



OPTIBAR PM 5060 C Handbook

Pressure transmitter for the measurement of process pressure, level, differential pressure, density and interface with metallic measuring cell

4...20 mA HART®

4...20 mA HART® with SIL-qualification

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1.1 Intended use

**DANGER!**

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

**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.*

**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!**

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

The OPTIBAR PM 5060 C process pressure transmitter is suitable for measuring the process pressure and level of gases, vapours and liquids and applications with higher temperatures and high pressures. In combination with a slave sensor, the OPTIBAR PM 5060 C also provides the option of electronic differential pressure measurement of differential pressure, level, density and interface. The available measuring ranges and the respective permissible overloads are indicated on the nameplate. For details refer to *Technical data* on page 75. 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 75).
- Only suitably qualified personnel may install and operate the device.
- Observe the generally accepted standards of good practice.

1.2 SIL-qualification according to IEC 61508

Only for signal converters with SIL-qualification

The Safety Integrity Level (SIL) of an electronic system assesses the reliability of integrated safety functions. To specify safety requirements more accurately, there are several SIL levels according to safety standard IEC 61508. The device complies with the requirements of IEC 61508: 2010 (Edition 2). In single channel operation it is qualified to SIL 2. In multi-channel architecture with HFT 1, the device can be used in homogenous redundancy to SIL 3.

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 Permissible mediums

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 Certification

CE marking

The device fulfils the statutory requirements of the following EC directives:

- EMC Directive 2004/108/EC
- EMC specification acc. to EN 61326/A1

The manufacturer certifies successful testing of the product by applying the CE marking.

Pressure Equipment Directive PED

Devices with a permissible pressure $PS \leq 200$ bar (20 MPa) comply with Article 3 Section (3) and are not subject to a conformity assessment. These devices were designed and manufactured in accordance with sound engineering practice (SEP).

The CE marking on the device does not apply to the pressure equipment directive.

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.

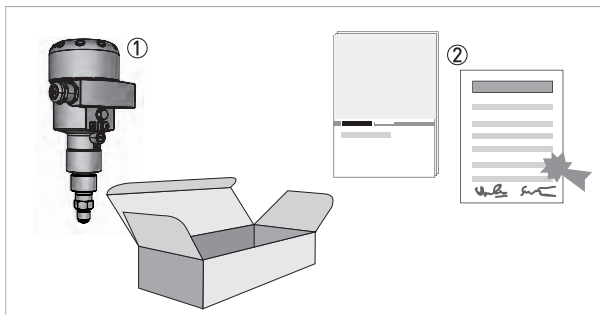


Figure 2-1: Scope of delivery

- ① Device in the version as ordered
- ② Documentation (test reports, factory and material certification (if ordered) and product documentation)
For SIL devices only, in addition Safety Manual and device parameters (default and job-related values).

Optional accessories

- Gaskets
- Assembled connecting cable (shielded four-wire cable)
- Unassembled cable gland

**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 description

The OPTIBAR PC 5060 C is suited to applications in virtually all areas of industry. It is used to measure the following types of pressure:

- Gauge pressure
- Absolute pressure
- Vacuum

Depending on the version, the OPTIBAR PM 5060 C is also suitable for electronic differential pressure measurement. To do this, the device is combined with a slave sensor. The configuration of the device, as well as the setup of the electronic differential pressure measurement is operated via the display and adjustment module. For further information refer to *Keypad functions* on page 51.

A piezoresistive measuring cell is used as the sensor element for measuring ranges up to 40 bar / 580 psi, in addition to a strain gauge measuring cell to 1000 bar / 14504 psi.

The measuring device is supplied ready for operation. The factory settings for the process data correspond to the order specifications.

For safety reasons do not exceed the measuring range or permissible process pressure. This also applies when, based on the order, a measuring cell is installed with a higher measuring range than the permissible pressure range of the process connection.

Only for signal converter with SIL-qualification

- Nameplate: with SIL logo.
- Scope of delivery: includes Safety Manual and documentation for device parameters.
- Parameterisation: Device status "Function Check" is output during parameterisation, the safety function is disabled.
- Measured value: "Failure" is output for measured values < -20% or > +120% nominal measuring range.
- Current output: Failure mode 20.5 mA cannot be selected.
- HART mode: analogue current output is fixed.
- Electronic temperature: "Failure" is output when the temperature values fall outside of the permissible range.
- Diaphragm seals with coatings are partially not permissible.



INFORMATION!

Only for signal converters with SIL-qualification

The necessary measures for use of the device in safety instrumented systems are described in the "Safety Manual". The SIL-functionality may not be disabled by the user or the Service department.

2.2.1 Device design

The following drawing shows the basic components of the pressure transmitter.

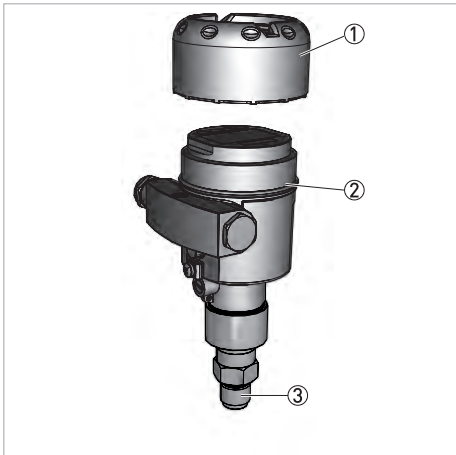


Figure 2-2: Basic components of single chamber pressure transmitter

- ① Housing cover, optional with display and adjustment module below
- ② Housing with electronics
- ③ Process assembly with measuring cell

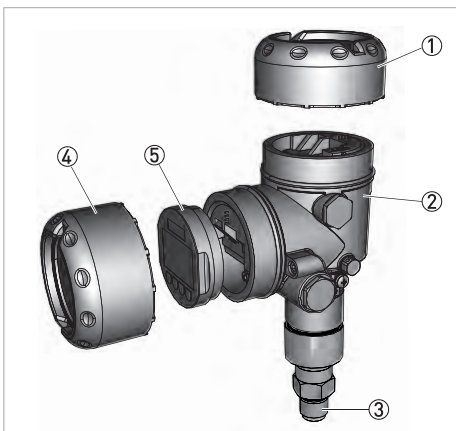


Figure 2-3: Basic components of double chamber pressure transmitter

- ① Housing cover
- ② Housing with electronics
- ③ Process assembly with measuring cell
- ④ Housing cover, optional with display and adjustment module below
- ⑤ Operating and display module

2.3 Nameplates



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.

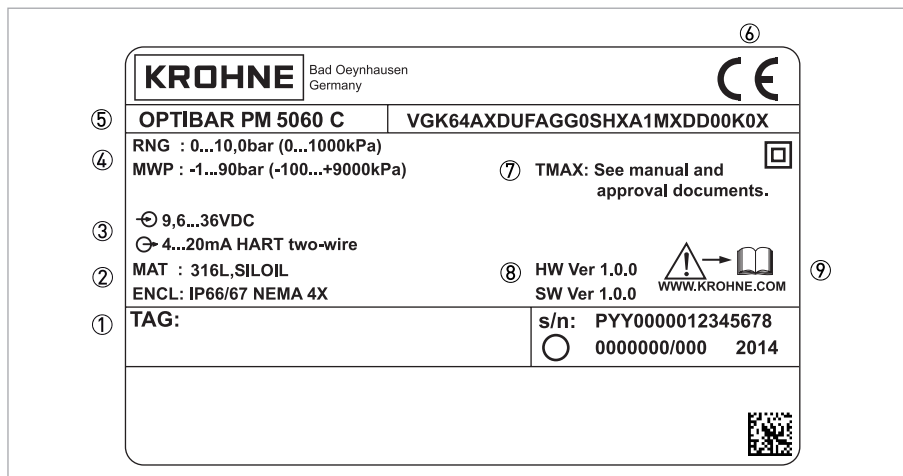


Figure 2-4: Example for a nameplate

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

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

2.5 Sealing concept

The metallic measuring cell is fully welded and is therefore sealed with respect to the process. The sealing of the process connection with respect to the process is carried out by a seal provided on site.

2.6 Venting

The ventilation for the electronics housing is assured via a filter element in the vicinity of the cable glands, which is permeable to air but moisture-blocking.



CAUTION!

In order to ensure effective ventilation, the filter element must be always free of deposits.



CAUTION!

Do not use a high-pressure cleaner to clean the housing. The filter element may become damaged and as a result moisture can penetrate into the housing. The exception to this is the IP69K single chamber housing.

All measuring cells are fully welded and therefore require no additional elastomer seals. Depending on the process connection chosen, additional seals may be necessary.

2.7 Functional Safety (SIL)

2.7.1 Objective

In the event of dangerous failures, process facilities and machines can lead to risks for personnel, the environment and materials. The risk of such failures must be assessed by the plant operator. Depending on that assessment, measures to reduce risk through fault avoidance, fault detection and fault management are to be taken.

The part of plant safety dependent on the correct function of the safety-related components for risk reduction is known as functional safety. Components used in such safety instrumented systems (SIS) must therefore be able to carry out their intended function (safety function) with a defined high degree of probability.

The safety requirements for such components are described in the international standards IEC 61508 and IEC 61511, which set the standard for uniform and comparable assessment of device, plant and machine safety, thus contributing to worldwide legal compliance. Depending on the degree of risk reduction required, one of four safety levels is chosen, from SIL1 for low risk to SIL4 for extremely high risk (SIL = Safety Integrity Level).

2.7.2 SIL-qualification

When developing devices that can be used in safety instrumented systems, special attention is paid to avoiding systematic faults as well as detecting and eliminating accidental faults.

Below are the most important properties and requirements in terms of functional safety according to IEC 61508 (Edition 2):

- Internal monitoring of safety-relevant circuit components
- Advanced standardisation of software development
- In case of error, transition of safety-relevant outputs to a defined safe state
- Determination of the probability of failure of the defined safety function
- Reliable parameterisation with an unsafe operating environment
- Proof tests

SIL-qualification of components is documented in a safety manual. All of the safety-relevant specifications and information that the users and planners need for project planning and for the operation of safety instrumented systems are compiled here. This document is included with each device with SIL-qualification.

2.7.3 Application range

The device can be used, for example, to measure the process pressure and hydrostatic level of liquids in safety instrumented systems (SIS) as per IEC 61508 and IEC 61511. Observe the information in the Safety Manual.

The following inputs/outputs are permitted:

- 4...20 mA current output

2.7.4 Safety concept of configuration



WARNING!

When adjustment is unlocked, the safety function must be classified as unreliable. This applies until configuration has been properly completed. If necessary, you must take other measures to maintain the safety function.



WARNING!

If configuration as described has not been completely and correctly carried out (e.g. premature interruption or power outage), the device remains in an unlocked and thus unsafe state.



WARNING!

Upon resetting to the basic setting, all safety-relevant parameters are reset to factory settings. For this reason, all safety-relevant parameters must be checked or set anew afterwards.

The following equipment is permitted for parameterization of the safety function:

- The integrated display and operating unit for on-site operation
- The DTM suitable for the device in conjunction with frame software according to the FDT/DTM standard, e.g. PACTware

To avoid possible errors during parameter adjustment in unsafe operating environments, a verification procedure is used that allows parameterization errors to be reliably detected. To do this, safety-relevant parameters must be verified after they have been stored in the device. In addition, to protect against unwanted or unauthorised adjustment, the device is locked in normal operating state against any parameter changes. This concept applies both to the operation at the device as well as to PACTware with DTM.

For protection against unwanted or unauthorised adjustment, the set parameters must be protected against unauthorised access. For this reason, the device is shipped in locked condition. The PIN in delivery status is "0000". When shipped with specific parameter settings, the device is accompanied by a list of the values differing from the basic settings.

All safety-relevant parameters must be verified following a change. The parameter settings of the measuring point must be documented. A list of all of the safety-relevant parameters present upon delivery can be found in the "Reset" chapter, on page 60. In addition, a list of the safety-relevant parameters can be saved and printed using PACTware/DTM.

The device must be unlocked using a PIN to make any changes to parameters. The status of the device is indicated in the display with the symbol of a locked or unlocked padlock. The PIN in delivery status is "0000".

Any parameter changes made by the operator are automatically saved for verification in the next step.

Following start-up, you must verify the modified parameters (confirm the correctness of the parameters). To do this you must first enter the PIN. Adjustment is then automatically locked. Then you must compare two strings. You must confirm that both strings are identical. This is to check the string display. Then confirm that the serial number of your device has been saved correctly. This checks for proper device communication. Then all of the modified parameters are listed and each must be confirmed. Upon completion of this procedure, the safety function is once again guaranteed.

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. Housing for protection category IP69K in accordance with ISO 20653 is also available. For further information refer to *Technical data* on page 75.

**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, Exlex V, etc.).

Ensure that all of the parts in the process are suitable for the current process conditions. This includes in particular:

- Parts active in the measurement
- Process connection
- Process seal

Process conditions include in particular:

- Process pressure
- Process temperature
- Chemical properties of the media
- Abrasion and mechanical impact

3.7 Mounting

**WARNING!**

Do not screw in using the housing! Tightening this way can cause damage to the rotary mechanism on the housing.

For devices with threaded process connections, the hexagon should be tighten with a suitable wrench. For further information refer to *Dimensions and weight* on page 89.

**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 Rotating the housing

The transmitter housing can be rotated 350° for better readability of the display or access to the wiring. A stop prevents the housing from being rotated too far.



- On all dual chamber housings, the locking screw must be loosened at the neck of the housing.
- ➡ The housing can then be rotated to the desired position.
- Once the desired position is reached, tightened the locking screw.

3.7.2 Mounting the display and adjustment module

The optional display and adjustment module can be set in any one of four different positions at 90° intervals. The installation of the adjustment module is carried out as per the illustrations below. To do so, unscrew the housing cover and insert the adjustment module clockwise. The display can be installed rotated at 90°. It is not necessary to interrupt the power supply.

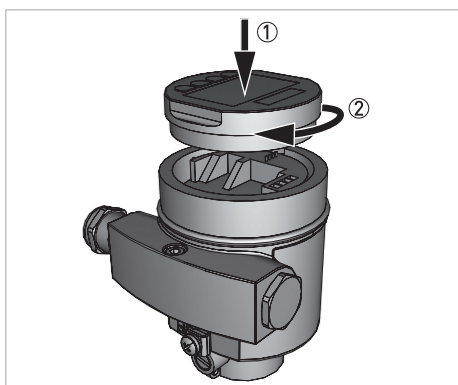


Figure 3-1: Installation in single chamber housing

- ① Insert the display and adjustment module into the housing
- ② Turn the display and adjustment module clockwise

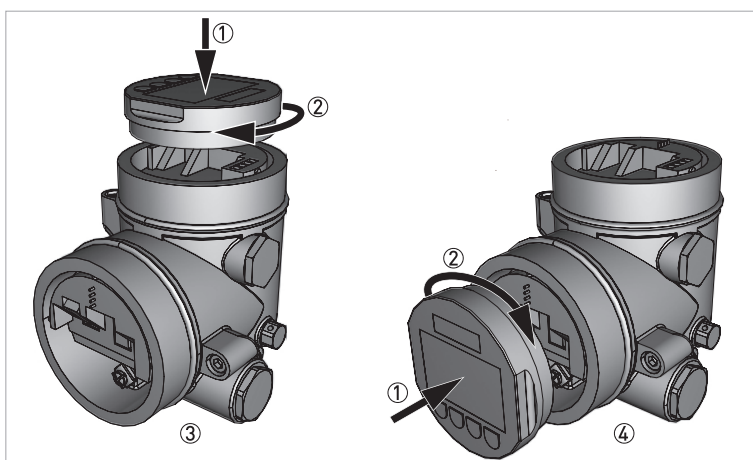


Figure 3-2: Installation in double chamber housing

- ① Insert the display and adjustment module into the housing
- ② Turn the display and adjustment module clockwise
- ③ Mounting on top
- ④ Mounting at side

3.7.3 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. For further information refer to *Technical data* on page 75.

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 75.



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.

3.9 Venting



CAUTION!

The filter element causes a delayed pressure equalisation when the housing cover is opened or closed quickly. During the process the measurement can change by up to 15 mbar for up to 5 seconds.



CAUTION!

In order to ensure effective ventilation, the filter element must be always free of deposits.



CAUTION!

Do not use a high-pressure cleaner to clean the housing. The filter element may become damaged and as a result moisture can penetrate into the housing. The exception to this is the IP69K single chamber housing.

The ventilation for the electronics housing is assured via a filter element in the vicinity of the cable glands, which is permeable to air but moisture-blocking.

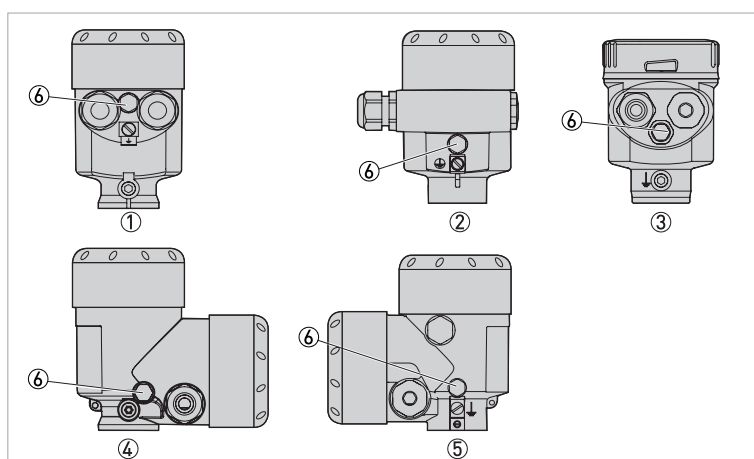


Figure 3-3: Venting in non-Ex, Ex ia and Ex d ia versions

- ① Single chamber housing, plastic, stainless steel precision casting
- ② Single chamber housing, aluminium
- ③ Single chamber housing, stainless steel electro-polished
- ④ Double chamber housing, plastic
- ⑤ Double chamber housing, aluminium
- ⑥ Filter element

The following devices feature a dummy plug instead of a filter element:

- Devices in the IP 66 / IP 68 (1bar) protection category - venting via capillary tube in nondetachable cable.
- Devices with absolute pressure

Devices in Ex d version

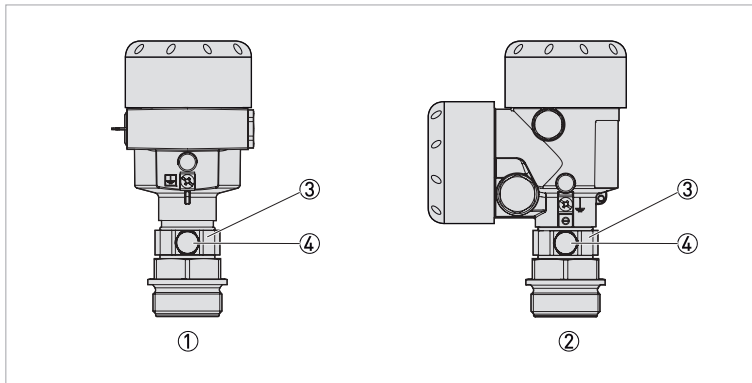


Figure 3-4: Ventilation Ex-housing

- ① Single chamber housing, aluminium and stainless steel precision casting
- ② Double chamber housing, aluminium and stainless steel precision casting
- ③ Rotating metal ring
- ④ Filter element

The filter element is integrated into the sensor assembly via a rotating metal ring. Align the metal ring downwards to better protect the filter element from deposits. Devices with absolute pressure feature a blind plug instead of a filter element.

Devices with second process barrier

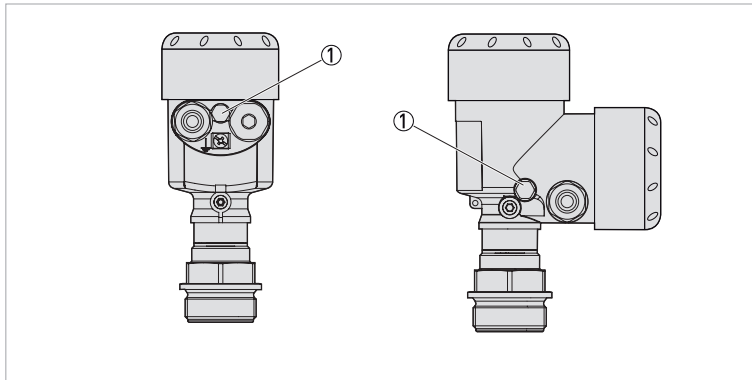
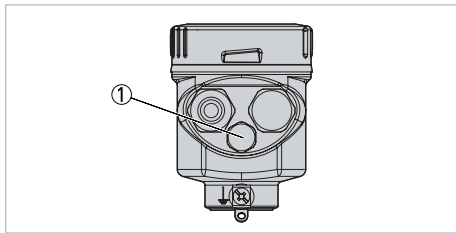


Figure 3-5: Ventilation gas-proof feedthrough

- ① Filter element

For devices with a secondary process barrier, the sensor assembly is completely encapsulated by an additional, gas-proof feedthrough. Additional venting is not required for absolute pressure sensors. With relative pressure sensors, the ambient pressure is measured and compensated by an additional sensor in the electronics.

Devices in IP69K version**Figure 3-6: Ventilation IP69K**

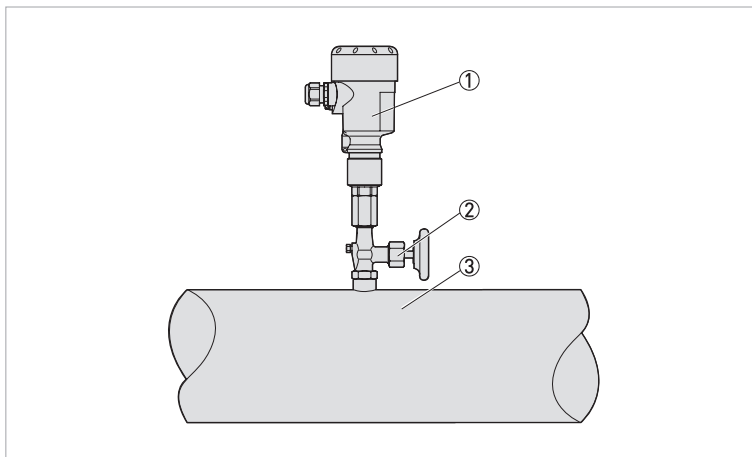
① Filter element

Devices with absolute pressure feature a blind plug instead of a filter element.

3.10 Measurement setup for measuring the process pressure

The following points should be observed in this application:

- The pressure transmitter must be mounted above the measuring point.

**Figure 3-7: Measurement setup for measuring the process pressure of gases**

① Pressure transmitter

② Shut-off valve

③ Tapping point

3.11 Measurement setup for measuring steam

The following points should be observed in this application:

- The pressure transmitter should be connected via a syphon to protect the measuring cell from non-permitted high temperatures.
- Siphon to be kept free of insulation.
- When using superheated steam, the siphon must be filled with water prior to start-up.

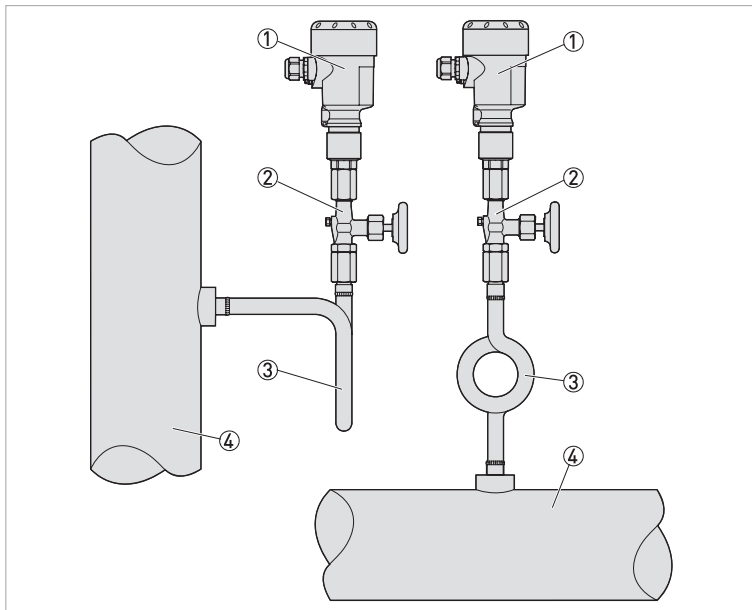


Figure 3-8: Measurement setup for measuring steam

- ① Pressure transmitter
- ② Shut-off valve
- ③ Syphon
- ④ Tapping point

3.12 Measurement setup for measuring fluids

The following points should be observed in this application:

- The pressure transmitter must be mounted below the measuring point.

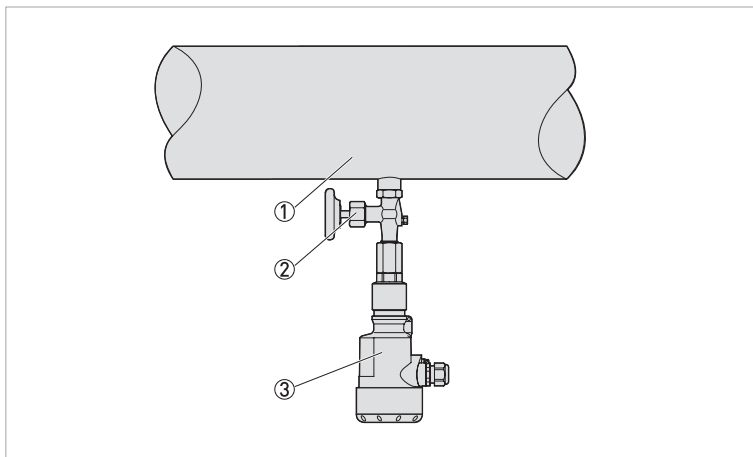


Figure 3-9: Measurement setup for measuring fluids

- ① Tapping point
- ② Shut-off valve
- ③ Pressure transmitter

3.13 Measurement setup for level measurement

The following points should be observed in this application:

- The pressure transmitter should be mounted below the lowest level.
- The pressure transmitter should be protected from filling/emptying current and agitator surges when mounted.

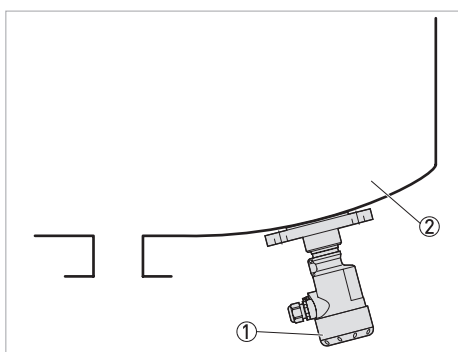


Figure 3-10: Measurement setup for level measurement

- ① Pressure transmitter
- ② Tank

3.14 External housing

A mounting plate is available as an option to facilitate the mounting of the external housing. For further information refer to *Technical data* on page 75.

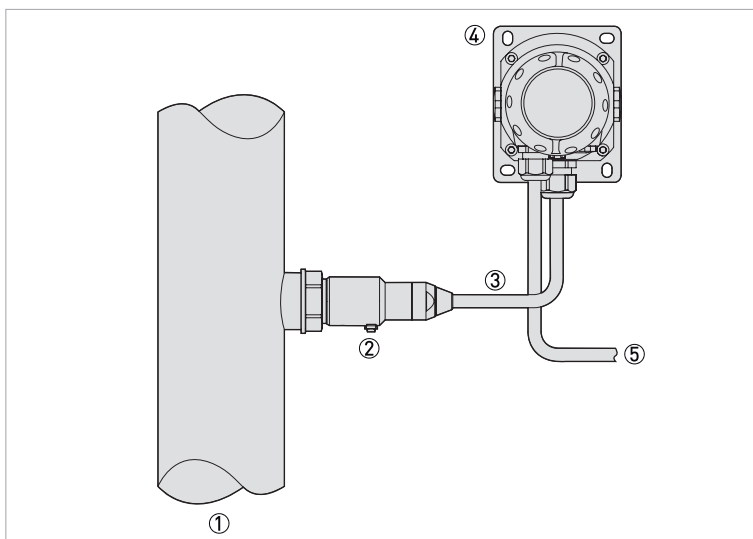


Figure 3-11: Measurement setup with an external housing

- ① Tapping point
- ② Sensor assembly
- ③ Connecting cable
- ④ External housing
- ⑤ Signal cable

IP68 version (25 bar)

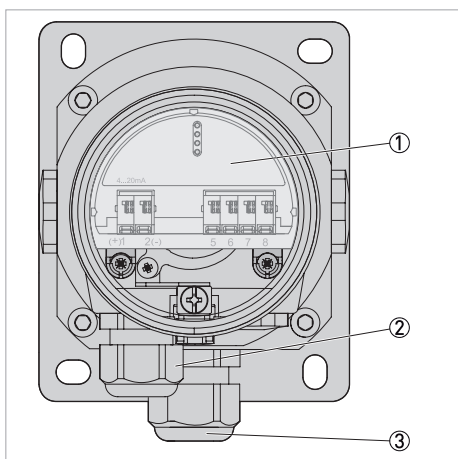


Figure 3-12: External housing (IP68)

- ① Electronic insert
- ② Cable gland for the power supply
- ③ Cable gland for the sensor connection cable

3.15 Electronic differential pressure

The OPTIBAR PM 5060 C slave sensor is combined with a master sensor for an electronic differential pressure measurement. The sensors are connected to each other via a shielded four-wire cable. The measured value of the slave sensor is scanned in and factored into the calculations. The measurement result (level, differential pressure, density or interface), as well as the measured value of the slave sensor (static pressure or head pressure) are output by the master sensor. Depending on the device version, output takes place as a 4...20 mA signal or digitally via HART, Profibus PA or Foundation Fieldbus with optional SIL-approval. The master sensor also takes care of the power supply and parameter adjustment.

Measurement result = measured value of master sensor (total pressure) - measured value of slave sensor (static pressure)

In principle, all sensor combinations in the OPTIBAR 5060 C device series are permitted, provided that the following requirements are met:

- Configuration of master sensor suitable for electronic differential pressure
- Type of pressure identical for both sensors, i.e. gauge pressure/gauge pressure or absolute pressure/absolute pressure
- The master sensor measures the higher pressure
- Single chamber housing for the master and slave sensor
- Measurement setup as illustrated in the following sections

The measuring range for each sensor is selected in accordance with the application requirements and the measuring ranges of the master and slave sensors do not have to be identical. Observe the maximum recommended turn down. For further information refer to *Pressure ranges* on page 82.

The "climate compensated gauge pressure" version is not suitable for electronic differential pressure measurement.

3.15.1 Measurement setup for level measurement

The master slave combination is suitable for level measurement in pressurised tanks. Note the following information regarding measurement setup.

- Install the master sensor below the minimum level
- Install the master sensor away from the filling stream or emptying area.
- Install the master sensor so that it is protected against pressure shocks from the stirrer.
- Install the slave sensor above the maximum level

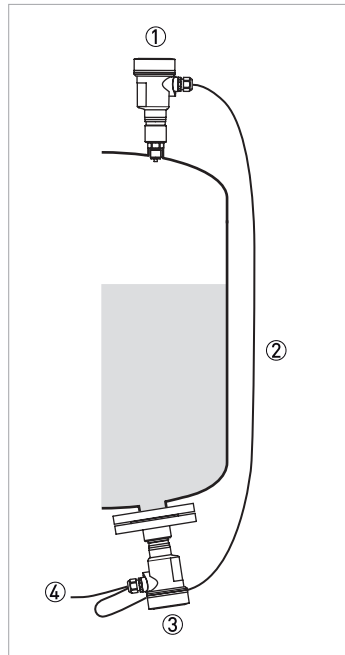


Figure 3-13: Measurement setup for level measurement in pressurised tanks

- ① Slave sensor
- ② Shielded four-wire cable
- ③ Master sensor
- ④ Power supply

3.15.2 Measurement setup for differential pressure measurement

The master-slave combination is suitable for differential pressure measurement.

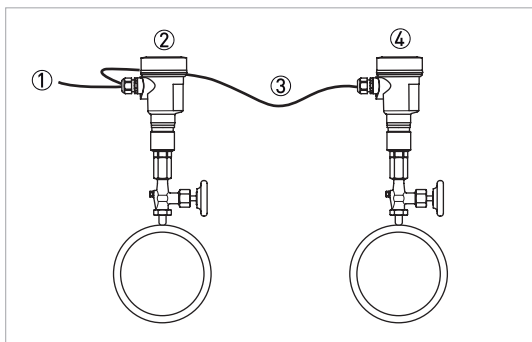


Figure 3-14: Measurement setup for differential pressure measurement of gases in pipelines

- ① Power supply/signal line
- ② Master sensor
- ③ Shielded four-wire cable
- ④ Slave sensor

3.15.3 Measurement setup for density measurement

The master-slave combination is suitable for density measurement. Requirements for a functioning measurement are:

- Tanks with variable level
- Distance between the measurement points as large as possible
- Level always above the upper measuring point

The mounting distance h of the two sensors should be at least 10%, preferably 20%, of the final value of the sensor measuring range. A greater distance increases the accuracy of the density measurement. Slight density changes cause only slight changes of the measured differential pressure. The measuring range must hence be selected accordingly. The density measurement is possible in open as well as in closed tanks.

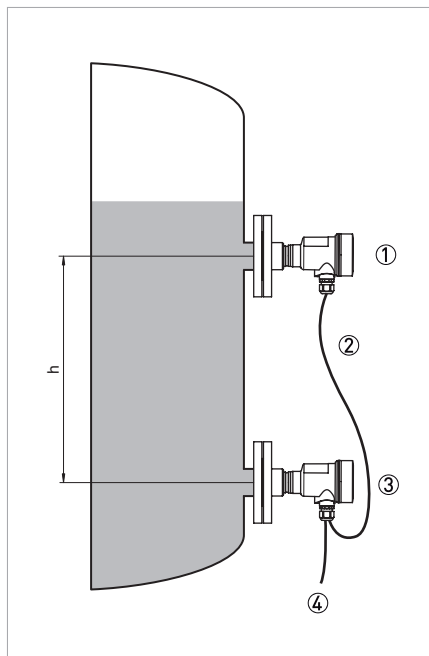


Figure 3-15: Measurement setup for density measurement, h = distance between the two measuring points

- ① Slave sensor
- ② Shielded four-wire cable
- ③ Master sensor
- ④ Power supply

3.15.4 Measurement setup for interface measurement

The master-slave combination is suitable for interface measurement. Requirements for a functioning measurement are:

- Tanks with variable level
- Media with constant density
- Interface always between the measuring points
- Total level always above the upper measuring point

The mounting distance h of the two sensors should be at least 10%, preferably 20%, of the final value of the sensor measuring range. A greater distance increases the accuracy of the interface measurement. The interface measurement is possible in open as well as in closed tanks.

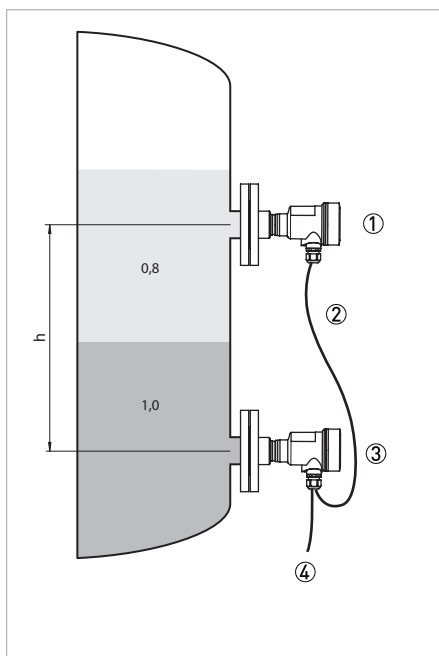


Figure 3-16: Measurement setup for interface measurement, h = distance between the two measuring points

- ① Slave sensor
- ② Shielded four-wire cable
- ③ Master sensor
- ④ Power supply

3.15.5 Measurement setup for density compensated level measurement

The master-slave combination is suitable for density compensated level measurement. Note the following information regarding measurement setup:

- Install the master sensor below the minimum level
- Install the slave sensor above the master sensor
- Install both sensors away from the filling stream and emptying and protected against pressure shocks from the stirrer.

The mounting distance h of the two sensors should be at least 10%, preferably 20%, of the final value of the sensor measuring range. A greater distance increases the accuracy of the density compensation.

The density compensated level measurement starts with the stored density 1 kg/dm^3 . As soon as both sensors are covered, this value will be replaced by the calculated density. Density compensation means that the level value in height units and the adjustment values do not change in case of a fluctuating density.

Density compensated level measurement is only possible when the tank is open, in other words unpressurised.

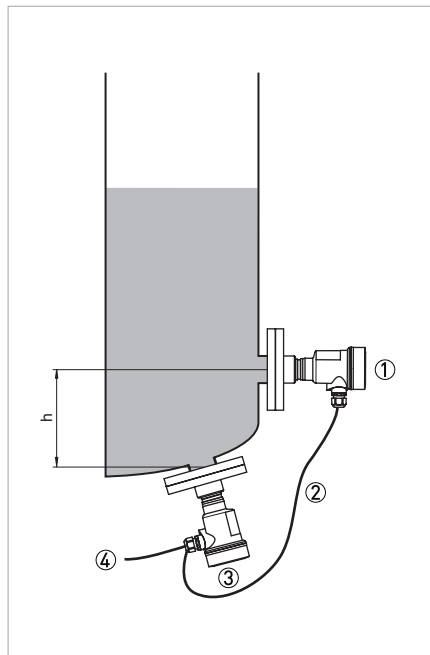


Figure 3-17: Measurement setup for density compensated level measurement, h = distance between the two measuring points

- ① Slave sensor
- ② Shielded four-wire cable
- ③ Master sensor
- ④ Power supply

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 M20 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: $-40...+105^{\circ}\text{C}$ / $-40...+221^{\circ}\text{F}$
- 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.
- A cable outer diameter of 5...9 mm / 0.2...0.35" ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.
- We generally recommend the use of a shielded cable for HART® multidrop mode.

For electronic differential pressure measurement, the voltage supply of the slave sensor and the signal transmission are carried out via the supplied, four-wire connecting cable from the master sensor. The data for this signal circuit can be found in the Technical Data section on page 75.

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

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

4.2.2 Laying electrical cables correctly

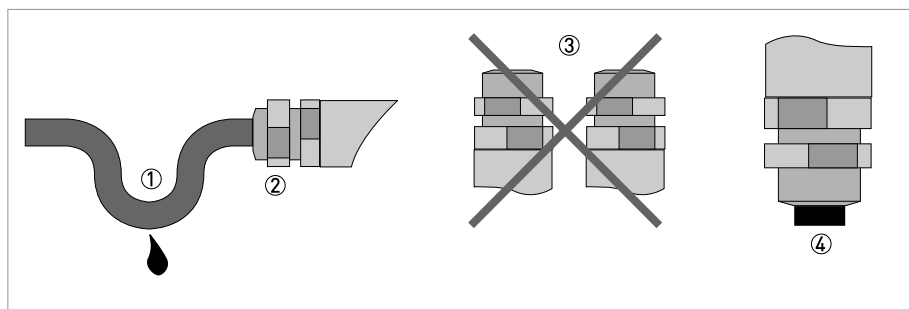


Figure 4-1: Protect housing from dust and water



- 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.

- 5...9 mm / 0.20...0.35" (standard)
- 6...12 mm / 0.24...0.47" (optional)
- 10...14 mm / 0.40...0.55" (optional)

The terminals in the terminal compartment are designed for wire cross-sections of up to 1.5 mm². To ensure a proper connection, you should strip the cable 40...50 mm / 1.6...2".

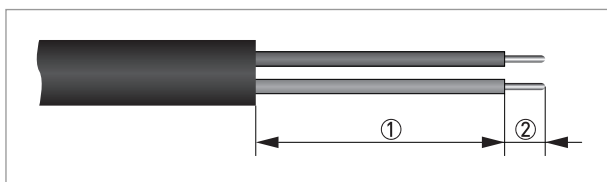


Figure 4-2: Stripping the cable

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

4.2.4 Cable entry 1/2-14 NPT (female)

With plastic housings, the NPT cable gland or the conduit steel tube must be screwed without grease into the thread.

4.2.5 Connector pin assignment

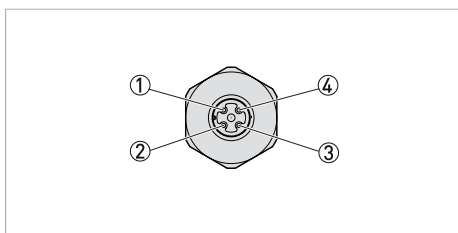


Figure 4-3: Connector M12 x 1, 4-pin, A-coding

- ① VS+
- ② Not Connected
- ③ Not Connected
- ④ VS-

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Brown	1
Pin ④	Blue	2

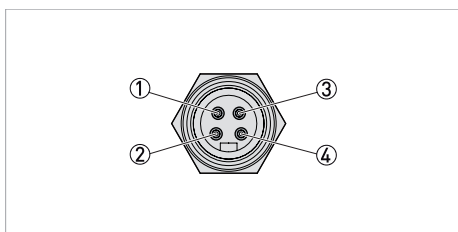


Figure 4-4: 7/8 connector, Foundation Fieldbus (FF)

- ① VS-
- ② VS+
- ③ Not connected
- ④ Cable shield

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Blue	1
Pin ②	Brown	2
Pin ④	Green / yellow	Grounding

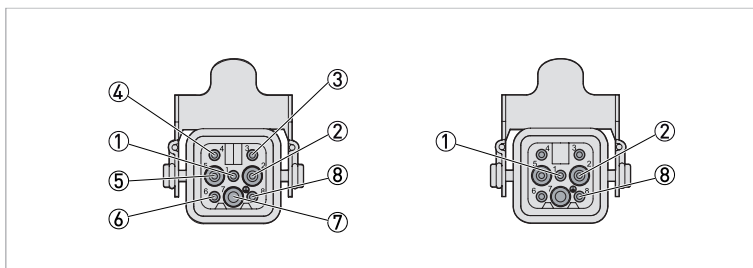


Figure 4-5: Connector, Harting HAN 8D (left) and Harting HAN 7D (right)

- ① VS-
- ② VS+

Contact pin	Colour of cable	Electronic insert for terminal
Pin ①	Black	1
Pin ②	Blue	2
Pin ⑧	Green / yellow	Grounding

4.2.6 Connection to the power supply

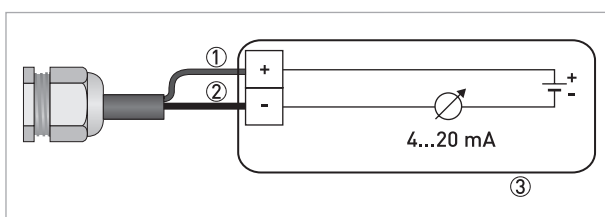


Figure 4-6: Connection to the power supply

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

4.2.7 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



Procedure

- Unscrew the housing cover.
- If present, remove the display and adjustment module by turning it to the left.
- Loosen union nut of the cable gland.
- For preparation of connection cable refer to *Cable preparation* on page 38.
- Push the cable through the cable gland into the terminal compartment.
- Insert the wire ends into the open terminal connection according to the wiring plan. Flexible cores with wire end sleeves as well as solid cores can be inserted directly into the terminal openings. In case of flexible cores, press the spring terminal with a small screwdriver to open the terminal opening.
- Check the proper hold of the wires in the terminals by lightly pulling on them.
- Connect the cable shield to the internal ground terminal, connect the outer ground terminal to the customer/plant equipotential bonding.
- Tighten the union nut of the cable gland. The sealing ring must completely enclose the cable.
- Screw the housing cover back on.

4.3.2 Connection in the housing base (external housing)



Procedure

- Unscrew the housing cover
- If present, remove the display and adjustment module by turning it to the left
- Loosen union nut of the cable gland
- For preparation of connection cable refer to *Cable preparation* on page 38
- Push the cable through the cable gland into the terminal compartment
- Insert the wire ends into the open terminals according to the wiring plan. Solid cores as well as flexible cores with wire end sleeves can be inserted directly into the terminal openings. In case of flexible cores, press the spring terminal with a small screwdriver to open the terminal opening.
- Check the proper hold of the wires in the terminals by lightly pulling on them
- Connect the cable shield to the internal ground terminal, connect the outer ground terminal to the equipotential bonding
- Tighten the union nut of the cable gland. The sealing ring must completely enclose the cable
- Screw the housing cover back on

4.3.3 Connection of electronic differential pressure

The voltage supply of the slave sensor and the signal transmission are carried out via the shielded, four-wire connecting cable from the master sensor. For this, use the supplied, confectioned cable. Electrical connection is made via spring-loaded terminals in the respective housings. Solid wires as well as flexible wires with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the terminal opening is then free. When the screwdriver is released, the terminal closes again.

1. Unscrew the housing cover
2. Loosen the compression nut on the cable gland and remove the blind plug
3. Remove approx. 10 cm / 4 inch of the cable mantle, strip approx. 1 cm / 0.4 inch insulation from the individual wires or use supplied connection cable
4. Insert the cable through the cable gland into the sensor
5. Insert the wire ends into the terminals according to the wiring plan.
6. Check the hold of the wires in the terminals by lightly pulling on them
7. Connect the screen to the internal ground terminal, connect the external ground terminal to the equipotential bonding
8. Tighten the compression nut of the cable gland. The sealing ring must completely encircle the cable
9. Unscrew the blind plugs from the master sensor, screw in the supplied cable gland
10. Connect cable to the master sensor, see steps 3 to 8
11. Screw on the housing cover. The electrical connection is now finished.

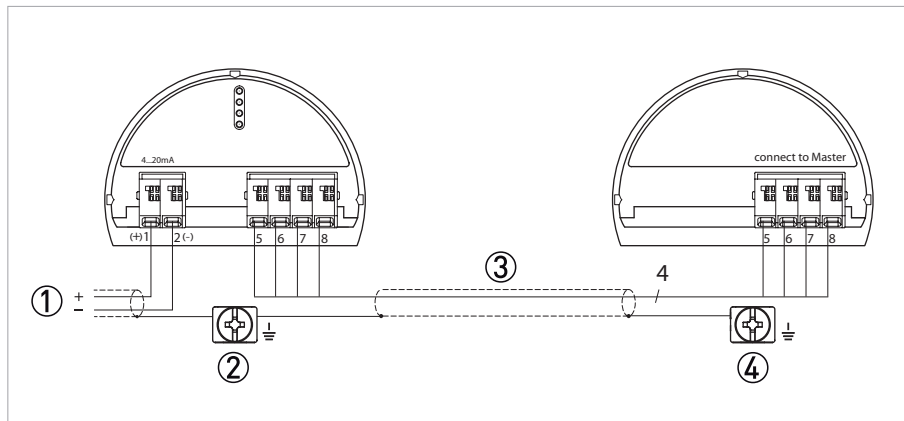


Figure 4-7: Connection example of electronic differential pressure

- ① Power supply
- ② Master sensor
- ③ Shielded four-wire cable
- ④ Slave sensor

The connection between the master and slave sensors is in accordance with the table:

Master sensor	Slave sensor
Terminal 5	Terminal 5
Terminal 6	Terminal 6
Terminal 7	Terminal 7
Terminal 8	Terminal 8

4.3.4 Single chamber housing

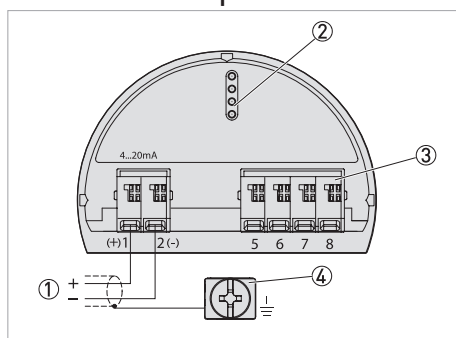


DANGER!

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

The following illustration applies to both the non-Ex as well as the the Ex ia, and the Ex d version.

Electronics compartment



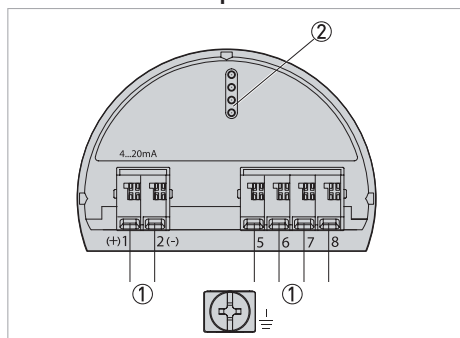
- ① Power supply / signal output
- ② Interface adapter for the display and adjustment module
- ③ Digital interface
- ④ Ground terminal for connection of the cable shield

4.3.5 Double chamber housing

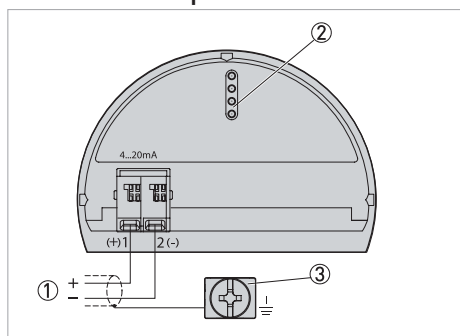
**DANGER!**

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

The following illustration applies to both the non-Ex as well as the Ex ia, and the Ex d version.

Electronics compartment

- ① Internal connection to terminal compartment
- ② Interface adapter for the display and adjustment module

Terminal compartment

- ① Power supply / signal output
- ② Interface adapter for the display and adjustment module
- ③ Ground terminal for connection of the cable shield

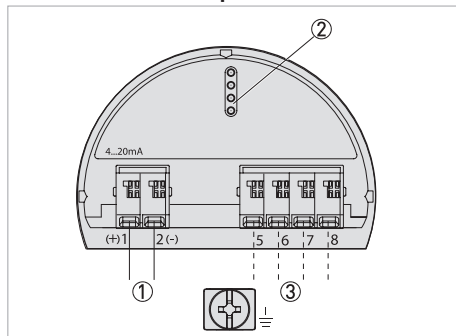
4.3.6 Double chamber housing Ex d ia



DANGER!

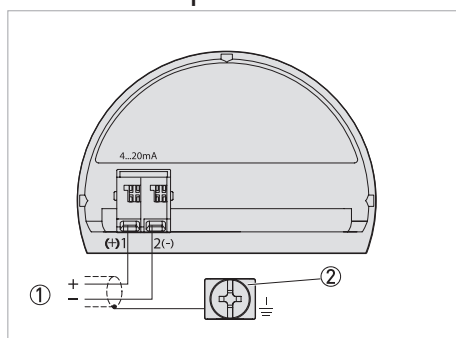
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

Electronics compartment



- ① Power supply / signal output
- ② Interface adapter for the display and adjustment module
- ③ Digital interface

Terminal compartment



- ① Power supply / signal output
- ② Ground terminal for connection of the cable shield

4.4 Grounding the measuring device

**WARNING!**

Within galvanic plants as well as vessels with cathodic corrosion protection there are considerable potential differences. Considerably equipotential bonding currents can be caused via the cable shield when the shield is grounded on both ends. To avoid this, the cable shield must only be connected to the grounding potential on one side of the control cabinet in such applications. The cable shield must not be connected to the internal ground terminal in the device and the outer ground terminal on the housing not to the equipotential bonding!

**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.

If a shielded cable is necessary, connect the cable shield on both ends to the grounding potential. In the signal converter, the cable shield must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the equipotential bonding with low impedance. If equipotential bonding currents are expected, the evaluation side must be connected with a ceramic capacitor (e.g. 1 nF, 1500 V). The low frequency equipotential bonding currents are thus suppressed, but the protective effect against high frequency interference signals remains.

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 75.

5.1 Comissioning

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 10 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 or PC.
3. Indication of a status message on the display or PC.
4. Output signal jumps to the set alarm current.
5. The current measuring value is outputted to the signal cable.

5.2 Operating sequence for SIL devices

Only for signal converters with SIL-qualification

Any change in the parameters of SIL-qualified devices must always take place as follows:

- Unlock adjustment
- Change parameters
- Lock adjustment and verify modified parameters

This ensures that all of the parameters modified were done so deliberately.

Unlock adjustment

The device is shipped in locked condition. To protect against unwanted or unauthorised adjustment, the device is locked against any change in parameters in normal operating state. Prior to any change in parameters you must enter the PIN for the device. The PIN in delivery status is "0000".

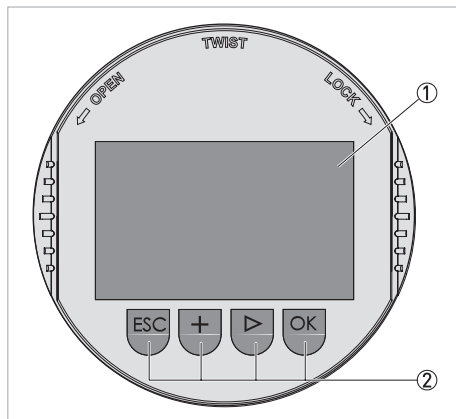
5.3 Keypad functions



INFORMATION!

The device can be configured either via the relevant fieldbus or the adjustment module.

The display and adjustment module is used for indication of measuring values, adjustment and diagnosis.



- ① LCD display
- ② Function buttons

The device is operated via the four keys of the display and adjustment module ②. The LC display ① indicates the individual menu items. Approx. 60 minutes after the last pressing of a key, an automatic reset in the indication of measuring values is triggered. Any values not confirmed with [OK] will not be saved.

[OK]

- Move back to the menu overview
- Confirm selected menu
- Editing the parameters
- Store value

[▷]

- Change measured value
- Select list entry
- Select editing position

[+]

- Change value of the parameter

[ESC]

- Cancel entry
- Jump to next higher menu

5.4 Quick set-up

To adapt the device quickly and easily to the application, select the menu item "Quick setup". This parameter adjustment essentially involves the selection of the application, position correction and adjustment of the span.



INFORMATION!

Differential pressure, density and interface are only available for electronic differential pressure when the slave sensor is activated

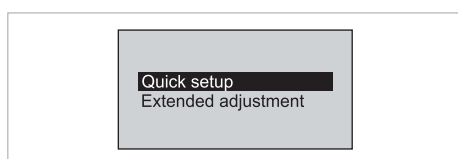


Figure 5-1: Quick set-up

In this chapter, not all settings are displayed graphically but all settings are described.

Figure 5-2: Overview Quick setup

- ① **Measurement loop name**
Assign a suitable measurement loop name
- ② **Electronic differential pressure**
Activate/deactivate the slave sensor for electronic differential pressure. If you have not connected a slave sensor, confirm this with "deactivate".
Application
Then select the application. The selection includes process pressure, level, differential pressure, density and interface.
- ③ **Adjustment units**
Determine the adjustment and temperature units of the device.

Adjustment process pressure

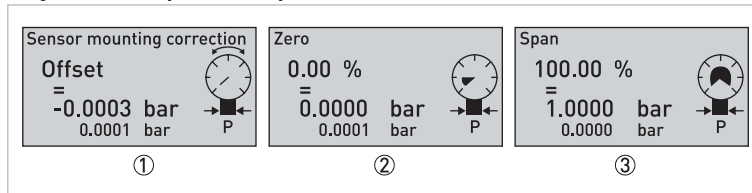


Figure 5-3: Adjustment process pressure

① **Sensor mounting correction**

In this menu item you compensate the influence of the installation position of the device (offset) on the measured value.

② **Zero**

In this menu item you determine the zero point of your measurement (LRV)
This value corresponds to the output signal of 4 mA.

③ **Span**

This value corresponds 100%, or rather an output signal of 20 mA (URV)
If the zero point is actually 0, this value corresponds to the measuring span.

Adjustment level

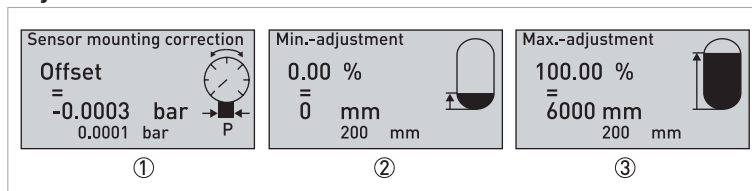


Figure 5-4: Adjustment level

① **Sensor mounting correction**

In this menu item you compensate the influence of the installation position of the device (offset) on the measured value.

② **Min.-adjustment**

Enter the (pressure) value for the min. level.
At 0% this corresponds to the output signal of 4 mA.

③ **Max.-adjustment**

Enter the (pressure) value for the max. level.
At 100% this corresponds to the output signal of 20 mA.

Adjustment differential pressure

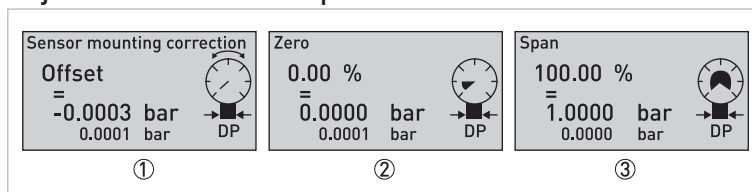


Figure 5-5: Adjustment differential pressure

① **Sensor mounting correction**

In this menu item you compensate the influence of the installation position of the device (offset) on the measured value.

② **Zero**

In this menu item you determine the zero point of your measurement (LRV)
This value corresponds to the output signal of 4 mA.

③ **Span**

This value corresponds 100%, or rather an output signal of 20 mA (URV)
If the zero point is actually 0, this value corresponds to the measuring span.

Adjustment density

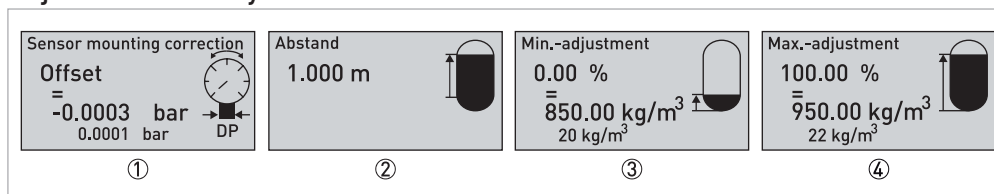


Figure 5-6: Adjustment density

① **Sensor mounting correction**

In this menu item you compensate the influence of the installation position of the device (offset) on the measured value.

② **Distance min. - max..**

Enter the distance between both measuring points.

③ **Min.-adjustment**

Enter the (pressure) value for the min. density.
This corresponds to the output signal of 4 mA.

④ **Max.-adjustment**

Enter the (pressure) value for the max. density.
At 100% this corresponds to the output signal of 20 mA.

Adjustment interface

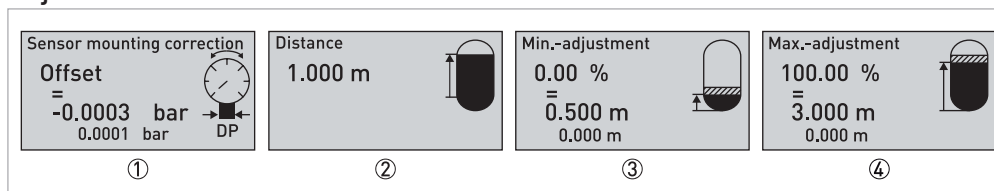


Figure 5-7: Adjustment interface

① **Sensor mounting correction**

In this menu item you compensate the influence of the installation position of the device (offset) on the measured value.

② **Distance max./min.**

Enter the distance between both measuring points.

③ **Min.-adjustment**

Enter the (pressure) value for the min. position of the interface.
This corresponds to the output signal of 4 mA.

④ **Max.-adjustment**

Enter the (pressure) value for the max. position of the interface.
At 100% this corresponds to the output signal of 20 mA.

5.5 Extended adjustment

The main menu is divided into five sections:

- Start-up
- Display
- Diagnosis
- Additional adjustments
- Info

5.5.1 Commissioning

Measurement loop name	Assign a unique device ID. This is useful or even necessary in digital systems and for monitoring large systems.	
Application	Here you select the application: process pressure, level, differential pressure ①, density ①, interface ① are available. The default setting is process pressure and the slave for electronic differential pressure is deactivated.	
Units	In this menu item the adjustment units, as well as the temperature unit are determined. The selection of the adjustment unit determines the unit displayed in the "Min-adjustment" and "Max-adjustment" items. In "Level" mode, it is possible to carry out the adjustment in a height unit (e.g. meters). To do so, the density of the medium must also be specified.	
	Adjustment units	Process pressure, differential pressure ① mbar, bar, Pa, kPa, MPa, psi, mmH2O, mmHg, inH2O, inHg and User-defined.
		Level Density input required: mm, cm, m, in and ft
		Density measurement ① kg/dm3 and lb/ft3
		Interface ① mm, cm, m, in and ft with density input/unit of media
	Temperature unit	°C, °F and K
	Static pressure	mbar, bar, Pa, kPa, MPa, psi, mmH2O, mmHg, inH2O and inHg
Sensor mounting correction	The mounting position of the device has a great impact on the measured value (offset), especially with small measuring ranges. The sensor mounting correction compensates for this offset. The sensor mounting correction can automatically take on the current measured value as correction value (auto correct). Or, this correction value can also be entered manually using the "Edit" function. When it comes to electronic differential pressure, the following options are available for the sensor mounting correction: automatic correction for both sensors, manual correction for the master (differential pressure), manual correction for the slave (static pressure). Once the sensor mounting correction is complete, the current measured value is corrected to 0. The sensor mounting correction can compensate for a maximum total of 20% of the nominal measuring range.	
	Offset	Input in adjustment unit, automatic transfer of the current measured value.
Adjustment	Adjustment refers to setting the zero point (zero) and maximum measured value (span). These values correspond to the values of 4 and 20 mA. If the adjustment ranges are exceeded, the message "Outside parameter limits" is displayed.	
	Distance	Density ① Distance in m (for kg/cm ³) and ft (for lb/ft ³) Interface ① Distance in mm, cm, m, in and ft
	Min.-adjustment / Zero	Process pressure, differential pressure ① Zero in X %, pressure Level (standard 0%) Min. in X %, pressure or filling height Density ① Min. in X %, density Interface ① Min. in X %, interface
	Max.-adjustment / Span	Process pressure, differential pressure ① Span in %, pressure Level (standard 100%) Min. in X %, pressure or filling height Density ① Min. in X %, density Interface ① Min. in X %, interface

Damping	For the damping of process-dependent measured value fluctuations, you can choose a suitable integration time. The values which can be entered are from 0 ... 999 seconds with an increment of 0.1 seconds.		
	Integration time		In 0.1 second increments.
Linearisation	A linearisation is necessary for all vessels in which the volume does not increase linearly with the level height, e.g. in a horizontal cylindrical or spherical tank, and the indication or output of the volume is required. Corresponding linearisation curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. Enter the desired parameters using the function buttons and save the entries. Note the following if the pressure transmitter with corresponding approval is used as part of an overfill protection system according to WHG (Water Resources Act): If a linearization curve is selected, the measuring signal is no longer linearly proportional to the level. This must be taken into consideration by the user, particularly when setting the switching point on the limit switch.		
	Type of linearisation		Level Linear, Horiz.cylinder, Sphere and User programmable.
Current output	In the current output menu, the saturation region for above or below a threshold is set. Under "Current output min./max." these limit values can be set. The factory setting is 3.8 mA and 20.5 mA. This corresponds to the NAMUR recommendation NE 43.		
	Mode	Output characteristic	0...100% = 4...20 mA or 0...100% = 20...4 mA
		Failure mode	≤ 3.6 mA, ≥ 21 mA, last valid measured value
	Min. and Max.	Min. current	3.8 mA, 4 mA
		Maximum current	20.5 mA, 20 mA
Lock adjustment / Unlock adjustment	In this menu item, a 4-digit PIN can be activated, which protects against undesirable or unintended changes of the settings. With a PIN active, remote access via software or other systems is also no longer possible.		
	Run now		
Only for signal converters with SIL-qualification Lock adjustment / Unlock adjustment	With this menu item you can protect the sensor parameters from unwanted or unintended changes. To avoid possible errors during parameter adjustment in unsafe operating environments, a verification procedure is used that allows parameterization errors to be reliably detected. Safety-relevant parameters must be verified before they are saved to the device. In addition, to protect against unwanted or unauthorised adjustment, the device is locked in normal operating state against any parameter changes.		
	1. Enter PIN Start-up - Lock adjustment - Unlock - The device is shipped in locked condition. The PIN in delivery status is "0000".		
	2. String comparison Afterwards you must compare the strings. This is to check the string display. Confirm that the two strings are identical. The verification texts are displayed in German and in English with any other menu language.		
	3. Serial number confirmation Then confirm that the serial number of your device has been properly transferred. This checks for proper device communication.		
	4. Parameter verification All safety-relevant parameters must be verified following a change: <ul style="list-style-type: none"> • SIL parameter 1: Zero adjustment • SIL parameter 2: Slave in/out • Non-SIL parameter 1: Display of measured value • Non-SIL parameter 2: Display value 1, unit of application • Non-SIL parameter 3: Display value 1, unit of application • Non-SIL parameter 4: Backlight Confirm the changed values one after the other If configuration as described has been completely and correctly carried out, the device is locked and ready to operate. Otherwise the device remains unlocked and thus in an unsafe state. As long as the device is supplied with power, the display and adjustment module remain in the momentarily set operating menu. There is no automatic, time-controlled jump back into the display of measured values.		

① Only available for electronic differential pressure when the slave sensor is activated.

5.5.2 Display

Menu language	In this menu item you can set the desired language. Factory settings: English	
	German, English, French, Spanish, Portuguese, Italian, Dutch, Russian, Turkish, Polish and Czech.	
Displayed value 1 and 2	In this menu item you can define how the measured value should be presented on the display. The factory setting is "Linear percent".	
	Process pressure	Process pressure, Percent, Scaled, Current output, Linear percent, Meas. cell temp. and Electronics temperature.
	Level	Filling height or Pressure (Adjustment units), Static pressure, Percent, Scaled, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Differential pressure ①	Differential pressure, Static pressure, Percent, Scaled, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Density ①	Density, Differential pressure, Percent, Scaled, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Interface ①	Interface height, Differential pressure, Percent, Scaled, Current output, Linear percent, Meas. cell temp. and Electronics temperature.
Backlight	A backlight on the display is available, which can be turned on or off in this menu. By default, this function is disabled.	
	Off, On	

① Only available for electronic differential pressure when the slave sensor is activated

5.5.3 Diagnostics

Device status	Status signals	Check function, Out of Specification, Maintenance required, Failure
Peak value	The respective minimum and maximum pressure values are stored in the device. Under "Peak values", these values can be viewed or reset. In addition to the pressure, the minimum and maximum values of the sensor cell and the electronics temperature is stored. These can be viewed or reset here.	
	Peak value Process pressure	Reset peak value
	Peak value Differential pressure ①	Reset peak value
	Peak value Static pressure ①	Reset peak value
	Peak value Meas. cell temp.	Reset peak value
	Peak value Electronic temperature	Reset peak value
Simulation	In menu item "Simulation", measured values can be simulated via the current output. These are issued as both analogue and digital (via HART®). The simulation is automatically cancelled 60 minutes after the last key stroke.	
	Process pressure	Process pressure, Percent, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Level	Filling height or Process pressure (Adjustment units), Percent, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Differential pressure ①	Differential pressure, Static pressure, Percent, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Density ①	Density, Differential pressure, Percent, Current output, Linear percent, Meas. cell temp. and Electronics temperature
	Interface ①	Interface height, Differential pressure, Percent, Current output, Linear percent, Meas. cell temp. and Electronics temperature

① Only available for electronic differential pressure when the slave sensor is activated

5.5.4 Additional adjustments

PIN	In this menu item the PIN can be changed. This option is only available if it has been enabled under "Setup - Lock adjustment". The PIN is "0000" by default factory conditions.	
	0000	Change PIN
Date / Time	Internal clock setting	
	Write date, time, data in device	
Reset	For more information refer to <i>Reset</i> on page 60.	
	Delivery status and Basic settings	
Copy instrument settings	For more information refer to <i>Saving the device settings</i> on page 62.	
	Copy instrument settings	
Special parameters	Changing these settings is possible only after consultation with a service employee.	
Scaling	In menu item "Scaling variable" you define the scaling variables and the scaling unit for the level mode. In menu item "Scaling format" you define the scaling format on the display and the scaling of the level measurement for 0% and 100%.	
	Scaling variable	Scaling variable
		Scaling unit
	Scaling format	Scaling format
		100% corresponds - user-defined value
		0% corresponds - user-defined value
Current output	In this menu item it is determined which measured variable relates to which current output. Under "Current output - Adjustment", the current output can be assigned a corresponding measured value.	
	Current output variable The selection is limited to linear percent for devices with SIL-qualification.	For applications Process pressure Process pressure, Percent, Linear percent, Meas. cell temp. and Electronics temperature
		For applications Level Filling height or Process pressure (Adjustment units), Percent, Scaled, Linear percent, Meas. cell temp. and Electronics temperature
		For applications Differential pressure ① Differential pressure, Static pressure, Percent, Linear percent, Meas. cell temp. and Electronics temperature
		For applications Density ① Density, Differential pressure, Percent, Scaled, Linear percent, Meas. cell temp. and Electronics temperature
		For applications Interface ① Interface height, Differential pressure, Percent, Scaled, Linear percent, Meas. cell temp. and Electronics temperature
	Current output adjustment	0% = 0% or 100% = 100%
HART®-Mode	The converter offers the HART® modes "Analogue current output" and "Fix current" (4 mA)". Under "Fix current (4 mA)", up to 64 sensors can be operated on a two-wire cable in multidrop mode. Each device must be assigned a HART® address between 0 and 63. The analogue signal is fixed at 4 mA. Under "Analogue current output", however, a 4...20 mA signal can also be issued for the assigned HART® address in multidrop mode.	
	HART® address	0...63
	Output mode	Analogue current output with HART® or Fix current (4 mA) with HART®

① Only available for electronic differential pressure when the slave sensor is activated

5.5.5 Info

Device name	Device name
	Serial number
Instrument version	Software version
	Hardware version
Factory calibration	Factory calibration date
	Date of last change
Sensor characteristics	Order-related device characteristics

5.6 Reset

The reset function resets specific user entries. There are 2 reset functions available:

Delivery status

Restore the default values at the time of delivery, including the order-specific settings. A false signal suppression, user programmable linearization curve as well as the measured value memory will be deleted.

Basic settings

Reset the set data, including special parameters to the default values of the manufacturer. A false signal suppression, user programmable linearization curve as well as the measured value memory will be deleted.

The safety-relevant menu items defined as functional safety according to IEC 61508 (Edition 2) are marked with (SIL).

The following menu items are affected during a reset

Menu item	Parameter	Standard value
Measurement loop name		Sensor
Slave for electronic differential pressure	Slave for electronic differential pressure	disabled
Application (SIL)	Application	Level
Unit	Adjustment units	mbar (cell ≤ 400 mbar) bar (cell ≥ 1 bar)
	Temperature unit	°C
Sensor mounting correction (SIL)		0.00 bar
Adjustment (SIL)	Zero / Min.-adjustment	0.00 bar - 0.00%
	Span / Max.-adjustment	+URL in bar - 100%
Damping (SIL)	Integration time	0.0 seconds
Current output (SIL)	Current output mode	Output characteristic 4...20 mA Failure mode ≤ 3.6 mA
	Current output variable	Linear percent - Level
	Current output adjustment	0...100% = 4...20 mA
	Current output min./max.	Min. 3.8 mA Max. 20.5 mA
Lock adjustment (SIL)		Unlock
simulation		Process pressure

Menu item	Parameter	Standard value
PIN		0000
Scaling	Scaling variable	Volume in l
	Scaling format	0% = 0 L / 100% = 0 L
HART®-Mode		Address 0

Reset - Display

Menu item	Default value
Language	No reset
Displayed value 1	Pressure
Displayed value 2	Ceramic measuring cell: Measuring cell temperature in °C Metallic measuring cell: Electronics temperature in °C
Backlight	Off

Reset - Diagnosis

Menu item	Parameter	Default value
Device status		No reset
Peak value	Pressure	Current measured value
	Temperature	Current temperature values measuring cell, electronics
simulation	Measured Value	Pressure
	simulation	Not active
Proof tests		No reset

Reset - Additional settings

Menu item	Parameter	Default value
Date / Time		No reset
Reset		No reset
Copy instrument settings		No reset
Scaling	Scaling variable	Volume in l
	Scaling format	0% corresponds 0 l 100% corresponds 0 l No decimal places
Current output 1 (SIL)	Current output - size	Linear percent - Level
	Current output - adjustment	0...100% corresponds to 4...20 mA
Current output 2	Current output - size	Meas. cell temp.
	Current output - adjustment	0...100% corresponds to 4...20 mA
HART®-Mode		Address 0
Special parameters (SIL)		No reset

5.7 Saving the device settings

We recommend noting the parameters and archiving them afterwards. They are thus available for multiple use or service purposes. If the signal converter is equipped with a display and adjustment module, the most important data can be read out of the sensor into the display and adjustment module. The data remain there permanently even if the sensor power supply fails. If it is necessary to exchange the signal converter, the display and adjustment module is inserted into the replacement device and the data are written into the signal converter under the menu item "Copy device data".

The following data and settings are saved in the adjustment module:

- All data from the "Set-up" and "Display" menus
- Sensor-specific units
- Temperature unit
- Linearisation
- User programmable linearisation curve

5.8 Diagnosis memory

The device has several internal memories which are available for diagnosis purposes. The data remain even with voltage interruption.

Measured value memory

Up to 100,000 measured values can be stored in a ring memory. Each entry contains a time stamp as well as the respective measured value. Storable values are for example:

- Process pressure
- Level
- Differential pressure ①
- Static pressure ①
- Interface ①
- Density ①
- Percent value
- Linear percent
- Scaled values
- Meas. cell temp.
- Electronic temperature

① Only available for electronic differential pressure when the slave sensor is activated

The measured value memory is active with the default settings and stores the pressure value and the measuring cell temperature every 10 seconds as well as the static pressure for electronic differential pressure.

Recording conditions are set via a PC with PACTware™/DTM or the control system with EDD.

Event memory

Up to 500 events are automatically stored with a time stamp in the event memory (permanent). Each entry contains the date/time, event type, event description and value. Event types are for example:

- Modification of a parameter
- Switch on and shut off times
- Status message
- Error message

The data are read out via a PC with PACTwareTM/DTM or the control system with EDD.

5.9 Failures and diagnostics

The operator of the system is responsible for taking suitable measures to remove interferences. The pressure transmitter offers maximum reliability. Nevertheless, faults can occur during operation. The first measures are to evaluate the error messages, check the output signals as well as the verification of measurement errors.

Asset Management and diagnostics

The device features self-monitoring, diagnostics and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "Diagnostics" via the display and adjustment module, PACTwareTM/DTM and EDD.

Status messages

The status messages are divided into the following categories:

- **Failure**
Due to a malfunction in the device, a failure message is outputted. This status message is always active. It cannot be deactivated by the user.
- **Check function**
The device is in operation, the measured value is temporarily invalid. This status message is inactive by default. It can be activated by the user via PACTwareTM/DTM or EDD.
- **Out of specification**
The measured value is unstable because the device specification is exceeded. This status message is inactive by default. It can be activated by the user via PACTwareTM/DTM or EDD.
- **Maintenance required**
Due to external influences, the device function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the device because a failure is expected in the near future. This status message is inactive by default. It can be activated by the user via PACTwareTM/DTM or EDD.

5.9.1 Advanced Error codes

Failure

Code Text message	Cause	Action or description	DevSpec State in CMD 48
F013 No measurement value available	No valid measured value available	Check the measuring cell or the overpressure or low pressure conditions.	Bit 0 of byte 0...5
F017 Adjustment span too small	Adjustment not within specification	Change adjustment according to the limit values	Bit 1 of byte 0...5
F025 Error in the linearisation table	Index markers are not continuously rising, for example illogical value pairs	check the linearization table, Delete table/Create new pairs	Bit 2 of byte 0...5
F36 No operable sensor software	Failed or interrupted software update	Repeat software update Check electronics version Exchange the electronics or send device for repair	Bit 3 of byte 0...5
F40 Error in the electronics	Hardware defect	Exchange the electronics or send device for repair	Bit 4 of byte 0...5
F041 Error in the electronics	No connection to sensor electronics	Check connection to sensor electronics (with remote version)	Bit 5 of byte 0...5
F042 Communication error slave	No connection to the slave	Check the connection between the master and slave	
F080	General software error	Disconnect operating voltage briefly	Bit 6 of byte 0...5
F105 Measured value is determined.	Device is still in the energizing phase. The measured value has not yet been determined.	Wait until the energizing phase is complete.	Bit 7 of byte 0...5
F125 Impermissible electronics temperature	Temperature of the electronics in the non-specified section	Check ambient temperature Isolate electronics Use device with higher temperature range	
F260 Error in the calibration	Error in the calibration carried out in the factory Error in EEPROM	Exchange the electronics Send device for repair	Bit 10 of byte 0...5
F261 Error in the configuration	Error during setup Error when carrying out a reset	Repeat setup, Repeat reset	Bit 11 of byte 0...5
F264 Installation / start-up error	Inconsistent settings (e.g. distance, adjustment units in application of process pressure) for selected applications or invalid sensor configuration (e.g. application of electronic differential pressure with a connected differential pressure measuring cell)	Changing settings or changing connected sensor configuration or application	Bit 12 of byte 0...5
F265 Measurement function disturbed	Sensor no longer carries out a measurement	Carry out a reset Disconnect operating voltage briefly	Bit 13 of byte 0...5
F266 Impermissible operating voltage	Operating voltage is below the specified range	Check electrical connection - if necessary, increase operating voltage	

Check function

Code Text message	Cause	Action or description	DevSpec State in CMD 48
C700 Simulation Active	A simulation is active	Finish simulation Wait for automatic end after 60 minutes	"Simulation Active" in "Standardised Status 0"

Out of specification

Code Text message	Cause	Action or description	DevSpec State in CMD 48
S600 Impermissible electronics temperature	Temperature of the electronics in the non-specified section	Check ambient temperature Isolate electronics Use device with higher temperature range	Bit 23-0 of byte 14...24
S603 Impermissible operating voltage	Operating voltage below specified range	Check electrical connection - if necessary, increase operating voltage	Bit 23-1 of byte 14...24
S605 Pressure value out of specification	Measured process pressure below or above the setting range	Check the nominal range of the device If necessary, use a device with a higher measuring range	Bit 23-2 of byte 14...24

Only for signal converter with SIL-qualification

If measured values are outside of the specification and an "Out of Specification" message is triggered, this message results in:

- Status message "Failure"
- Fault signal via the current output

Maintenance required

Code Text message	Cause	Action or description	DevSpec State in CMD 48
M500 Error with the reset delivery status	Saved reset delivery status is incorrect	Send device for repair	Bit 0 of byte 14...24
M501 Error in the non active linearisation table	Index markers are not continuously rising, for example illogical value pairs	check the linearization table, Delete table/Create new	Bit 1 of byte 14...24
M502 Error in the event memory	Hardware error in EEPROM	Exchange the electronics Send device for repair	Bit 2 of byte 14...24
M504 Error on a device interface	Hardware defect	Check connections Exchange the electronics Send device for repair	Bit 3 of byte 14...24
M507 Error in the device settings	Error during setup Error when carrying out a reset	Repeat setup, Repeat reset	Bit 4 of byte 14...24

5.9.2 Check 4...20 mA signal

Connect a multimeter in the suitable measuring range according to the wiring plan.

Error code	Cause	Action or description
4...20 mA signal is missing	Faulty connection to power supply	Check connection and if necessary correct according to wiring plan
	No power supply	Check cable for breaks; repair if necessary
	Operating voltage too low or load-resistance too high	Check, adapt if necessary
Signal is >22 mA or <3.6 mA	Electronic module or sensor defective	Exchange the device or send device for repair
4...20 mA signal not stable	Variation in the measured value	Use the display and adjustment module or PACTware/DTM to set damping, depending on the device

**DANGER!**

In hazardous area applications, the regulations for the wiring of intrinsically safe circuits must be observed.

5.9.3 Error messages via the display and operating module

Error code	Cause	Action or description
E013	No measurement value available or pressure greater than nominal range	Exchange the device or send device for repair
E017	Adjustment span too small	Repeat with modified values
E036	No executable signal converter software	Carry out software update or send device for repair
E041	Hardware error	Exchange the device or send device for repair

Depending on the reason for the fault and the measures taken, the steps described previously may need to be carried out again.

5.9.4 Software update

The following components are required for an update of the device software:

- Sensor
- Power supply
- USB interface driver
- PC with PACTware™
- Software update as file



INFORMATION!

The latest version of the signal converter software and the USB interface driver can be found on the manufacturer website (Downloads). Further information is provided in the software update file.

Certain approvals can be subject to a specific software version. Therefore, when carrying out an update, ensure the approval is retained.

Only for signal converters with SIL-qualification

Ensure that you are using the correct software with SIL-qualification. Devices with SIL-qualification can only be updated with the appropriate software. It is impossible to accidentally update it with the wrong software version.

5.10 Adjustment

The pressure transmitter always measures a pressure, regardless of the process variable selected in the menu item "application". To properly output the selected process variable, there must be an allocation of 0 % and 100 % of the output signal (adjustment). In the case of the "level" application the hydrostatic pressure when the vessel is full and empty, for example, could be entered for adjustment. See the following example:

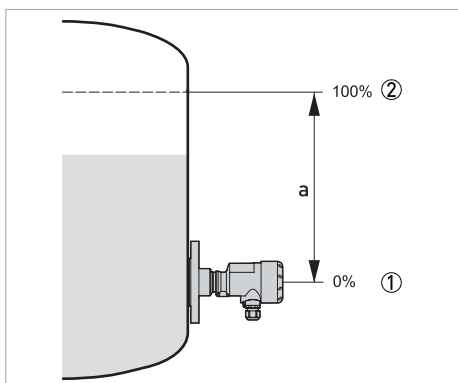


Figure 5-8: Level measurement ($a = 5 \text{ m} / 196,9''$)

Min. level 0% corresponds to 0 mbar / 0 psi

Max. level 100% corresponds to 490.5 mbar / 7.1 psi

If these values are not known, adjustments can be made with levels of 10 % and 90 % for example. Using these inputs, the actual filling height is then calculated. The current level plays no role in this adjustment, the min/max adjustment is always carried out without changing the product. This means that these settings can be made in advance and the device does not need to be installed.



INFORMATION!

If the adjustment ranges are exceeded, the value entered is not saved. Editing can be cancelled with [ESC] or corrected to a value within the adjustment range. Adjustment is carried out accordingly for the remaining process variables such as process pressure, differential pressure and flow.

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 device 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.

Change electronic insert

In case of a defect, the electronic insert can be exchanged by the user against an identical type. If no electronic insert is available on site, it can be ordered from the respective local sales representative. To order a replacement, the serial number of the signal converter is required. This is located on the nameplate of the device or on the delivery note.

Only for signal converters with SIL-qualification

Only an appropriate electronic insert with SIL-qualification may be used with SIL-qualified devices. All application specific settings must be entered anew. Therefore, after replacing the electronics you must perform the start-up again. If you saved the configuration data from the initial start-up of the sensor, you can transfer that to the replacement electronics insert. In this case it is no longer necessary to perform the start-up again.

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:	
Tel. no.:		Fax no. and/or Email address:	
Manufacturer's order no. or serial no.:			
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 through any residual media contained in the 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.

6.8 Exchange process assembly for IP68 (25 bar) version



DANGER!

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



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!

In the case of the IP68 (25 bar) version the user can change the process assembly on site. The connection cable and external housing can be retained.

Required tool:

- Size 2 Allen wrench

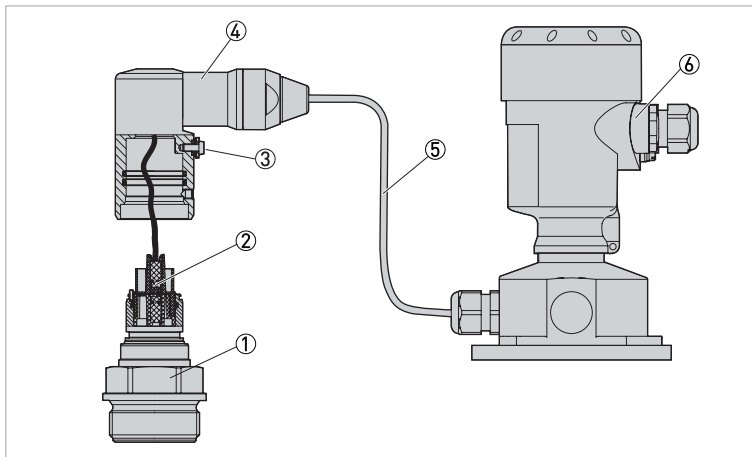


Figure 6-1: IP68 version 25 bar (external housing)

- ① Process assembly
- ② Connector
- ③ Fixing screw
- ④ Cable assembly
- ⑤ Connection cable
- ⑥ External housing

1. Loosen fixing screw with Allen wrench.
2. Carefully remove the cable assembly from the process assembly.
3. Loosen connector.
4. Mount new process assembly on the measuring station.
5. Reassemble connector.
6. Insert cable assembly on process assembly and rotate to desired position.
7. Tighten fixing screw using Allen wrench.

This completes the replacement

7.1 Measuring principle

7.1.1 Piezoresistive or strain gauge measuring cell

The process pressure acts on the sensor element via the process diaphragm and an internal transfer fluid. The process pressure causes a resistance change, which is converted into an appropriate output signal and outputted as a measured value.

For measuring ranges up to and including 40 bar a piezoresistive sensor element is used. For pressure ranges from 40 bar a strain gauge sensor element is used.

Relative pressure: The measuring cell is open to the atmosphere. The ambient pressure is referenced in the measuring cell and compensated and thus has no influence on the measurement.

Absolute pressure: The measuring cell is evacuated and enclosed. The process pressure is measured in reference to vacuum. Any change in the ambient pressure changes the measured value.

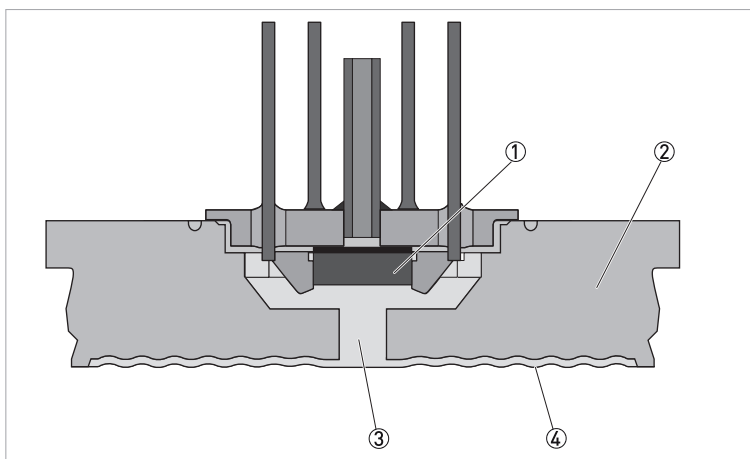


Figure 7-1: Setup of a piezoresistive measuring cell

- ① Sensor Element
- ② Base body
- ③ Transfer fluid
- ④ Process diaphragm

7.1.2 Metallic - ceramic measuring cell

For small measuring ranges or higher temperature ranges, the measurement unit is the ceramic capacitive measuring cell. This consists of a special temperature compensating isolating diaphragm system.

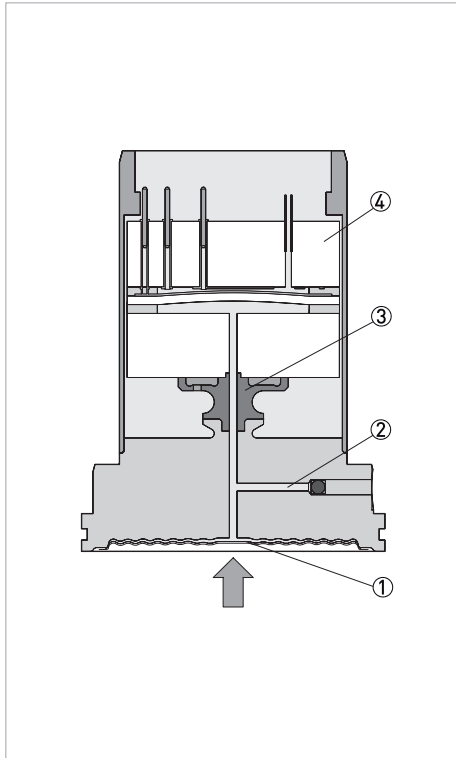


Figure 7-2: Setup of metallic-ceramic measuring cell

- ① Process diaphragm
- ② Isolating liquid
- ③ FeNi adapter
- ④ Metallic - ceramic measuring cell

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	<ul style="list-style-type: none"> • Piezoresistive measuring cell (up to and including 40 bar) • Strain gauge measuring cell (from 40 bar) • Metallic - ceramic measuring cell
Application range	<ul style="list-style-type: none"> • Process pressure measurement • Level of liquids • Differential pressure measurement ① • Density measurement ① • Interface measurement ①
Measuring range	100 mbar...1000 bar / 1.45...14500 psi
Display and user interface	
Display on signal converter	<ul style="list-style-type: none"> • Dot-matrix display 45x27 mm / 1.77x1.06", illuminated • Display turnable in 90° steps • Digit size 13x7 mm / 0.51x0.27" • 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, French, Spanish, Portuguese, Italian, Dutch, Russian, Turkish, Polish and Czech
Operating	Local operation via 4 push buttons on the display and adjustment module
Remote control	<ul style="list-style-type: none"> • PACTware™, incl. Device Type Manager (DTM) • HART® Hand Held Communicator from Emerson Process • AMS® from Emerson Process • PDM® from Siemens
Integrated clock	
Date format	Day / Month / Year
Time format	12 hours / 24 hours
Time zone	CET (Factory setting)
Rate deviation	Maximum 10.5 minutes / year

Measuring accuracy

Process pressure			
Reference conditions acc. to DIN 61298-1	<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 Measuring accuracy according to IEC 61298-2 (terminal based) Curve characteristic: linear Vertical mounting position, measuring diaphragm pointing down Effect of mounting position (piezoresistive or strain gauge measuring cell): dependent on process connection and diaphragm seals Effect of mounting position (metallic - ceramic measuring cell): < 5 mbar / 0.5 kPa / 0.07 psig Deviation at current output due to strong, high-frequency electromagnetic fields within the scope of EN 61326 (<± 150 µA) 		
Reference accuracy acc. to DIN EN 60770	Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4...20 mA current output and refers to the set measuring span. Turn down (TD) is the relation of nominal range/set measuring span. [% of the set span]		
	Accuracy class	0.075%	0.10%
	TD of 1:1 to 5:1	< ±0.075%	< ±0.10%
	TD > 5:1	< ±0.015% x TD	< ±0.02% x TD
Effect of ambient or medium temperature	Ambient temperature effect on zero and span in relation to the set measuring span. Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4...20 mA current output. [% of the set span]		
	Piezoresistive or strain gauge measuring cell		
	Turn Down	In the compensated temperature range 10...+70°C / +50...+158°F	Outside the compensated temperature range
	TD 1:1	< ±0.05% per 10K	typ. < ±0.05% per 10K
	TD to 5:1	< ±0.10% per 10K	-
	TD to 10:1	< ±0.15% per 10K	-
	Metallic - ceramic measuring cell		
	Ambient or medium temperature	Accuracy class 0.10%	Accuracy class 0.20%
	-40...0°C / -40...+32°F	< ±0.375 + 0.375 x TD	< ±0.65 + 0.65 x TD
	0...100°C / +32...+212°F	< ±0.075 + 0.075 x TD	< ±0.20 + 0.20 x TD
	100...120°C / +212...+248°F	< ±0.125 + 0.125 x TD	< ±0.25 + 0.25 x TD
Effect of mounting position	A position-dependent zero offset can be corrected.		
	≤0.1 mbar per 10° inclination		
Long-term stability acc. to DIN 16086 and IEC 60770-1	Applies to the digital interfaces (HART®, Profibus PA, Foundation Fieldbus) as well as for the analogue 4...20 mA current output. [% of URL]		
	Time period	Piezoresistive or strain gauge measuring cell	Metallic - ceramic measuring cell
	1 year	<0.1% x TD	<0.05% x TD
	5 years		<0.1% x TD
Dynamic output behaviour	10 years		<0.2% x TD
	These parameters depend on the fill fluid, temperature and, if applicable, the diaphragm seal. For more information refer to <i>Dynamic output behaviour</i> on page 88		
Damping	63% of the input variable 0...999 seconds, adjustable in 0.1 second steps.		

Operating conditions

Temperature		
Version	Ambient temperature	Storage and transport temperature
Standard version	-40...+80°C / -40...+176°F	-60...+80°C / -76...+176°F
IP66 / IP68 version (1 bar / 14.5 psi)	-20...+80°C / -4...+176°F	-20...+80°C / -4...+176°F
IP68 version (25 bar / 362 psi), connection cable PUR	-20...+80°C / -4...+176°F	-20...+80°C / -4...+176°F
IP68 version (25 bar / 362 psi), connection cable PE	-20...+60°C / -4...+140°F	-20...+60°C / -4...+140°F
Temperature derating metallic - ceramic measuring cell		
Version	Medium temperature	Maximum ambient temperature
+150°C / +302°F	+110°C / +230°F	+80°C / +176°F
	+150°C / +302°F	+60°C / +140°F
+180°C / +356°F	+150°C / +302°F	+80°C / +176°F
	+180°C / +356°F	+65°C / +149°F
+200°C / +392°F	+160°C / +320°F	+80°C / +176°F
	+200°C / +392°F	+65°C / +149°F

Further operating conditions

Ingress protection acc. to IEC 529 / EN 60529			
Plastic (PBT)	Single chamber	IP66 / IP67	NEMA 6P
	Double chamber	IP66 / IP67	NEMA 6P
Aluminium	Single chamber	IP66 / IP67	NEMA 6P
		IP68 (1 bar / 14.5 psi)	-
	Double chamber	IP66 / IP67	NEMA 6P
Stainless steel (electro- polished)	Single chamber	IP69K	-
	Single chamber	IP66 / IP67	NEMA 6P
Stainless steel (precision casting)	Single chamber	IP66 / IP67	NEMA 6P
		IP68 (1 bar / 14.5 psi)	-
	Double chamber	IP66 / IP67	NEMA 6P
Stainless steel	Sensor for external housing	IP68 (25 bar / 362.6 psi)	-
Vibration			
Reference conditions	Single chamber housing, aluminium		
Vibration resistance acc. to EN 60068-2-6	4 g at 5...200 Hz		
Shock resistant according to EN 60068-2- 27	100 g, 6 ms (mechanical shock)		

Materials

Gaskets			
Sealing	Standard version	Version with extended temperature range	Version for oxygen application
Without sealing (for process connection acc. to EN 837)	-40...+105°C / -40...+221°F	-	-40...+60°C / -40...+140°F
FKM (VP2/A)	-20...+105°C / -4...+221°F	-20...+150°C / -4...+302°F	-20...+60°C / -4...+140°F
EPDM (A+P 75, 5/KW75F)	-30...+105°C / -22...+221°F	-30...+150°C / -22...+302°F	-30...+60°C / -22...+140°F
FFKM (Perlast® G75S)	-15...+105°C / +5...+221°F	-15...+150°C / +5...+302°F	-15...+60°C / +5...+140°F
FEPM (Fluoraz® SD 890)	-5...+105°C / +23...+221°F	-	-5...+60°C / +23...+140°F
Wetted parts (piezoresistive or strain gauge measuring cell)			
Process connection	316 L / 1.4404		
Diaphragm	316 L / 1.4404		
Diaphragm for measuring range from 100 bar, non-flush version	Elgiloy® 2.4711		
Gasket process connection G1/2 (EN 837)	Thread G1/2 (EN 837)	Aramid fibres, bound with NBR	
	Thread G1 1/2 (DIN 3852-A)	Aramid fibres, bound with NBR	
	M44 x 1.25 (DIN 13), M30 x 1.5	FKM, FFKM and EPDM	
	FKM (VP2/A, A+P 70.16), EPDM (A+P 75.5/KW75F), FFKM (Perlast® G75S), FEPM (Fluoraz® SD890		
Wetted parts (metal/ceramic measuring cell)			
Process connection	316 L / 1.4404		
Diaphragm	Alloy C-276, optional: gold coated 20 µ, gold/rhodium coated 5 µ/1 µ		
Gasket process connection G1 1/2 (DIN 3852-A)	Klingsersil C-4400		
M44 x 1.25 (DIN 13)	FKM, FFKM, EPDM		

Materials for food applications	
Surface quality	
Aseptic connections	$R_a < 0.8 \mu\text{m}$
Non-wetted parts	
Electronics housing	Plastic PBT (Polyester), powder coated die-cast aluminium, 316 L / 1.4404
External housing	Plastic PBT (polyester) and 316 L / 1.4404
Base, wall mount external housing	Plastic PBT (polyester) and 316 L / 1.4404
Gasket between base and wall mount	EPDM (permanently attached)
Housing cover sealing ring	Silicone (aluminium or plastic housing), NBR (stainless steel housing)
Inspection window in housing cover (display, adjustment module)	Polycarbonate (UL746-C listed)
Ground terminal	316 Ti, 316 L / 1.4404
Connection cable, master and slave sensor	PE and PUR
Nameplate carrier on connecting cable	PE hard
Connection cable for IP68 (1 bar) version	PE

Process connection

Thread	from G1/2 and 1/2-14 NPT (female)
Flanges	from DN 25 (DIN) / 1" (ASME)
Flanges with extension	from DN 25 (DIN) / 1" (ASME)
Internal transfer fluid (piezoresistive or strain gauge measuring cell)	Pressure port with inner diaphragm <ul style="list-style-type: none"> • Silicone oil $\leq 40 \text{ bar} / 580 \text{ psi}$ • Halocarbon oil for oxygen applications $\leq 40 \text{ bar} / 580 \text{ psi}$ • Dry measuring cell (without fill fluid) for pressure ranges $\geq 60 \text{ bar} / 870 \text{ psi}$
	Pressure ports with flush diaphragm <ul style="list-style-type: none"> • Synthetic oil (Neobee) up to 250 bar (FDA-listed for the food industry) • Silicone oil for G1/2" and G1" process connections (LU, P6, C5)
Other connections	ISO 2852 / DIN 32676, DIN 11851, Neumo BioConnect / BioControl, Varivent, DRD, SMS and PMC

Tightening torques

Maximum tightening torques for NPT cable gland and conduit pipe	
Plastic housing	10 Nm / 7.4 ft lb
Aluminium housing	50 Nm / 37 ft lb
Stainless steel housing	50 Nm / 37 ft lb

Electrical connections

Mechanical - Standard	
Cable gland	M20 x 1.5 mm
cable diameter	5...9 mm / 0.20...0.35" 6...12 mm / 0.24...0.47" 10...14 mm / 0.39...0.55"
Cable entry	Blind plug: M20 x 1.5 mm, 1/2-14 NPT
	Closing cap: M20 x 1.5 mm, 1/2-14 NPT
	Connector option: M12 x 1, Harting HAN 7D,8D, 7/8" FF
Wire cross-section	Solid wire with cords: 0.2 mm...2.5 mm ² / AWG 24...14
	Cord with wire end sleeve: 0.2 mm...1.5 mm ² / AWG 4...16
Mechanical - IP66 / IP68 (1 bar)	
Connection cable	
Construction	Four wires, one pressure compensation capillary, one suspension cable, screen braiding, metal foil and cable jacket
Wire cross-section	0.5 mm ² / AWG 20
Wire resistance	< 0.036 Ω/m
Tensile strength	< 1200 N / 270 lbf
Standard length	5 m / 16.40 ft
Max. length	25 m / 82.02 ft
Min. bending radius	25 mm / 0.98" at 25°C / 77°F
Diameter	Approx. 8 mm / 0.31"
Colour	Non-Ex version: black
	Ex version: blue (optional)
Mechanical - Electronic differential pressure measurement	
Connection cable between master and slave sensor	
Data transfer	Digital (I ² C bus)
Structure of connecting cable	Four wires, one suspension cable, screen braiding, metal foil, cable jacket
Standard length	5 m
Max. length	25 m
Min. bending radius at 25°C	25 mm
Diameter	8 mm / 0.315 in
Material	PUR, PE
Colour	Blue, Black
Wire cross-section	0.34 mm ² (AWG 22)
Wire resistance	< 0.05 Ω/m
Mechanical - IP68 (25 bar)	
Connecting cable between IP68 device and external housing	
Construction	Four wires, one pressure compensation capillary, one suspension cable, screen braiding, metal foil and cable jacket
Wire cross-section	0.5 mm ² / AWG 20
Wire resistance	< 0.036 Ω/m / 0.011 Ω/ft
Standard length	5 m / 16.40 ft

Max. length	25 m / 82.02 ft	
Min. bending radius	25 mm / 0.98" at 25°C / 77°F	
Diameter	ca. 8 mm / 0.31"	
Colour	Blue	
Cable entry / Connector		
External housing	1 x cable gland M20 x 1.5 (cable Ø 5...9 mm), 1 x blind plug M20 x 1.5 or	
	1 x connector (depending on version), 1 x blind plug M20 x 1.5	
Spring load terminals for wire cross-section up to	2.5 mm ² / AWG 14	
Electrical		
Operating voltage	Non-Ex device: 9.6...35 VDC	
	Ex ia device: 9.6...30 VDC	
	Ex d device: 9.6...35 VDC	
	Ex ia d device: 15...35 VDC	
	Background lighting on display from 16 VDC	
	Electronic differential pressure from 12 VDC	
Reverse polarity protection	Integrated	
Permissible residual ripple	Non-Ex devices	for U _n 12 VDC (9.6 < UB < 14 VDC) ≤0.7 V _{eff} (16...400 Hz)
	Ex ia d devices and Ex ia devices	for U _n 24 VDC (18 < UB < 35 VDC) ≤1.0 V _{eff} (16...400 Hz)
	Load	R _{L, max} = (UB-9.6) / 22 mA
Potential connection in device	Electronics: not electrically isolated	
	Ground terminal: galvanically connected with process connection	
Over voltage category	III	
Protection class	II	

Inputs and outputs

Output signal	
Output signal	4...20 mA / HART® version 7.3 3.8...20.5 mA / HART® version 7.3 (factory setting acc. to NAMUR recommendation)
Signal resolution	0.3 µA
Error signal of current output (adjustable)	High alarm ≥ 21 mA Low alarm ≤ 3.6 mA, last valid measurement
Max. output current	21.5 mA
Boot-up current	≤ 10 mA for 5 ms after switching on, then ≤ 3.6 mA
Damping (63% of input variable), adjustable	0...999 seconds, adjustable

Approvals and certificates

CE	The device complies with the legal requirements of the EC directive. The manufacturer confirms compliance with these regulations by affixing the CE marking.
Electromagnetic compatibility (EMC)	EMC conformity for EN 61326-1 (05/2006)
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
Classification according to Pressure Equipment Directive (PED 97/23/EC)	For gases of fluid group 1 and liquids of fluid group 1, the requirements are fulfilled according to article 3, paragraph 3 (sound engineering practice).

① Only available for electronic differential pressure when the slave sensor is activated

7.3 Pressure ranges

7.3.1 Adjustment of piezoresistive or strain gauge measuring cell

Adjustment

Data refers to the nominal measuring range, pressure values smaller than -1 bar cannot be set

Adjustment range of min/max adjustment in relation to the nominal range:

- Percent value -10...110%
- Pressure value -20...120%

Adjustment range of the zero / span adjustment in relation to the nominal range

- Zero -20...+95%
- Span: -120...+120%
- Difference between zero and span: max. 120% of the nominal range

Level (min./max. adjustment)

- Percent value -10...110%
- Pressure value -120...120%

Differential pressure ① (zero/span adjustment)

- Zero -95...+95%
- Span: -120...+120%

Density ① (min./max. adjustment)

- Percent value -10...110%
- Density value according to the measuring ranges in kg/dm³

Interface ① (min./max. adjustment)

- Percent value -10...110%
- Height value according to the measuring ranges in m

① Only available for electronic differential pressure when the slave sensor is activated

Recommended maximum Turn Down (TD): 20:1 (no limit)

Nominal ranges and overload capacity in bar/kPa

This information is provided as an overview and refers to the measuring cell. Limitations due to the material and design of the process connection as well as the type of pressure selected are possible. The information given on the nameplate applies.

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Max. working pressure		
0...+0.4 bar / 0...+40 kPa	+2 bar / +200 kPa	-1 bar / -100 kPa
0...+1 bar / 0...+100 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
0...+2.5 bar / 0...+250 kPa	+10 bar / +1000 kPa	-1 bar / -100 kPa
0...+10 bar / 0...+1000 kPa	+35 bar / +3500 kPa	-1 bar / -100 kPa
0...+25 bar / 0...+2500 kPa	+50 bar / +5000 kPa	-1 bar / -100 kPa
0...+40 bar / 0...+4000 kPa	+80 bar / +8000 kPa	-1 bar / -100 kPa
0...+100 bar / 0...+10000 kPa	+200 bar / +20000 kPa	-1 bar / -100 kPa
0...+250 bar / 0...+25000 kPa	+500 bar / +50000 kPa	-1 bar / -100 kPa
0...+600 bar / 0...+60000 kPa	+1200 bar / +120000 kPa	-1 bar / -100 kPa
0...+1000 bar / 0...+100000 kPa	+1500 bar / +150000 kPa	-1 bar / -100 kPa
-1...0 bar / -100...0 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
-1...+1.5 bar / -100...+150 kPa	+10 bar / +1000 kPa	-1 bar / -100 kPa
-1...+10 bar / -100...+1000 kPa	+80 bar / +8000 kPa	-1 bar / -100 kPa
-1...+25 bar / -100...+2500 kPa	+80 bar / +8000 kPa	-1 bar / -100 kPa
-1...+40 bar / -100...+4000 kPa	+80 bar / +8000 kPa	-1 bar / -100 kPa
-0.2...+0.2 bar / -20...+20 kPa	+2 bar / +200 kPa	-1 bar / -100 kPa
-0.5...+0.5 bar / -50...+50 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Absolute pressure		
0...+1 bar / 0...+100 kPa	+5 bar / +500 kPa	0 bar abs.
0...+2.5 bar / 0...+250 kPa	+10 bar / +1000 kPa	0 bar abs.
0...+10 bar / 0...+1000 kPa	+35 bar / +3500 kPa	0 bar abs.
0...+25 bar / 0...+2500 kPa	+50 bar / +5000 kPa	0 bar abs.
0...+40 bar / 0...+4000 kPa	+80 bar / +8000 kPa	0 bar abs.

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Max. working pressure		
0...+5 psig	+25 psig	-14.51 psig
0...+15 psig	+75 psig	-14.51 psig
0...+30 psig	+120 psig	-14.51 psig
0...+150 psig	+450 psig	-14.51 psig
0...+300 psig	+600 psig	-14.51 psig
0...+600 psig	+1200 psig	-14.51 psig
0...+1500 psig	+3000 psig	-14.51 psig
0...+3000 psig	+6000 psig	-14.51 psig
0...+9000 psig	+18000 psig	-14.51 psig
0...+15000 psig	+22500 psig	-14.51 psig
-14.5...0 psig	+75 psig	-14.51 psig
-14.5...+20 psig	+120 psig	-14.51 psig
-14.5...+150 psig	+1200 psig	-14.51 psig
-14.5...+300 psig	+1200 psig	-14.51 psig
-14.5...+600 psig	+1200 psig	-14.51 psig
-3...+3 psig	+25 psig	-14.51 psig
-7...+7 psig	+75 psig	-14.51 psig

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Absolute pressure		
0...15 psi	75 psig	0 psi
0...30 psi	120 psig	0 psi
0...150 psi	1200 psig	0 psi
0...300 psi	1200 psig	0 psi

7.3.2 Adjustment of metallic - ceramic measuring cell

Adjustment

Data refers to the nominal measuring range, pressure values smaller than -1 bar cannot be set

Adjustment range of min/max adjustment in relation to the nominal range:

- Percent value (-10...110%)
- Pressure value (-20...120%)

Adjustment range of the zero / span adjustment in relation to the nominal range

- Zero (-20...+95%)
- Span (-120...+120%)
- Difference between zero and span: max. 120% of the nominal range

Level (min./max. adjustment)

- Percent value -10...110%
- Pressure value -120...120%

Differential pressure ① (zero/span adjustment)

- Zero -95...+95%
- Span: -120...+120%

Density ① (min./max. adjustment)

- Percent value -10...110%
- Density value according to the measuring ranges in kg/dm³

Interface ① (min./max. adjustment)

- Percent value -10...110%
- Height value according to the measuring ranges in m

① Only available for electronic differential pressure when the slave sensor is activated

Recommended maximum Turn Down (TD): 20:1 (no limit)

Nominal ranges and overload capacity in bar/kPa

This information is provided as an overview and refers to the measuring cell. Limitations due to the material and design of the process connection are possible. The information given on the nameplate applies.

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Max. working pressure		
0...+0.1 bar / 0...+40 kPa	+15 bar / +1500 kPa	-1 bar / -100 kPa
0...+0.4 bar / 0...+40 kPa	+30 bar / +3000 kPa	-1 bar / -100 kPa
0...+1 bar / 0...+100 kPa	+35 bar / +3500 kPa	-1 bar / -100 kPa
0...+2.5 bar / 0...+250 kPa	+50 bar / +5000 kPa	-1 bar / -100 kPa
0...+10 bar / 0...+1000 kPa	+90 bar / +9000 kPa	-1 bar / -100 kPa
0...+25 bar / 0...+2500 kPa	+130 bar / +13000 kPa	-1 bar / -100 kPa
-1...0 bar / -100...0 kPa	+35 bar / +3500 kPa	-1 bar / -100 kPa
-1...+1.5 bar / -100...+150 kPa	+40 bar / +4000 kPa	-1 bar / -100 kPa
-1...+10 bar / -100...+1000 kPa	+90 bar / +9000 kPa	-1 bar / -100 kPa
-1...+25 bar / -100...+2500 kPa	+130 bar / +13000 kPa	-1 bar / -100 kPa
-0.05...+0.05 bar / -5...+5 kPa	+15 bar / +5000 kPa	-0.2 bar / -20 kPa
-0.2...+0.2 bar / -20...+20 kPa	+20 bar / +2000 kPa	-0.4 bar / -40 kPa
-0.5...+0.5 bar / -50...+50 kPa	+35 bar / +3500 kPa	-1 bar / -100 kPa

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Absolute pressure		
0...+0.1 bar / 0...+10 kPa	+15 bar / +1500 kPa	0 bar abs.
0...+0.4 bar / 0...+40 kPa	+30 bar / +3000 kPa	0 bar abs.
0...+1 bar / 0...+100 kPa	+35 bar / +3500 kPa	0 bar abs.
0...+2.5 bar / 0...+250 kPa	+50 bar / +5000 kPa	0 bar abs.
0...+10 bar / 0...+1000 kPa	+90 bar / +9000 kPa	0 bar abs.
0...+25 bar / 0...+25000 kPa	+130 bar / +13000 kPa	0 bar abs.

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Max. working pressure		
0...+0.15 psig	+225 psig	-14.51 psig
0...+5 psig	+375 psig	-11.60 psig
0...+15 psig	+525 psig	-14.51 psig
0...+30 psig	+600 psig	-14.51 psig
0...+150 psig	+1350 psig	-14.51 psig
0...+300 psig	+1500 psig	-14.51 psig
-14.5...0 psig	+500 psig	-14.51 psig
-14.5...+20 psig	+580 psig	-14.51 psig
-14.5...+150 psig	+1480 psig	-14.51 psig
-14.5...+300 psig	+1575 psig	-14.51 psig
-3...+3 psig	+290 psig	-14.51 psig
-7...+7 psig	+510 psig	-14.51 psig

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Absolute pressure		
0...1.5 psi	225 psig	0 psi
0...5 psi	435 psig	0 psi
0...15 psi	510 psig	0 psi
0...30 psi	725 psig	0 psi
0...150 psi	1300 psig	0 psi
0...300 psi	1900 psig	0 psi

7.4 Ambient temperature effect on current output

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

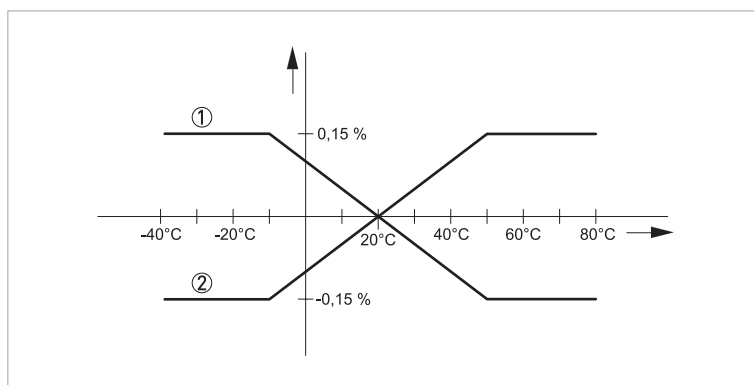


Figure 7-3: Ambient temperature effect on current output

- ① Falling characteristics
- ② Rising characteristics

7.5 Dynamic output behaviour

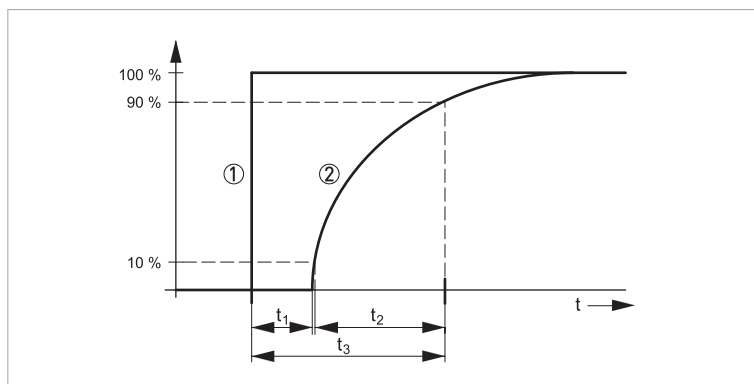


Figure 7-4: Behaviour at an abrupt change in the process variable.
 t_1 - dead time; t_2 - rise time; t_3 - step response time

- ① Process variable
- ② Output signal

Dead time (t_1)	≤ 45 ms
Rise time (t_2)	≤ 35 ms (10...90%)
Step response time (t_3)	≤ 80 ms (t_i : 0 seconds, 10...90%)
Damping (63% of input variable)	0...999 seconds, adjustable

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

7.6 Dimensions and weight

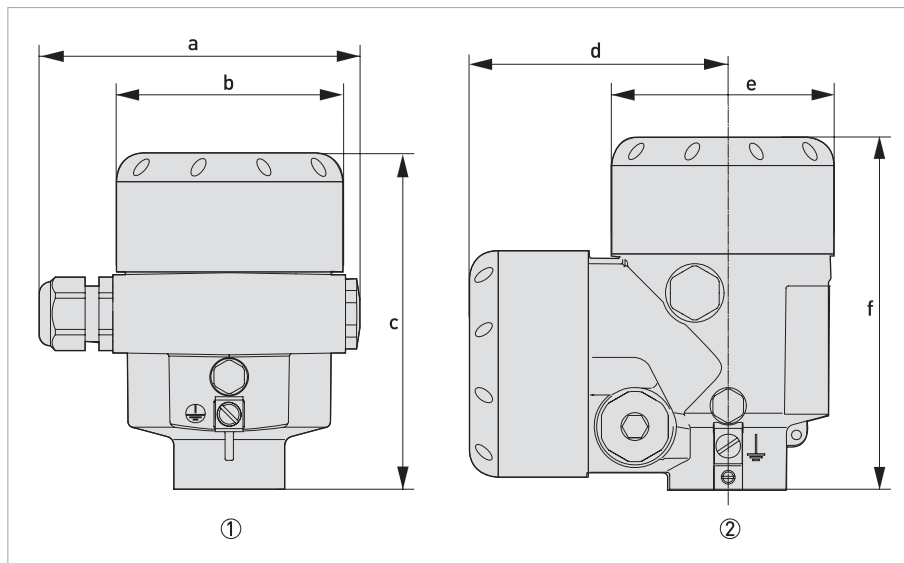


Figure 7-5: Aluminium housing

- ① Single chamber
- ② Double chamber

	Dimension [mm]	Dimension [inch]
a	116	4.57
b	86	3.39
c	116	4.57
d	87	3.43
e	86	3.39
f	120	4.72



INFORMATION!

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, aluminium	0.83	1.84
Double chamber, aluminium	1.24	2.73

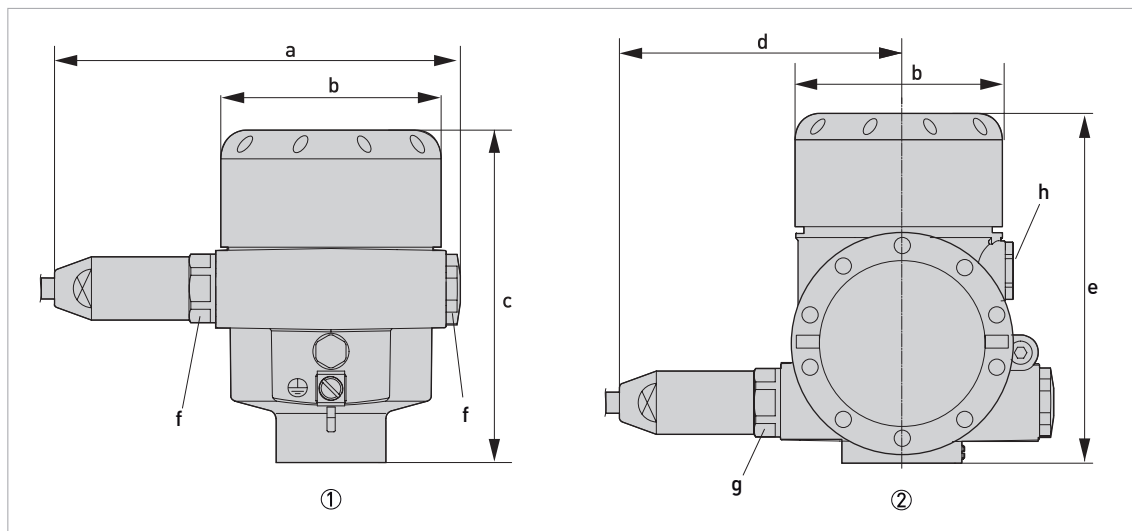


Figure 7-6: Aluminium housing in IP66 / IP68 version (1 bar)

- ① Single chamber
② Double chamber

	Dimension [mm]	Dimension [inch]
a	150	5.91
b	86	3.39
c	116	4.57
d	105	4.13
e	120	4.72
f	M20 x 1.5	
g	M20 x 1.5 / 1/2-14 NPT	
h	M16 x 1.5	



INFORMATION!

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

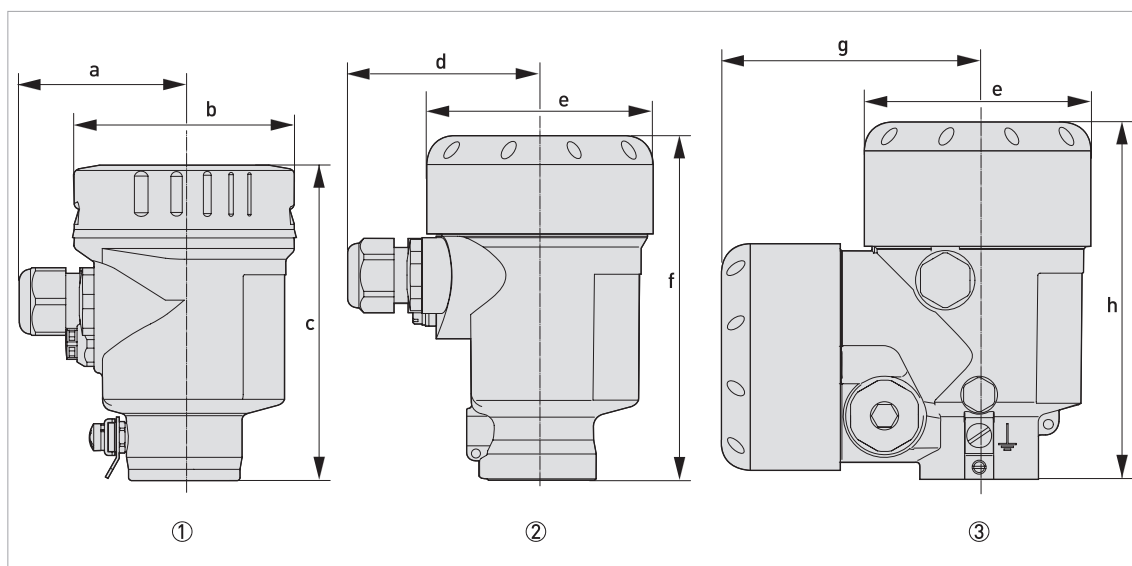


Figure 7-7: Stainless steel housing

- ① Single chamber, stainless steel (electro-polished)
- ② Single chamber, precision casting
- ③ Double chamber, precision casting

	Dimension [mm]	Dimension [inch]
a	59	2.32
b	80	3.15
c	112	4.41
d	69	2.72
e	79	3.11
f	117	4.61
g	87	3.42
h	120	4.72



INFORMATION!

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, stainless steel (electro-polished)	0.73	1.61
Single chamber, precision casting	1.31	2.89
Double chamber, precision casting	2.86	6.31

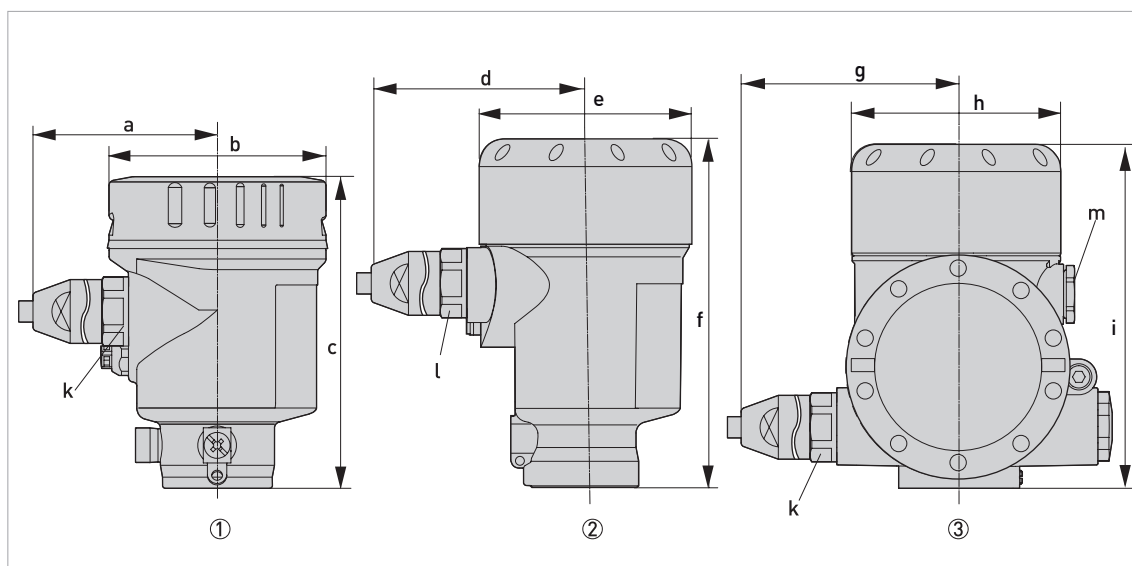


Figure 7-8: Stainless steel housing in IP66 / IP68 version (1 bar)

- ① Single chamber, stainless steel (electro-polished)
- ② Single chamber, precision casting
- ③ Double chamber, precision casting

	Dimension [mm]		Dimension [inch]
a	93		3.66
b	80		3.15
c	112		4.41
d	103		4.06
e	79		3.11
f	117		4.61
g	105		4.13
h	86		3.39
i	120		4.72
k	M20 x 1.5 / 1/2-14 NPT		
l	M20 x 1.5		
m	M16 x 1.5		



INFORMATION!

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

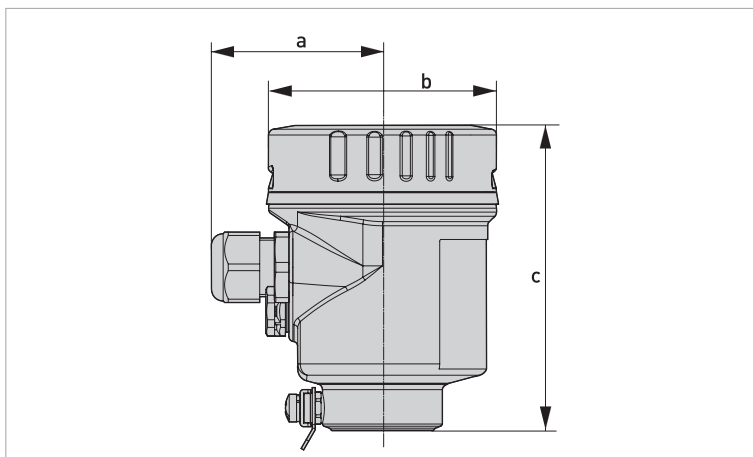


Figure 7-9: Stainless steel (electro-polished) in IP69K version

	Dimension [mm]	Dimension [inch]
a	59	2.32
b	80	3.15
c	104	4.10

**INFORMATION!**

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, stainless steel (electro-polished)	0.73	1.61

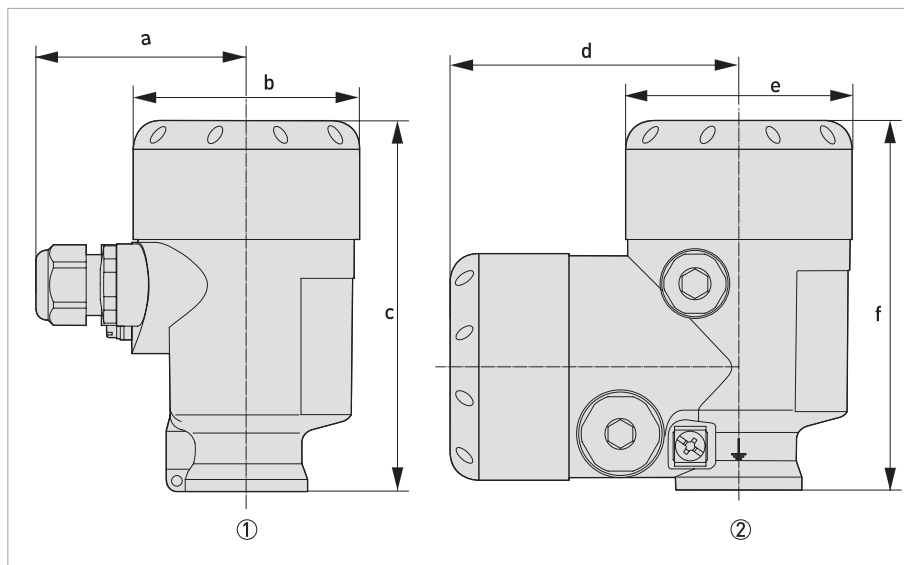


Figure 7-10: Plastic housing

- ① Single chamber
② Double chamber

	Dimension [mm]	Dimension [inch]
a	69	2.72
b	79	3.11
c	112	4.41
d	84	3.31
e	79	3.11
f	112	4.41

**INFORMATION!**

With integrated display and adjustment module the height of the housing increases by 9 mm / 0.35 inch.

Housing version	Weight [kg]	Weight [lb]
Single chamber, plastic	0.40	0.88
Double chamber, plastic	0.51	1.13

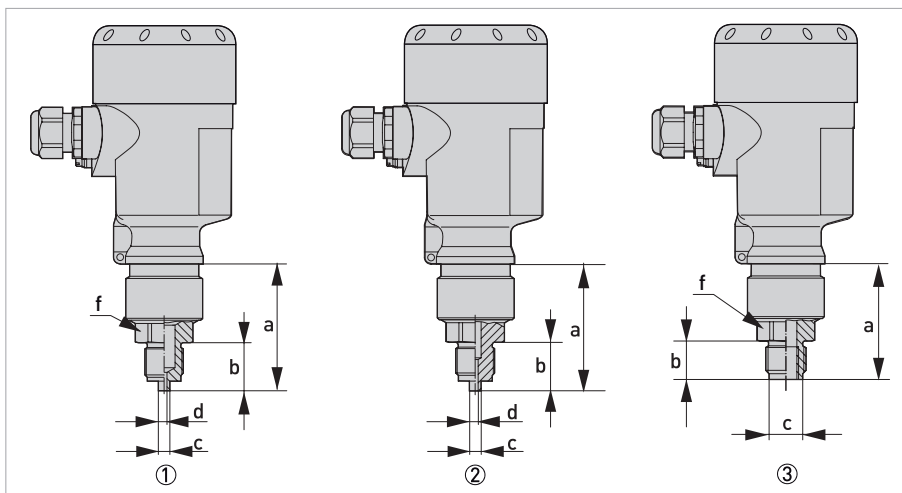


Figure 7-11: Thread non flush

- ① Thread ISO 228 G1/2 EN 837
 ② Thread DIN 13 M20 x 1.5 EN 837
 ③ Thread ISO 228 G1/2 - G1/4 female DIN 3852

Dimension [mm]	a	b	c	d	e	f	g
①	73	23	6	3	-	G1/2	-
②	75	25	6	3	-	M20 x 1.5	-
③	70	20	17.5	-	-	G1/2	-

Dimension [inch]	a	b	c	d	e	f	g
①	2.87	0.90	0.24	0.12	-	G1/2	-
②	2.95	0.98	0.24	0.12	-	M20 x 1.5	-
③	2.76	0.79	0.69	-	-	G1/2	-

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

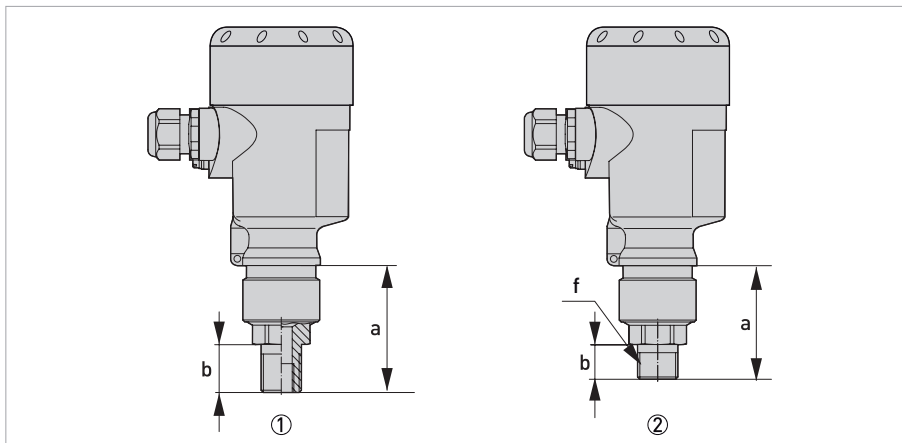


Figure 7-12: Thread non flush

① Thread ANSI 1/2-14 NPT - 1/4-18 NPT female thread ASME B1.20.1

② Thread ANSI 1/2-14 NPT, PN 1000

Dimension [mm]	a	b	c	d	e	f
①	65	25	-	-	-	-
②	65	19	-	-	-	1/2-14 NPT

Dimension [inch]	a	b	c	d	e	f
①	2.56	0.98	-	-	-	-
②	2.56	0.75	-	-	-	1/2-14 NPT

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

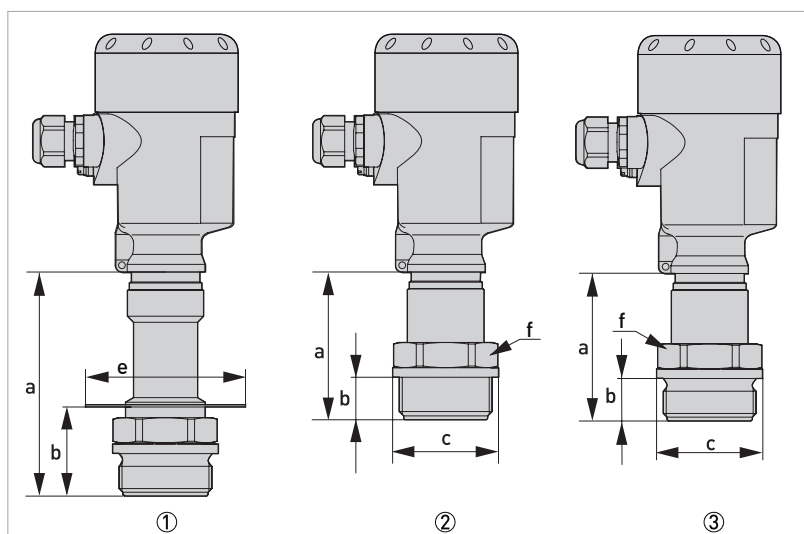


Figure 7-13: Thread flush (metallic - ceramic measuring cell)

- ① Thread ISO 228 G1/2 with temperature adapter for 180°C / 356°F and shielding plate for 200°C / 392°F, DIN 3852-A
 ② Thread ANSI 1 1/2-11.5 NPT
 ③ Thread ISO 228 G1/2, DIN 3852-A

Dimension [mm]	a	b	c	d	e	f
①	118	46	-	-	84	-
②	78	22	55	-	-	WS 46
③	78	22	55	-	-	WS 46

Dimension [inch]	a	b	c	d	e	f
①	4.65	1.81	-	-	3.31	-
②	3.07	0.87	2.17	-	-	1.81
③	1.73	0.87	2.17	-	-	1.81

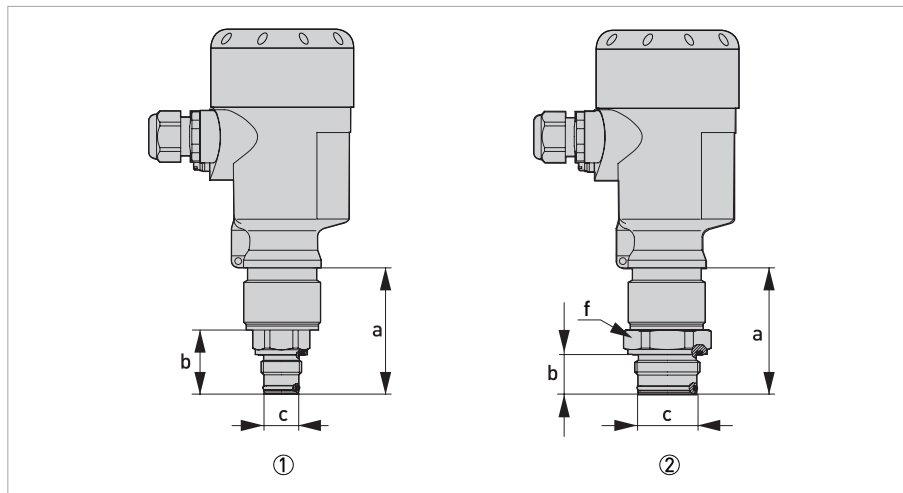


Figure 7-14: Thread flush

- ① Thread ISO 228 G1/2 with radial O-ring
 ② Thread ISO 228 G1 with radial O-ring

Dimension [mm]	a	b	c	d	e	f
①	65	20.5	18	-	-	-
②	65	20.5	30	-	-	WS 41

Dimension [inch]	a	b	c	d	e	f
①	2.56	0.81	0.71	-	-	-
②	2.56	0.81	1.18	-	-	1.61

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

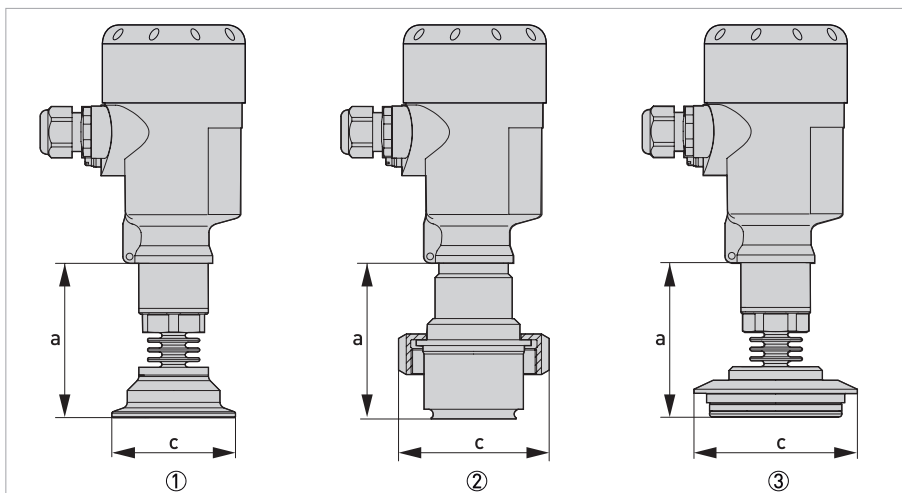


Figure 7-15: Hygienic connection 150°C / 302°F

- ① Clamp DN50 2" PN16, DIN 32676 / ISO 2852
 ② Hygienic connection with grooved union nut F40 PN25
 ③ Varivent N50-40 PN25, 316 L

Dimension [mm]	a	b	c	d	e	f
①	80	-	64	-	-	-
②	82	-	78	-	-	-
③	80	-	84	-	-	-

Dimension [inch]	a	b	c	d	e	f
①	3.15	-	2.52	-	-	-
②	3.23	-	3.07	-	-	-
③	3.15	-	3.31	-	-	-

**INFORMATION!**

For the version with a temperature range up to 150°C / 302°F the measure of length increases by 28 mm / 1.1".

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

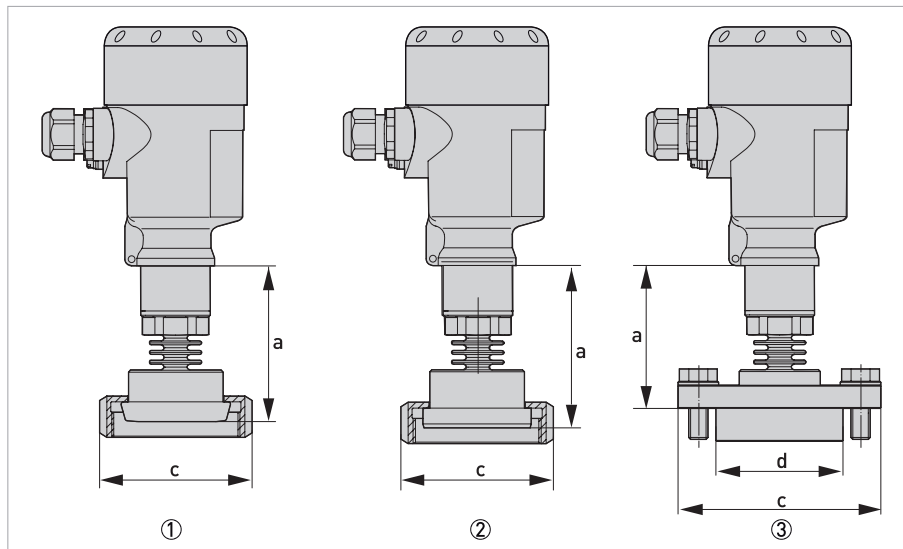


Figure 7-16: Hygienic connection 150°C / 302°F

- ① Compression fitting DIN 11851, DN40 PN40, 316 L
 ② Compression fitting DIN 11864-1 Form A, DN50 PN 40
 ③ Flange DRD PN40

Dimension [mm]	a	b	c	d	e	f
①	79	-	74	-	-	-
②	82	-	78	-	-	-
③	80	-	105	65	-	-

Dimension [inch]	a	b	c	d	e	f
①	3.11	-	2.91	-	-	-
②	3.23	-	3.07	-	-	-
③	3.15	-	4.13	2.56	-	-

**INFORMATION!**

For the version with a temperature range up to 150°C / 302°F the measure of length increases by 28 mm / 1.1".

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

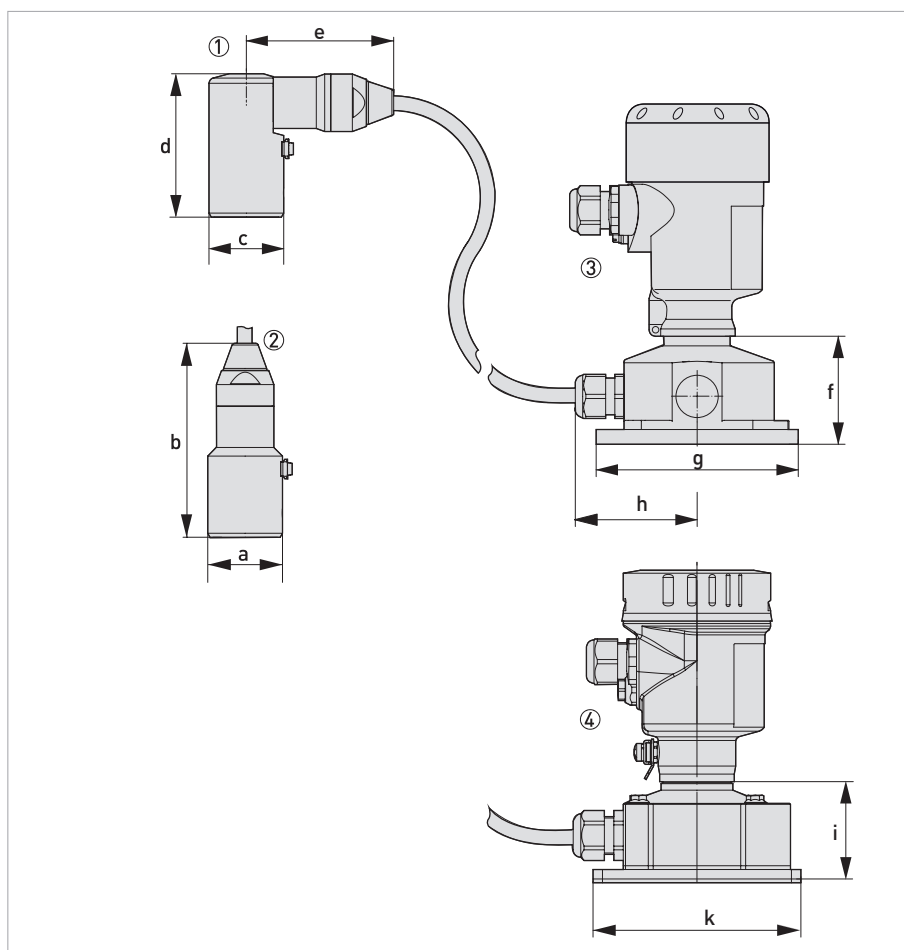


Figure 7-17: External housing

- ① Cable outlet, lateral
- ② Cable outlet, axial
- ③ Housing base in plastic
- ④ Housing base in stainless steel

	Dimension [mm]	Dimension [inch]
a	41.6	1.64
b	108	4.25
c	41.6	1.64
d	80	3.15
e	82	3.23
f	59	2.32
g	110 x 90	4.33 x 3.54
h	66	2.60
i	51	2.01
k	110 x 90	4.33 x 3.54

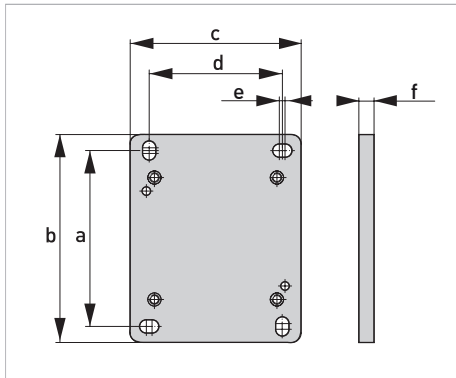


Figure 7-18: Mounting plate

	Dimension [mm]	Dimension [inch]
a	93	3.66
b	110	4.33
c	90	3.54
d	70	2.76
e	3	0.12
f	8	0.31

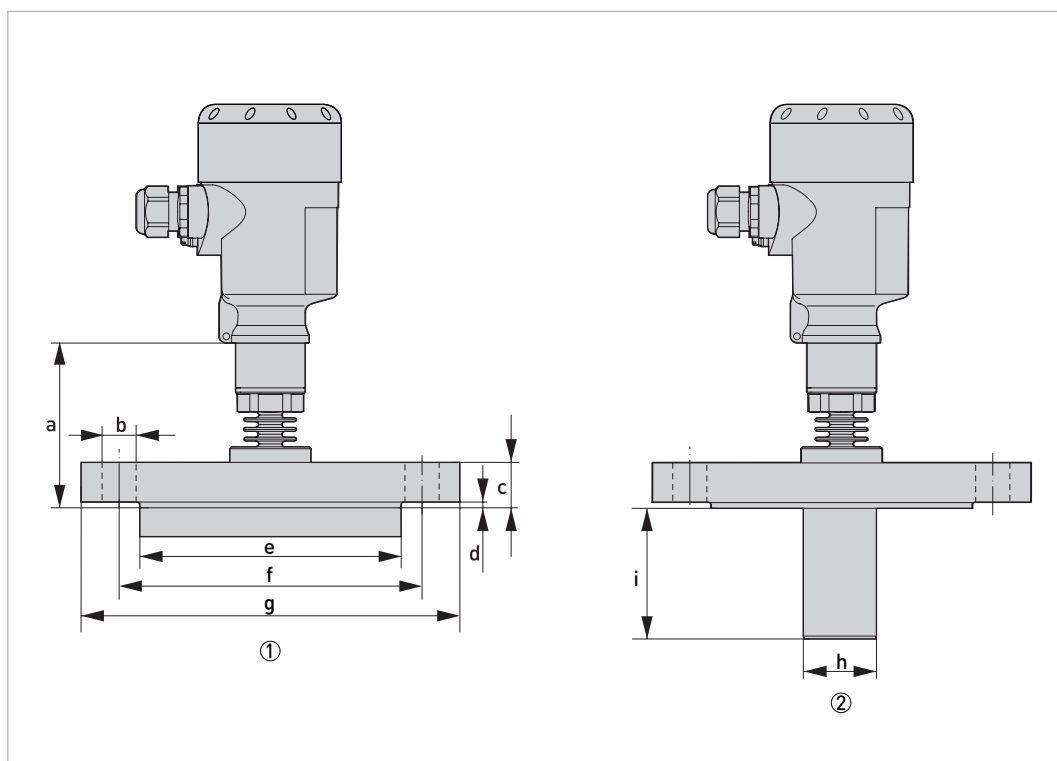


Figure 7-19: Dimensions - Flange

- ① Flange connection acc. to DIN 2501
 ② Flange connection acc. to ASME B16.5

Flange connection acc. to DIN 2501 or ASME B16.5

Dimension [mm]	a	b	c	d	e	f	g	h	i
DN40 PN40 Form C	80	4 x Ø 18	18	3	88	110	150	-	-
DN50 PN40 Form C	80	4 x Ø 18	20	3	102	125	165	-	-
DN50 PN40 Form C with extension	80	4 x Ø 18	20	3	102	125	165	38	10...200
DN80 PN40 Form C	80	8 x Ø 18	24	3	138	180	200	-	-
2" Class 150 lb RF	80	4 x Ø 19.1	19.1	3.2	91.9	120.7	152.4	-	-
3" Class 150 lb RF	80	4 x Ø 19.1	23.9	3.2	127	152.4	190.5	-	-

Dimension [inch]	a	b	c	d	e	f	g	h	i
DN40 PN40 Form C	3.15	4 x Ø 0.71	0.71	0.12	3.46	4.33	5.91	-	-
DN50 PN40 Form C	3.15	4 x Ø 0.71	0.79	0.12	4.02	4.92	6.50	-	-
DN50 PN40 Form C with extension	3.15	4 x Ø 0.71	0.79	0.12	4.02	4.92	6.50	1.5	0.39...7.87
DN80 PN40 Form C	3.15	8 x Ø 0.71	0.95	0.12	5.43	6.30	7.87	-	-
2" Class 150 lb RF	3.15	4 x Ø 0.75	0.75	0.13	3.62	4.75	6	-	-
3" Class 150 lb RF	3.15	4 x Ø 0.75	0.94	0.13	5	6	7.50	-	-

**INFORMATION!**

For the version with a temperature range up to 150°C / 302°F the measure of length increases by 28 mm / 1.1".

**INFORMATION!**

For the version with "secondary process barrier" the measure of length increases by 17 mm / 0.67".

**INFORMATION!**

Other versions are available on request.

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	DD Revision
2013-04-01	1.0.x	1.0.x	1	1
2016-07-01	1.2.x	1.0.x	2	2
2019-03-01	1.3.x	1.0.x	3	3

HART[®] identification codes and revision numbers

Manufacturer ID:	69 (0x45)
Device:	195 (0xC5)
Device Revision:	1
DD Revision:	1
HART [®] Universal Revision:	7
FC 475 system SW.Rev.:	≥ 3.7
PDM version:	≥ 8.0
FDT version:	≥ 1.2

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.

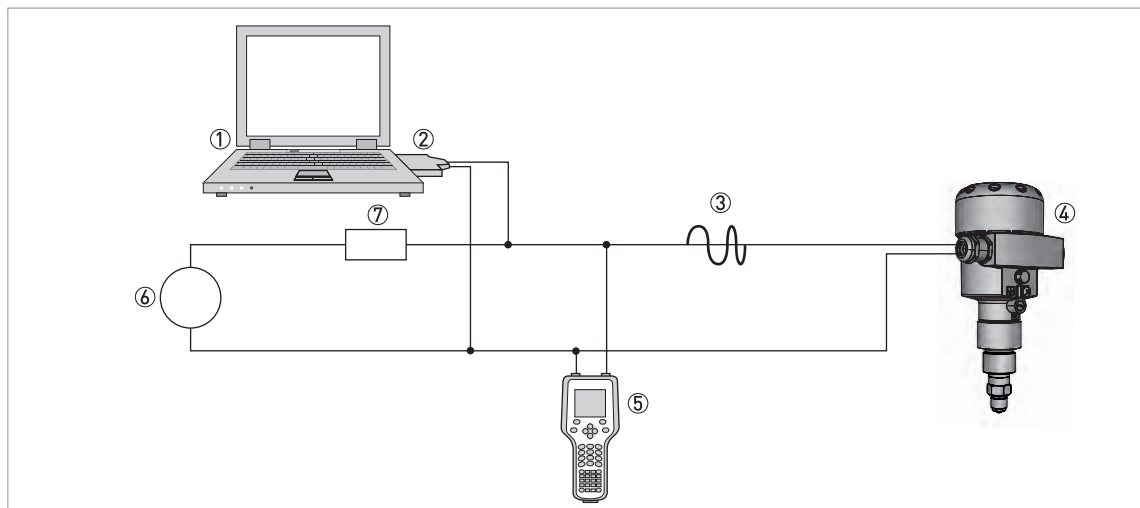


Figure 8-1: Point-to-Point connection

- ① Primary master with e.g. PACTware[™] FDT/DTM
- ② FSK modem
- ③ HART[®] signal
- ④ OPTIBAR PM 5060 C
- 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
Linear percent value	Physical unit	Meas. cell temp.	Electronic temperature

Table 8-1: HART[®] output values acc. to HART[®] 7 (factory setting)

8.5 Field Communicator 475 (FC 475)

The Field Communicator is a hand terminal from Emerson Process Management that is designed to configure HART[®] and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the Field Communicator.

8.5.1 Installation

The HART[®] Device Description for the signal converter must be installed on the Field Communicator. Otherwise only the functions of a generic DD are available to the user and the entire device control is not possible. A "Field Communicator Easy Upgrade Programming Utility" is required to install the DDs on the Field Communicator.

The Field Communicator must be equipped with a system card with "Easy Upgrade Option". For details consult the Field Communicator User's Manual.

8.5.2 Operation

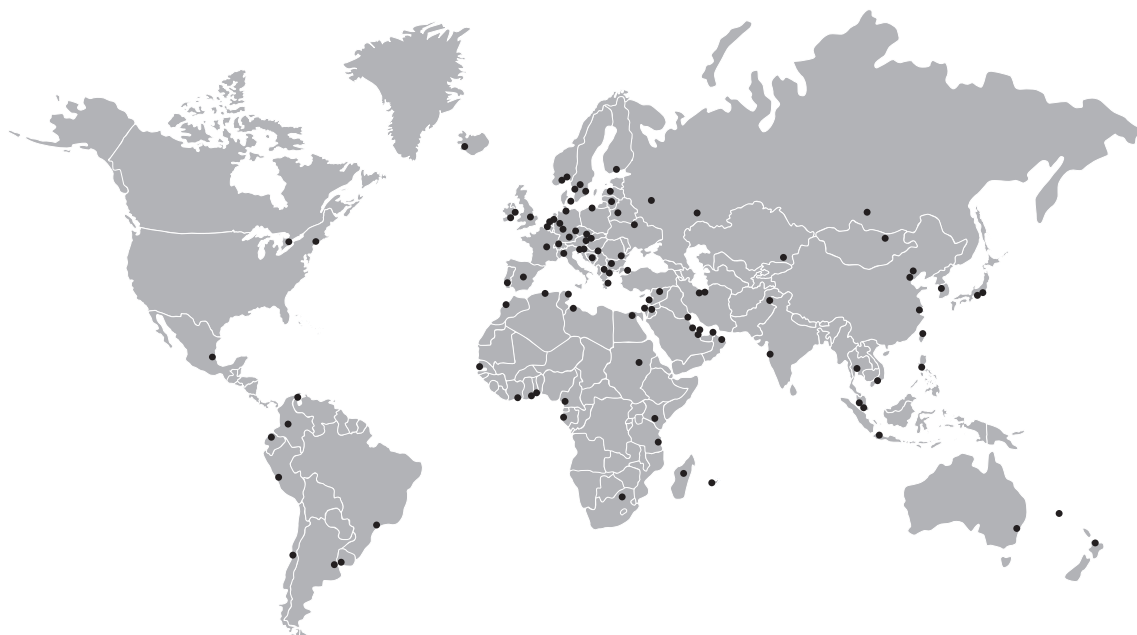
Operating the signal converter via the Field Communicator is very similar to manual device control using the keyboard.

8.6 Field Device Tool / Device Type Manager (FDT / DTM)

A Field Device Tool Container (FDT Container) is basically a PC program used to configure a field device via HART[®]. To adapt to different devices, the FDT container uses a so-called Device Type Manager (DTM).

8.6.1 Installation

If the DTM for the signal converter has not yet been installed on the FDT Container, setup is required and is available for download from the website or on CD-ROM. See the supplied documentation for information on how to install and set up the DTM.



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