figure 2-4: Example for a nameplate

- ① Observe the installation and operating instructions
- ② CE marking and marking of notified body
- ③ Hardware and Software version
- ④ Product name and type code
- ⑤ Nominal range
Permissible process pressure
Nominal range of absolute pressure measurement
- ⑥ Permissible temperature range
- ⑦ Electronics power supply and signal output
- ⑧ Ingress protection and material of wetted parts
(Diaphragm, process connections, sealing and fill fluid)
- ⑨ Approvals and approval guidelines

2.4 Terms and abbreviations

The following terms and abbreviations are used in this document.

URL Upper Range Limit	Upper measuring range limit. Also called nominal range. The highest value that can be measured by a particular device.
LRL Lower Range Limit	Lower measuring range limit. The lowest value that can be measured by a particular device.
URV Upper Range Value	The calibrated measuring range or the highest adjusted measured value. This value corresponds to the 20 mA signal.
LRV Lower Range Value	The calibrated measuring range or the lowest adjusted measured value. This value corresponds to the 4 mA signal.
SPAN Span	Measuring span or measuring range. $SPAN = URL - LRL$
CAL SPAN Calibrated Span	Calibrated or adjusted measuring span. $CAL SPAN = URV - LRV$. Also called "cSPAN". This is the span set to the 4...20 mA output.
TD Turn Down	The ratio from the measuring span to the adjusted measuring span. $TD = SPAN / (CAL SPAN) = (+URL) / (CAL SPAN)$ The following applies: $URV \leq URL$, $CAL SPAN \leq SPAN$, $TD \geq 1$

Example for TD Turn Down	
LRL = 0 bar URL = 3 bar / 43.5 psi	SPAN = 3 bar / 43.5 psi
URV = 2 bar / 29 psi LRV = 0.5 bar / 7.25 psi	CAL SPAN = 1.5 bar / 21.75 psi TD = 2:1

3.1 General notes on installation

**INFORMATION!**

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**

Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Ingress protection for housing

The housing of the signal converter fulfills the requirements for ingress protection in accordance with IEC 60529. For further information refer to *Technical data* on page 48.

**CAUTION!**

The first digit stands for the protection of the inner electronic components against the ingress of foreign bodies including dust. The first digit "6" means that the housing is dust-proof. The second digit designates the protection of the inner electronic components against the ingress of water. The second digit "6" means that the housing is waterproof and also resistant against a strong jet of water. The number "7" means that the housing is waterproof even submersed under water for a given pressure and time. The number "8" means that the housing is permanently waterproof even under water.

3.3 Packaging

**CAUTION!**

Devices for oxygen applications are sealed in PE foil and a "DEGREASED" label (oil and grease-free) is affixed. Remove this foil just before mounting the device. Once the protection for the process connection has been removed, the label O₂ will be visible on the process connection. No oil, grease or dirt should penetrate. Danger of explosion.

Your device was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test following ISO 22248. The packaging of standard devices consists of environmentally friendly, recyclable cardboard and PE foil. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

3.4 Storage

**CAUTION!**

Observe the storage information found on the packaging. Labels on the original packaging must always remain legible and may not be damaged.

- Store the device in a dry, dust-free location.
- Avoid extended direct exposure to the sun.
- Store the device in the original packaging supplied.
- Do not expose to aggressive media.
- Avoid mechanical shocks.
- Storage temperature: -40...+80°C / -40...+176°F
- Relative air humidity: 20...85%.

3.5 Transport

- Use original packaging for transport and ensure that the packaging does not get crushed or damaged by sharp objects or other boxes.
- Do not throw or drop the device.
- Avoid temperatures below -40°C / -40°F and above +80°C / +176°F.
- When transporting by ship, use seaworthy outer packing.

3.6 Installation specifications

**INFORMATION!**

Observe the relevant directives, ordinances, standards and accident prevention regulations (e.g. VDE/VDI 3512, DIN 19210, VBG, Elex V, etc.).

The accuracy of the measurement is only guaranteed if the transmitter and accompanying impulse line(s), if any, have been correctly installed. In addition, extreme ambient conditions including large fluctuations in temperature, vibrations and shocks should be kept as far away as possible from the measuring equipment.

3.7 Mounting



CAUTION!

- *Prior to installing the transmitter, it is essential to verify whether the version of the device on hand completely fulfils the technical and safety requirements of the measuring point. This applies in particular to the measuring range, overpressure resistance, temperature, explosion protection and operating voltage.*
- *Check the materials used for the wetted parts (e.g. gasket, process connection, separating diaphragm etc.) for suitability as regards process compatibility.*
- *The device must not be heated by radiated heat (e.g. exposure to the sun) to an electronics housing surface temperature above the maximum permissible ambient temperature. If it is necessary to prevent damage from heat sources, a heat protection (e.g. sun shade) has to be installed.*

3.7.1 Opening the device, installing and dismantling the graphic display



DANGER!

Check whether the ambient air around the signal converter is explosive. Opening the signal converter in an explosive atmosphere may result in ignition and explosion.



DANGER!

The product may cause the signal converter to become extremely hot. Possible risk of burning. For this reason, promptly shut off the process or isolate the signal converter sufficiently from the product prior to starting work and check that the converter has cooled down to room temperature.



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

Electrically, the graphic display is connected to the device using a plug connector on the connection board with the aid of a flying lead. The display is mechanically fixed by way of a spacer plugged into the connection board. For optimal readability, the display can be rotated on this bracket by 350°, adjusting to any of the pressure transmitter's possible installation positions.



Procedure

- Ensure that the signal converter has been de-energised!
- Remove the housing cover from the signal converter by hand.
If the housing cover is stuck and cannot be moved by hand, use a suitable square material to carefully remove it. Place this tool in the flaring located in the housing cover. Take care not to damage the optionally available window cover! Use a lever action to now carefully apply greater torque to loosen it. As soon as the housing cover opens, put the tool away and turn the cover by hand until it opens.
- Ensure that no moisture gets into the device while it is open (drops, spray, liquid mist, etc. ...).
- If there is a display, it can be removed by pulling it forward gently. Pay attention to the connecting cable between the device and the display. To completely remove the display, the connecting cable must be carefully pulled out of the connector on the board.
- ➡ The connection board is now available for further work.
- To install the display and close the housing, follow the steps in reverse order.
Note that the housing covers for devices with displays and devices without displays are different heights. Never attempt, even on a temporary basis, to install a housing cover for a blind device on a device with an installed display.



INFORMATION!

Each time a housing cover is opened, the thread should be cleaned and greased. Use only resin-free and acid-free grease.

Ensure that the housing gasket is properly fitted, clean and undamaged.

3.7.2 Process connections

Before installation of the device, please check the correct position of the high (H) and low (L) pressure side. You can see the designations (H / L) underneath the measuring cell acc. to the following figure.

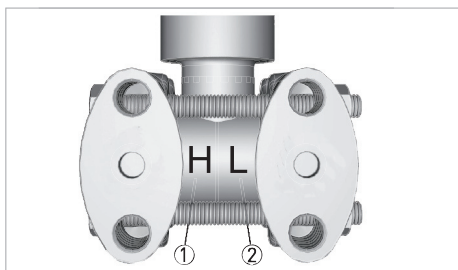


Figure 3-1: Process connection of the differential pressure transmitter

- ① High-pressure side
- ② Low-pressure side

The process connections of the differential pressure transmitter are usually 1/4-18 NPT (female) at a distance of 54 mm / 2.13". Through optional oval flange adapters, the connections 1/2-14 NPT (female) are also selectable.

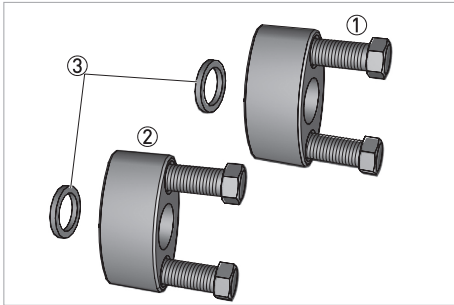


Figure 3-2: Oval flange adapter

- ① 7/16 UNF screws
- ② Oval flange adapter
- ③ Sealing ring



If the adapter is not supplied pre-assembled, proceed as follows:

- Position the adapter with inserted O-ring.
- Use the screws supplied to screw the adapter to the transmitter.
- Tighten the screws to a torque of 25 Nm (stainless steel screws) or 12.5 Nm (stainless steel acc. to NACE).

3.7.3 Mounting bracket

Scope of delivery

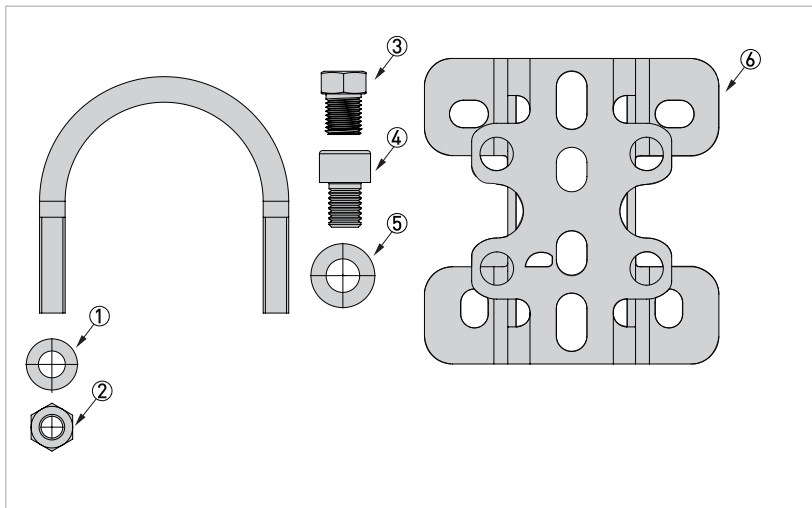


Figure 3-3: Scope of delivery

- ① 2x Washer ISO 7089-8-200 HV
- ② 2x Hexagonal nut ISO 4032-M8-42-70
- ③ 4x Hexagonal head screw 7/16-20 UNF x 1/2 Grade5
- ④ 2x Cylinder head screw ISO 4762-M10-14-A4-50
- ⑤ 2x Washer ISO 7089-10-200-HV
- ⑥ 1x Mounting bracket

Mounting bracket for easy pipe or wall mounting.

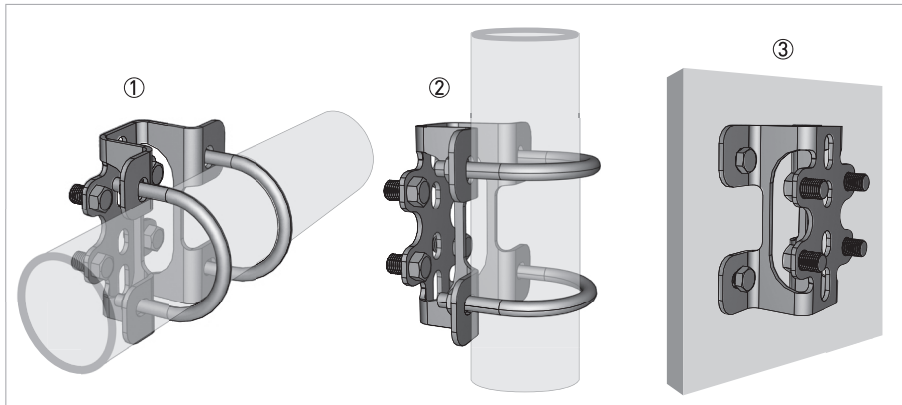


Figure 3-4: Mounting bracket

- ① Horizontal 2" pipe mounting
- ② Vertical 2" pipe mounting
- ③ Wall mount

Mounting bracket for easy valve and pressure transmitter mounting.

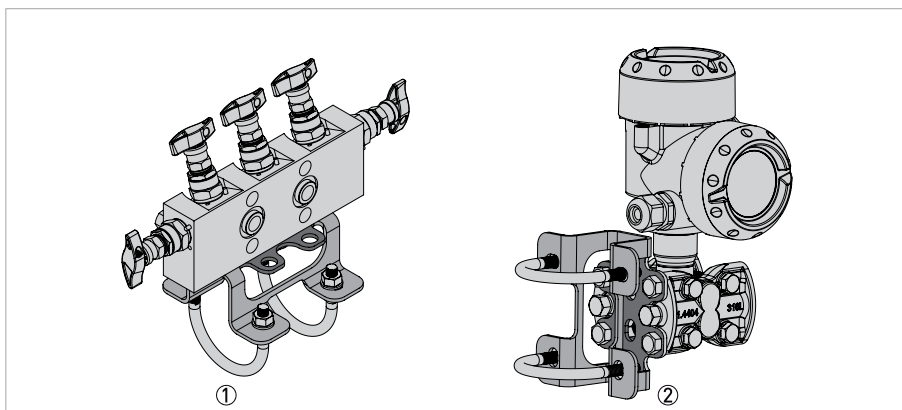


Figure 3-5: Mounting bracket

- ① Mounting bracket on a valve
- ② Mounting bracket on a pressure transmitter

3.7.4 Manifolds

Manifolds allow for easy installation and commissioning of the transmitter. They separate the device from the process side and ensure simple control of the measuring point. They are available as 3-way and 5-way versions. The integrated equalize valve allows pressure equalization between the high (H) and low (L) pressure side during commissioning. With the manifold, it is possible to disassemble the differential pressure transmitter without interrupting the process. This means higher system availability and even simpler commissioning or maintenance purposes. The 3-way manifold with double-sided flange adapters allows a mechanically robust connection between the differential pressure transmitter and, for example, the impulse lines or the flange adapters of a averaging pitot tube. With a 5-way manifold, two additional valves allow to blow out of the impulse lines and the calibration of the differential pressure transmitter in place.

3.7.5 Differential pressure transmitter

Primary elements, such as averaging pitot tubes, orifice plates or venturis are designed for certain line sizes and flow conditions. Therefore, prior to installation, the line size and pressure rating has to be checked and the measuring point number compared. For detailed instructions on installing a primary element refer to DIN EN ISO 5167.

3.7.6 Pressure connection with impulse line

Please review the following information for pressure connection with impulse line:

- Select the shortest impulse line possible and install without sharp bends.
- Avoid material deposits and blockages in the impulse line. Accordingly, install the impulse lines so that such occurrences are impossible. Do not exceed a slope of approx. 8% in the piping.
- Ensure that the impulse line flows freely before installation and rinse with compressed air or, even better, with the product itself.
- When measuring liquid, the impulse line must be completely purged of air.
- Run the impulse line so that trapped air (when measuring liquids) or condensate (when measuring gas) can flow back into the process.
- Hot steam must not enter the process connection (the over temperature will destroy the device). To avoid this situation, a suitable water trap (such as a syphon filled with water prior to installation) can be installed upstream from the measuring device.
- All connections must be tight and fixed properly.
- The process lines must be installed so that the medium cannot be blown out of the measuring chambers.

3.7.7 Vibrations

In case of strong vibrations at the measuring point, the device should be mounted via impulse lines in a calm place.

3.7.8 Temperature limits

Higher process temperatures often mean also higher ambient temperatures for electronics and connection cables. Make sure that the upper temperature limits for the environment of the electronics housing and connection cable are not exceeded. .

3.8 Instructions for oxygen applications

Oxygen and other gases can be explosive when brought into contact with oils, grease and plastics, so the following measures must also be taken:

- All components of the plant, such as e.g. measuring devices must be cleaned according to the requirements of BAM (DIN 19247).
- Depending on the seal material, certain temperatures and pressures must not be exceeded in oxygen applications, refer to *Technical data* on page 48.

**CAUTION!**

Devices for oxygen applications are sealed in PE foil and a "DEGREASED" label (oil and grease-free) is affixed. Remove this foil just before mounting the device. Once the protection for the process connection has been removed, the label O_2 will be visible on the process connection. No oil, grease or dirt should penetrate. Danger of explosion.

3.9 Measurement setup for flow measurement

3.9.1 In gases and liquids with solids content

- Include the pressure tapping points above or to the side on the process line.
- The device must be mounted above the chosen tapping point.

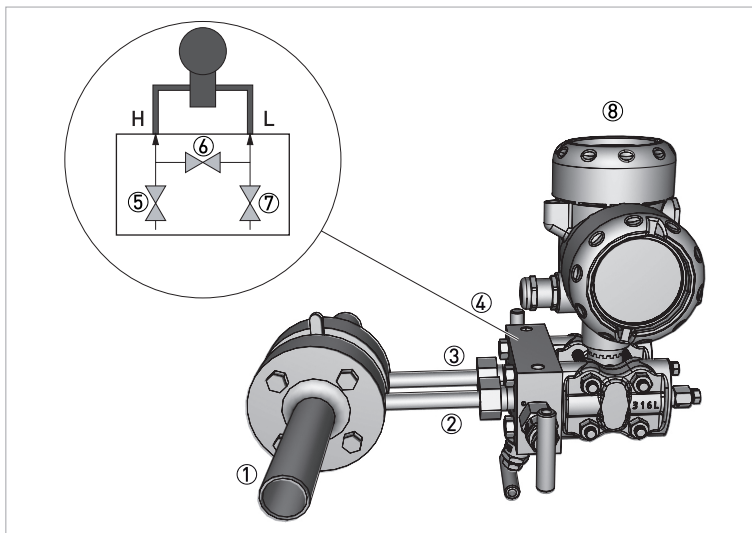


Figure 3-6: Application example

- ① Pipeline with primary element
- ② Low-pressure line (L)
- ③ High-pressure line (H)
- ④ 3-valve manifold
- ⑤ Shut-off valve
- ⑥ Equalizing valve
- ⑦ Shut-off valve
- ⑧ Pressure transmitter

3.9.2 In vapours and pure liquids

- Include the pressure tapping points to the side on the process line.
- The device must be mounted at the same height or underneath the tapping points.
- In steam applications, fill the impulse lines and and/or condensate vessels with an appropriate liquid.

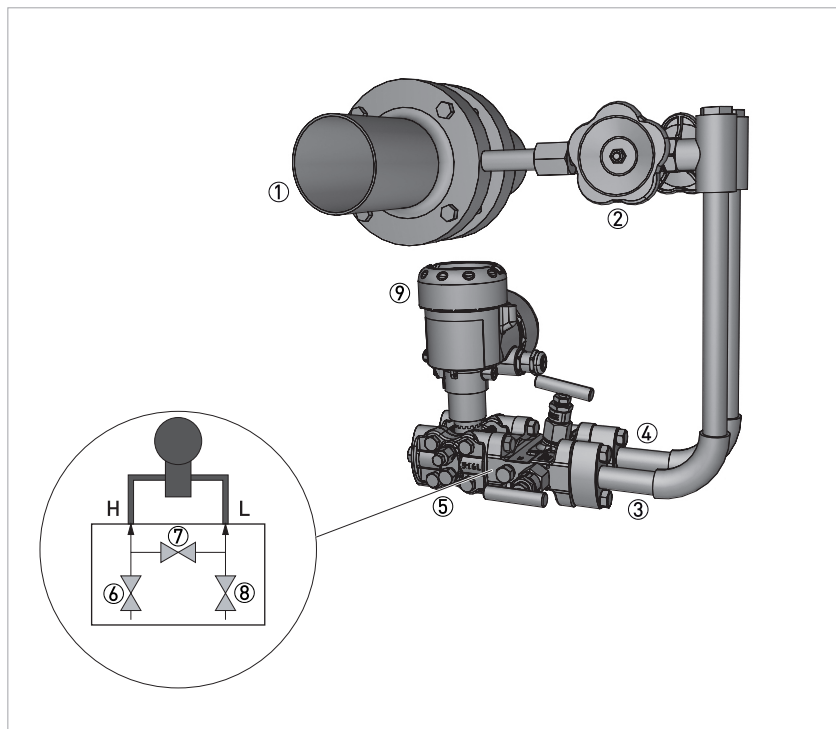


Figure 3-7: Application example

- ① Pipeline with primary element
- ② Primary shut-off valve
- ③ Low-pressure line (L)
- ④ High-pressure line (H)
- ⑤ 3-valve manifold
- ⑥ Shut-off valve
- ⑦ Equalizing valve
- ⑧ Shut-off valve
- ⑨ Pressure transmitter

3.10 Measurement setup for level measurement

3.10.1 In open vessels with impulse line

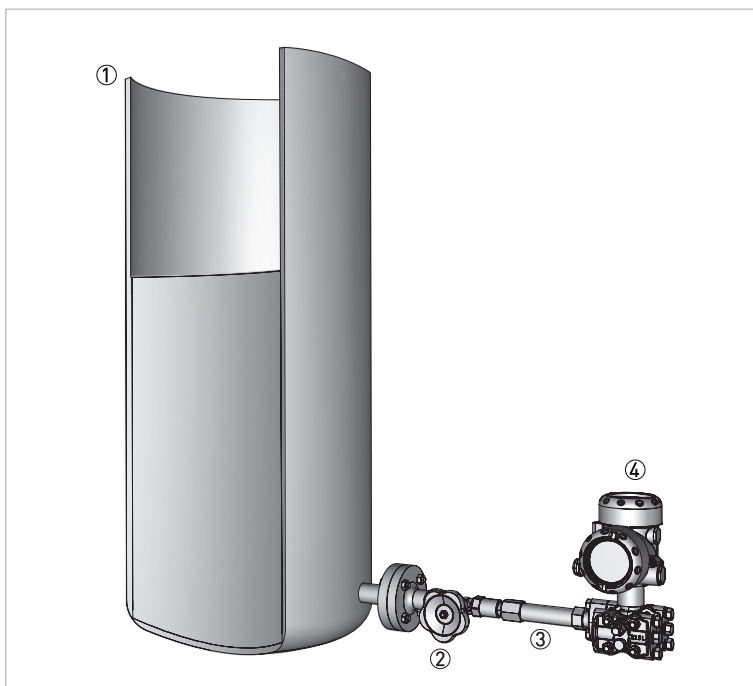


Figure 3-8: Application example

- ① Tank
- ② Shut-off valve
- ③ Impulse line
- ④ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse lines are always filled with liquid.
- The low-pressure side (L) is open to atmospheric pressure.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

3.10.2 In closed vessels with gas-filled impulse lines

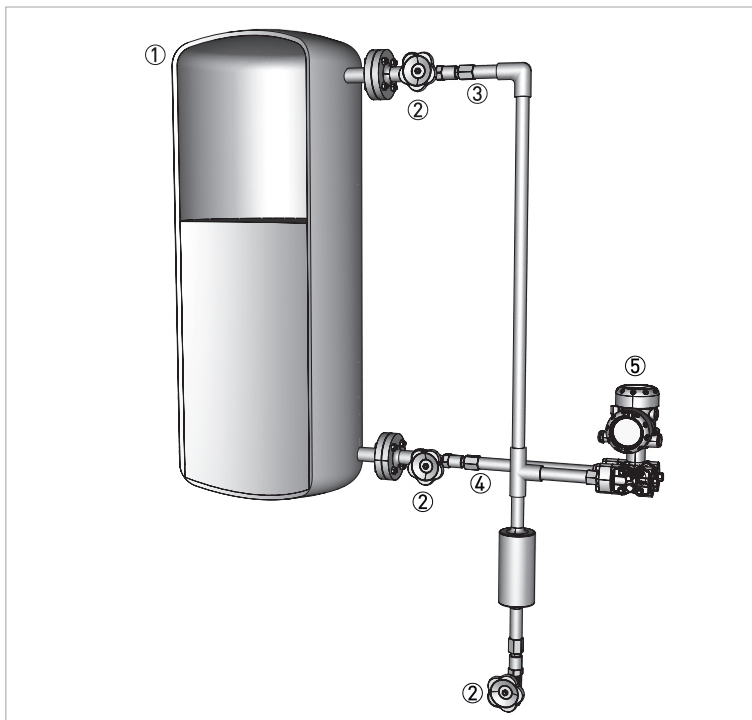


Figure 3-9: Application example

- ① Tank
- ② Shut-off valve
- ③ Low-pressure line (L)
- ④ High-pressure line (H)
- ⑤ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse line is always filled with liquid.
- The low-pressure side (L) must always be connected above the maximum level.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

3.10.3 In closed vessels with liquid / condensate filled impulse lines



Figure 3-10: Application example

- ① Tank
- ② Shut-off valve
- ③ Low-pressure line (L)
- ④ High-pressure line (H)
- ⑤ Differential pressure transmitter

The following points should be observed in this application:

- Mount the differential pressure transmitter below the lower process connection so that the impulse lines are always filled with liquid.
- The low-pressure side (L) must always be connected above the maximum level.
- For measurements of fluids with solid content, the installation of separators and drain valves is recommended to enable collection and removal of debris and sediment.

4.1 Safety instructions

**DANGER!**

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

**DANGER!**

Observe the national regulations for electrical installations!

**WARNING!**

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Notes for electrical cables

**DANGER!**

The device must be grounded to a spot in accordance with regulations in order to protect personnel against electric shocks.

**DANGER!**

Cables may only be connected when the power is switched off! Since the transmitter has no switch-off elements, overcurrent protection devices, lightning protection and/or energy isolating devices need to be provided by the customer.

Metric thread M16 x 1.5 mm

The cable glands with metric threads are screwed in by the factory. They are sealed using plastic plugs to protect them during transport. Remove these plugs prior to establishing an electrical connection.

4.2.1 Requirements for signal cables supplied by the customer

If the signal cable was not ordered, it is to be provided by the customer. The following requirements regarding the electrical specifications of the signal cable must be observed:

Specifications for standard signal cables

- Test voltage: ≥ 500 VAC RMS (750 VDC)
- Temperature range: $-40\dots+105^{\circ}\text{C}$ / $-40\dots+221^{\circ}\text{F}$
- Capacity: ≤ 200 pF/m / 61 pF/ft
- Inductance: ≤ 0.7 $\mu\text{H}/\text{m}$ / 0.2 $\mu\text{H}/\text{ft}$
- Use cable with round cross section.
- We generally recommend the use of a shielded cable for HART[®] multidrop mode.

Make sure that the cable used features the required temperature resistance and fire safety for the maximum possible ambient temperature.

4.2.2 Laying electrical cables correctly

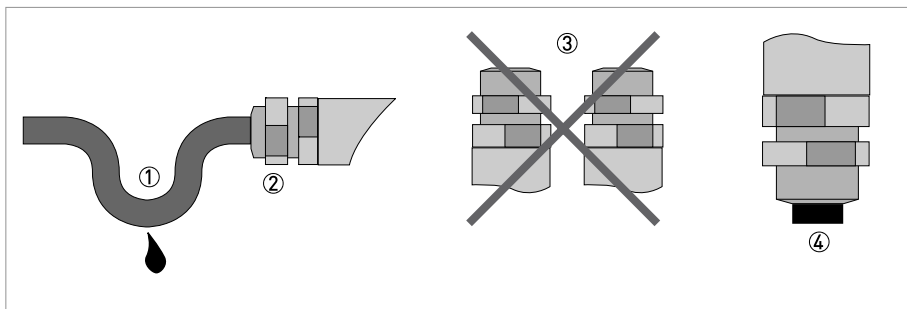


Figure 4-1: Protect housing from dust and water



- ① Lay the cable in a loop just before the housing.
- ② Tighten the screw connections of the cable entry.
- ③ Never mount the housing with the cable entries facing upwards.
- ④ Seal cable entries that are not needed with a plug.

4.2.3 Cable preparation

The device is connected with standard two-wire cable without shielding. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, a shielded cable should be used.

Check which outer diameter is suitable for the cable gland in order to ensure the sealing effect according to the specified IP protection class.

- 4.5...10 mm / 0.18...0.39" (standard)
- 4...11 mm / 0.16...0.43" (optional)

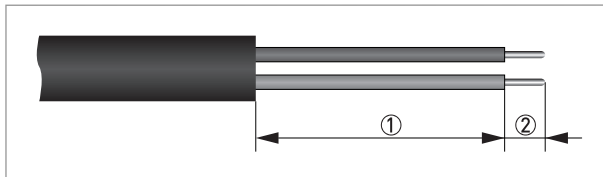


Figure 4-2: Stripping the cable

- ① 40...50 mm / 1.6...2"
- ② 5 mm / 0.2"

4.2.4 Connector pin assignment

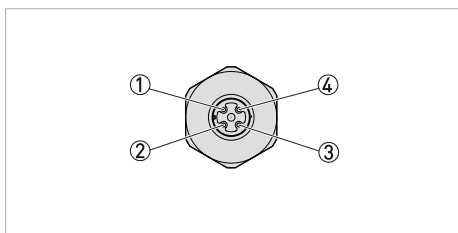


Figure 4-3: Connector M12 x 1, 4-pin, A-coding

- ① Shield
- ② Not used
- ③ VS-
- ④ VS+

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Green	Shield
Pin ②	Not used	Not used
Pin ③	Black	2
Pin ④	Red	1

4.2.5 Connection to the power supply

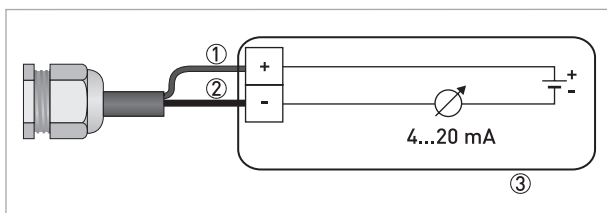


Figure 4-4: Connection to the power supply

- ① Red
- ② Black
- ③ Power supply with load

4.2.6 Cable shield and grounding

If a shielded cable is necessary, connect the cable shield on both ends to the grounding potential.

In the device, the cable shield must be connected directly to the internal ground terminal.

The ground terminal outside on the housing must be connected to the grounding potential with low impedance.



DANGER!

In hazardous areas, the grounding is carried out according to the installation instructions.



CAUTION!

Significant potential differences exist inside galvanization plants as well as on vessels with cathodic corrosion protection. A two-sided shield grounding can cause unacceptably high shield currents as a result.



CAUTION!

The metallic and wetted parts (process connection, cap flange, measuring cell and separating diaphragm etc.) are conductive connected with the inner and outer ground terminal on the housing.

4.3 Electrical connection

The power supply and signal output are connected via screw terminals in the housing. The display and adjustment module is connected to the interface adapter via contact pins.

4.3.1 Connection in the terminal compartment

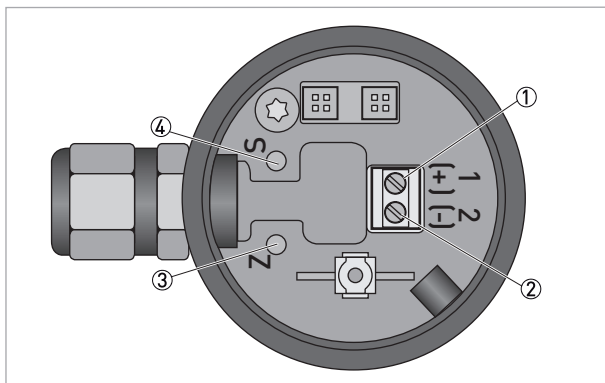


Figure 4-5: Connection in the terminal compartment

- ① (V_{in+}) signal terminals
- ② (V_{in-}) signal terminals
- ③ Push button Zero point (Zero)
- ④ Push button Span point (Span)

4.4 Grounding the measuring device

**DANGER!**

There should be no difference in potential between the pressure sensor and the housing or protective earth of the transmitter!

- The pressure sensor must be properly grounded.
- Do not use the grounding cable to connect any other electrical devices to ground at the same time.
- The pressure transmitter is connected to ground by means of a functional grounding conductor.
- In hazardous areas, grounding is used at the same time for equipotential bonding.

A ground terminal is provided on the outside of the housing to accommodate wire widths of up to 1.5 mm².

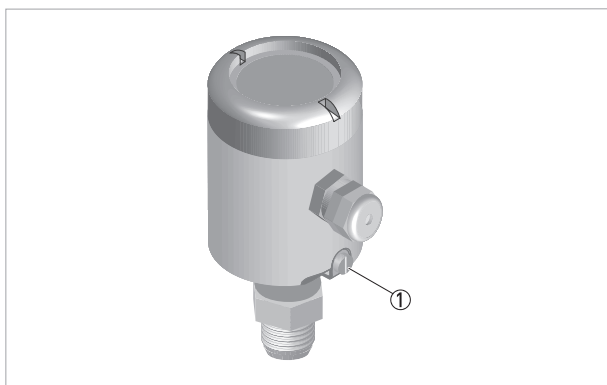


Figure 4-6: Position of the ground terminal on the housing

① Ground terminal

4.5 Description of the current output

The current output is a 2-wire 4...20 mA output with a low alarm of 3.6 mA and high alarm of 21 mA set by default. A high frequency HART[®] signal superimposes this signal. For further information on the current output, refer to *Technical data* on page 48.

5.1 Commissioning

The signal converter may only be started up after it has been completely installed and checked by appropriately qualified personnel. Switch on the operating voltage for start-up.

Prior to applying the operating voltage check that

1. the pressure transmitter is completely installed
2. the process connection fits properly
3. the signal and, if necessary, supply lines are properly connected
4. the impulse lines are completely filled with the process medium

After connecting the signal converter to the power supply or after voltage recovery, the device performs a self test for approximately 5 seconds.

Self testing routine

1. Internal check of the electronics.
2. Indication of the device type, hardware and software version as well as the measurement loop name on the display.
3. Output signal jumps to the set alarm current.
4. The current measuring value is emitted to the signal cable.

5.2 Factory settings on delivery

The pressure transmitter factory settings can be based on a measuring span specified by the customer in the order. This and other information is located on the device nameplate. If the customer has not specified any settings, the device always leaves the factory with the following settings:

Device parameter	Factory pre-setting
Lower current value (0% URL)	4 mA
Upper current value (100% URL)	20 mA
Alarm Current	Low Alarm < 3.6 mA
Damping	2.0 seconds
HART® Short Tag	SENSOR
HART® Long Tag	Sensor
HART® Polling Address	0
Unit Pressure	mbar / bar
Unit Temperature	°C
Measuring Rate	20 ms
Main display value [*]	Pressure value in %
Sensor temperature [*]	Display in °C
Write protection [*]	No
Language [*]	English
Contrast [*]	50%
Bargraph indication [*]	Yes

Table 5-1: Overview factory settings

[*] only with an optional display and adjustment module

During a factory reset (which can be selected using the keyboard on the display), the pressure transmitter is automatically started with the above factory settings.

5.3 General operation

Both the configuration options and the procedure for adjusting the measuring device parameters are considerably different for the blind version compared to the version with the operating and adjustment module. With such a module, other setting and configuration options are available without requiring push buttons on the connection board. For this reason, the settings for each version are described separately below.

5.3.1 Operation without display and adjustment module

To configure the device without the display and adjustment module, the housing cover must be open, providing clear access to the push buttons on the connection board.

5.3.2 Sensor mounting correction (offset)

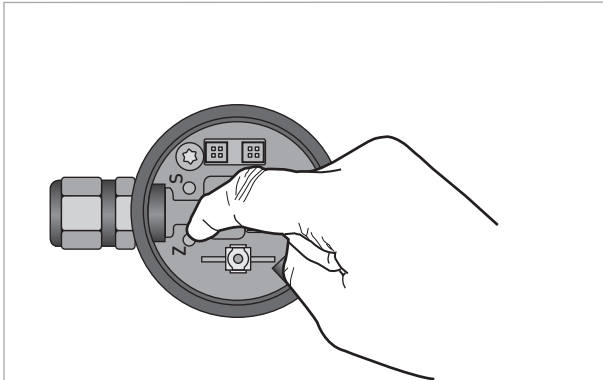


Figure 5-1: Sensor mounting correction

When delivered, the measuring device is set up for vertical installation (cover opens to the top). Zero point offsets (e.g. slightly slanted mounting position) may occur when installing the pressure transmitter and they must be eliminated. Hold the push button down for at least 10 seconds and release within 30 seconds.



INFORMATION!

Prior to starting with the correction, ensure that the pressure transmitter has already reached its operating temperature (approx. 5 minutes operating time, where the pressure transmitter has already reached the ambient temperature).

5.3.3 Zero point and lower range limit (4 mA)

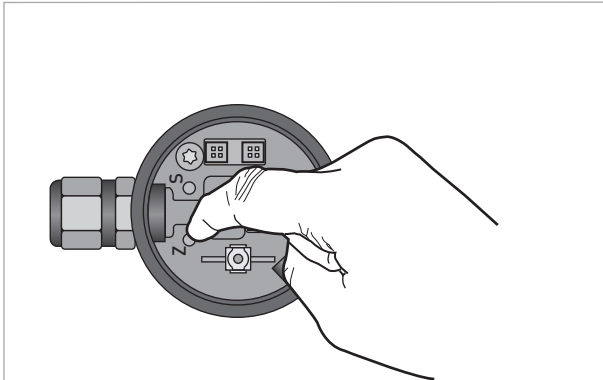


Figure 5-2: Zero point and lower range limit

The pressure must be stable with sufficient accuracy for the application. Hold the push button down for at least 1 second and release within 5 seconds. This way the lower range value is stored in a fail-safe memory.

5.3.4 Span and upper range limit (20 mA)

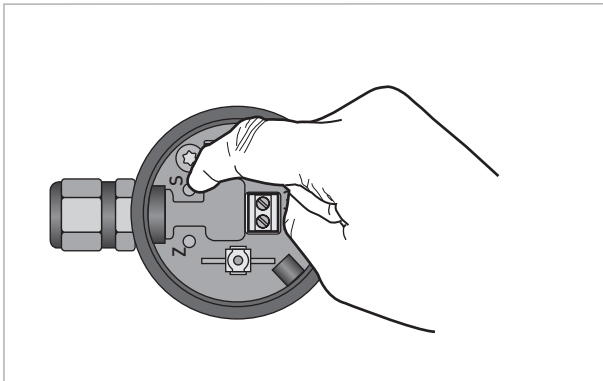


Figure 5-3: Span and upper range limit

The pressure must be stable with sufficient accuracy for the application. Hold the push button down for at least 1 second and release within 5 seconds. This way the upper range value is stored in a fail-safe memory.

5.3.5 Factory reset

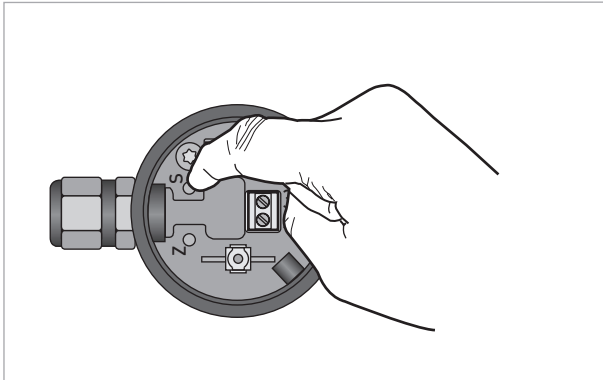


Figure 5-4: Factory reset

Hold the push button down for at least 10 seconds and release within 30 seconds. The pressure transmitter now resets itself and loads the factory settings (see details on page 36).



INFORMATION!

A Factory reset is possible despite write protection.

5.4 Operation with display and adjustment module

5.4.1 Display and operating elements

The following illustrations show examples of the display while in measuring mode, in the selection menu and when configuring measurement values.

Display during measuring mode

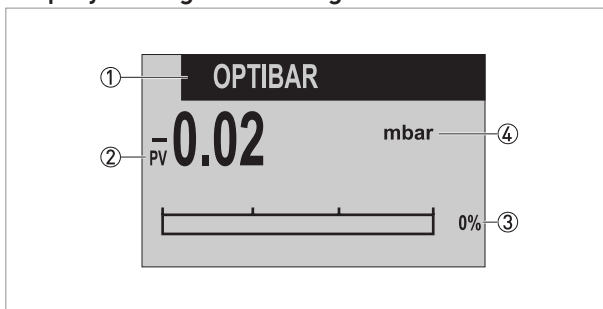


Figure 5-5: Example of display during normal measuring mode

- ① TAG ID
- ② Measured value
- ③ Bargraph indication in %
- ④ Unit of measured value

Display in selection menu

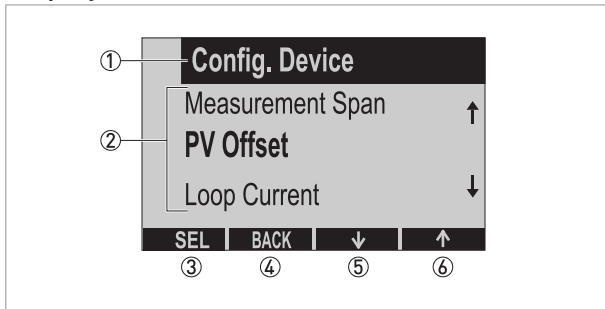


Figure 5-6: Example of display in the selection menu for device configuration

- ① Selected main menu
- ② List of possible submenus
- ③ Button for menu selection (SEL)
- ④ Button used to go back one level in the menu (BACK)
- ⑤ Button in the menu used to navigate down the list (↓)
- ⑥ Button in the menu used to navigate up the list (↑)

Display for configuration of settings

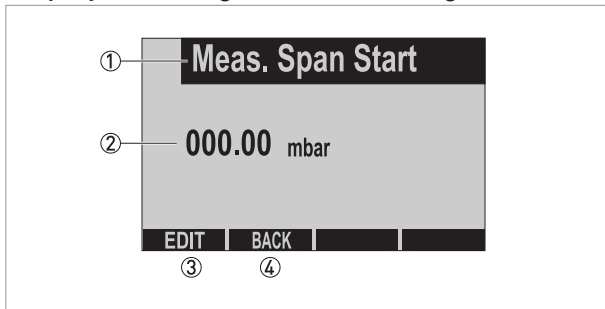


Figure 5-7: Example of display when editing the setting values

- ① Menu name of setting value
- ② Setting value to be edited and corresponding unit
- ③ Button to select editing mode (EDIT)
- ④ Button used to go back one level in the menu (BACK)

Navigation in the operating menu

	MENU		SEL		EDIT	
	→		→		→	
Normal operation		Config. menu		Editing menu		Edit
	←		←	↑↓	←	
	BACK		BACK	SAVE QUIT	BACK	

5.4.2 Structure of the operating menu

Measuring mode/menu	Function of the existing buttons
Display mode and normal mode	MENU: indicate menu
	BACK: back to indication
	• ↓: contrast darker
	• ↑: contrast lighter
Selection mode and configuration menu	SEL: select menus
	BACK: one level back
	↓: navigate down the list
	↑: navigate up the list
Editing menu	Edit numerical value:
	SEL: select digit position
	BACK: store
	↓: reduce value or browse character map
	↑: increase value or browse character map
	Confirm set numerical value:
	EDIT: back to editing mode
	BACK: one level back
	QUIT: reset to original value
	SAVE: save new value
	Selection from list or confirm action:
	SAVE: save selection
	BACK: one level back
	↓: navigate down the list
	↑: navigate up the list

Table 5-2: Overview structure of the operating menu

5.4.3 Description of the function

Main Menu	Submenu	Description	
Configuration	Sensor mounting correction	Automatically or manually corrects sensor mounting.	
	Units	Selection of units for the pressure and temperature values.	
	Damping		PV damping constant for the analogue current output and HART®.
			0 seconds: no damping
			0.5 seconds: digital value filter with PT1 element 1.0 seconds and more: only PT1 element
	Adjustment	Automatically or manually adjusts the zero point and measuring span	
	Alarm Current	Selection of the alarm current.	
	Output direction	Selection of the current output characteristic.	
	Output Range	Selection of the current output limits.	
	Service	Service menu for qualified users.	
	HART®	Polling address and preamble bytes	
	Tag Name	Specifies the name of the device (maximum 16 characters).	
Write Protection	Switches write protection for the transmitter on or off. A factory reset is possible via the push button despite write protection. Default PIN: 3050.		
Factory reset	Resets all settings to those configured at the factory.		
Display	Value on display	Selection of the measured value on display.	
	Unit Pressure	Selection of the units for the pressure and temperature values on the display.	
	Bargraph	Activates or deactivates the bar graph in the start view. The bar graph indicates the output in percent (0...100%) of the measuring span.	
	Contrast	Setting option to increase or decrease the display contrast (between 30...100%).	
	Language	Selection of display language. The softkeys remain hereby excluded.	
Diagnosis ①	Measured values	Display of respective current output values.	
	Peak value	Peak values for the pressure, sensor and electronic temperature measured values.	
	Simulation	Simulation of the output values for pressure, sensor and electronic temperature. The simulation ends automatically after 60 min.	
	System time	Display on the hour counter.	
	Devices info	Information about the device, serial number etc.	

Table 5-3: Description of the function

① Also available when write protection is enabled.

6.1 Replacement



DANGER!

Observe the national regulations for electrical installations!



DANGER!

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!



DANGER!

Check whether the ambient air around the signal converter is explosive. Opening the signal converter in an explosive atmosphere may result in ignition and explosion.



WARNING!

*Installation, assembly, start-up and maintenance may only be performed by personnel trained in **explosion protection**. Additional regional standards, safety directives and laws must be observed at all times.*



WARNING!

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.



CAUTION!

The product may cause the signal converter to become extremely hot. Possible risk of burning. For this reason, promptly shut off the process or isolate the signal converter sufficiently from the product prior to starting work and check that the converter has cooled down to room temperature.

6.1.1 Replace the pressure caps

If required, the cap flanges can be exchanged by the user for an identical type. If spare parts such as gaskets, screws, nuts or cap flanges are not available, they can be ordered through your local representative.



- To remove the pressure caps, loosen the M8 hexagonal screws crosswise with an open-ended spanner SW13. Remove the pressure caps carefully to avoid damaging the separating diaphragms.
- Clean the O-ring groove in the pressure caps and, if necessary, the separating diaphragms with a suitable solvent and a soft cloth.
- Note the additional cleaning with oil and grease-free version.
- Insert the new O-rings into the groove of the pressure caps and ensure that the seals are seated correctly. Only use new and undamaged O-rings.
- Carefully fit the pressure caps to the differential pressure cell so that the seal remains in the groove during installation.
- Ensure the correct position and exact alignment of the two process flanges.
- A flat surface is suitable as an aid for aligning the process flanges.
- Use undamaged M8 screws for cap mounting and tighten them crosswise.

Proceed in 3 steps:

1. First tighten the screws with a tightening torque of 8 Nm.
2. Tighten the screws with a tightening torque of 12 Nm.
3. Finally, tighten the screws with a tightening torque of 16 Nm.
For PN400 versions, the final cap tightening torque is 18 Nm.
When using copper gaskets, the final cap tightening torque is 22 Nm.

After the installation in the measuring point, repeat the zero adjustment.

6.2 Maintenance

When used correctly, no maintenance is required in normal operation. In some applications, the measurement can be distorted by adhesive media. In this case, suitable measures should be taken to avoid adhesions and especially hardening on the diaphragm surface and in the pressure connection.

6.3 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.4 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

**INFORMATION!**

For more precise information, please contact your local sales office.

6.5 Repairs

Repairs must be carried out exclusively by the manufacturer or the manufacturer authorised specialist companies.

6.6 Returning the device to the manufacturer

6.6.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



WARNING!

Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



WARNING!

If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

6.6.2 Form (for copying) to accompany a returned device



CAUTION!

To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:	
Department:		Name:	
Telephone number:		Email address:	
Fax number:			
Manufacturer order number or serial number:			
The device has been operated with the following medium:			
This medium is:	<input type="checkbox"/>	radioactive	
	<input type="checkbox"/>	water-hazardous	
	<input type="checkbox"/>	toxic	
	<input type="checkbox"/>	caustic	
	<input type="checkbox"/>	flammable	
	<input type="checkbox"/>	We checked that all cavities in the device are free from such substances.	
	<input type="checkbox"/>	We have flushed out and neutralized all cavities in the device.	
We hereby confirm that there is no risk to persons or the environment caused by any residual media contained in this device when it is returned.			
Date:		Signature:	
Stamp:			

6.7 Disposal



LEGAL NOTICE!

Disposal must be carried out in accordance with legislation applicable in your country.

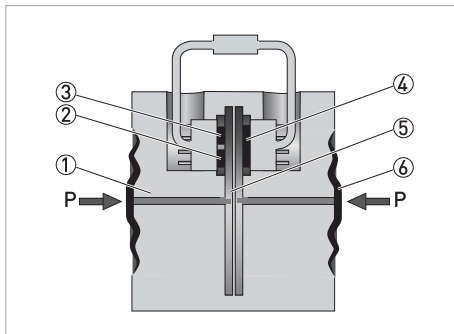
Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:



According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste.**

The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

7.1 Measuring principle



- ① Fill fluid
- ② Temperature sensor
- ③ Absolute pressure sensor
- ④ Differential pressure sensor
- ⑤ Overload system
- ⑥ Separating diaphragm

The process pressure is transferred via the separating metallic diaphragms ⑥ of the high and low pressure side and the fill fluid ① to the piezoresistive silicon sensor. Through the prevailing pressure differential, the silicon diaphragm of the differential pressure sensor ④ is deflected and changes the resistance value of the four piezoresistive elements in the bridge circuit. The change in resistance of the bridge circuit is proportional to the differential pressure. Additionally, the measured cell temperature ② and the prevailing static pressure ③ on the low pressure side is measured and then made available to the signal converter for further processing. If the measurement limit is exceeded, the overload system ⑤ restricts the prevailing process pressure at the differential pressure sensor and protects it from damage.

7.2 Technical data



INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).

Measuring system

Measuring principle	Piezoresistive differential pressure measuring cell
Application range	<ul style="list-style-type: none"> • Flow measurement with square root output in gases, vapours and liquids • Differential pressure measurement • Level measurement of liquids
Measuring range	100 mbar, 500 mbar, 3 bar, 16 bar / 1.45 psi, 7.25 psi, 43.51 psi, 232.06 psi
Display and User interface	
Display on signal converter	<ul style="list-style-type: none"> • Dot-matrix display 32 x 20 mm / 1.26 x 0.79" • Display infinitely rotatable by 350° • Ambient temperatures below -20°C / -4°F may affect the readability of the display
Display function	<ul style="list-style-type: none"> • Display of measured value or derived measured value such as filling height • Warning and diagnostic information • All parameters are accessible via the operating menu
Operating and display languages	German, English, Spanish and French
Operating	Local operation via 4 softkeys on the display and adjustment module
Remote control	<ul style="list-style-type: none"> • PACTware™ via GenericHART® • HART® Hand Held Communicator

Measuring accuracy

Differential pressure			
Reference conditions acc. to IEC 60770-1	<ul style="list-style-type: none"> • Ambient temperature (constant): +18...+30°C / +64...+86°F • Relative humidity (constant): 45...75% • Ambient pressure (constant): 860...1060 mbar / 12.5...15.4 psi • Mounting position: vertical • Rising characteristics • Measurement start at 0.00 bar / psi • Process diaphragm: 316L / 1.4404 • Fill fluid: silicone oil • Material of process flanges: 316L / 1.4404 • Power supply: 24 VDC ±3 VDC • Load for HART®: 250 Ω 		
Reference accuracy acc. to DIN EN 61298	Includes the linearity, hysteresis and non-repeatability under reference conditions. Applies to the digital interfaces (HART®) as well as for the analogue 4...20 mA current output. [% of the set span]		
		TD < 10:1	
		TD > 10:1	
	100 mbar / 1.5 psi	<± 0.1%	<± 0.01% x TD
	500 mbar / 7.3 psi		<± 0.05% + 0.005% x TD
3 bar / 43.51 psi			
16 bar / 232.1 psi		<± 0.01% x TD	

Effect of ambient temperature	Ambient temperature effect on zero and span in relation to the set measuring span. Applies to the digital interfaces (HART®) as well as for the analogue 4...20 mA current output. [% of the set span]			
		-10...+60°C / +14...+140°F	-40...+85°C / -40...+185°F	
	100 mbar / 1.5 psi	<± 0.15% + 0.15% x TD	<± 0.15% + 0.20% x TD	
	500 mbar / 7.3 psi	<± 0.15% + 0.05% x TD	<± 0.2% + 0.06% x TD	
	3 bar / 43.51 psi			
16 bar / 232.1 psi	<± 0.15% + 0.15% x TD	<± 0.15% + 0.20% x TD		
Effect of system pressure	Ambient temperature effect on zero and span in relation to the set measuring span. Zero-point offsets can be calibrated out under operating pressure. Applies to the digital interfaces (HART®) as well as for the analogue 4...20 mA current output. [% of the set span]			
		up to nominal pressure	on zero	on span
	100 mbar / 1.5 psi	160 bar / 2320 psi	160 bar / 2320 psi: <± 0.20% x TD	160 bar / 2320 psi: <± 0.20%
	500 mbar / 7.3 psi		160 bar / 2320 psi: <± 0.10% x TD	160 bar / 2320 psi: <± 0.10%
	3 bar / 43.51 psi			
16 bar / 232.1 psi				
Effect of mounting position	A position-dependent zero offset can be corrected			
	≤0.35 mbar per 10° inclination around the transverse axis			
Long-term stability acc. to DIN 16086 and IEC 60770-1	Applies to the digital interfaces (HART®) as well as for the analogue 4...20 mA current output. [% of the set span]			
	<0.1% x TD (Turn Down) over a period of 5 years			
Total performance in accordance with DIN 16086	At a temperature change of -10...+60°C / +14...+140°F, up to the indicated nominal pressure. [% of the set span]			
		Nominal pressure	-10...+60°C / +14...+140°F	
	100 mbar / 1.5 psi	160 bar / 2320 psi	<± 0.37%	
	500 mbar / 7.3 psi		<± 0.24%	
	3 bar / 43.51 psi			
16 bar / 232.1 psi	<± 0.33%			
The details of total performance comprise the reference accuracy, the effect of the ambient temperature on the zero signal and the measuring span as well as the effect of the static pressure on the measuring span.				
$E_{\text{perf}} = \sqrt{((E_{\Delta TZ} + E_{\Delta TS})^2 + E_{\Delta PS}^2 + E_{\text{lin}}^2)}$ $E_{\Delta TZ} = \text{Effect of ambient temperature on the zero signal}$ $E_{\Delta TS} = \text{Effect of ambient temperature on the measuring span}$ $E_{\Delta PS} = \text{Effect of the static pressure on the measuring span}$ $E_{\text{lin}} = \text{Reference accuracy}$				
Dynamic output behaviour	These parameters depend on the fill fluid, temperature and, if applicable, the diaphragm seal. For further information refer to <i>Dynamic behaviour of the current output</i> on page 55			
Damping	63% of the input variable 0...999 seconds, adjustable in 0.1 second steps.			
Temperature				
The evaluation is made using the HART® output signal.				
Resolution	1°C / 1.8°F			
Accuracy	± 1°K			

System pressure				
Reference conditions acc. to IEC 60770-1	<ul style="list-style-type: none"> Ambient temperature (constant): +18...+30°C / +64...+86°F Relative humidity (constant): 45...75% Ambient pressure (constant): 860...1060 mbar / 12.5...15.4 psi Mounting position: vertical 			
Reference accuracy acc. to DIN EN 61298	Includes the non-linearity, hysteresis and repeatability under reference conditions. Applies to the digital interfaces (HART®) as well as for the analogue 4...20 mA current output. [% of URL]			
		up to nominal pressure acc. to URL absolute pressure	TD 1:1	
	100 mbar / 1.5 psi	160 bar / 2320 psi	<± 0.10%	
	500 mbar / 7.3 psi			
	3 bar / 43.51 psi			
16 bar / 232.1 psi				
Effect of ambient temperature	Ambient temperature effect on zero and span. [% of URL]			
		up to nominal pressure acc. to URL absolute pressure	-10...+60°C / +14...140°F	-40...+80°C / -40...+176°F
	100 mbar / 1.5 psi	160 bar / 2320 psi	<± 0.5%	<± 0.5%
	500 mbar / 7.3 psi			
	3 bar / 43.51 psi			
16 bar / 232.1 psi				
Long-term stability acc. to DIN EN 61298-1	<± 0.1% of URL over a period of 5 years			

Operating conditions

Temperature	
Process temperature	-40...+105°C / -40...+221°F
Ambient temperature	-40...+80°C / -40...+176°F
Storage temperature	-40...+80°C / -40...+176°F
Climate category	4K 4H (air temperature: -20...+55°C, humidity: 4...100% according to DIN EN 60721-3-4)

Further operating conditions

Protection category according to IEC 529 / EN 60529	Single chamber Housing, IP66/67, NEMA 4X or IP66/68 (0.2 bar) NEMA 6P (depends on electrical connection)
--	--

Vibration	
Reference conditions	<ul style="list-style-type: none"> Without mounting bracket Process flanges 316L / 1.4404 PN 160 Single chamber housing
Vibration resistance acc. to IEC 60770-1	10...58 Hz, 0.35 mm 58...1000 Hz, 20 m/s ² 1 octave per minute, 10 cycles per axis
Shock resistant according to IEC 60770-1	500 m/s ² , 6 ms 100 shocks per axis
Noise according to IEC 60770-1	10...200 Hz, 1 (m/s ²) ² /Hz 200...500 Hz, 0.3 (m/s ²) ² /Hz 4 hours per axis

Materials

Gaskets	
EPDM	-40...+105°C / -40...+221°F
Copper	
FKM	-20...+105°C / -4...+221°F
Filling oil	
Silicone oil	-40...+105°C / -40...+221°F
Halocarbon oil	
Wetted parts	
Process connection, screwed flange	316L / 1.4404, NACE MR0175 / MR0103
Separating diaphragm	316L / 1.4435, NACE MR0175 / MR0103
Vent and lock screws	316L / 1.4404, NACE MR0175 / MR0103
Non-wetted parts	
Housing	316L / 1.4404
Lid cover sealing ring	EPDM
Housing lid	316L / 1.4404
Sight glass	Makrolon
Grounding screw	316L / 1.4404
Cable gland	Plastic (polyamide) black; nickel-plated brass; 316 / 1.4305

Process connection

Process	1/4-18 NPT (Female), IEC 61518 A
Mounting	7/16 UNF, M10 (up to PN160)

Electrical connections

Mechanical			
Cable gland	Type	Ingress Protection	Cable diameter
	A - M16 x 1.5 plastic	IP66/67 NEMA 4X	4.5...10 mm / 0.18...0.39"
	E - M16 x 1.5 nickel plated brass	IP66/67 NEMA 4X	4.5...10 mm / 0.18...0.39"
	X - M16 x 1.5 316L	IP66/68 NEMA 6P (0.2 bar)	4...11 mm / 0.16...0.43"
	C - M12 4-pin quick disconnect	IP66/67 NEMA 4X	n/a
Wire cross-section	Solid wire with cords: 0.34...2.5 mm ² / AWG 22...14		
	Cord with wire end sleeve: 0.34...1.5 mm ² / AWG 24...16		
Electrical			
Operating voltage	Non-Ex device: 12...45 VDC		
Reverse polarity protection	Integrated		
Permissible residual ripple	for U_n 12 VDC ($12 < U_B < 14$ VDC) $\leq 0.7 V_{eff}$ (16...400 Hz)		
Load	$R_{L,max} = (U_B - 12) / 22$ mA		
Potential connection in device	Electronics: Not electrically isolated		
	Ground terminal: Galvanically connected with process connection		
Overvoltage category	III		
Protection class	II		

Inputs and outputs

Output signal	
Output signal	4...20 mA / HART [®] version 7.5 3.8...20.5 mA (factory setting acc. to NAMUR recommendation)
Signal resolution	0.3 μ A
Error signal of current output (adjustable)	High alarm ≥ 21 mA Low alarm ≤ 3.6 mA
Max. output current	24 mA
Boot-up current	≤ 5 mA for 15 ms after switching on, then ≤ 3.6 mA
Damping	0.0 seconds: no damping
	0.5 seconds: with digital filter + PT1 element
	from 1.0 second: 63% of the input measurement from 1...30 seconds can be set in 1 second increments
Boot-up time first measurement value	3.5 seconds

Approvals and certificates

CE	The device complies with the legal requirements of the EU directive. The manufacturer confirms compliance with these regulations by affixing the CE marking.
Electromagnetic compatibility (EMC)	EMC conformity for EN 61326-1:2013 and EN 61326-2-3:2013
NAMUR	NE 21 - Electromagnetic compatibility of equipment NE 43 - Signal level for the failure information of digital transmitters NE 53 - Compatibility of field devices and display/adjustment components NE 107 - Self-monitoring and diagnosis of field devices
Classification according to Pressure Equipment Directive (PED 2014/68/EU)	For gases of fluid group 1 and liquids of fluid group 1, the requirements are fulfilled according to article 4, paragraph 3 (sound engineering practice).
RoHS	The device complies with the Directive 2011/65/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
AD2000	The pressure retaining material 316L (1.4404/1.4435) complies with the AD2000 W2 and W10 guidelines.

7.3 Pressure ranges

Min. / Max. adjustment:

Percent value: -10...110%

Pressure value: -20...120%

Zero/Span adjustment

Zero: -95...+95%

Span: -120...+120%

Difference between zero and span: max. = 120% of the nominal range.

Maximum allowed turn down = 50:1 (recommended 20:1)

Nominal range	100 mbar	500 mbar	3 bar	16 bar
Limit URL (upper)	100 mbar	500 mbar	3 bar	16 bar
Limit LRL (lower)	-100 mbar	-500 mbar	-3 bar	-16 bar
Smallest adjustable measuring span	1 mbar	5 mbar	30 mbar	160 mbar
Turn down	100:1	100:1	100:1	100:1
MWP (maximum system pressure) ①	160 bar	160 bar	160 bar	160 bar
Minimum system pressure	1 mbar abs (under reference conditions)			

① MWP corresponds to the PS designation in the PED (maximum system pressure)

Nominal range	1.45 psi	7.25 psi	43.51 psi	232.06 psi
Limit URL (upper)	1.45 psi	7.25 psi	43.51 psi	232.06 psi
Limit LRL (lower)	-1.45 psi	-7.25 psi	-43.51 psi	-232.06 psi
Smallest adjustable measuring span	0.015 psi	0.073 psi	0.435 psi	2.321 psi
Turn down	100:1	100:1	100:1	100:1
MWP (maximum system pressure) ①	2320 psi	2320 psi	2320 psi	2320 psi
Minimum system pressure	0.015 psi abs (under reference conditions)			

① MWP corresponds to the PS designation in the PED (maximum system pressure)

7.4 Ambient temperature effect on current output

< 0.05% / 10 K, max. < 0.15%, each case at -40...+80°C / -40...+176°F

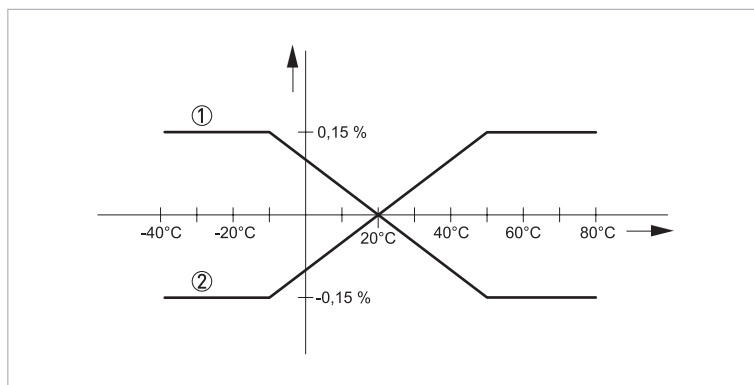


Figure 7-1: Ambient temperature effect on current output

- ① Falling characteristics
- ② Rising characteristics

7.5 Dynamic behaviour of the current output

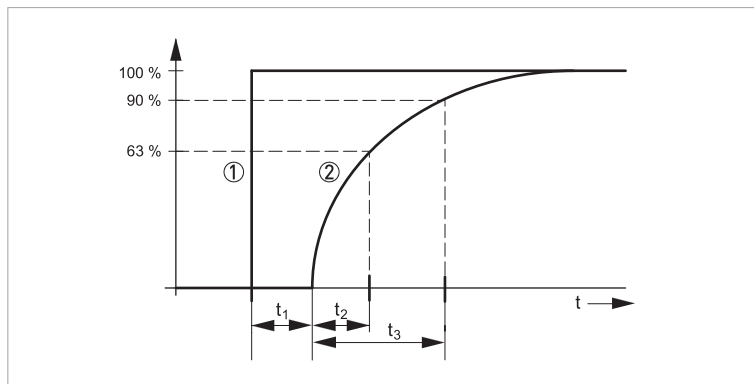


Figure 7-2: Behaviour at an abrupt change in the process variable.
 t_1 - dead time; t_2 - rise time; t_3 - step response time

- ① Process variable
- ② Output signal

These parameters depend on the fill fluid, temperature and, if applicable, the diaphragm seal

	Dead time (t_1) [ms]	T63% (t_2) [ms]	T90% (t_3) [ms] ①
100 mbar / 1.50 psi	50	95	220
500 mbar / 7.3 psi		75	200
3 bar / 43.51 psi		60	175
16 bar / 232.1 psi			

- ① Step response time is the sum of dead time and T90%

7.6 Dimensions and weight

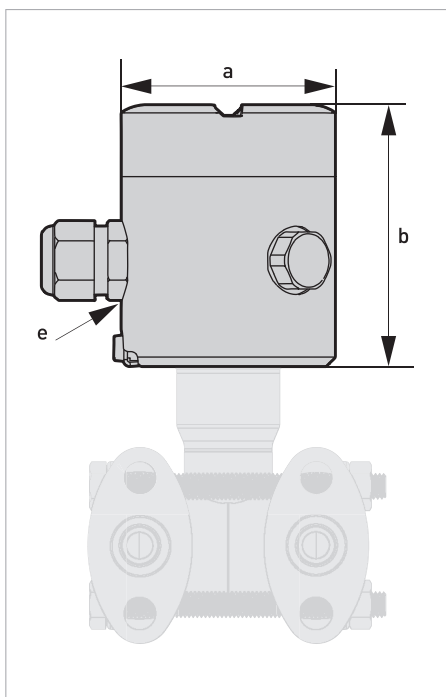


Figure 7-3: Dimension of the enclosure

Dimension	Blind Version		Version with display	
	mm	inch	mm	inch
a	64	2.52	64	2.52
b	65	2.8	73	3.1
e	M16 x 1.5			

Table 7-1: Dimension in mm / inch

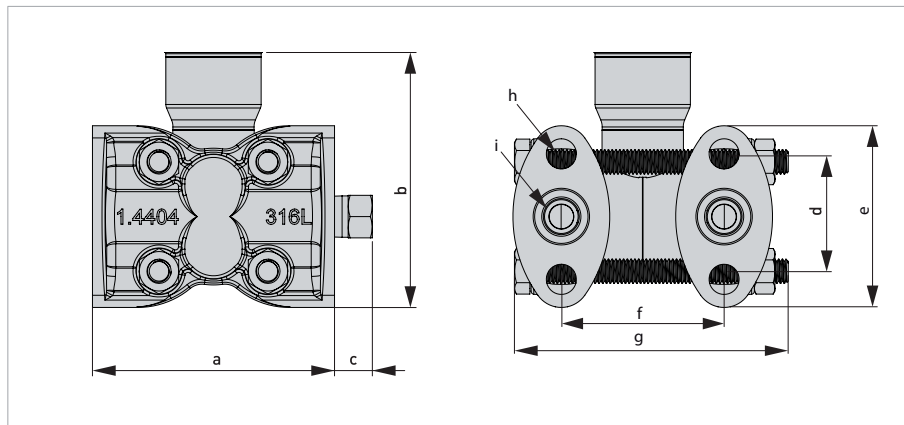


Figure 7-4: 1/4-18 NPT Process connection without venting (S0)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	83.9	3.3
c	12.5	0.49
d	41.3	1.63
e	60	2.36
f	54	2.13
g	91	3.58
h	7/16 UNF or M10	
i	1/4-18 NPT	

	Weight [kg]	Weight [lb]
Process connection	1.48	3.26

**INFORMATION!**

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing

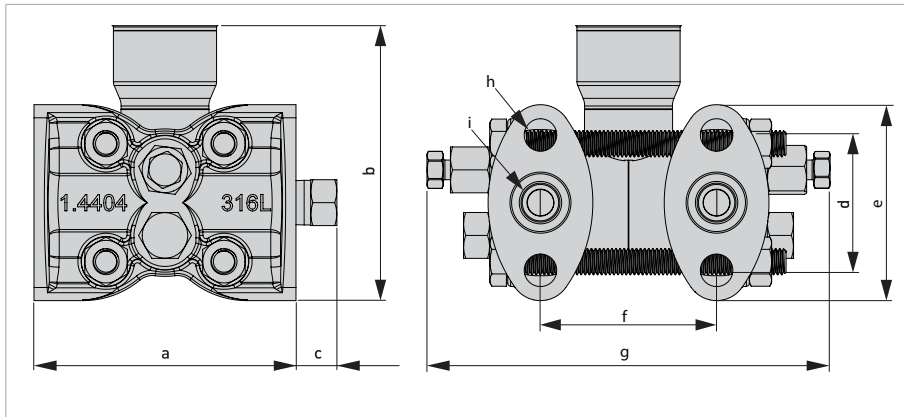


Figure 7-5: 1/2 NPT with side vent (SD)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	83.9	3.3
c	12.5	0.49
d	41.3	1.63
e	60	2.36
f	54	2.13
g	125	4.92
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

	Weight [kg]	Weight [lb]
Process connection, side vent	0.734	1.62



INFORMATION!

Overall height of the differential pressure transmitter = b (process connection) + overall height of the respective housing

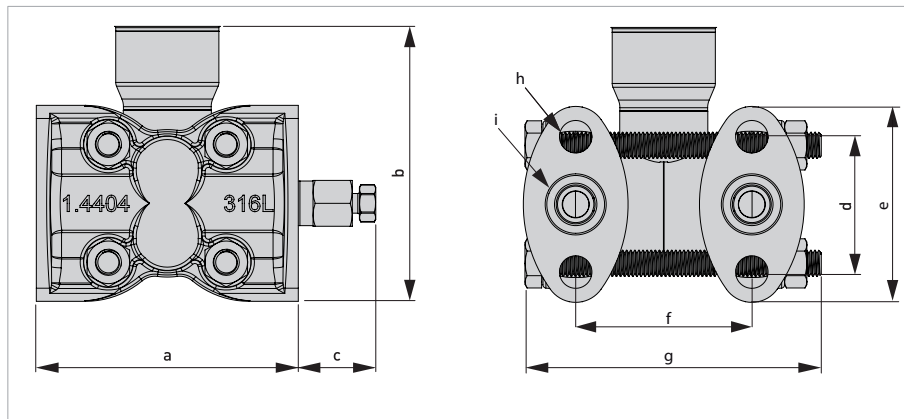


Figure 7-6: 1/4 NPT venting on the process axis (SR)

	Dimension [mm]	Dimension [inch]
a	80	3.15
b	83.9	3.3
c	12.5	0.49
d	41.3	1.63
e	60	2.36
f	54	2.13
g	125	4.92
h		7/16 UNF
i		1/4-18 NPT according to IEC 61518 A

	Weight [kg]	Weight [lb]
Process connection, side vent	1.5	3.31

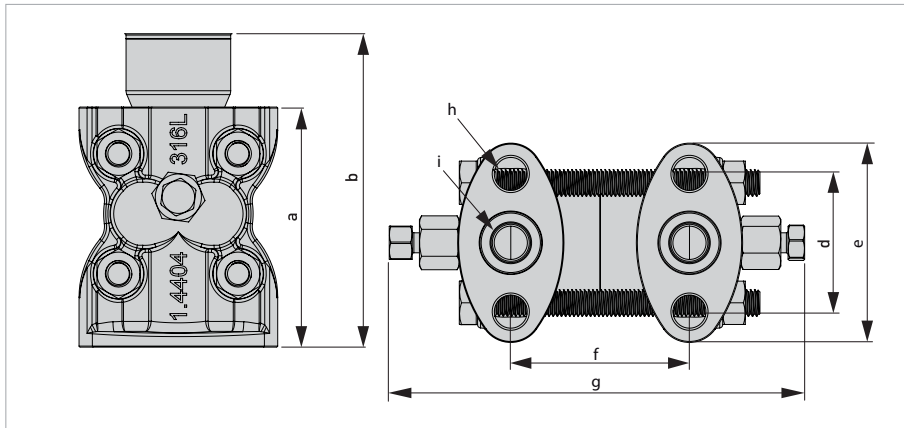


Figure 7-7: 90° vertical 1/4-18 Process connection, side vent (VD)

	Dimension [mm]	Dimension [inch]
a	72	2.83
b	94	3.7
d	41.3	1.63
e	60	2.36
f	54	2.13
g	125	4.92
h	7/16 UNF	
i	1/4-18 NPT according to IEC 61518 A	

	Weight [kg]	Weight [lb]
Process connection, side vent	0.629	1.39

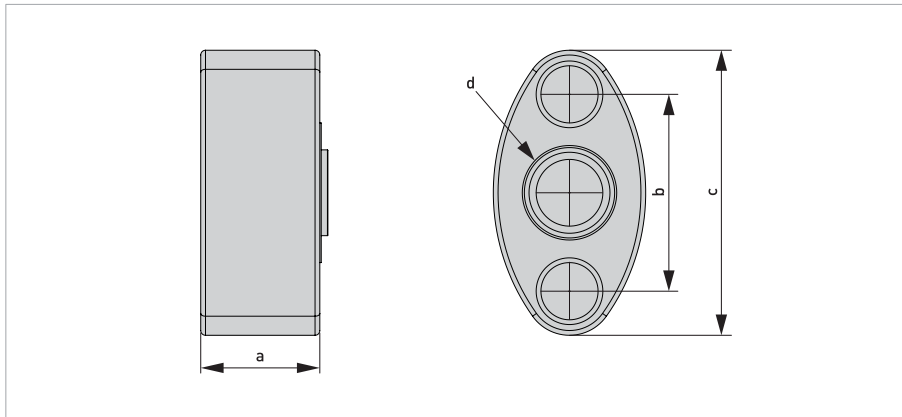


Figure 7-8: Oval flange adapter (Ax)

	Dimension [mm]	Dimension [inch]
a	25.3	0.996
b	41.3	1.63
c	60	2.36
d	1/2 NPT	

	Weight [kg]	Weight [lb]
Mounting bracket	0.196	0.43

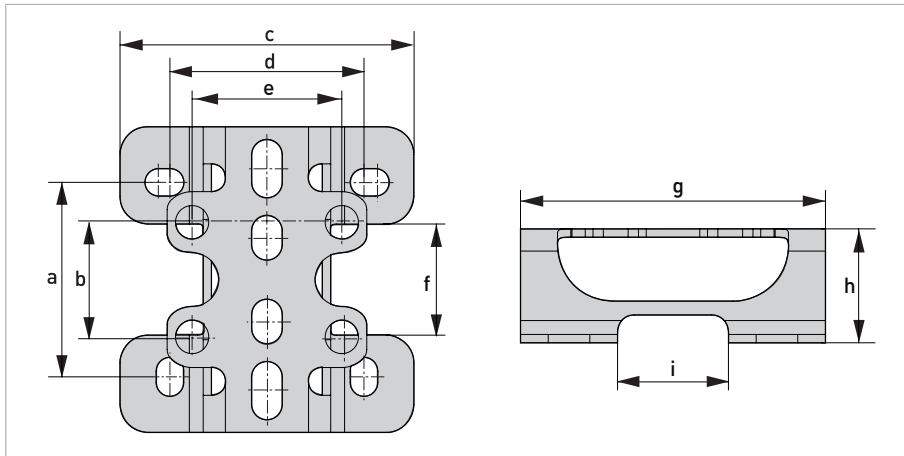


Figure 7-9: Mounting bracket for pipe and wall mounting 2" / 50.8 mm

	Dimension [mm]	Dimension [inch]
a	70	2.76
b	41.3	1.63
c	106	4.17
d	70	2.76
e	54	2.13
f	40	1.57
g	110	4.33
h	41	1.61
i	40	1.57

	Weight [kg]	Weight [lb]
Mounting bracket	0.33	0.73

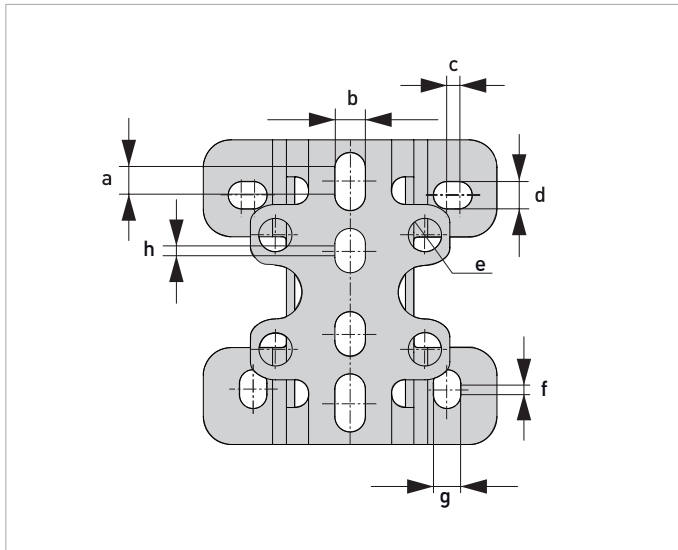


Figure 7-10: Drilling diameter for mounting bracket

	Dimension [mm]	Dimension [inch]
a	10	0.39
b	11	0.43
c	4	0.16
d	10	0.39
e	4x Ø12	4x Ø0.47
f	4	0.16
g	10	0.39
h	5	0.2

8.1 General description

The open HART[®] protocol which can be used for free, is integrated into the signal converter for communication.

Devices which support the HART[®] protocol are classified as either operating devices or field devices. When it comes to operating devices (Master), both manual control units (Secondary Master) and PC-supported workstations (Primary Master) are used in, for example, a control centre.

HART[®] field devices include measuring sensors, signal converters and actuators. The field devices range from 2-wire to intrinsically safe versions for use in hazardous areas.

The HART[®] data are superimposed over the analogue 4...20 mA signal via FSK modem. This way, all of the connected devices can communicate digitally with one another via the HART[®] protocol while simultaneously transmitting the analogue signals.

When it comes to the field devices and secondary masters, the FSK or HART[®] modem is integrated. If a PC is used, an external modem must be connected to the serial interface (USB interface). There are, however, other connection variants which can be seen in the following connection figures.

8.2 Software history



INFORMATION!

In the table below, "x" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.

Release date	SW version	HW version	HART [®]
			Device Revision
2019-01-01	1.02.01	1.0.x	1

Table 8-1: Overview software history

HART[®] identification codes and revision numbers

Manufacturer ID:	69 (0x45)
Device:	170 (0xAA)
Device Revision:	1
HART [®] Universal Revision:	7

Table 8-2: Overview identification codes and revision numbers

8.3 Connection variants

The signal converter is a 2-wire device with a passive 4...20 mA current output and a HART[®] interface.

- **Point-to-Point is supported**
In conventional point-to-point operation, the signal converter communicates as a slave with the master.
- **Multidrop mode is supported**
In a multidrop communication system, more than 2 devices are connected to a common transmission cable.
- **Burst Mode is not supported**
In the burst operation a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.

There are two ways of using the HART[®] communication:

- as Point-to-Point connection and
- as multidrop connection, with 2-wire connection.

8.3.1 Point-to-Point connection - analogue / digital mode

Point-to-Point connection between the signal converter and the HART[®] Master.

The current output of the device is passive.

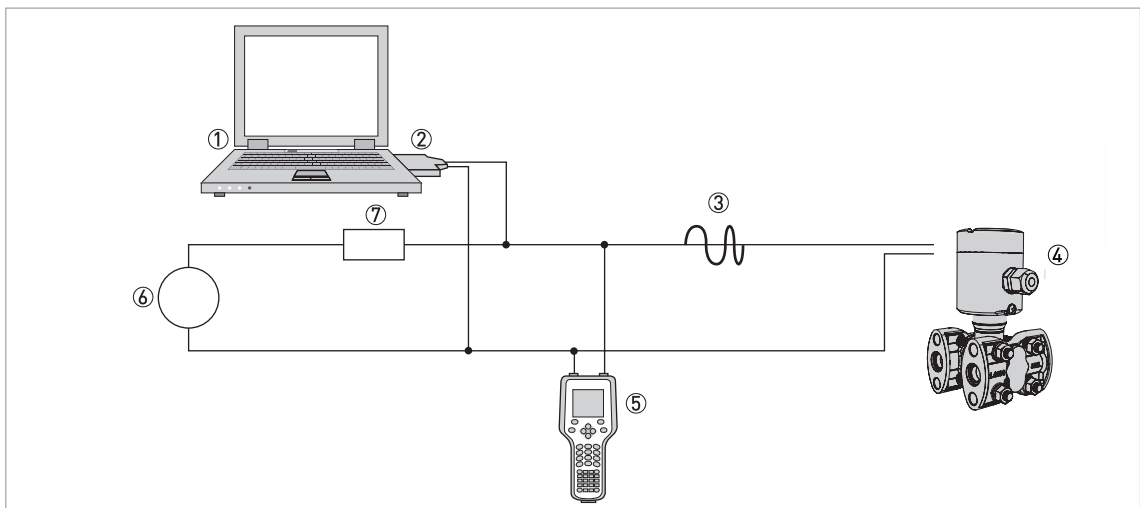


Figure 8-1: Point-to-Point connection

- ① Primary master with e.g. PACTware[™] FDT/DTM
- ② FSK modem
- ③ HART[®] signal
- ④ OPTIBAR DP 3050
- ⑤ Secondary master with HART[®] DD
- ⑥ Power supply for devices (slaves) with passive current output
- ⑦ Load $\geq 250 \Omega$ (Ohm)

8.4 Inputs / Outputs and HART[®] dynamic variables and device variables

PV = Primary Variable; SV = Secondary Variable; TV = Third Variable; QV = Quarternary Variable

HART [®] dynamic variable			
PV	SV	TV	QV
Physical unit	Static pressure	Meas. cell temp.	Electronic temperature

Table 8-3: HART[®] output values acc. to HART[®] 7 (factory setting)



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