



OPTIBAR PM 3050 C Handbook

Compact pressure transmitter with metallic diaphragm

2-wire 4...20 mA / HART®

HW.REV. 1.x.x

SW.REV. 1.x.x

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1.1 Software history



INFORMATION!

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

Changes and effect on compatibility

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

Release date	SW version	HW version	Changes and compatibility	Documentation
2017-12-01	1.0.X_	1.0.X_	-	MA OPTIBAR PM 3050 C R01

1.2 Intended use

**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 pressure transmitter series **OPTIBAR** were designed and constructed to measure the absolute and gauge pressure of gases, vapours and liquids. The available measuring ranges and permitted maximum working pressures for each are indicated on the nameplate and described in the "Technical data" section. To observe the intended use, adhere to the following points:

- Observe the instructions in this document.
- Comply with the technical specifications (for details refer to *Technical limits* on page 7).
- Observe the permissible products (for details refer to *Permissible products* on page 7).
- Only suitably qualified personnel may install and operate the device.
- Observe the generally accepted standards of good practice.

**CAUTION!**

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

**DANGER!**

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

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.
- Observe the ingress protection of the housing during use.

1.4 Permissible products

The device is designed to measure the pressure of vaporous, gaseous and liquid media. Device variants featuring recessed diaphragms are not suitable for the measurement of products containing solids or viscous and paste-like products. Prior to using any corrosive or abrasive products, the operator must check the resistance of all parts 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 61326-1:2013

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

Pressure Equipment Directive PED

Devices with a permissible pressure $PS \leq 200$ bar (20 MPa) comply with 2014/68/EU Article 4 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.



DANGER!

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

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.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

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.

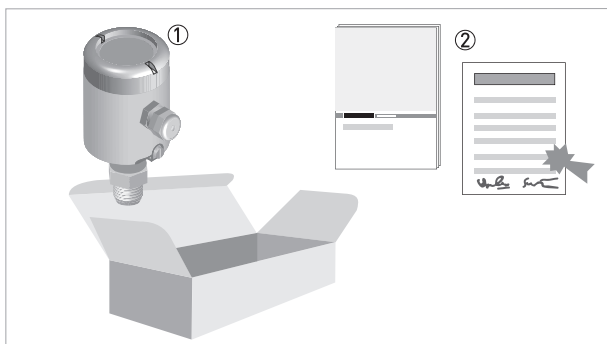


Figure 2-1: Scope of delivery

① Device in the version as ordered.

② Documentation (calibration protocol, factory and material certification (if ordered) and product documentation)

**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 Description of device

The pressure transmitters are designed solely for the direct measurement of process pressures and indirect level measurement in straight, symmetrical tanks. In addition to the main measuring parameters, it is also possible to measure the sensor temperature.

Use internal push buttons to set the device for the zero point, span and sensor mounting correction. An optional display and adjustment module makes this and other settings possible using 4 push buttons in conjunction with an LCD display.

Depending on the measuring range and overload resistance, piezoresistive or thin film sensors may be used. The pressure is transmitted either directly or by way of a separating diaphragm and a liquid fill to a measuring diaphragm, which then distorts and reverses under the applied pressure. The measuring diaphragm features resistors that change their resistance value based on the mechanical distortion, enabling the applied pressure to be inferred.

Communication takes place via an analogue 4...20 mA current signal in 2-wire technology with superimposed HART® signal.

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

2.2.1 Device design

The following exploded drawing shows the general design.

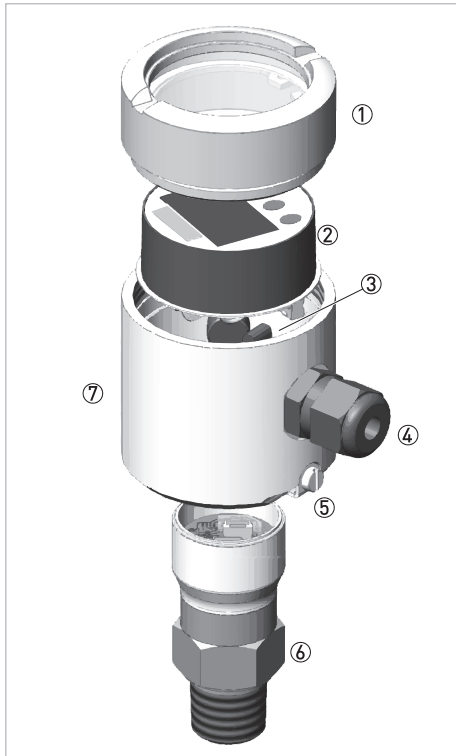


Figure 2-2: Device design

- ① Stainless steel lid
- ② Display unit (optional)
- ③ Converter module
- ④ Cable entry
- ⑤ Grounding screw
- ⑥ Process connection with built-in pressure cell
- ⑦ Stainless steel housing

2.2.2 Process connection variants

The following process connection variants are available:

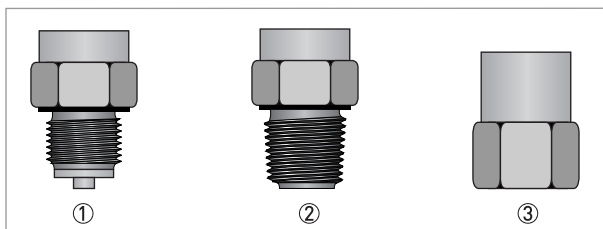


Figure 2-3: Process connection variants

- ① G1/2-B (EN 837-1)
- ② 1/2" NPT - Male
- ③ 1/2" NPT - Female

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.

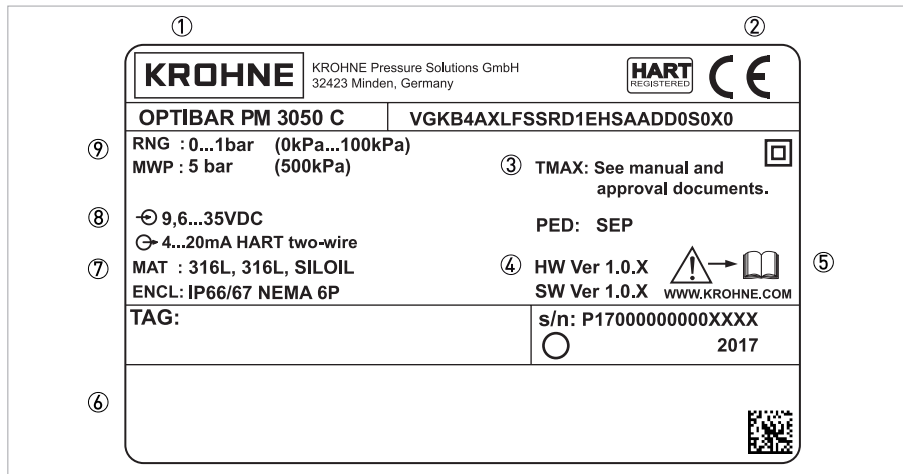


Figure 2-4: Example for a nameplate

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

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 Storage

**INFORMATION!**

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 continuous direct sunlight.
- Store the device in the original packaging.
- Storage temperature: -40...+85°C / -40...+185°F

3.3 Transport

- Use original packaging for transport and ensure that the packaging does not get crushed or damaged by sharp objects or other boxes.
- Observe any transportation information found on the packaging.
- When transporting by ship, use seaworthy outer packing.

3.4 Installation specifications

**INFORMATION!**

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

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

3.5 Mounting

**WARNING!**

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

Devices with threaded process connections, the hexagon should be tighten with a suitable wrench. For more information refer to *Dimensions and weights* on page 41.

**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.*

3.5.1 Sealing and screwing-in

Connecting shank G:

A flat gasket in accordance with DIN EN 837-1 is required for sealing.

NPT thread connection:

Seal the thread with Teflon or other similar permissible, resistant sealing material.

Process connection for special connections:

Information regarding the installation of variants with special connections is available from the manufacturer on request.

3.5.2 Humidity

Use a suitable cable and tighten the cable gland in accordance with the recommended torque specifications. Protect the transmitter from penetrating moisture by dropping the cable down before the screw connection. Any liquids running along the cable will thus drip off before reaching the screw connection; refer to *Correct routing of electrical cables* on page 20. This is particularly important for unprotected installation outside or in rooms in which moisture is an issue (e.g. as a result of cleaning processes) or on cooled or heated containers.

3.5.3 Pressure connection via impulse line

Bear the following in mind when connecting the pressure connection via an impulse line:

- Select the shortest impulse line possible and lay without sharp bends.
- Avoid deposits and blockages in the impulse line. Accordingly, lay the impulse line so that such occurrences are impossible. Do not exceed a drop or rise of approx. 8% in the pipe.
- Ensure that the impulse line flows freely before the connection and rinse with compressed air or, even better, with the product itself.
- When measuring liquid, the impulse line must be completely purged of air.
- Run the impulse line so that trapped air (when measuring liquids) or condensate (when measuring gas) can flow back into the process line.
- Hot steam must not enter the process connection (the excess temperature will destroy the device). To avoid this situation, a suitable water trap (such as a U-tube filled with water prior to installation) can be installed upstream from the measuring device.
- Ensure that the connection is perfectly sealed!

3.5.4 Opening the device, installing and dismantling the graphic display



DANGER!

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



DANGER!

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



DANGER!

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

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



Procedure

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



INFORMATION!

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

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

3.6 Ventilating the pressure sensor

In the case of gauge pressure transmitters, mechanical reasons make it necessary to charge the reference side of the pressure sensor with atmospheric pressure. Ventilation occurs in versions in IP65 via a special aerator fitted with a Gore-Tex® filter. Ensure that the ventilation opening is not covered or closed (e.g. covering over with paint not permitted).

For the IP 67 version, a vented cable fitted with a capillary tube must be used. In the process, ensure that the capillary tubes are vented in a dry room protected from moisture and that no dust or moisture can penetrate the capillary tube opening.

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!

**DANGER!**

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

**WARNING!**

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

**INFORMATION!**

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

4.2 Notes for electrical cables

**DANGER!**

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

**DANGER!**

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

Metric thread M16 x 1.5 mm

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

4.2.1 Requirements for signal cables provided by the customer



INFORMATION!

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

Specifications for standard signal cables

- 2 wire cable
- Casing colour: grey
- Colour of wires:
Pair 1: black / red; pair 2: green / white
- 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 $\mu\text{H}/\text{ft}$

4.2.2 Correct routing of electrical cables

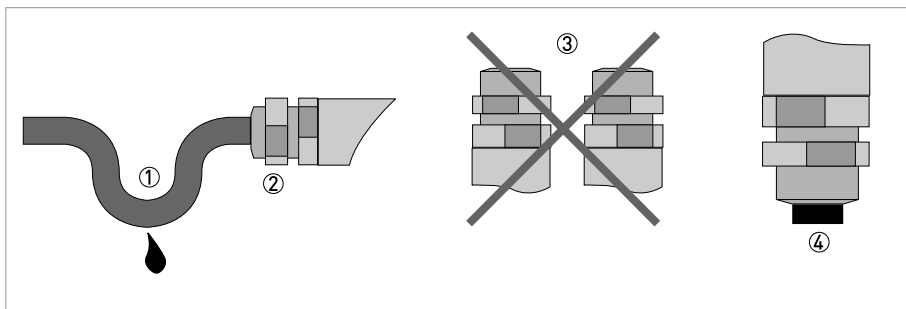


Figure 4-1: Protect housing from dust and water



- ① Lay the cable in a loop just before the housing.
- ② Tighten the screw connection of the cable entry securely.
- 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 Connection to the power supply

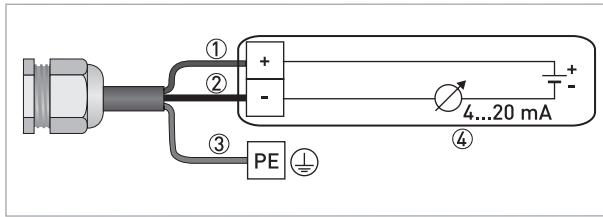


Figure 4-2: Connection to the feed unit

- ① Red
- ② Black
- ③ Green/yellow
- ④ Feed unit with load

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 Cable preparation

The terminals in the terminal compartment are suitable for wire widths from 0.34...2.5 mm². You should remove the cable sheath 40...50 mm / 1.6...2" to ensure proper connection.

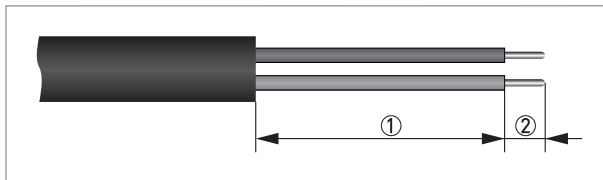


Figure 4-3: Stripping the cable

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

4.3.2 Connection in the terminal compartment

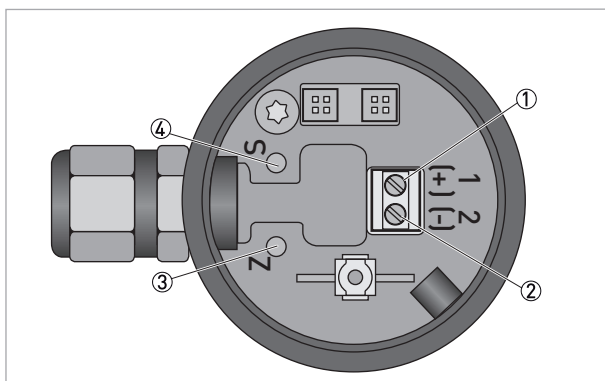


Figure 4-4: Connection in the terminal compartment

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

4.4 Grounding the measuring device



DANGER!

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

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

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

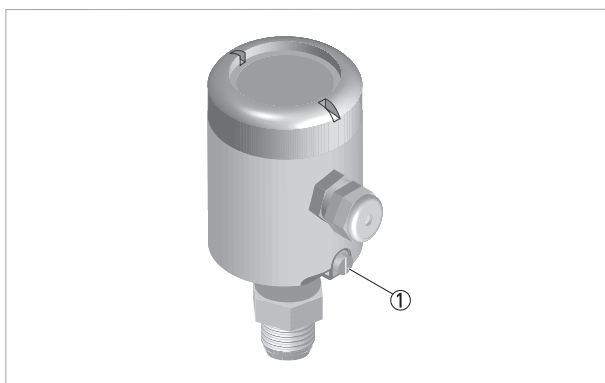


Figure 4-5: Position of the ground terminal on the housing

- ① Ground terminal

4.5 Description of the current output

The current output is a 2-wire 4...20 mA output.

Overload condition:

- Lower limit: 3.8 mA
- Upper limit: 20.5 mA

Alarm current:

- Low alarm current: < 3.6 mA
- High alarm current: > 21 mA

Default setting: Low alarm

The transmitter works with voltages of 12...45 VDC, no load.

$$R_{\text{Load}} [\text{K}\Omega] = (U_{\text{B}} [\text{V}] - 12 \text{ V}) / \text{alarm current max. [mA]}$$

where U_{B} = supply voltage and R_{Load} = max. load resistance (load)

5.1 Start-up

The pressure transmitter 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, it is crucial to check the correctness of the process connection and the electrical connection and ensure that the impulse line has been completely filled with the process medium. Then proceed with start-up. If available, the shut-off fixtures are to be activated in the following sequence (all valves are closed in the base setting):



- Open extraction shut-off valve, if any.
- Open shut-off valve, if any.

For shut-down reverse the order.



INFORMATION!

Please note that the absolute pressure transmitters with measuring ranges ≤ 100 kPa abs (1 bara) were affected by the externally present atmospheric pressure during transport and storage.

5.2 Factory settings on delivery

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

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

[*] only with an optional display and adjustment module

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

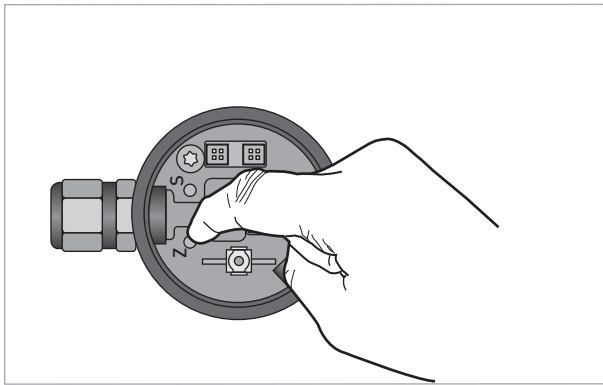
5.3 General operation

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

5.4 Operation without display and adjustment module

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

5.4.1 Sensor mounting correction (offset)



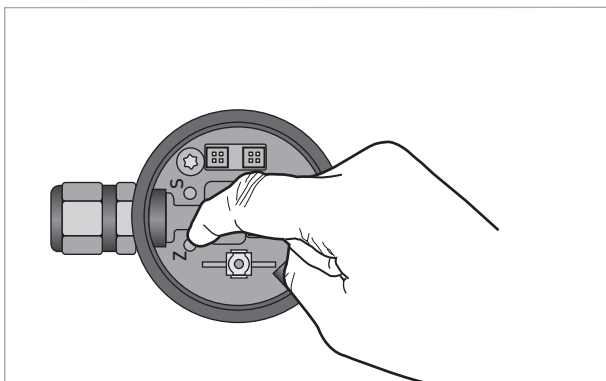
When delivered, the measuring device is set up for vertical installation (cover opens to the top). Zero point offsets (e.g. slightly slanted mounting position or due to pressure sensors etc.) may occur when installing the pressure transmitter and they must be eliminated. Hold the push button down for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



INFORMATION!

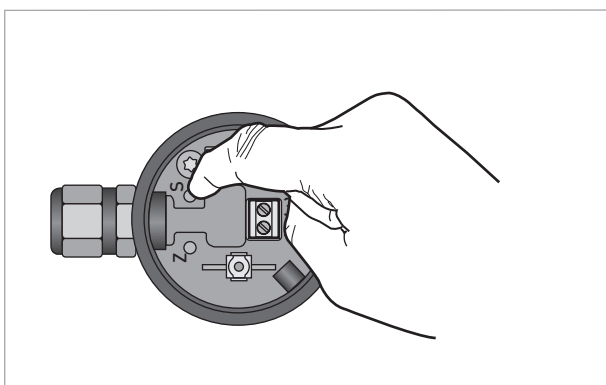
Prior to starting with the correction, ensure that the pressure transmitter has already reached its operating temperature (approx. 5 minutes operating time, where the pressure transmitter has already reached the ambient temperature).

5.4.2 Zero point and lower range limit (4 mA)



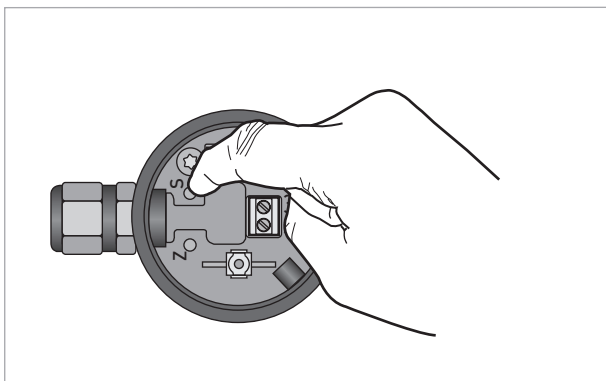
The pressure must be stable with sufficient accuracy for the application. Hold the push button down for at least 1 second and release within 5 seconds. This way the lower range limit is stored in a fail-safe memory.

5.4.3 Span and upper range limit (20 mA)



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

5.4.4 Factory reset



Hold the push button down for at least 10 seconds using a blunt object and then release within 30 seconds. The pressure transmitter now resets itself and loads the factory settings (see details on page 24).



INFORMATION!

A Factory reset is possible despite write protection.

5.5 Operation with display and adjustment module

5.5.1 Display and operating elements

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

Display during measuring mode

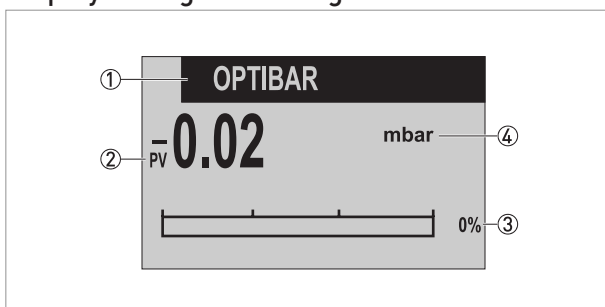


Figure 5-1: Example of display during normal measuring mode

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

Display in selection menu

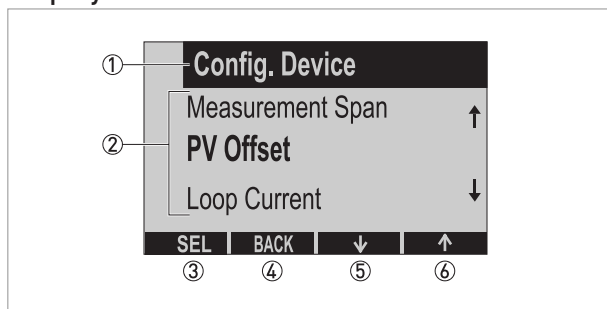


Figure 5-2: Example of display in the selection menu for device configuration

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

Display for configuration of settings

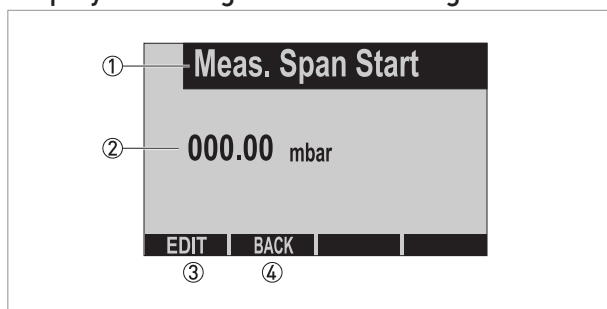


Figure 5-3: Example of display when editing the setting values

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

Navigation in the operating menu

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

5.5.2 Structure of the operating menu

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

5.5.3 Description of the function

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

① Also available when write protection is enabled.

6.1 Replacing the pressure sensor, the electronics and the display

**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 pressure transmitter is explosive. Opening the device in an explosive atmosphere may result in ignition and explosion.

**DANGER!**

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

**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.

Pressure sensor and electronics

When used as intended in normal operation, the pressure transmitter is completely maintenance-free. For this type of device, the manufacturer makes no provision for repairs, replacement of electronics or measuring element for the user. To ensure safe operation, the entire device must be replaced in the event of damage to or failure of the pressure sensor or the electronics. The replaced device may not be repaired for reasons of safety. Please clearly mark the device as defective and dispose of it properly.

**CAUTION!**

Adhere to national disposal regulations. Proper disposal avoids negative consequences for people and the environment and allows valuable raw materials to be recycled.

Display

A faulty display cannot be repaired but can only be replaced by a new display module. In this case, however, the cause of the damage or failure of the graphic display must be identified. If the failure can be traced back to the overheating or overloading of the device, the entire device must be clearly marked as defective, replaced and disposed of properly. Repairs are not permitted.

**INFORMATION!**

For more detailed information please contact your local representative.

6.2 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.

6.3 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.

6.4 Repairs

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

6.5 Returning the device to the manufacturer

6.5.1 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.*

6.5.2 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:			

6.6 Disposal



LEGAL NOTICE!

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

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



According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**. The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

7.1 Measuring principle

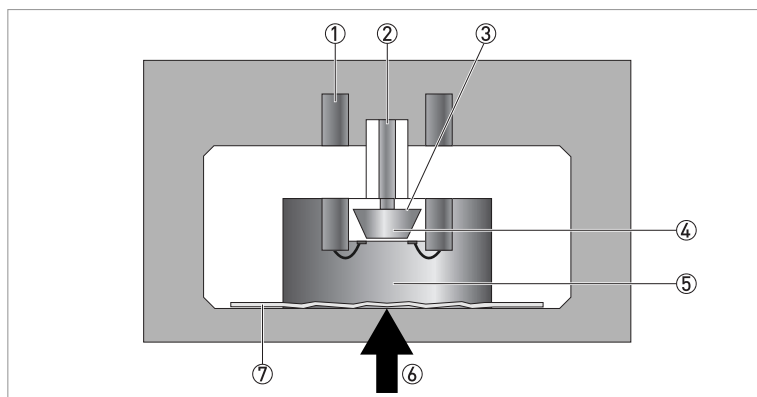


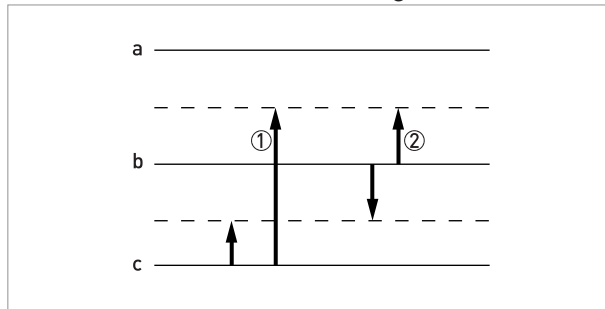
Figure 7-1: Measuring principle for pressure measurement

- ① Signal cables of measuring bridge
- ② Ventilation (only with gauge pressure transmitters)
- ③ Silicone cell
- ④ Silicone diaphragm with piezoresistive elements
- ⑤ Liquid fill
- ⑥ Process pressure "P"
- ⑦ Metal diaphragm

The process pressure is transmitted from the metal diaphragm ⑦ via the liquid fill behind it ⑤ directly to the silicone measuring cell ③. The embedded piezoresistive measuring elements on the silicone diaphragm ④ experience a corresponding strain which is then converted via a Wheatstone Bridge circuit to a voltage proportional to the applied process pressure.

Absolute pressure, gauge pressure and vacuum can be measured using this measuring principle.

Available measurement configurations



a: P_e = Effective pressure [2 bar]

b: P_{amb} = Ambient pressure [1.013 bar]

c: P_0 = Vacuum [0 bar]

① Absolute pressure [1.513 bara]

② Gauge pressure [0.5 barg]

Absolute pressure

During the production process, the sensor is evacuated on the negative side of the measuring cell and then sealed and referenced against a vacuum.

The pressure transmitter now measures the absolute pressure ① compared to a "zero" pressure in an empty space (vacuum).

Gauge pressure

The back of the sensor is open to the atmosphere via air ventilation. The device is thus automatically referenced to the continuously changing ambient air pressure, indicating the gauge pressure ② in the process compared to the respective atmospheric pressure.

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	Metallic diaphragm with piezoresistive measuring cell
Application range	Measurement of absolute and gauge pressure of gases, vapours and liquids.
Measuring range	100 mbar...100 bar / 1.45...1450 psi
Display and user interface	
Display on signal converter	<ul style="list-style-type: none"> • Dot-matrix display 32 x 20 mm / 1.26 x 0.79" • Display turnable in 360° steps • 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
Operating	Local operation via 4 push buttons on the display and adjustment module
Remote control	<ul style="list-style-type: none"> • PACTware™ via GenericHART® • HART® Hand Held Communicator from Emerson Process

Measuring accuracy

Reference conditions acc. to DIN 61298-1	<ul style="list-style-type: none"> • Ambient temperature (constant): +15...+25°C / +59...+77°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 < 0.2 mbar/20 Pa [0.003 psig] • Deviation at current output due to strong, high-frequency electromagnetic fields within the scope of EN 61326 		
Reference accuracy acc. to DIN EN 60770	Includes the non-linearity, hysteresis and repeatability under reference conditions. Applies to the digital interfaces as well as for the analogue 4...20 mA current output. [% of the set span]		
	Accuracy class	0.10%	0.20%
	TD of 1:1 to 5:1	< ± 0.1%	< ± 0.2%
	TD > 5:1	< ± 0.025% + 0.015% x TD	< ± 0.05% + 0.03% 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 interface HART® as well as for the analogue 4...20 mA current output. [% of the set span]		
	Accuracy class	0.10%	0.20%
	-40...+85°C / -40...+185°F	< ± 0.15% + 0.15% x TD	< ± 0.35% + 0.2% x TD
	Exception: 100 mbar	< ± 0.45% + 0.15% x TD	< ± 0.65% + 0.2% 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 interface HART® as well as for the analogue 4...20 mA current output. [% of URL] < 0.1% x TD within one year
Ambient temperature effect on analogue current output	max. < 0.10%, inside -40...+85°C / -40...+212°F

Operating conditions

Version	Ambient temp.	Process temp.	Storage and transport temperature
Standard	-40...+85°C / -40...+185°F	-40...+85°C / -40...+185°F	-40...+85°C / -40...+185°F

Further operating conditions

Protection category according to IEC 529 / EN 60529			
Stainless steel	Single chamber Housing	IP66 / IP67	NEMA 6P
Vibration			
Reference conditions	Stainless steel, single chamber housing, process connection thread G1/2" EN 837-1		
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

Wetted parts	
Process connection	316L / 1.4404
Diaphragm	316L / 1.4435
Fill fluid	Silicone oil
Gasket for process connection (included)	Thread G1/2 (EN 837-1), elastomer-bonded fibre gaskets
Non-wetted parts	
Electronics housing	316L / 1.4404
Housing cover sealing ring	EPDM
Housing cover	316L / 1.4404
Sight glass	Makrolon
Grounding screw	316L / 1.4404
Cable gland	Plastic (polyamide) black; nickel-plated brass; 316 / 1.4305

Process connection

Thread	from G1/2 EN837-1, 1/2" NPT; 1/2" NPT (female)
Tightening torques	
Maximum tightening torques for the process connection	
G1/2	30 Nm / 22 ft lb

Electrical connections

Mechanical - Standard	
Cable gland	M16 x 1.5 mm
cable diameter	4.5...10 mm / 0.18...0.39" 4...11 mm / 0.16...0.43"
Wire cross-section	Solid wire with cords: 0.34 mm...2.5 mm ² / AWG 22...14
	Cord with wire end sleeve: 0.34 mm...1.5 mm ² / AWG 22...16
Electrical	
Operating voltage	Non-Ex device: 12...45 VDC
Reverse polarity protection	Integrated
Permissible residual ripple	for U _n 12 VDC (12 < U _B < 14 VDC) ≤ 0.7 V _{eff} (16...400 Hz)
Load	R _{L, max} = (U _B -12) / 22 mA
Potential connection in device	Electronics: not electrically isolated
	Ground terminal: galvanically connected with process connection
Over voltage category	III
Protection class	II

Inputs / outputs

Output signal	
Output signal	4...20 mA / HART® version 7.5 3.8...20.5 mA (factory setting acc. to NAMUR recommendation)
Signal resolution	0.3 µA
Error signal of current output (adjustable)	High alarm ≥ 21 mA Low Alarm ≤ 3.6 mA
Max. output current	24 mA
Boot-up current	≤ 10 mA for 5 ms after switching on, then ≤ 3.6 mA
Damping	0.0 seconds: no damping
	0.5 seconds: with digital filter + PT1 element
	from 1.0 second: 63% of the input measurement from 1...30 seconds can be set in 1 second increments.

Approvals and certificates

CE	The device complies with the legal requirements of the EU directive. The manufacturer confirms compliance with these regulations by affixing the CE marking.
Electromagnetic compatibility (EMC)	EMC conformity for EN 61326-1:2013 und EN 61326-2-3:2013
NAMUR	NE 21 - Electromagnetic compatibility of equipment NE 43 - Signal level for the failure information of digital transmitters NE 53 - Compatibility of field devices and display/adjustment components NE 107 - Self-monitoring and diagnosis of field devices
Classification according to Pressure Equipment Directive (PED 2004/108/EC)	For gases of fluid group 1 and liquids of fluid group 1, the requirements are fulfilled according to article 4, paragraph 3 (sound engineering practice).

7.3 Pressure ranges

Adjustment

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

- Zero (-10...+95%)
- Span (5...+120%)
- Difference between zero and span: max. 120% of the nominal range

Recommended maximum Turn Down (TD): 10:1 (limited to 20:1)

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.

Gauge pressure

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
Max. working pressure		
0...+0.1 bar / 0...+10 kPa	+2.5 bar / +250 kPa	-0.8 bar / -80 kPa
0...+0.4 bar / 0...+40 kPa	+4 bar / +400 kPa	-0.8 bar / -80 kPa
0...+1 bar / 0...+100 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
0...+4 bar / 0...+400 kPa	+20 bar / +2000 kPa	-1 bar / -100 kPa
0...+10 bar / 0...+1000 kPa	+40 bar / +400 kPa	-1 bar / -100 kPa
0...+40 bar / 0...+4000 kPa	+100 bar / +10 kPa	-1 bar / -100 kPa
0...+100 bar / 0...+10000 kPa	+300 bar / +30 kPa	-1 bar / -100 kPa
-0.4...+0.4 bar / -40...+40 kPa	+4 bar / +400 kPa	-0.8 bar / -80 kPa
-1...0 bar / -100...0 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
-1...+1 bar / -100...+100 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
-1...+4 bar / -100...+400 kPa	+20 bar / +2000 kPa	-1 bar / -100 kPa
-1...+10 bar / -100...+1000 kPa	+40 bar / +4000 kPa	-1 bar / -100 kPa
-1...+40 bar / -100...+4000 kPa	+100 bar / +10 MPa	-1 bar / -100 kPa

Absolute pressure

Nominal range	Max. working pressure (MWP)	Overload capacity min. pressure
0...0.4 bar / 0...+40 kPa	+4 bar / +400 kPa	-1 bar / -100 kPa
0...+1 bar / 0...+100 kPa	+5 bar / +500 kPa	-1 bar / -100 kPa
0...+4 bar / 0...+400 kPa	+20 bar / +2000 kPa	-1 bar / -100 kPa
0...+10 bar / 0...+1000 kPa	+40 bar / +4000 kPa	-1 bar / -100 kPa
0...+40 bar / 0...+4000 kPa	+100 bar / +10 MPa	-1 bar / -100 kPa
0...+100 bar / 0...+10000 kPa	+300 bar / +30 MPa	-1 bar / -100 kPa

7.4 Dimensions and weights

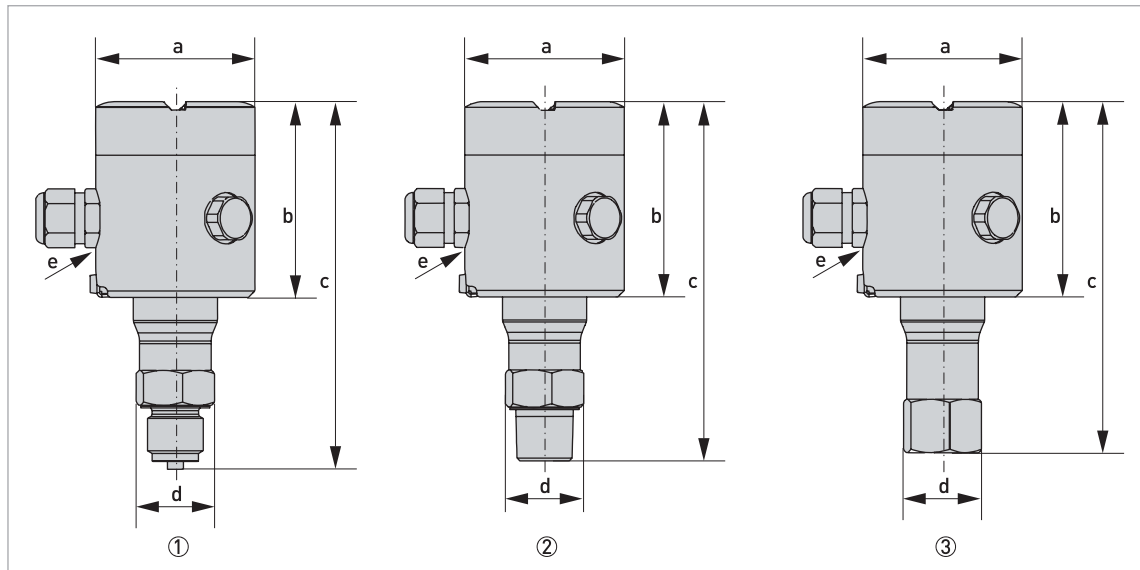


Figure 7-2: Dimensions for available process connection variants

d = WS27

e = M16x1.5

- ① G1/2
- ② 1/2" NPT - Male
- ③ 1/2" NPT - Female

Version	Dimensions			Weight
	a	b	c	
	[mm / "]			[g / lb]

Process connection G $\frac{1}{2}$

Blind version	60 / 2.4	65 / 2.8	129 / 4.9	734 / 1.60
Version with display	60 / 2.4	73 / 3.1	137 / 5.2	834 / 1.80

Process connection 1/2" NPT - male

Blind version	60 / 2.4	65 / 2.8	126 / 4.8	710 / 1.57
Version with display	60 / 2.4	73 / 3.1	134 / 5.1	810 / 1.78

Process connection 1/2" NPT - female

Blind version	60 / 2.4	65 / 2.8	123 / 4.6	748 / 1.65
Version with display	60 / 2.4	73 / 3.1	131 / 5.0	834 / 1.80

7.5 Dynamic output behaviour

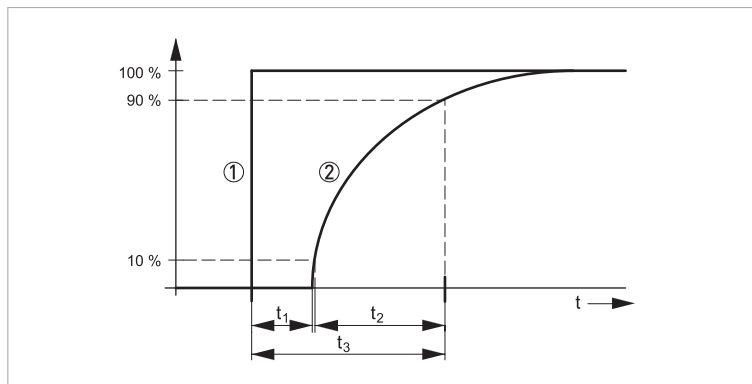


Figure 7-3: Behaviour at an abrupt change in the process variable.
 t_1 - dead time; t_2 - rise time; t_3 - step response time

- 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)	1...30 seconds, adjustable

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

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
2018-01-01	1.0.x	1.0.x	1

HART[®] identification codes and revision numbers

Manufacturer ID:	69 [0x45]
Device:	209 [0xD1]
Device Revision:	1
HART [®] Universal Revision:	7

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.

8.4 Inputs/outputs and HART® dynamic variables and device variables

PV = Primary Variable; SV = Secondary Variable; TV = Tertiary Variable

HART® dynamic variable		
PV	SV	TV
Process pressure	Meas. cell temp.	Electronic temperature

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









KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

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KROHNE