

Operating Instructions

Process pressure transmitter IPT-2x

GB

Foundation Fieldbus
Metallic measuring cell



Process pressure transmitter IPT-2x



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Safety instructions for Ex areas



Take note of the Ex specific safety instructions for Ex applications. These instructions are attached as documents to each instrument with Ex approval and are part of the operating instructions.

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1 About this document

1.1 Function

This instruction provides all the information you need for mounting, connection and setup as well as important instructions for maintenance, fault rectification, the exchange of parts and the safety of the user. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

1.3 Symbols used



Information, note, tip: This symbol indicates helpful additional information and tips for successful work.



Note: This symbol indicates notes to prevent failures, malfunctions, damage to devices or plants.



Caution: Non-observance of the information marked with this symbol may result in personal injury.



Warning: Non-observance of the information marked with this symbol may result in serious or fatal personal injury.



Danger: Non-observance of the information marked with this symbol results in serious or fatal personal injury.



Ex applications

This symbol indicates special instructions for Ex applications.



List

The dot set in front indicates a list with no implied sequence.



Sequence of actions

Numbers set in front indicate successive steps in a procedure.



Battery disposal

This symbol indicates special information about the disposal of batteries and accumulators.

2 For your safety

2.1 Authorised personnel

All operations described in this documentation must be carried out only by trained, qualified personnel authorised by the plant operator. During work on and with the device, the required personal protective equipment must always be worn.

2.2 Appropriate use

The IPT-2x is a pressure transmitter for process pressure and hydrostatic level measurement.

You can find detailed information about the area of application in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of this product can give rise to application-specific hazards, e.g. vessel overfill through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the protective characteristics of the instrument can be impaired.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.

To avoid any danger, the safety approval markings and safety tips on the device must also be observed.

2.5 EU conformity

The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.

The EU conformity declaration can be found on our homepage.

Due to the design of its process fittings, the device does not subject of EU pressure device directive if it is operated at process pressures ≤ 200 bar.¹⁾

2.6 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfils the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment²⁾
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.7 Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the following text is only available in the English language.

Installations in the US shall comply with the relevant requirements of the National Electrical Code (ANSI/NFPA 70).

Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code.

¹⁾ Exception: Versions with measuring ranges from 250 bar. These are subject of the EU Pressure Device Directive.

²⁾ Not fulfilled when connecting to an external display and adjustment unit.

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- Instrument IPT-2x

The further scope of delivery encompasses:

- Documentation
 - Quick setup guide IPT-2x
 - Test certificate for pressure transmitters
 - Instructions for optional instrument features
 - Ex-specific "*Safety instructions*" (with Ex versions)
 - If necessary, further certificates



Information:

Optional instrument features are also described in this operating instructions manual. The respective scope of delivery results from the order specification.

Scope of this operating instructions

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.0
- Software version from 1.2.0



Note:

You can find the hardware and software version of the instrument as follows:

- On the type plate of the electronics module
- In the adjustment menu under "*Info*"

Type label

The type label contains the most important data for identification and use of the instrument:

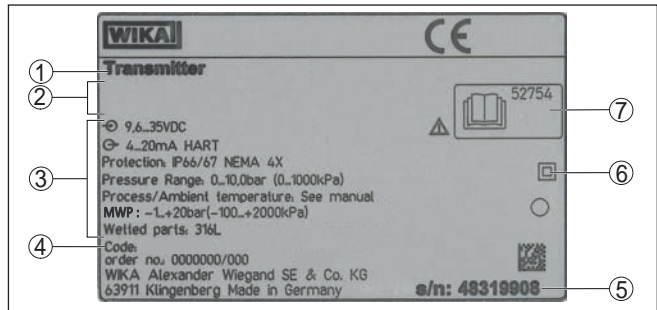


Fig. 1: Layout of the type label (example)

- 1 Instrument type
- 2 Field for approvals
- 3 Technical data
- 4 Product code
- 5 Serial number of the instrument
- 6 Symbol of the device protection class
- 7 ID numbers, instrument documentation

3.2 Principle of operation

Application area

IPT-2x is suitable for applications in virtually all industries. It is used for the measurement of the following pressure types.

- Gauge pressure
- Absolute pressure
- Vacuum

Measured products

Measured products are gases, vapours and liquids.

The device is especially suitable for applications with higher temperatures and high pressures.

Measured variables

The IPT-2x is suitable for the measurement of the following process variables:

- Process pressure
- Level

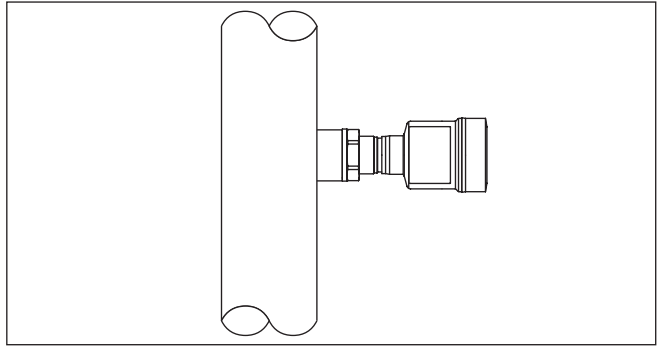


Fig. 2: Process pressure measurement IPT-2x

Measuring system

The process pressure acts on the sensor element via the process diaphragm. The process pressure causes a resistance change which is converted into a corresponding output signal and output as measured value.

Piezoresistive sensor element

Measuring ranges up to 40 bar: piezoresistive sensor element with internal transmission liquid is used.

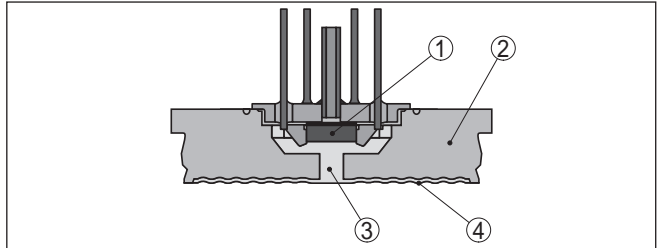


Fig. 3: Configuration of the measuring system with piezoresistive sensor element

- 1 Sensor element
- 2 Base element
- 3 Transmission liquid
- 4 Process diaphragm

Strain gauge (DMS) sensor element

For measuring ranges above 100 bar, a strain gauge (DMS) sensor element (dry system) is used.

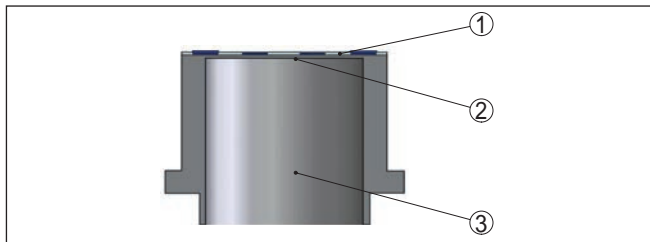


Fig. 4: Configuration of the measuring system with strain gauge (DMS) sensor element

- 1 Sensor element
- 2 Process diaphragm
- 3 Pressure cylinder

Ceramic/metallic measuring cell

With small measuring ranges ≤ 400 mbar or higher temperature ranges, the ceramic/metallic measuring cell is the measuring unit. It consists of the ceramic-capacitive measuring cell and a special, temperature-compensated chemical seal system.

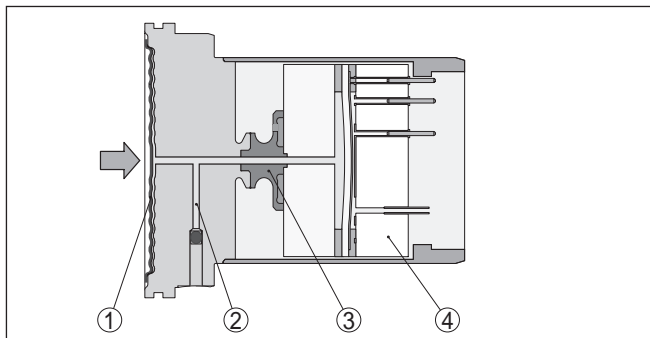


Fig. 5: Configuration of the ceramic/metallic measuring cell

- 1 Process diaphragm
- 2 Isolating liquid
- 3 FeNi adapter
- 4 Ceramic-capacitive measuring cell

Pressure types

The measuring cell design depends on the selected pressure type.

Relative pressure: the measuring cell is open to the atmosphere. The ambient pressure is detected in the measuring cell and compensated. It thus has no influence on the measured value.

Absolute pressure: the measuring cell contains vacuum and is encapsulated. The ambient pressure is not compensated and does hence influence the measured value.

Seal concept

The measuring system is completely welded and thus sealed against the process.

The process fitting is sealed against the process by a suitable seal. It must be provided by the customer, depending on the process fitting also included in the scope of delivery, see chapter "*Technical data*", "*Materials and weights*".

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 ... 85 %

Lifting and carrying

With instrument weights of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

4 Mounting

4.1 General instructions

Process conditions



Note:

For safety reasons, the instrument must only be operated within the permissible process conditions. You can find detailed information on the process conditions in chapter "*Technical data*" of the operating instructions or on the type label.

Hence make sure before mounting that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions in particular are:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

Protection against moisture

Protect your instrument against moisture ingress through the following measures:

- Use a suitable connection cable (see chapter "*Connecting to power supply*")
- Tighten the cable gland or plug connector
- Lead the connection cable downward in front of the cable entry or plug connector

This applies mainly to outdoor installations, in areas where high humidity is expected (e.g. through cleaning processes) and on cooled or heated vessels.



Note:

Make sure that the degree of contamination specified in chapter "*Technical data*" meets the existing ambient conditions.



Note:

Make sure that during installation or maintenance no moisture or dirt can get inside the instrument.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

Screwing in

Devices with threaded fitting are screwed into the process fitting with a suitable wrench via the hexagon.

See chapter "*Dimensions*" for wrench size.

**Warning:**

The housing or the electrical connection may not be used for screwing in! Depending on the device version, tightening can cause damage, e. g. to the rotation mechanism of the housing.

Vibrations

If there is strong vibration at the mounting location, the instrument version with external housing should be used. See chapter "*External housing*".

Permissible process pressure (MWP) - Device

The permissible process pressure range is specified by "MWP" (Maximum Working Pressure) on the type label, see chapter "*Structure*". The MWP takes the element of the measuring cell and processing fitting combination with the weakest pressure into consideration and may applied permanently. The specification refers to a reference temperature of +20 °C (+68 °F). It also applies when a measuring cell with a higher measuring range than the permissible pressure range of the process fitting is installed order-related.

In order to prevent damage to the device, a test pressure may only exceed the specified MWP briefly by 1.5 times at reference temperature. The pressure stage of the process fitting as well as the overload resistance of the measuring cell are taken into consideration here (see chapter "*Technical Data*").

In addition, a temperature derating of the process fitting, e. g. with flanges, can limit the permissible process pressure range according to the respective standard.

Permissible process pressure (MWP) - Mounting accessory

The permissible process pressure range is stated on the type label. The instrument should only be operated with these pressures if the mounting accessory used also fulfils these values. This should be ensured by suitable flanges, welded sockets, tension rings with Clamp connections, sealings, etc.

Temperature limits

Higher process temperatures often mean also higher ambient temperatures. Make sure that the upper temperature limits stated in chapter "*Technical data*" for the environment of the electronics housing and connection cable are not exceeded.

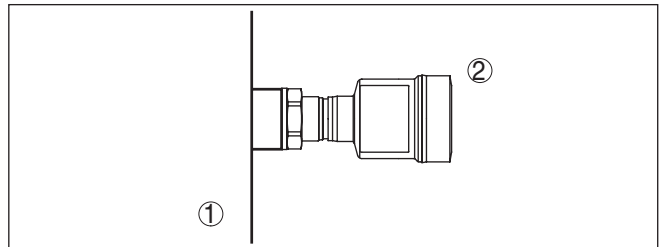


Fig. 6: Temperature ranges

- 1 Process temperature
- 2 Ambient temperature

Oxygen applications

4.2 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 system, e.g. measuring instruments, must be cleaned in accordance with the requirements of recognized regulations or standards
- Depending on the seal material, certain temperatures and pressures must not be exceeded in oxygen applications, see chapter "Technical data"



Danger:

Instruments for oxygen applications must be unpacked just before mounting. After removing the protective cover of the process fitting, the label "O₂" will be visible on the process fitting. Penetration of oil, grease and dirt should be avoided. Danger of explosion!

Filter element - Function

4.3 Ventilation and pressure compensation

The filter element in the electronics housing has the following functions:

- Ventilation of the electronics housing
- Atmospheric pressure compensation (with relative pressure measuring ranges)



Caution:

The filter element causes a time-delayed pressure compensation. When quickly opening/closing the housing cover, the measured value can change for approx. 5 s by up to 15 mbar.

For an effective ventilation, the filter element must be always free from buildup. In case of horizontal mounting, turn the housing so that the filter element points downward after the instrument is installed. This provides better protection against buildup.



Caution:

Do not use a high-pressure cleaner. The filter element could be damaged, which would allow moisture into the housing.

The following paragraphs describe how the filter element is arranged in the different instrument versions.

Filter element - Position

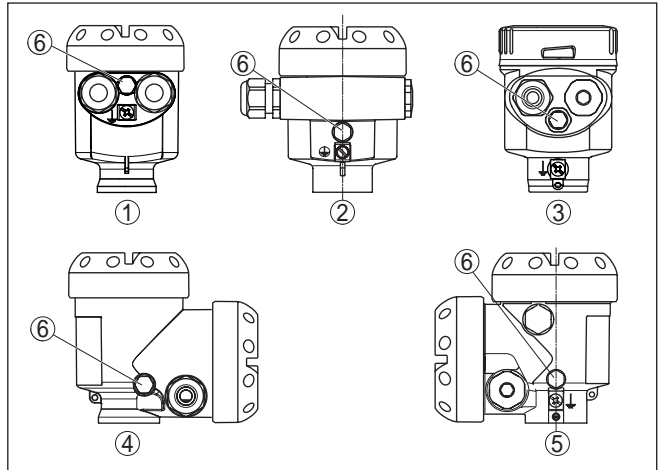


Fig. 7: Position of the filter element

- 1 Plastic, stainless steel single chamber (precision casting)
- 2 Aluminium - single chamber
- 3 Stainless steel single chamber (electropolished)
- 4 Plastic double chamber
- 5 Aluminium - double chamber
- 6 Filter element

With the following instruments a blind plug is installed instead of the filter element:

- Instruments in protection IP66/IP68 (1 bar) - ventilation via capillaries in non-detachable cable
- Instruments with absolute pressure

Filter element - Position Ex-d version

→ Turn the metal ring in such a way that the filter element points downward after installation of the instrument. This provides better protection against buildup.

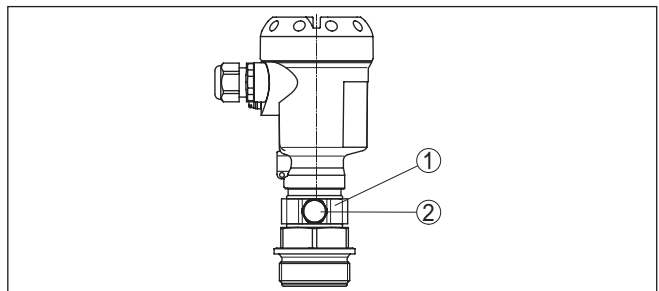


Fig. 8: Position of the filter element - Ex-d version

- 1 Rotatable metal ring
- 2 Filter element

Instruments with absolute pressure have a blind plug mounted instead of the filter element.

**Filter element - Position
Second Line of Defense**

The Second Line of Defense (SLOD) is a second level of the process separation in form of a gas-tight leadthrough in the housing neck, preventing products from penetrating into the housing.

With these instruments, the process assembly is completely encapsulated. An absolute pressure measuring cell is used so that no ventilation is required.

With relative pressure measuring ranges, the ambient pressure is detected and compensated by a reference sensor in the electronics.

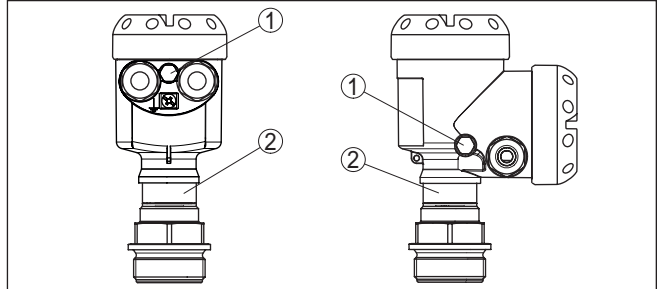


Fig. 9: Position of the filter element - gastight leadthrough

- 1 Filter element
- 2 Gas-tight leadthrough

**Filter element - Position
IP69K version**

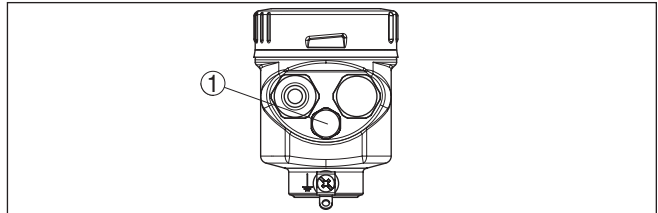


Fig. 10: Position of the filter element - IP69K version

- 1 Filter element

Instruments with absolute pressure have a blind plug mounted instead of the filter element.

4.4 Process pressure measurement

Keep the following in mind when setting up the measuring system:

- Mount the instrument above the measuring point

Possible condensation can then drain off into the process line.

**Measurement setup in
gases**

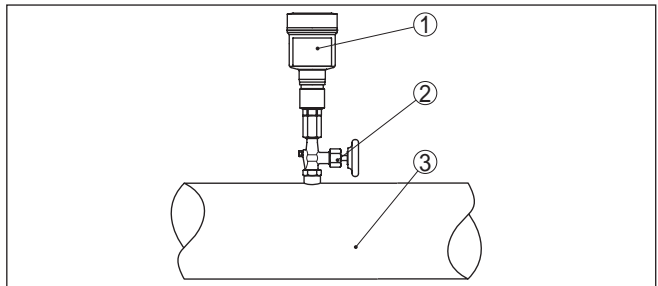


Fig. 11: Measurement setup for process pressure measurement of gases in pipelines

- 1 IPT-2x
- 2 Blocking valve
- 3 Pipeline

Measurement setup in vapours

Keep the following in mind when setting up the measuring system:

- Connect via a siphon
- Do not insulate the siphon
- Fill the siphon with water before setup

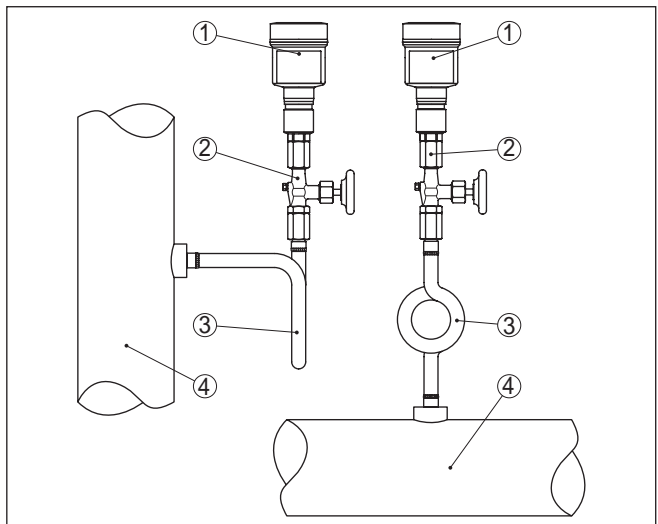


Fig. 12: Measurement setup for the process pressure measurement of gases in pipelines

- 1 IPT-2x
- 2 Blocking valve
- 3 Siphon in U or circular form
- 4 Pipeline

A protective accumulation of water is formed through condensation in the pipe bends. Even in applications with hot steam, a medium temperature $< 100\text{ °C}$ on the transmitter is ensured.

Measurement setup in liquids

Keep the following in mind when setting up the measuring system:

- Mount the instrument below the measuring point

The effective pressure line is always filled with liquid and gas bubbles can bubble up to the process line.

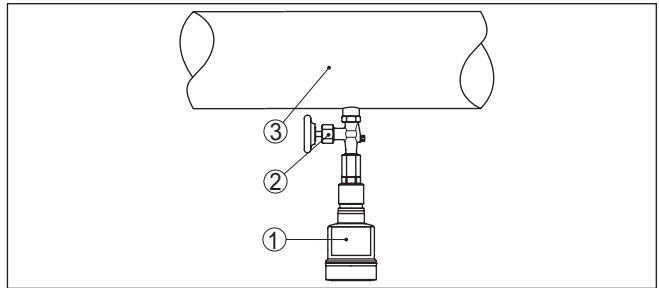


Fig. 13: Measurement setup for the process pressure measurement of liquids in pipelines

- 1 IPT-2x
- 2 Blocking valve
- 3 Pipeline

4.5 Level measurement

Measurement setup

Keep the following in mind when setting up the measuring system:

- Mount the instrument below the min. level
- Do not mount the instrument close to the filling stream or emptying area
- Mount the instrument so that it is protected against pressure shocks from the stirrer

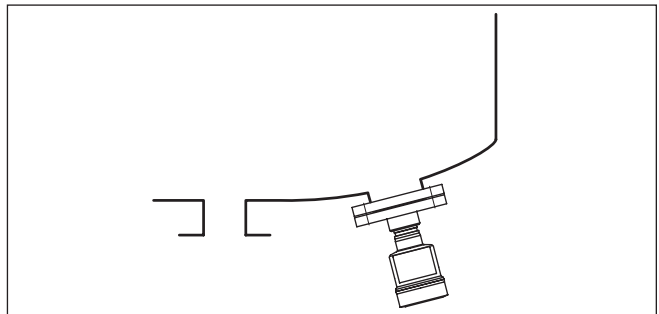


Fig. 14: Measurement setup for the level measurement

4.6 External housing

Configuration

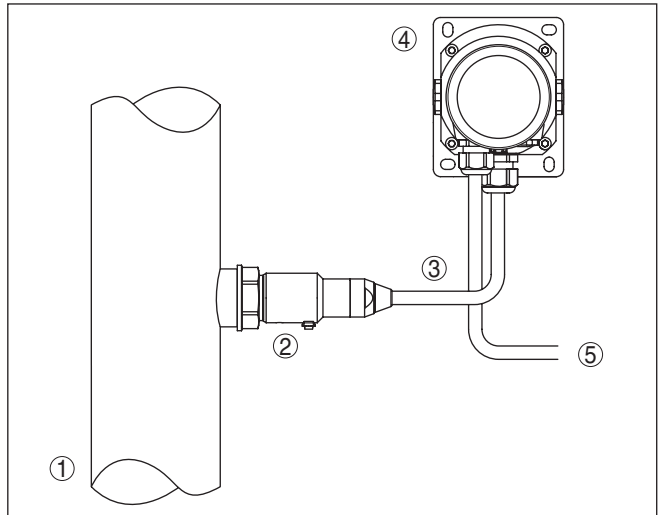


Fig. 15: Configuration, process module, external housing

- 1 Pipeline
- 2 Process module
- 3 Connection cable process assembly - External housing
- 4 External housing
- 5 Signal cable

5 Connecting to the bus system

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Carry out electrical connection by trained, qualified personnel authorised by the plant operator
- If overvoltage surges are expected, overvoltage arresters should be installed



Warning:

Only connect or disconnect in de-energized state.

Voltage supply

The instrument requires a operating voltage of 9 ... 32 V DC. Operating voltage and the digital bus signal are carried on the same two-wire connection cable. Power is supplied via the H1 power supply.

Connection cable

Connection is carried out with screened cable according to Fieldbus specification.

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

Cable screening and grounding

Make sure that the cable screen and grounding are carried out according to Fieldbus specification. We recommend to connect the cable screening to ground potential on both ends.

In systems with potential equalisation, connect the cable screening directly to ground potential at the power supply unit, in the connection box and at the sensor. The screen in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).

Cable glands

Metric threads

In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.



Note:

You have to remove these plugs before electrical connection.

NPT thread

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

**Note:**

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

On plastic housings, the NPT cable gland or the Conduit steel tube must be screwed into the threaded insert without grease.

Max. torque for all housings, see chapter "Technical data".

5.2 Connecting

Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

**Information:**

The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When reinserting the terminal block, you should hear it snap in.

Connection procedure

Proceed as follows:

1. Unscrew the housing lid
2. If a display and adjustment module is installed, remove it by turning it slightly to the left
3. Loosen compression nut of the cable gland and remove blind plug
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry



Fig. 16: Connection steps 5 and 6

- 1 Single chamber housing
- 2 Double chamber housing

6. Insert the wire ends into the terminals according to the wiring plan

**Note:**

Solid cores as well as flexible cores with wire 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.

7. Check the hold of the wires in the terminals by lightly pulling on them
 8. Connect the shielding to the internal ground terminal, connect the external ground terminal to potential equalisation
 9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
 10. Reinsert the display and adjustment module, if one was installed
 11. Screw the housing lid back on
- The electrical connection is finished.

5.3 Single chamber housing



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

Electronics and connection compartment

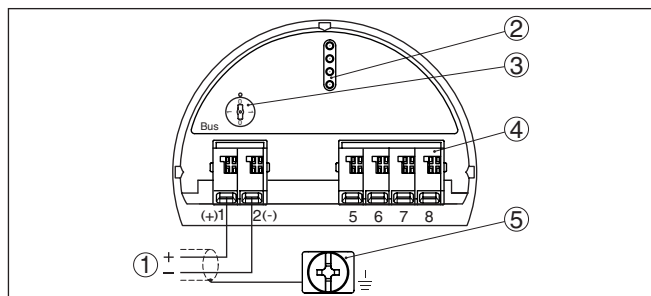


Fig. 17: Electronics and connection compartment - single chamber housing

- 1 Voltage supply, signal output
- 2 Contact pins for the display and adjustment module or interface adapter
- 3 Simulation switch ("1" = mode for simulation release)
- 4 For external display and adjustment unit
- 5 Ground terminal for connection of the cable screening

5.4 Double chamber housing



The following illustrations apply to the non-Ex as well as to the Ex-ia version.

Electronics compartment

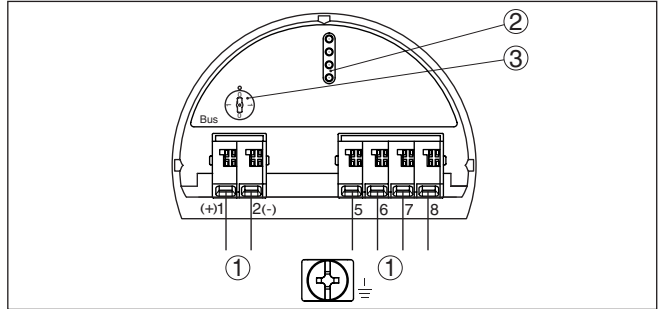


Fig. 18: Electronics compartment - double chamber housing

- 1 Internal connection to the connection compartment
- 2 Contact pins for the display and adjustment module or interface adapter
- 3 Simulation switch ("1" = mode for simulation release)

Connection compartment

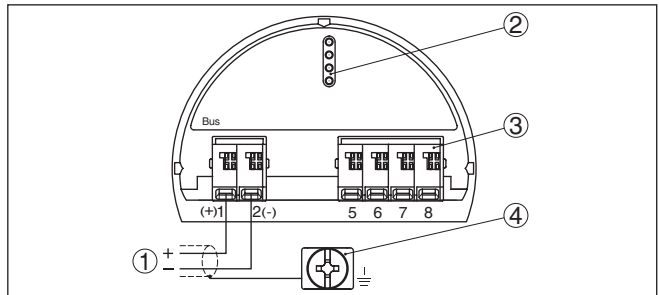


Fig. 19: Connection compartment - double chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit
- 4 Ground terminal for connection of the cable screening

5.5 Housing IP66/IP68 (1 bar)

Wire assignment, connection cable

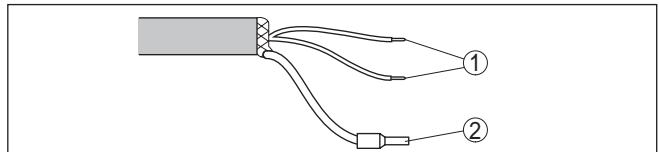


Fig. 20: Wire assignment in permanently connected connection cable

- 1 Brown (+) and blue (-) to power supply or to the processing system
- 2 Shielding

5.6 External housing with version IP68 (25 bar)

Overview

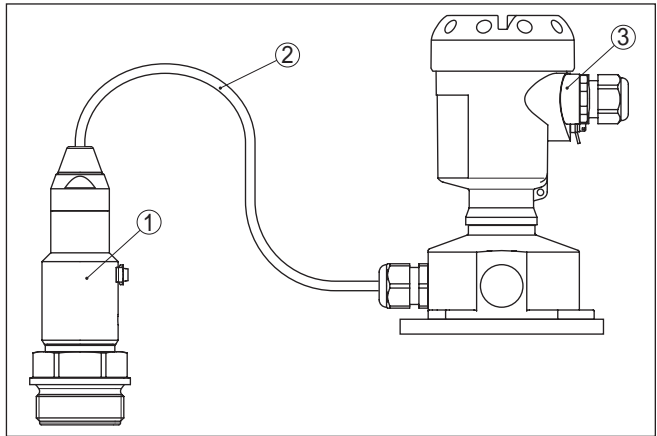


Fig. 21: IPT-2x in IP68 version 25 bar with axial cable outlet, external housing

- 1 Transmitter
- 2 Connection cable
- 3 External housing

Electronics and connection compartment for power supply

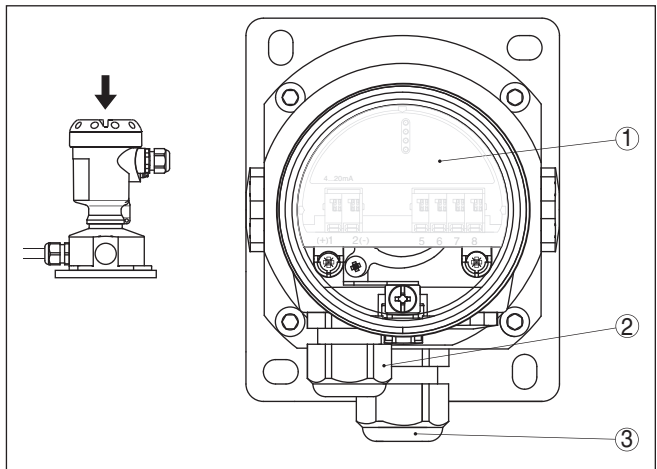


Fig. 22: Electronics and connection compartment

- 1 Electronics module
- 2 Cable gland for voltage supply
- 3 Cable gland for connection cable, transmitter

Terminal compartment, housing socket

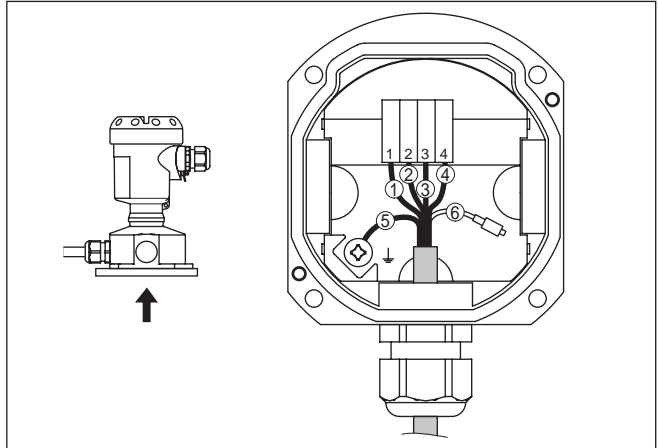


Fig. 23: Connection of the process component in the housing base

- 1 Yellow
- 2 White
- 3 Red
- 4 Black
- 5 Shielding
- 6 Breather capillaries

Electronics and connection compartment

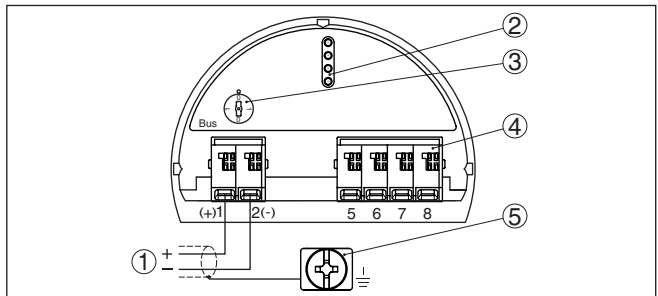


Fig. 24: Electronics and connection compartment - single chamber housing

- 1 Voltage supply, signal output
- 2 Contact pins for the display and adjustment module or interface adapter
- 3 Simulation switch ("1" = mode for simulation release)
- 4 For external display and adjustment unit
- 5 Ground terminal for connection of the cable screening

5.7 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check:

- Internal check of the electronics
- Indication of a status message on the display or PC

Then the actual measured value is output to the signal cable. The value takes into account settings that have already been carried out, e.g. default setting.

6 Set up with the display and adjustment module

6.1 Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. You can choose any one of four different positions - each displaced by 90°. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing lid
2. Place the display and adjustment module on the electronics in the desired position and turn it to the right until it snaps in.
3. Screw housing lid with inspection window tightly back on

Disassembly is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.



Fig. 25: Installing the display and adjustment module in the electronics compartment of the single chamber housing

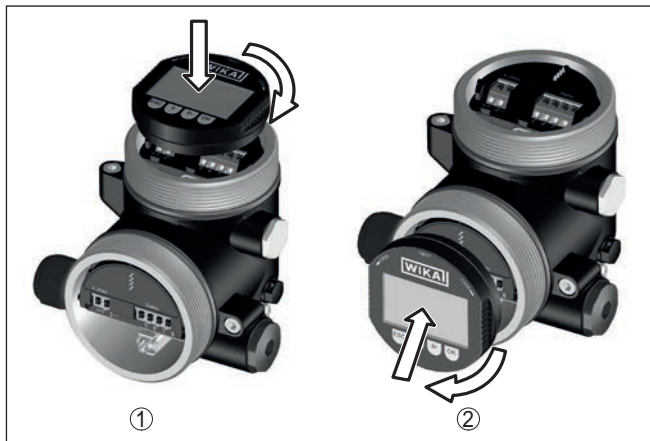


Fig. 26: Installing the display and adjustment module in the double chamber housing

- 1 In the electronics compartment
- 2 In the connection compartment



Note:

If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher lid with an inspection glass is required.

6.2 Adjustment system

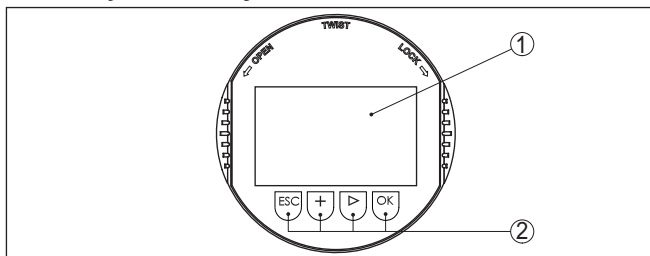


Fig. 27: Display and adjustment elements

- 1 LC display
- 2 Adjustment keys

Key functions

- **[OK]** key:
 - Move to the menu overview
 - Confirm selected menu
 - Edit parameter
 - Save value
- **[>]** key:
 - Change measured value presentation
 - Select list entry
 - Select menu items

- Select editing position
- **[+]** key:
 - Change value of the parameter
- **[ESC]** key:
 - Interrupt input
 - Jump to next higher menu

Adjustment system

The instrument is operated via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the function of the individual keys in the previous illustration.

Time functions

When the **[+]** and **[->]** keys are pressed quickly, the edited value, or the cursor, changes one value or position at a time. If the key is pressed longer than 1 s, the value or position changes continuously.

When the **[OK]** and **[ESC]** keys are pressed simultaneously for more than 5 s, the display returns to the main menu. The menu language is then switched over to "English".

Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with **[OK]** will not be saved.

6.3 Measured value indication

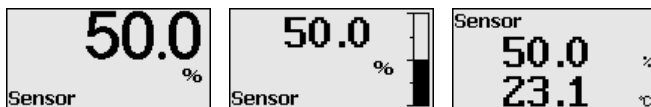
Measured value indication

With the **[->]** key you can move between three different indication modes.

In the first view, the selected measured value is displayed in large digits.

In the second view, the selected measured value and a corresponding bargraph presentation are displayed.

In the third view, the selected measured value as well as a second selectable value, e.g. the temperature, are displayed.



With the **"OK"** key you move (during the initial setup of the instrument) to the selection menu "Language".

Selection language

In this menu item, you can select the national language for further parameterization.



With the **[->]** button, you can select the requested language, with **"OK"** you confirm the selection and move to the main menu.

You can change your selection afterwards with the menu item "Setup - Display, Menu language".

6.4 Parameter adjustment - Quick setup

To quickly and easily adapt the sensor to the application, select the menu item "Quick setup" in the start graphic on the display and adjustment module.



Select the individual steps with the [->] key.

After the last step, "Quick setup terminated successfully" is displayed briefly.

The return to the measured value indication is carried out through the [->] or [ESC] keys or automatically after 3 s



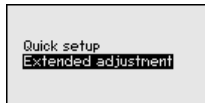
Note:

You can find a description of the individual steps in the quick setup guide of the sensor.

You can find "Extended adjustment" in the next sub-chapter.

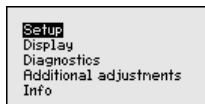
6.5 Parameter adjustment - Extended adjustment

For technically demanding measuring points, you can carry out extended settings in "Extended adjustment".



Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g., for measurement loop name, application, units, position correction, adjustment, signal output

Display: Settings, e.g., for language, measured value display, lighting

Diagnosis: Information, e.g. on instrument status, pointer, measurement reliability, simulation

Additional adjustments: PIN, date/time, reset, copy function

Info: Instrument name, hardware and software version, date of manufacture, device ID, sensor features



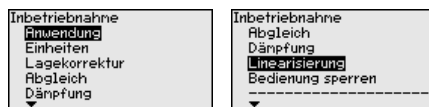
Note:

For optimum adjustment of the measuring point, the individual sub-menu items in the main menu item "Setup" should be selected one

after the other and provided with the correct parameters. If possible, go through the items in the given sequence.

The procedure is described below.

The following submenu points are available:



The submenu points are described below.

6.5.1 Setup

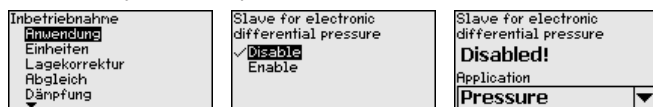
Application

In this menu item you activate/deactivate the slave sensor for electronic differential pressure and select the application.

IPT-2x can be used for process pressure and level measurement. Default setting is process pressure measurement. The mode can be changed in this adjustment menu.

If you have connected **no** slave sensor, you confirm this with "*Deactivate*".

Depending on the selected application, different subchapters in the following adjustment steps are important. There you can find the individual adjustment steps.

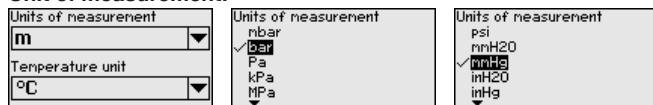


Enter the requested parameters via the appropriate keys, save your settings with **[OK]** and jump to the next menu item with the **[ESC]** and the **[->]** key.

Units

In this menu item, the adjustment units of the instrument are determined. The selection determines the unit displayed in the menu items "*Min. adjustment (Zero)*" and "*Max. adjustment (Span)*".

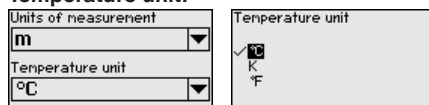
Unit of measurement:



If the level should be adjusted in a height unit, the density of the medium must also be entered later during the adjustment.

In addition, the temperature unit of the instrument is specified. The selection determines the unit displayed in menu items "*Peak value, temperature*" and "in the variables of the digital output signal".

Temperature unit:



Enter the requested parameters via the appropriate keys, save your settings with **[OK]** and jump to the next menu item with the **[ESC]** and the **[->]** key.

Position correction

Especially with chemical seal systems, the installation position of the instrument can shift (offset) the measured value. Position correction compensates this offset. In the process, the actual measured value is taken over automatically. With relative pressure measuring cells a manual offset can also be carried out.



Note:

If the current measured value is automatically accepted, it must not be falsified by medium coverage or static pressure.

With the manual position correction, the offset value can be determined by the user. Select for this purpose the function "Edit" and enter the requested value.

Save your settings with **[OK]** and move with **[ESC]** and **[->]** to the next menu item.

After the position correction is carried out, the actual measured value is corrected to 0. The corrective value appears with an inverse sign as offset value in the display.

The position correction can be repeated as often as necessary. However, if the sum of the corrective values exceeds 20 % of the nominal measuring range, then no position correction is possible.

Adjustment

IPT-2x always measures pressure independently of the process variable selected in the menu item "Application". To output the selected process variable correctly, an allocation of the output signal to 0 % and 100 % must be carried out (adjustment).

With the application "Level", the hydrostatic pressure, e.g. with full and empty vessel, is entered for adjustment. See following example:

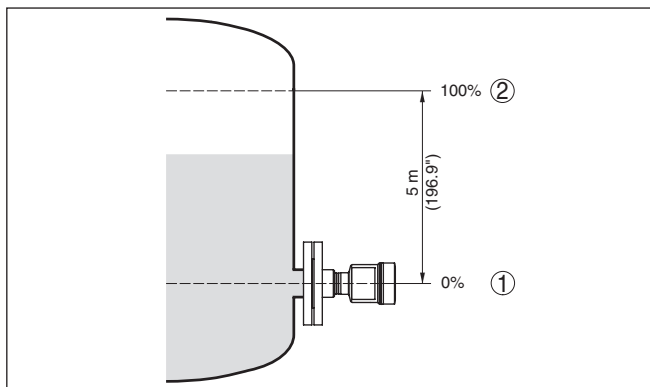


Fig. 28: Parameter adjustment example "Min./max. adjustment, level measurement"

- 1 Min. level = 0 % corresponds to 0.0 mbar
- 2 Max. level = 100 % corresponds to 490.5 mbar

If these values are not known, an adjustment with filling levels of e.g. 10 % and 90 % is also possible. By means of these settings, the real filling height is then calculated.

The actual product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.



Note:

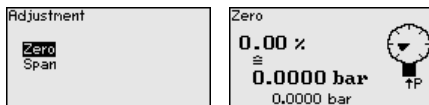
If the adjustment ranges are exceeded, the entered value will not be accepted. Editing can be interrupted with **[ESC]** or corrected to a value within the adjustment ranges.

For the other process variables such as e.g. process pressure, differential pressure or flow, the adjustment is performed in like manner.

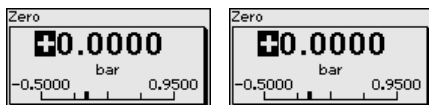
Zero adjustment

Proceed as follows:

1. Select the menu item "Setup" with **[>]** and confirm with **[OK]**.
Now select with **[>]** the menu item "Zero adjustment" and confirm with **[OK]**.



2. Edit the mbar value with **[OK]** and set the cursor to the requested position with **[>]**.



3. Set the requested mbar value with **[+]** and store with **[OK]**.

- Go with **[ESC]** and **[->]** to the span adjustment

The zero adjustment is finished.



Information:

The Zero adjustment shifts the value of the span adjustment. The span, i.e. the difference between these values, however, remains unchanged.

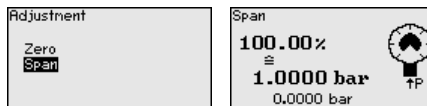
For an adjustment with pressure, simply enter the actual measured value indicated at the bottom of the display.

If the adjustment ranges are exceeded, the message "Outside parameter limits" appears. The editing procedure can be aborted with **[ESC]** or the displayed limit value can be accepted with **[OK]**.

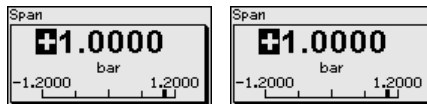
Span adjustment

Proceed as follows:

- Select with **[->]** the menu item Span adjustment and confirm with **[OK]**.



- Edit the mbar value with **[OK]** and set the cursor to the requested position with **[->]**.



- Set the requested mbar value with **[+]** and store with **[OK]**.

For an adjustment with pressure, simply enter the actual measured value indicated at the bottom of the display.

If the adjustment ranges are exceeded, the message "Outside parameter limits" appears. The editing procedure can be aborted with **[ESC]** or the displayed limit value can be accepted with **[OK]**.

The span adjustment is finished.

Min. adjustment level

Proceed as follows:

- Select the menu item "Setup" with **[->]** and confirm with **[OK]**.
Now select with **[->]** the menu item "Adjustment", then "Min. adjustment" and confirm with **[OK]**.



- Edit the percentage value with **[OK]** and set the cursor to the requested position with **[->]**.
- Set the requested percentage value (e.g. 10 %) with **[+]** and save with **[OK]**. The cursor jumps now to the pressure value.
- Enter the pressure value corresponding to the min. level (e.g. 0 mbar).

- Save settings with **[OK]** and move with **[ESC]** and **[->]** to the max. adjustment.

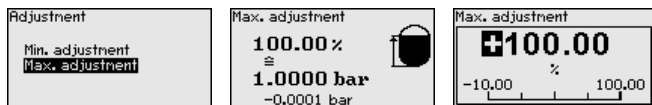
The min. adjustment is finished.

For an adjustment with filling, simply enter the actual measured value indicated at the bottom of the display.

Max. adjustment level

Proceed as follows:

- Select with **[->]** the menu item Max. adjustment and confirm with **[OK]**.



- Edit the percentage value with **[OK]** and set the cursor to the requested position with **[->]**.
- Set the requested percentage value (e.g. 90 %) with **[+]** and save with **[OK]**. The cursor jumps now to the pressure value.
- Enter the pressure value for the full vessel (e.g. 900 mbar) corresponding to the percentage value.
- Save settings with **[OK]**

The max. adjustment is finished.

For an adjustment with filling, simply enter the actual measured value indicated at the bottom of the display.

Damping

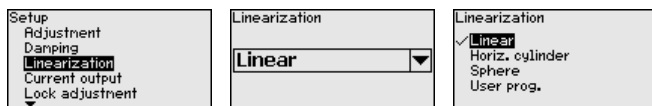
To damp process-dependent measured value fluctuations, set an integration time of 0 ... 999 s in this menu item. The increment is 0.1 s.



The setting in the delivery status depends on the sensor type.

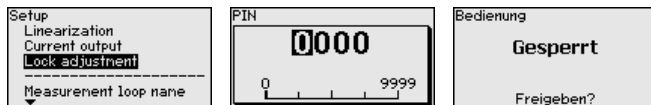
Linearisation

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. a horizontal cylindrical or spherical tank - and the indication or output of the volume is required. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. The linearization applies to the measured value indication and the current output.



Lock/Unlock adjustment

In the menu item "Lock/unlock adjustment" you safeguard the sensor parameters against unauthorized or unintentional modifications.



With active PIN, only the following adjustment functions are possible without entering a PIN:

- Select menu items and show data
- Read data from the sensor into the display and adjustment module

Releasing the sensor adjustment is also possible in any menu item by entering the PIN.



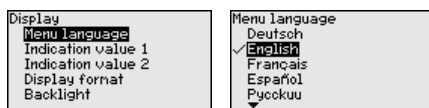
Caution:

With active PIN, adjustment via PACTware/DTM and other systems is also blocked.

6.5.2 Display

Language

This menu item enables the setting of the requested national language.



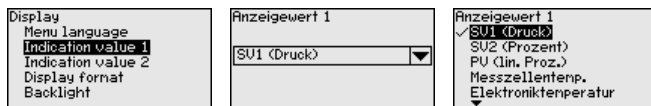
The following languages are available:

- German
- English
- French
- Spanish
- Russian
- Italian
- Dutch
- Portuguese
- Japanese
- Chinese
- Polish
- Czech
- Turkish

In delivery status, the IPT-2x is set to English.

Display value 1 and 2

In this menu item, you define which measured value is displayed.



The default setting for the display value is "*Lin. percent*".

Display format 1 and 2

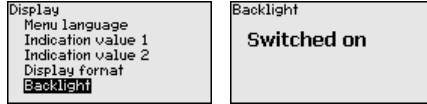
In this menu item you define the number of decimal positions with which the measured value is displayed.



The default setting for the display format is "Automatic".

Backlight

The display and adjustment module has a backlight for the display. In this menu item you can switch on the lighting. You can find the required operating voltage in chapter "Technical data".

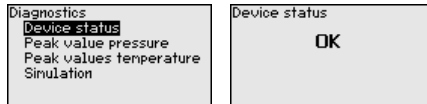


In delivery status, the lighting is switched on.

6.5.3 Diagnostics

Sensor status

In this menu item, the device status is displayed.

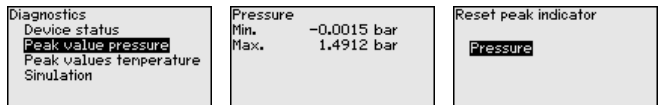


In case of error, e.g. the error code F017, e.g. the error description "Adjustment span too small" and a four digit figure are displayed for service purposes. You can find the error codes with description, reason as well as rectification in chapter "Asset Management".

Peak value, pressure

The respective min. and max. measured values are saved in the sensor. The two values are displayed in menu item "Peak values, pressure".

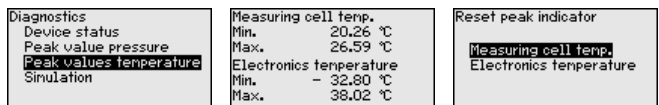
In another window you can carry out a reset of the peak values separately.



Peak value, temperature

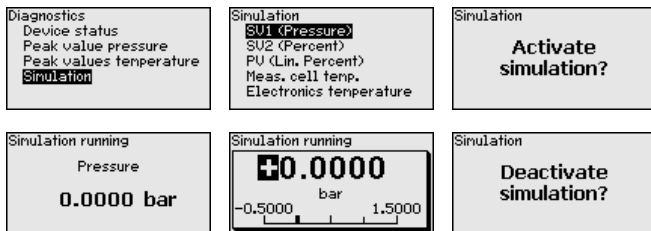
The respective min. and max. measured values of the measuring cell and the electronics temperature are stored in the sensor. In menu item "Peak value, temperature", both values are displayed.

In another window you can carry out a reset of the two peak values separately.



Simulation

In this menu item you simulate measured values. Hence, the signal path can be tested via the bus system to the input card of the control system.



Select the requested simulation variable and set the requested value.

To deactivate the simulation, you have to push the **[ESC]** key and confirm the message "Deactivate simulation" with the **[OK]** key.



Caution:

During simulation, the simulated value is output as digital signal. The status message along with the Asset Management function is "Maintenance".



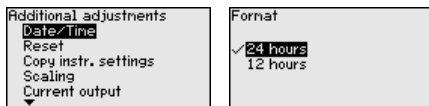
Information:

The sensor terminates the simulation automatically after 60 minutes.

6.5.4 Additional adjustments

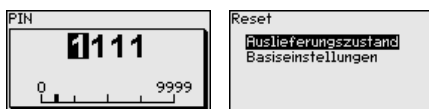
Date/Time

In this menu item, you adjust the internal clock of the sensor. There is no adjustment for summer/winter (daylight saving) time.



Reset

After a reset, certain parameter adjustments made by the user are reset.



The following reset functions are available:

Delivery status: Restores the parameter settings at the time of shipment from the factory, incl. the order-specific settings. Any user-defined linearisation curve as well as the measured value memory are deleted.

Basic settings: Resets the parameter settings, incl. special parameters, to the default values of the respective instrument. Any programmed linearisation curve as well as the measured value memory are deleted.

The following table shows the default values of the instrument. Depending on the instrument version or application, all menu items may not be available or some may be differently assigned:

Setup

| Menu item | Parameter | Default value |
|---------------------|--|---|
| Application | Application | Level |
| | Slave for electronic differential pressure | Deactivated |
| Units | Unit of measurement | mbar (with nominal measuring range ≤ 400 mbar) bar (with nominal measuring ranges ≥ 1 bar) |
| | Temperature unit | $^{\circ}\text{C}$ |
| Position correction | | 0.00 bar |
| Adjustment | Zero/Min. adjustment | 0.00 bar 0.00 % |
| | Span/Max. adjustment | Nominal measuring range in bar 100.00 % |
| Damping | Integration time | 1 s |
| Linearisation | | Linear |
| Lock adjustment | | Released |

Display

| Menu item | Default value |
|------------------------|--|
| Menu language | Selected language |
| Displayed value 1 | Signal output in % |
| Displayed value 2 | Ceramic measuring cell: Measuring cell temperature in $^{\circ}\text{C}$ Metallic measuring cell: Electronics temperature in $^{\circ}\text{C}$ |
| Display format 1 and 2 | Number of positions after the decimal point, automatically |
| Backlight | Switched on |

Diagnostics

| Menu item | Parameter | Default value |
|----------------------|-------------|--|
| Sensor status | | - |
| Peak value indicator | Pressure | Actual measured value |
| | Temperature | Actual temperature values from measuring cell, electronics |
| Simulation | | Process pressure |

Additional adjustments

| Menu item | Parameter | Default value |
|--------------------------|-----------|-------------------------|
| PIN | | 0000 |
| Date/Time | | Actual date/Actual time |
| Copy instrument settings | | |
| Special parameters | | No reset |

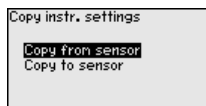
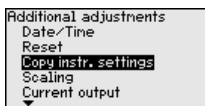
| Menu item | Parameter | Default value |
|-----------|----------------|--|
| Scaling | Scaling size | Volume in l |
| | Scaling format | 0 % corresponds to 0 l 100 % corresponds to 0 l |

Copy instrument settings The instrument settings are copied with this function. The following functions are available:

- **Read from sensor:** Read data from sensor and store into the display and adjustment module
- **Write into sensor:** Store data from the display and adjustment module back into the sensor

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "Setup" and "Display"
- In the menu "Additional adjustments" the items "Reset, Date/Time"
- The user-programmable linearization curve



The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.



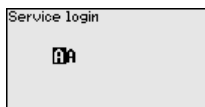
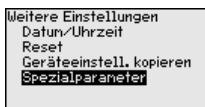
Note:

Before the data are saved in the sensor, a safety check is carried out to determine if the data match the sensor. In the process the sensor type of the source data as well as the target sensor are displayed. If the data do not match, a fault message is outputted or the function is blocked. The data are saved only after release.

Special parameters

In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

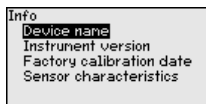
Change the settings of the special parameters only after having contacted our service staff.



6.5.5 Info

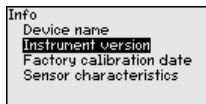
Device name

In this menu item, you can read out the instrument name and the instrument serial number:



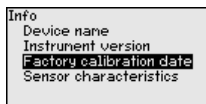
Instrument version

In this menu item, the hardware and software version of the sensor is displayed.



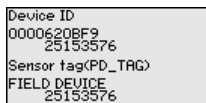
Factory calibration date

In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.



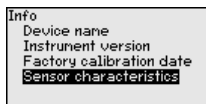
Device ID

In this menu item, the identification number of the instrument in a Foundation Fieldbus system is shown.



Sensor characteristics

In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.



6.6 Saving the parameterisation data

On paper

We recommended writing down the adjustment data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

In the display and adjustment module

If the instrument is equipped with a display and adjustment module, the parameter adjustment data can be saved therein. The procedure is described in menu item "Copy device settings".

7 Setup with PACTware

7.1 Parameter adjustment

The further setup steps with detailed descriptions can be found in the online help of PACTware and the DTMs.



Note:

Keep in mind that for the setup of device, the current version of the DTM Collection must be used.

The latest DTM Collection and PACTware version can be downloaded free of charge via the Internet.

7.2 Saving the parameterisation data

We recommend documenting or saving the parameterisation data via PACTware. That way the data are available for multiple use or service purposes.

8 Diagnosis, asset management and service

8.1 Maintenance

Maintenance

If the device is used properly, no special maintenance is required in normal operation.

Precaution measures against buildup

In some applications, product buildup on the diaphragm can influence the measuring result. Depending on the sensor and application, take precautions to ensure that heavy buildup, and especially a hardening thereof, is avoided.

Cleaning

The cleaning helps that the type label and markings on the instrument are visible.

Take note of the following:

- Use only cleaning agents which do not corrode the housings, type label and seals
- Use only cleaning methods corresponding to the housing protection rating

8.2 Diagnosis memory

The instrument has several memories available for diagnostic purposes. The data remain there even in case of voltage interruption.

Measured value memory

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value.

Depending on the instrument version, values that can be stored are for example:

- Level
- Process pressure
- Differential pressure
- Static pressure
- Percentage value
- Scaled values
- Current output
- Lin. percent
- Measuring cell temperature
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores pressure value and measuring cell temperature every 10 s, with electronic differential pressure also the static pressure.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

Event memory

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

- Modification of a parameter

- Switch-on and switch-off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

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

8.3 Asset Management function

The instrument features self-monitoring and diagnostics according to NE 107 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 respective adjustment module.

Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance required

and explained by pictographs:

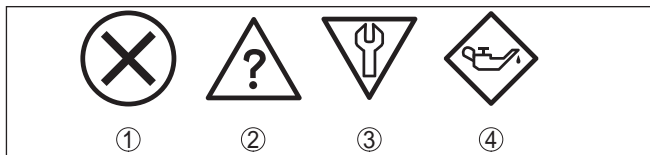


Fig. 29: Pictographs of the status messages

- 1 Failure - red
- 2 Out of specification - yellow
- 3 Function check - orange
- 4 Maintenance required - blue

Failure: Due to a malfunction in the instrument, a fault message is output.

This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is being worked on, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default.

Out of specification: The measured value is unreliable because an instrument specification was exceeded (e.g. electronics temperature).

This status message is inactive by default.

Maintenance required: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default.

Failure

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|---|--|---|---------------------------|
| F013 No valid measured value available | Gauge pressure or low pressure Measuring cell defective | Exchange measuring cell Send instrument for repair | Bit 0 |
| F017 Adjustment span too small | Adjustment not within specification | Change the adjustment according to the limit values | Bit 1 |
| F025 Error in the linearization table | Index markers are not continuously rising, for example illogical value pairs | Check linearisation table Delete table/Create new | Bit 2 |
| F036 no operable sensor software | Failed or interrupted software update | Repeat software update Check electronics version Exchanging the electronics Send instrument for repair | Bit 3 |
| F040 Error in the electronics | Hardware defect | Exchanging the electronics Send instrument for repair | Bit 4 |
| F041 Communication error | No connection to the sensor electronics | Check connection between sensor and main electronics (with separate version) | Bit 13 |
| F042 Communication error Slave | No connection to the Slave | Check connection between Master and Slave | Bit 28 of Byte 0 ... 5 |
| F080 General software error | General software error | Disconnect operating voltage briefly | Bit 5 |
| F105 Measured value is determined | The instrument is still in the start phase, the measured value could not yet be determined | Wait for the end of the switch-on phase | Bit 6 |
| F113 Communication error | Error in the internal instrument communication | Disconnect operating voltage briefly Send instrument for repair | Bit 12 |
| F260 Error in the calibration | Error in the calibration carried out in the factory Error in the EEPROM | Exchanging the electronics Send instrument for repair | Bit 8 |
| F261 Error in the instrument settings | Error during setup Error when carrying out a reset | > Repeat setup Repeat reset | Bit 9 |
| F264 Installation/Setup error | Inconsistent settings (e.g.: distance, adjustment units with application process pressure) for selected application Invalid sensor configuration (e.g.: application electronic differential pressure with connected differential pressure measuring cell) | Modify settings Modify connected sensor configuration or application | Bit 10 |

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|--|--|---|---------------------------|
| F265 Measurement function disturbed | Sensor no longer carries out a measurement | Carry out a reset Disconnect operating voltage briefly | Bit 11 |

Tab. 5: Error codes and text messages, information on causes as well as corrective measures

Function check

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|---------------------------|------------------------|--|---------------------------|
| C700 Simulation active | A simulation is active | Finish simulation Wait for the automatic end after 60 mins. | Bit 27 |

Out of specification

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|---|---|--|---------------------------|
| S600 Impermissible electronics temperature | Temperature of the electronics in the non-specified range | Check ambient temperature Insulate electronics Use instrument with higher temperature range | Bit 23 |
| S603 Impermissible operating voltage | Operating voltage below specified range | Check electrical connection If necessary, increase operating voltage | Bit 26 |
| S605 Impermissible pressure value | Measured process pressure below or above the adjustment range | Check nominal measuring range of the instrument If necessary, use an instrument with a higher measuring range | Bit 29 |

Maintenance

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|---|--|--|---------------------------|
| M500 Error in the delivery status | The data could not be restored during the reset to delivery status | Repeat reset Load XML file with sensor data into the sensor | Bit 15 |
| M501 Error in the non-active linearisation table | Index markers are not continuously rising, for example illogical value pairs | Check linearisation table Delete table/Create new | Bit 16 |
| M502 Error in the event memory | Hardware error EEPROM | Exchanging the electronics Send instrument for repair | Bit 17 |
| M504 Error at a device interface | Hardware defect | Exchanging the electronics Send instrument for repair | Bit 19 |

| Code Text message | Cause | Rectification | DevSpec Diagnosis Bits |
|--|---|----------------------------------|---------------------------|
| M507 Error in the instrument settings | Error during setup Error when carrying out a reset | Carry out reset and repeat setup | Bit 22 |

Tab. 8: Error codes and text messages, information on causes as well as corrective measures

8.4 Rectify faults

Reaction when malfunction occurs

The operator of the system is responsible for taking suitable measures to rectify faults.

Fault rectification

The first measures are:

- Evaluation of fault messages
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC/notebook with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "Setup" must be carried out again or must be checked for plausibility and completeness.

8.5 Exchange process module on version IP68 (25 bar)

On version IP68 (25 bar), the user can exchange the process module on site. Connection cable and external housing can be kept.

Required tools:

- Hexagon key wrench, size 2



Caution:

The exchange may only be carried out in the complete absence of line voltage.



In Ex applications, only a replacement part with appropriate Ex approval may be used.



Caution:

During exchange, protect the inner side of the parts against contamination and moisture.

Proceed as follows when carrying out the exchange:

1. Loosen the fixing screw with the hexagon key wrench
2. Carefully detach the cable assembly from the process module

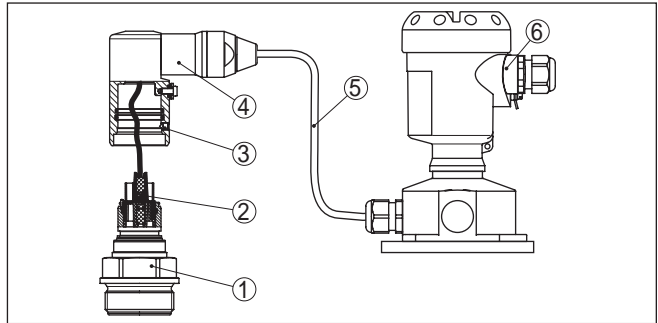


Fig. 30: IPT-2x in IP68 version, 25 bar and lateral cable outlet, external housing

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

3. Loosen the plug connector
4. Mount the new process module on the measuring point
5. Plug the connector back in
6. Mount the cable assembly on the process module and turn it to the desired position
7. Tighten the fixing screw with the hexagon key wrench

The exchange is finished.

8.6 Instrument repair

You can find information for a return shipment under "Service" on our local website.

If a repair is necessary, please proceed as follows:

- Complete one form for each instrument
- If necessary, state a contamination
- Clean the instrument and pack it damage-proof
- Attach the completed form and possibly also a safety data sheet to the instrument

9 Dismount

9.1 Dismounting steps

**Warning:**

Before dismantling, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic media etc.

Take note of chapters "*Mounting*" and "*Connecting to voltage supply*" and carry out the listed steps in reverse order.

9.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive

The instrument does not fall in the scope of the EU WEEE directive. Article 2 of this Directive exempts electrical and electronic equipment from this requirement if it is part of another instrument that does not fall in the scope of the Directive. These include stationary industrial plants.

Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points.

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

10 Supplement

10.1 Technical data

Materials and weights

Materials, wetted (piezoresistive/strain gauge measuring cell)

| | |
|---|---|
| Process fitting | 316L |
| Diaphragm standard | 316L |
| Diaphragm from measuring range 100 bar | 316L, Elgiloy (2.4711) |
| Seal ring, O-ring | FKM (VP2/A), EPDM (A+P 70.10-02), FFKM (Perlast G75S), FEPM (Fluoraz SD890) |
| Seal for process fitting (in the scope of delivery) | |
| – Thread G $\frac{1}{2}$ (EN 837) | Aramid/NBR |

Materials, wetted (ceramic/metallic measuring cell)

| | |
|---|--|
| Process fitting | 316L |
| Diaphragm | Alloy C276 (2.4819), gold-coated 20 μ , gold/rhodium-coated 5 μ /1 μ ³⁾ |
| Seal for process fitting (in the scope of delivery) | |
| – Thread G1 $\frac{1}{2}$ (DIN 3852-A) | Klingersil C-4400 |
| – Thread M44 x 1.25 (DIN 13) | FKM, FFKM, EPDM |

Surface quality, hygienic process fittings, $R_a < 0.8 \mu\text{m}$ typ.

Materials, non-wetted parts

| | |
|--|--|
| Isolating liquid ceramic/metallic measuring cell | KN 92 medical white oil (FDA conform) |
| Internal transmission liquid piezoresistive measuring cell | Synthetic oil KN 77, Neobee M 20 KN 59 (FDA conform), Halocarbon oil 6.3 KN 21 ⁴⁾⁵⁾ |
| Housing | |
| – Housing | Plastic PBT (Polyester), Aluminium AlSi10Mg (powder-coated, basis: Polyester), 316L |
| – Cable gland | PA, stainless steel, brass |
| – Cable gland: Seal, closure | NBR, PA |
| – Seal, housing lid | Silicone SI 850 R, NBR silicone-free |
| – Inspection window housing cover | Polycarbonate (UL-746-C listed), glass ⁶⁾ |
| – Ground terminal | 316L |
| External housing - deviating materials | |
| – Housing and socket | Plastic PBT (Polyester), 316L |

³⁾ Not on instruments with SIL qualification.

⁴⁾ Transmission liquid with measuring ranges up to 40 bar. With measuring ranges from 100 bar dry measuring cell.

⁵⁾ Halocarbon oil: Generally in oxygen applications, not with vacuum measuring ranges, not with absolute measuring ranges $< 1 \text{ bar}_{\text{abs}}$.

⁶⁾ Glass with Aluminium and stainless steel precision casting housing

| | |
|---|---------------------------------|
| – Socket seal | EPDM |
| – Seal below wall mounting plate ⁷⁾ | EPDM |
| – Inspection window housing cover | Polycarbonate (UL-746-C listed) |
| Ground terminal | 316Ti/316L |
| Connection cable with IP68 (25 bar) version ⁸⁾ | |
| – Cable cover | PE, PUR |
| – Type label support on cable | PE hard |
| Connection cable with IP68 (1 bar) version ⁹⁾ | PE, PUR |

Weights

| | |
|---------------------|--|
| Total weight IPT-2x | approx. 0.8 ... 8 kg (1.764 ... 17.64 lbs), depending on process fitting and housing |
|---------------------|--|

Torques

Max. torque, metric process fittings

| | |
|--|-----------------------|
| – G $\frac{1}{4}$, G $\frac{1}{2}$ | 50 Nm (36.88 lbf ft) |
| – G $\frac{1}{2}$ front-flush, G1 front-flush | 40 Nm (29.50 lbf ft) |
| – G1 $\frac{1}{2}$ front-flush (piezoresistive measuring cell) | 40 Nm (29.50 lbf ft) |
| – G1 $\frac{1}{2}$ front-flush (ceramic/metallic measuring cell) | 200 Nm (147.5 lbf ft) |

Max. torque, non-metric process fittings

| | |
|---|-----------------------|
| – $\frac{1}{2}$ NPT inside, $\frac{1}{4}$ NPT, ≤ 40 bar/500 psig | 50 Nm (36.88 lbf ft) |
| – $\frac{1}{2}$ NPT inside, $\frac{1}{4}$ NPT, > 40 bar/500 psig | 200 Nm (147.5 lbf ft) |
| – 7/16 NPT for tube $\frac{1}{4}$ " | 40 Nm (29.50 lbf ft) |
| – 9/16 NPT for tube $\frac{3}{8}$ " | 50 Nm (36.88 lbf ft) |

Max. torque for NPT cable glands and Conduit tubes

| | |
|-------------------------------------|----------------------|
| – Plastic housing | 10 Nm (7.376 lbf ft) |
| – Aluminium/Stainless steel housing | 50 Nm (36.88 lbf ft) |

Input variable - Piezoresistive/Strain gauge measuring cell

The specifications are only an overview and refer to the measuring cell. Limitations due to the material and version of the process fitting as well as the selected pressure type are possible. The specifications on the nameplate apply.¹⁰⁾

⁷⁾ Only for 316L with 3A approval

⁸⁾ Between transmitter and external electronics housing.

⁹⁾ Fix connected to the sensor.

¹⁰⁾ Data on overload capability apply for reference temperature.

Nominal measuring ranges and overload capability in bar/kPa

| Nominal range | Overload capability | |
|-----------------------------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| Gauge pressure | | |
| 0 ... +0.4 bar/0 ... +40 kPa | +1.2 bar/+120 kPa | -1 bar/-100 kPa |
| 0 ... +1 bar/0 ... +100 kPa | +3 bar/+300 kPa | -1 bar/-100 kPa |
| 0 ... +2.5 bar/0 ... +250 kPa | +7.5 bar/+750 kPa | -1 bar/-100 kPa |
| 0 ... +10 bar/0 ... +1000 kPa | +30 bar/+3000 kPa | -1 bar/-100 kPa |
| 0 ... +25 bar/0 ... +2500 kPa | +75 bar/+7500 kPa | -1 bar/-100 kPa |
| 0 ... +40 bar/0 ... +4000 kPa | +120 bar/+12 MPa | -1 bar/-100 kPa |
| 0 ... +100 bar/0 ... +10 MPa | +200 bar/+20 MPa | -1 bar/-100 kPa |
| 0 ... +250 bar/0 ... +25 MPa | +500 bar/+50 MPa | -1 bar/-100 kPa |
| 0 ... +600 bar/0 ... +60 MPa | +1200 bar/+120 MPa | -1 bar/-100 kPa |
| 0 ... +1000 bar/0 ... +100 MPa | +1500 bar/+150 MPa | -1 bar/-100 kPa |
| -1 ... 0 bar/-100 ... 0 kPa | +3 bar/+300 kPa | -1 bar/-100 kPa |
| -1 ... +1.5 bar/-100 ... +150 kPa | +7.5 bar/+750 kPa | -1 bar/-100 kPa |
| -1 ... +10 bar/-100 ... +1000 kPa | +30 bar/+3000 kPa | -1 bar/-100 kPa |
| -1 ... +25 bar/-100 ... +2500 kPa | +75 bar/+7500 kPa | -1 bar/-100 kPa |
| -1 ... +40 bar/-100 ... +4000 kPa | +120 bar/+12 MPa | -1 bar/-100 kPa |
| -0.2 ... +0.2 bar/-20 ... +20 kPa | +1.2 bar/+120 kPa | -1 bar/-100 kPa |
| -0.5 ... +0.5 bar/-50 ... +50 kPa | +3 bar/+300 kPa | -1 bar/-100 kPa |
| Absolute pressure | | |
| 0 ... 1 bar/0 ... 100 kPa | 3 bar/300 kPa | 0 bar abs. |
| 0 ... 2.5 bar/0 ... 250 kPa | 7.5 bar/750 kPa | 0 bar abs. |
| 0 ... 10 bar/0 ... 1000 kPa | 30 bar/3000 kPa | 0 bar abs. |
| 0 ... 25 bar/0 ... 2500 kPa | 75 bar/+7500 kPa | 0 bar abs. |
| 0 ... 40 bar/0 ... 4000 kPa | 120 bar/+12 MPa | 0 bar abs. |

Nominal measuring ranges and overload capacity in psi

| Nominal range | Overload capability | |
|-----------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| Gauge pressure | | |
| 0 ... +5 psig | +15 psig | -14.5 psig |
| 0 ... +15 psig | +45 psig | -14.5 psig |
| 0 ... +30 psig | +90 psig | -14.5 psig |
| 0 ... +150 psig | +450 psig | -14.5 psig |
| 0 ... +300 psig | +900 psig | -14.5 psig |
| 0 ... +500 psig | +1500 psig | -14.5 psig |

| Nominal range | Overload capability | |
|---------------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| 0 ... +1450 psig | +3000 psig | -14.5 psig |
| 0 ... +3000 psig | +6000 psig | -14.5 psig |
| 0 ... +9000 psig | +18000 psig | -14.5 psig |
| 0 ... +15000 psig | +22500 psig | -14.5 psig |
| -14.5 ... 0 psig | +45 psig | -14.5 psig |
| -14.5 ... +20 psig | +90 psig | -14.5 psig |
| -14.5 ... +150 psig | +450 psig | -14.5 psig |
| -14.5 ... +300 psig | +900 psig | -14.5 psig |
| -14.5 ... +600 psig | +1200 psig | -14.5 psig |
| -3 ... +3 psig | +15 psig | -14.5 psig |
| -7 ... +7 psig | +45 psig | -14.5 psig |
| Absolute pressure | | |
| 0 ... 15 psi | 45 psi | 0 psi |
| 0 ... 30 psi | 90 psi | 0 psi |
| 0 ... 150 psi | 450 psi | 0 psi |
| 0 ... 300 psi | 600 psi | 0 psi |
| 0 ... 500 psig | 1500 psi | 0 psi |

Input variable - Ceramic/metallic measuring cell

The specifications are only an overview and refer to the measuring cell. Limitations due to the material and version of the process fitting are possible. The specifications on the nameplate apply.¹¹⁾

Nominal measuring ranges and overload capability in bar/kPa

| Nominal range | Overload capability | |
|-----------------------------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| Gauge pressure | | |
| 0 ... +0.1 bar/0 ... +10 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 | +50 bar/+5000 kPa | -1 bar/-100 kPa |
| 0 ... +25 bar/0 ... +2500 kPa | +50 bar/+5000 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 | +50 bar/+5000 kPa | -1 bar/-100 kPa |
| -1 ... +10 bar/-100 ... +1000 kPa | +50 bar/+5000 kPa | -1 bar/-100 kPa |
| -1 ... +25 bar/-100 ... +2500 kPa | +50 bar/+5000 kPa | -1 bar/-100 kPa |

¹¹⁾ Data on overload capability apply for reference temperature.

| Nominal range | Overload capability | |
|-----------------------------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| -0.2 ... +0.2 bar/-20 ... +20 kPa | +20 bar/+3000 kPa | -1 bar/-100 kPa |
| -0.5 ... +0.5 bar/-50 ... +50 kPa | +35 bar/+3500 kPa | -1 bar/-100 kPa |
| Absolute pressure | | |
| 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 | 50 bar/5000 kPa | 0 bar abs. |
| 0 ... 25 bar/0 ... 2500 kPa | 50 bar/5000 kPa | 0 bar abs. |

Nominal measuring ranges and overload capacity in psi

| Nominal range | Overload capability | |
|---------------------|---------------------|------------------|
| | Maximum pressure | Minimum pressure |
| Gauge pressure | | |
| 0 ... +1.5 psig | +220 psig | -14.5 psig |
| 0 ... +5 psig | +435 psig | -14.5 psig |
| 0 ... +15 psig | +510 psig | -14.5 psig |
| 0 ... +30 psig | +725 psig | -14.5 psig |
| 0 ... +150 psig | +725 psig | -14.5 psig |
| 0 ... +300 psig | +725 psig | -14.5 psig |
| -14.5 ... 0 psig | +510 psig | -14.5 psig |
| -14.5 ... +20 psig | +725 psig | -14.5 psig |
| -14.5 ... +150 psig | +725 psig | -14.5 psig |
| -14.5 ... +300 psig | +725 psig | -14.5 psig |
| -3 ... +3 psig | +290 psi | -14.5 psig |
| -7 ... +7 psig | +525 psig | -14.5 psig |
| Absolute pressure | | |
| 0 ... 15 psi | 525 psi | 0 psi |
| 0 ... 30 psi | 725 psi | 0 psi |
| 0 ... 150 psi | 725 psig | 0 psi |
| 0 ... 300 psi | 725 psig | 0 psi |

Adjustment ranges

Specifications refer to the nominal measuring range, pressure values lower than -1 bar cannot be set

Min./Max. adjustment:

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

Zero/Span adjustment:

| | |
|------------------------------------|---------------------------------|
| - Zero | -20 ... +95 % |
| - Span | -120 ... +120 % |
| - Difference between zero and span | max. 120 % of the nominal range |
| Max. permissible Turn Down | Unlimited (recommended 20 : 1) |

Switch-on phase

Start-up time with operating voltage U_b

| | |
|------------------|-------------|
| - ≥ 12 V DC | ≤ 9 s |
| - < 12 V DC | ≤ 22 s |

Output variable

| | |
|--------------------------------------|---|
| Output signal | digital output signal, Foundation Fieldbus protocol |
| Transmission rate | 31.25 Kbit/s |
| Damping (63 % of the input variable) | 0 ... 999 s, adjustable |
| Channel Numbers | |
| - Channel 1 | Process value |
| - Channel 8 | Electronics temperature |
| Current value | |
| - Non-Ex, Ex-ia and Ex-d instruments | 12 mA, ± 0.5 mA |

Dynamic behaviour output

Dynamic characteristics depending on medium and temperature

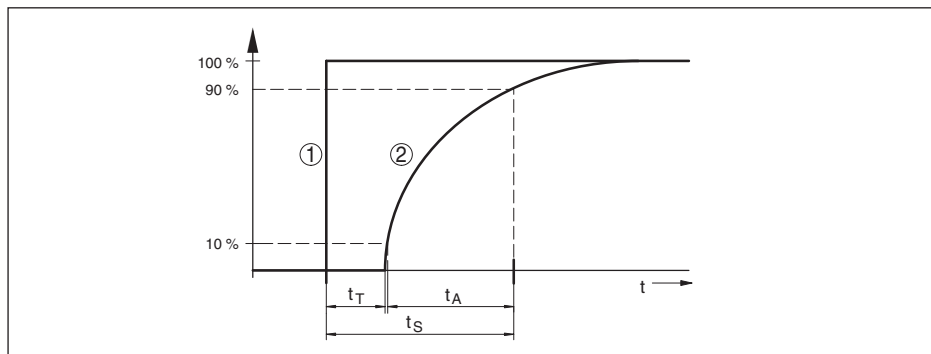


Fig. 31: Behaviour in case of sudden change of the process variable. t_T : dead time; t_A : rise time; t_S : jump response time

- 1 Process variable
- 2 Output signal

| | IPT-2x | IPT-2x - IP68 (25 bar) |
|-------------------------|--------------|------------------------|
| Dead time | ≤ 25 ms | ≤ 50 ms |
| Rise time (10 ... 90 %) | ≤ 55 ms | ≤ 150 ms |

| | | |
|---|---------------|-------------------------------|
| | IPT-2x | IPT-2x - IP68 (25 bar) |
| Step response time (ti: 0 s, 10 ... 90 %) | ≤ 80 ms | ≤ 200 ms |

Damping (63 % of the input variable) 0 ... 999 s, adjustable via menu item "*Damping*"

Reference conditions and influencing variables (according to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

| | |
|---------------------|---|
| – Temperature | +15 ... +25 °C (+59 ... +77 °F) |
| – Relative humidity | 45 ... 75 % |
| – Air pressure | 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig) |

Determination of characteristics Limit point adjustment according to IEC 61298-2

Characteristic curve Linear

Reference installation position upright, diaphragm points downward

Influence of the installation position < 0.2 mbar/20 Pa (0.003 psig)

Deviation (according to IEC 60770-1)

Specifications refer to the set span. Turn down (TD) is the ratio: nominal measuring range/set span.

| Accuracy class | Non-linearity, hysteresis and repeatability with TD 1 : 1 up to 5 : 1 | Non-linearity, hysteresis and repeatability with 5 : 1 |
|----------------|---|--|
| 0.075 % | < 0.075 % | < 0.015 % x TD |
| 0.1 % | < 0.1 % | < 0.02 % x TD |
| 0.2 % | < 0.2 % | < 0.04 % x TD |

Influence of the product temperature

Thermal change zero signal and output span

Turn down (TD) is the relation nominal measuring range/adjusted span.

The thermal change of the zero signal and output span corresponds to the value F_T in chapter "*Calculation of the total deviation (according to DIN 16086)*".

Piezoresistive/strain gauge measuring cell

The basic temperature error in % from the above graphic can increase due to the additional factors such as temperature range (factor FMZ) and Turn Down (factor FTD). The additional factors are listed in the following tables.

Additional factor through accuracy class

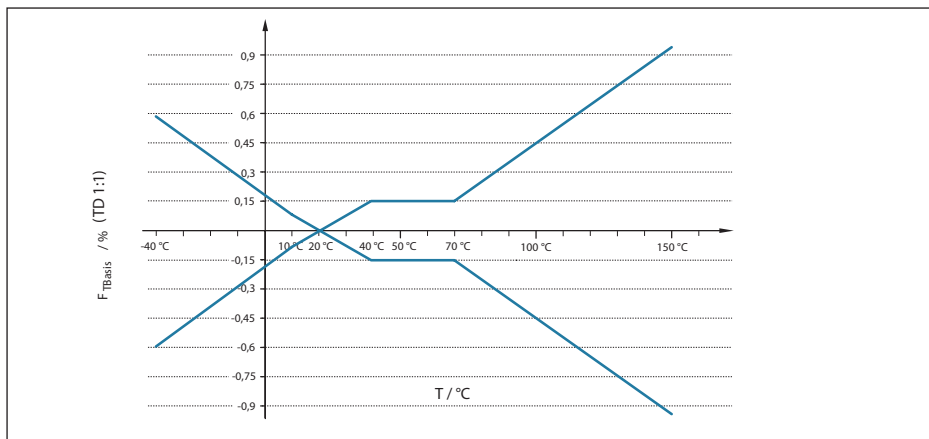


Fig. 32: Basic temperature error F_{TBasis} at TD 1 : 1

The basic temperature error in % from the above graphic can increase due to the additional factors such as temperature range (factor FMZ) and Turn Down (factor FTD). The additional factors are listed in the following tables.

Additional factor through accuracy class

| Accuracy class | 0.075 %, 0.1 % | 0.2 % |
|----------------|----------------|-------|
| Factor FMZ | 1 | 3 |

Additional factor through Turn Down

The additional factor FTD through Turn down is calculated according to the following formula:

$$F_{TD} = 0.5 \times TD + 0.5$$

In the table, example values for typical Turn downs are listed.

| Turn Down | TD 1 : 1 | TD 2.5 : 1 | TD 5 : 1 | TD 10 : 1 | TD 20 : 1 |
|------------|----------|------------|----------|-----------|-----------|
| Factor FTD | 1 | 1.75 | 3 | 5.5 | 10.5 |

Ceramic/Metal measuring cell - Standard

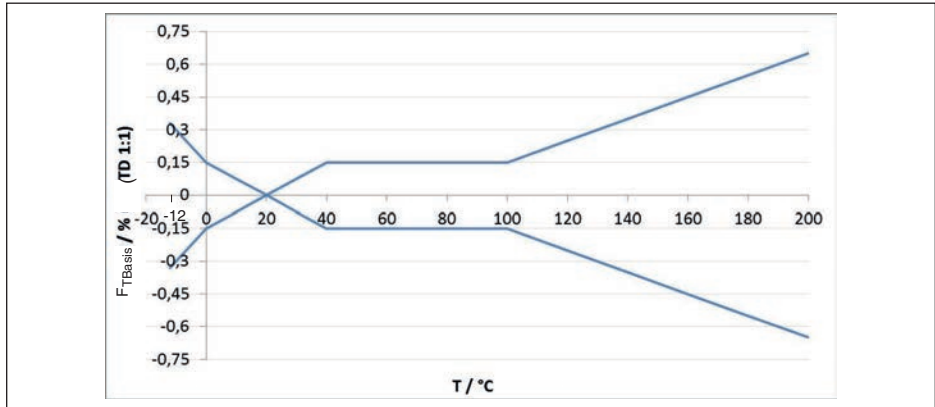


Fig. 33: Basic temperature error F_{TBasis} at TD 1 : 1

The basic temperature error in % from the above graphic can increase due to the additional factors, depending on the measuring cell version (factor FMZ) and the Turn Down (factor FTD). The additional factors are listed in the following tables.

Additional factor through measuring cell version

| Measuring cell version | Measuring cell - Standard | |
|------------------------|---------------------------|-------|
| | 0.075 %, 0.1 % | 0.2 % |
| Factor FMZ | 1 | 3 |

Additional factor through Turn Down

The additional factor FTD through Turn down is calculated according to the following formula:

$$F_{TD} = 0.5 \times TD + 0.5$$

In the table, example values for typical Turn downs are listed.

| Turn Down | TD 1 : 1 | TD 2.5 : 1 | TD 5 : 1 | TD 10 : 1 | TD 20 : 1 |
|------------|----------|------------|----------|-----------|-----------|
| Factor FTD | 1 | 1.75 | 3 | 5.5 | 10.5 |

Long-term stability (according to DIN 16086)

Applies to the respective **digital** signal output (e.g. HART, Profibus PA) as well as to **analogue** current output 4 ... 20 mA under reference conditions. Specifications refer to the set span. Turn down (TD) is the ratio nominal measuring range/set span.¹²⁾

Long-term stability - Ceramic/metallic measuring cell

| Time period | |
|-------------|---------------|
| One year | < 0.05 % x TD |
| Five years | < 0.1 % x TD |

¹²⁾ With ceramic/metallic measuring cell with gold-coated diaphragm, the values must be multiplied with factor 3.

| | |
|--------------------|--------------|
| Time period | |
| Ten years | < 0.2 % x TD |

Long-term stability - Piezoresistive/Strain gauge measuring cell

| | |
|---|--------------------|
| Version | |
| Measuring ranges > 1 bar | < 0.1 % x TD/year |
| Measuring ranges > 1 bar, isolating liquid, synthetic oil, diaphragm Elgiloy (2.4711) | < 0.15 % x TD/year |
| Measuring range 1 bar | < 0.15 % x TD/year |
| Measuring range 0.4 bar | < 0.35 % x TD/year |

Ambient conditions

| Version | Ambient temperature | Storage and transport temperature |
|--|----------------------------------|-----------------------------------|
| Standard version | -40 ... +80 °C (-40 ... +176 °F) | -60 ... +80 °C (-76 ... +176 °F) |
| Version IP66/IP68 (1 bar) | -20 ... +80 °C (-4 ... +176 °F) | -20 ... +80 °C (-4 ... +176 °F) |
| Version IP68 (25 bar), with connection cable PUR | -20 ... +80 °C (-4 ... +176 °F) | -20 ... +80 °C (-4 ... +176 °F) |
| Version IP68 (25 bar), connection cable PE | -20 ... +60 °C (-4 ... +140 °F) | -20 ... +60 °C (-4 ... +140 °F) |

Process conditions - Piezoresistive/Strain gauge measuring cell

Process temperature

| Seal | Sensor version | | | | |
|--|---|-------------------------------------|------------------------------------|-------------------------------------|------------------------------------|
| | Standard | Extended temperature range | Hygienic fittings | | Version for oxygen applications |
| | $p_{abs} \geq 1 \text{ mbar}$ | | $p_{abs} \geq 1 \text{ mbar}$ | $p_{abs} \geq 10 \text{ mbar}$ | $p_{abs} \geq 10 \text{ mbar}$ |
| Without consideration of the seal ¹³⁾ | -20/-40 ... +105 °C (-4/-40 ... +221 °F) | - | - | - | -20 ... +60 °C |
| FKM (VP2/A) | -20 ... +105 °C (-4 ... +221 °F) | -20 ... +150 °C (-4 ... +302 °F) | -20 ... +85 °C (-4 ... +185 °F) | -20 ... +150 °C (-4 ... +302 °F) | (-4 ... +140 °F) |
| EPDM (A+P 70.10-02) | -20 ... +105 °C (-4 ... +221 °F) | -20 ... +150 °C (-4 ... +302 °F) | -20 ... +85 °C (-4 ... +185 °F) | -20 ... +150 °C (-4 ... +302 °F) | (-4 ... +140 °F) |
| FFKM (Perlast G75S) | -15 ... +105 °C (+5 ... +221 °F) | -15 ... +150 °C (+5 ... +302 °F) | -15 ... +85 °C (+5 ... +185 °F) | -15 ... +150 °C (+5 ... +302 °F) | -15 ... +60 °C (+5 ... +140 °F) |
| FPEM (Fluoraz SD890) | -5 ... +105 °C (+23 ... +221 °F) | - | - | - | -5 ... +60 °C (+23 ... +140 °F) |

Temperature derating

¹³⁾ Process fittings acc. to DIN 3852-A, EN 837

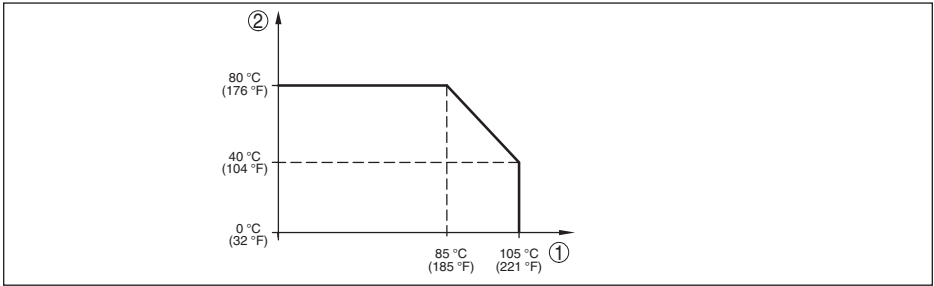


Fig. 34: Temperature derating IPT-2x, version up to +105 °C (+221 °F)

- 1 Process temperature
- 2 Ambient temperature

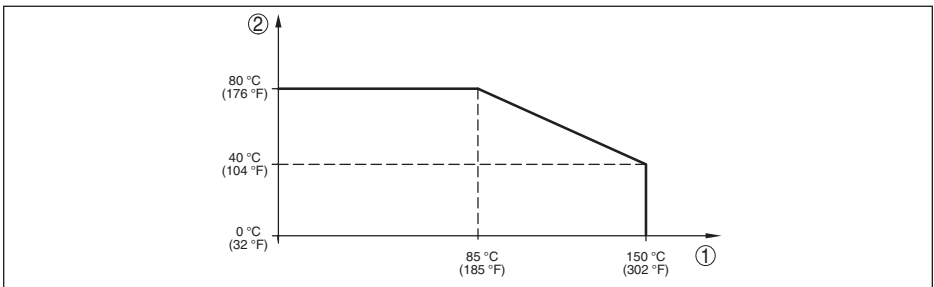


Fig. 35: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
- 2 Ambient temperature

SIP process temperature (SIP = Sterilization in place)

Vapour stratification for 2 h¹⁴⁾ +150 °C (+302 °F)

Process pressure

Permissible process pressure see specification "Process pressure" on the type label

Mechanical stress

| Version | Without cooling zone | | With cooling zone | |
|--|----------------------------|--|----------------------------|--|
| | All housing versions | Double chamber stainless steel housing | All housing versions | Double chamber stainless steel housing |
| Vibration resistance 1 to 4 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance) | 4 g (GL characteristics 2) | 0.7 g (GL characteristics 1) | 4 g (GL characteristics 2) | 0.7 g (GL characteristics 1) |
| Shock resistance 2.3 ms according to EN 60068-2-27 (mechanical shock) | 50 g | | 50 g | 20 g |

¹⁴⁾ Instrument configuration suitable for vapour

Process conditions - Ceramic/metallic measuring cell

Process temperature

| Version | Temperature range | | |
|----------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | $p_{abs} \geq 50 \text{ mbar}$ | $p_{abs} \geq 10 \text{ mbar}$ | $p_{abs} \geq 1 \text{ mbar}$ |
| Standard | -12 ... +150 °C (+10 ... +284 °F) | | |
| Extended temperature range | -12 ... +180 °C (+10 ... +356 °F) | -12 ... +160 °C (+10 ... +320 °F) | -12 ... +120 °C (+10 ... +248 °F) |
| | -12 ... +200 °C (+10 ... +392 °F) | | |

Temperature derating

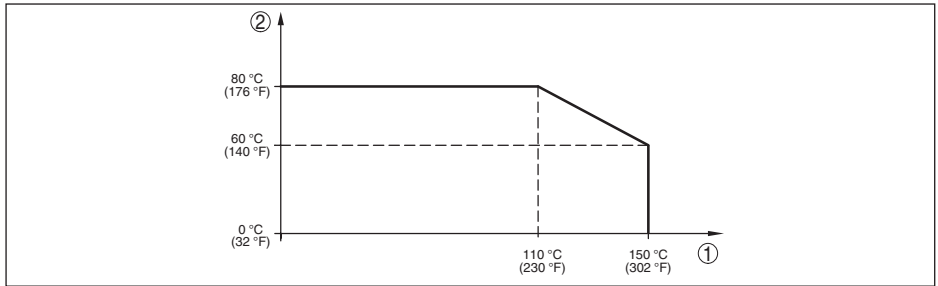


Fig. 36: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
- 2 Ambient temperature

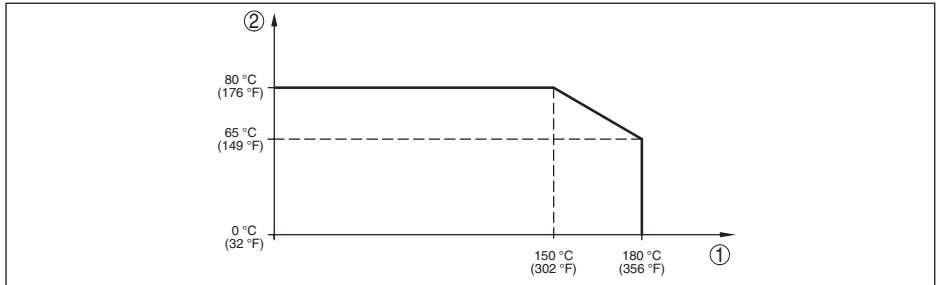


Fig. 37: Temperature derating IPT-2x, version up to +180 °C (+356 °F)

- 1 Process temperature
- 2 Ambient temperature

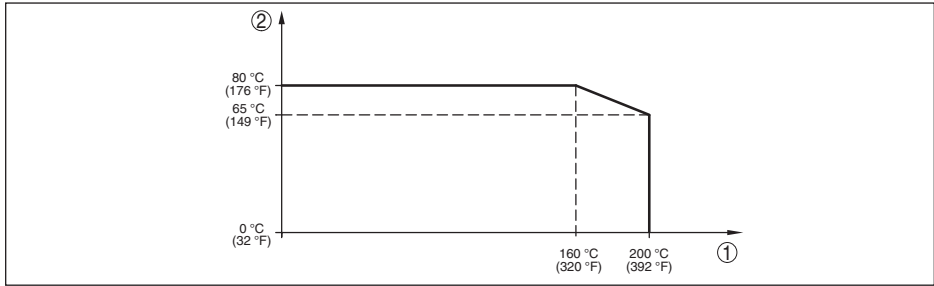


Fig. 38: Temperature derating IPT-2x, version up to +200 °C (+392 °F)

- 1 Process temperature
- 2 Ambient temperature

Process pressure

Permissible process pressure see specification "Process pressure" on the type label

Mechanical stress¹⁵⁾

Vibration resistance 1 to 4 g at 5 ... 200 Hz according to EN 60068-2-6 (vibration with resonance)

4 g

Shock resistance

50 g, 2.3 ms according to EN 60068-2-27 (mechanical shock)¹⁶⁾

Electromechanical data - version IP66/IP67 and IP66/IP68 (0.2 bar)¹⁷⁾

Options of the cable entry

- Cable entry M20 x 1.5; ½ NPT
- Cable gland M20 x 1.5, ½ NPT (cable ø see below table)
- Blind plug M20 x 1.5; ½ NPT
- Closing cap ½ NPT

| Material cable gland/Seal insert | Cable diameter | | | |
|----------------------------------|----------------|-------------|-------------|--------------|
| | 5 ... 9 mm | 6 ... 12 mm | 7 ... 12 mm | 10 ... 14 mm |
| PA/NBR | ● | ● | - | ● |
| Brass, nickel-plated/NBR | ● | ● | - | - |
| Stainless steel/NBR | - | - | ● | - |

Wire cross-section (spring-loaded terminals)

- Massive wire, stranded wire 0.2 ... 2.5 mm² (AWG 24 ... 14)
- Stranded wire with end sleeve 0.2 ... 1.5 mm² (AWG 24 ... 16)

¹⁵⁾ Depending on the instrument version.

¹⁶⁾ 2 g with housing version stainless steel double chamber

¹⁷⁾ IP66/IP68 (0.2 bar), only with absolute pressure.

Electromechanical data - version IP66/IP68 (1 bar)

Connection cable, mechanical data

| | |
|--|---|
| – Configuration | Wires, breather capillaries, strain relief, screen braiding, metal foil, mantle |
| – Standard length | 5 m (16.4 ft) |
| – Min. bending radius (at 25 °C/77 °F) | 25 mm (0.984 in) |
| – Diameter | approx. 8 mm (0.315 in) |
| – Colour - version PE | Black |
| – Colour - version PUR | Blue |

Connection cable, electrical data

| | |
|----------------------|------------------------------|
| – Wire cross-section | 0.5 mm ² (AWG 20) |
| – Wire resistance R` | 0.037 Ω/m (0.012 Ω/ft) |

Electromechanical data - version IP68 (25 bar)

Connection cable transmitter - external housing, mechanical data

| | |
|--------------------------------------|--|
| – Configuration | Wires, strain relief, breather capillaries, screen braiding, metal foil, mantle ¹⁸⁾ |
| – Standard length | 5 m (16.40 ft) |
| – Max. length | 180 m (590.5 ft) |
| – Min. bending radius at 25 °C/77 °F | 25 mm (0.985 in) |
| – Diameter | approx. 8 mm (0.315 in) |
| – Material | PE, PUR |
| – Colour | Black, blue |

Connection cable transmitter - external housing, electrical data

| | |
|----------------------|------------------------------|
| – Wire cross-section | 0.5 mm ² (AWG 20) |
| – Wire resistance | 0.037 Ω/m (0.012 Ω/ft) |

Display and adjustment module

| | |
|-----------------|------------------------|
| Display element | Display with backlight |
|-----------------|------------------------|

Measured value indication

| | |
|--------------------|---|
| – Number of digits | 5 |
|--------------------|---|

Adjustment elements

| | |
|----------|----------------------------------|
| – 4 keys | [OK], [->], [+], [ESC] |
|----------|----------------------------------|

Protection rating

| | |
|--------------------------------------|------|
| – unassembled | IP20 |
| – Mounted in the housing without lid | IP40 |

Materials

| | |
|---------------------|----------------|
| – Housing | ABS |
| – Inspection window | Polyester foil |

Functional safety

| |
|------------------|
| SIL non-reactive |
|------------------|

¹⁸⁾ Breather capillaries not with Ex-d version.

Interface to the external display and adjustment unit

| | |
|-------------------|--------------------------------|
| Data transmission | Digital (I ² C-Bus) |
| Connection cable | Four-wire |

| Sensor version | Configuration, connection cable | |
|--|---------------------------------|----------|
| | Max. cable length | Shielded |
| 4 ... 20 mA/HART 4 ... 20 mA/HART SIL | 50 m | ● |
| Profibus PA, Foundation Fieldbus | 25 m | ● |

Integrated clock

| | |
|----------------------------|----------------|
| Date format | Day.Month.Year |
| Time format | 12 h/24 h |
| Time zone, factory setting | CET |
| Max. rate deviation | 10.5 min/year |

Additional output parameter - Electronics temperature

| | |
|----------------------------------|---------------------------------------|
| Range | -40 ... +85 °C (-40 ... +185 °F) |
| Resolution | < 0.1 K |
| Deviation | ±3 K |
| Output of the temperature values | |
| – Indication | Via the display and adjustment module |
| – Output | Via the respective output signal |

Voltage supply

| | |
|---|------------------|
| Operating voltage U_B | 9 ... 32 V DC |
| Operating voltage U_B with lighting switched on | 13.5 ... 32 V DC |
| Power supply by/max. number of sensors | Fieldbus/32 |

Potential connections and electrical separating measures in the instrument

| | |
|----------------------------------|--|
| Electronics | Not non-floating |
| Reference voltage ¹⁹⁾ | 500 V AC |
| Conductive connection | Between ground terminal and metallic process fitting |

Electrical protective measures²⁰⁾

| Housing material | Version | Protection acc. to IEC 60529 | Protection acc. to NEMA |
|------------------|----------------|------------------------------|-------------------------|
| Plastic | Single chamber | IP66/IP67 | Type 4X |
| | Double chamber | | |

¹⁹⁾ Galvanic separation between electronics and metal housing parts

²⁰⁾ Protection rating IP66/IP68 (0.2 bar) only in conjunction with absolute pressure.

| Housing material | Version | Protection acc. to IEC 60529 | Protection acc. to NEMA |
|-------------------------------------|--|--|-------------------------|
| Aluminium | Single chamber | IP66/IP67 IP66/IP68 (0.2 bar) IP68 (1 bar) | Type 4X Type 6P - |
| | Double chamber | IP66/IP67 IP66/IP68 (0.2 bar) | Type 4X Type 6P |
| Stainless steel (electro-polished) | Single chamber | IP66/IP67 IP69K | Type 4X |
| Stainless steel (precision casting) | Single chamber | IP66/IP67 IP66/IP68 (0.2 bar) IP68 (1 bar) | Type 4X Type 6P - |
| | Double chamber | IP66/IP67 IP66/IP68 (0.2 bar) | Type 4X Type 6P |
| Stainless steel | Transmitter, version with external housing | IP68 (25 bar) | - |

Connection of the feeding power supply unit Networks of overvoltage category III

Altitude above sea level

- by default up to 2000 m (6562 ft)
- with connected overvoltage protection up to 5000 m (16404 ft)

Pollution degree²¹⁾ 2

Protection rating (IEC/EN 61010-1) II

10.2 Device communication Foundation Fieldbus

In the following, the necessary device-specific details are shown. You can find further information of Foundation Fieldbus on www.fieldbus.com.

Overview

The following table gives you an overview of the instrument versions and the corresponding device descriptions, the electrical characteristics of the bus system as well as the applied function blocks.

| | | |
|----------------|--|--------------------|
| Revisions Data | DD-Revision | Rev_01 |
| | CFF-File | 020101.cff |
| | Device Revision | 0101.ff0, 0101.ff5 |
| | Cff-Revision | xx xx 01 |
| | Device software revision | > 1.1.0 |
| | ITK (Interoperability Test Kit) Number | 6.2.0 |

²¹⁾ When used with fulfilled housing protection.

| | | |
|-----------------------------|--|--|
| Electrical Characteristics | Physical Layer Type | Low-power signaling, bus-powered, FISCO I.S. |
| | Input Impedance | > 3000 Ohms between 7.8 KHz - 39 KHz |
| | Unbalanced Capacitance | < 250 pF to ground from either input terminal |
| | Output Amplitude | 0.8 V P-P |
| | Electrical Connection | 2 Wire |
| | Polarity Insensitive | Yes |
| | Max. Current Load | 11 mA |
| | Device minimum operating voltage | 9 V |
| Transmitter Function Blocks | Resource Block (RB) | 1 |
| | Transducer Block (TB) | 1 |
| | Standard Block (AI) | 3 |
| | Execution Time | 30 mS |
| Advanced Function Blocks | Discret Input (DI) | Yes |
| | PID Control | Yes |
| | Output Splitter (OS) | Yes |
| | Signal Characterizer (SC) | Yes |
| | Integrator | Yes |
| | Input Selector (IS) | Yes |
| | Arithmetic (AR) | Yes |
| Diagnostics | Standard | Yes |
| | Advanced | Yes |
| | Performance | No |
| | Function Blocks Instantiable | No |
| General Information | LAS (Link Active Scheduler) | Yes |
| | Master Capable | Yes |
| | Number of VCRs (Virtual Communication Relationships) | 47 |

10.3 Calculation of the total deviation

The total deviation of a pressure transmitter indicates the maximum measurement error to be expected in practice. It is also called maximum practical deviation or operational error.

According to DIN 16086, the total deviation F_{total} is the sum of the basic deviation F_{perf} and the long-term stability F_{stab} :

$$F_{\text{total}} = F_{\text{perf}} + F_{\text{stab}}$$

The basic deviation F_{perf} consists of the thermal change of the zero signal and the output span F_T as well as the deviation F_{KI} :

$$F_{\text{perf}} = \sqrt{(F_T)^2 + (F_{KI})^2}$$

The thermal change of zero signal and output span F_T is specified in chapter "Technical data". The

basic temperature error F_T is shown in a graphic. Depending on the measuring cell version and Turn down, this value must be multiplied with the additional factors FMZ and FTD:

$$F_T \times FMZ \times FTD$$

Also these values are specified in chapter "Technical data".

This applies for a digital signal output through HART, Profibus PA or Foundation Fieldbus.

With a 4 ... 20 mA output, the thermal change of the current output F_a must be added:

$$F_{perf} = \sqrt{((F_T)^2 + (F_{KI})^2 + (F_a)^2)}$$

To provide a better overview, the formula symbols are listed together below:

- F_{total} : Total deviation
- F_{perf} : Basic deviation
- F_{stab} : Long-term stability
- F_T : Thermal change of zero signal and output span (temperature error)
- F_{KI} : Deviation
- F_a : Thermal change of the current output
- FMZ: Additional factor measuring cell version
- FTD: Additional factor Turn down

10.4 Calculation of the total deviation - Practical example

Data

Pressure measurement in the pipeline 4 bar (400 KPa), product temperature 40 °C

IPT-2x with measuring range 10 bar, deviation < 0.1 %, process fitting G1 (piezoresistive measuring cell)

The required values for the temperature error F_T , deviation F_{KI} and long-term stability F_{stab} are available in the technical data.

1. Calculation of the Turn down

$$TD = 10 \text{ bar} / 4 \text{ bar}, TD = 2.5 : 1$$

2. Determination temperature error F_T

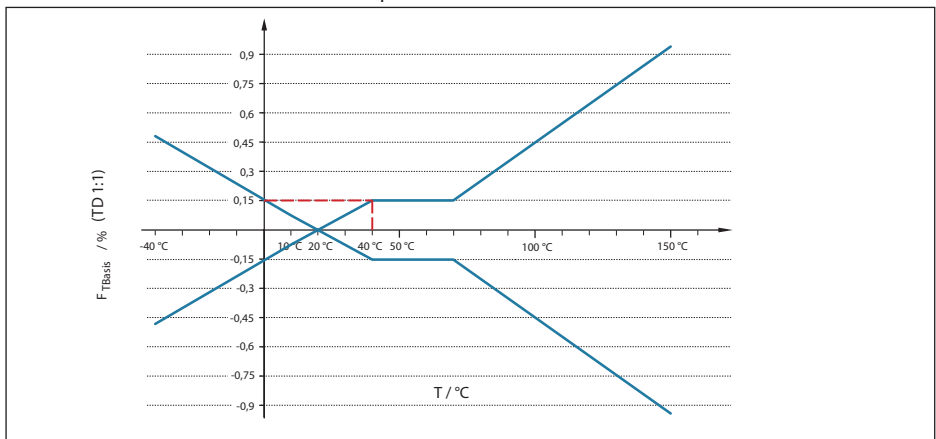


Fig. 39: Determination of the basic temperature error for the above example: $F_{TBasis} = 0.15 \%$

| Accuracy class | In the compensated temperature range of 10 ... +70 °C | |
|----------------|---|-------|
| | 0.075 %, 0.1 % | 0.2 % |
| Factor FMZ | 1 | 3 |

Tab. 29: Determination of the additional factor measuring cell for above example: $F_{MZ} = 1$

| Turn Down | TD 1 : 1 | TD 2.5 : 1 | TD 5 : 1 | TD 10 : 1 | TD 20 : 1 |
|------------|----------|------------|----------|-----------|-----------|
| Factor FTD | 1 | 1.75 | 3 | 5.5 | 10.5 |

Tab. 30: Determination of the additional factor "turn down" for the above example: $F_{TD} = 1.75$

$$F_T = F_{TBasis} \times F_{MZ} \times F_{TD}$$

$$F_T = 0.15 \% \times 1 \times 1.75$$

$$F_T = 0.26 \%$$

3. Determination of deviation and long-term stability

| Accuracy class | Non-linearity, hysteresis and non-repeatability | |
|----------------|---|---------------|
| | TD ≤ 5 : 1 | TD > 5 : 1 |
| 0.05 % | < 0.05 % | < 0.01 % x TD |
| 0.1 % | < 0.1 % | < 0.02 % x TD |
| 0.2 % | < 0.2 % | < 0.04 % x TD |

Tab. 31: Determination of the deviation from table: $F_{KI} = 0.1 \%$

| Version | |
|---|--------------------|
| Measuring ranges > 1 bar | < 0.1 % x TD/year |
| Measuring ranges > 1 bar, isolating liquid, synthetic oil, diaphragm Elgiloy (2.4711) | < 0.15 % x TD/year |
| Measuring range 1 bar | < 0.15 % x TD/year |
| Measuring range 0.4 bar | < 0.35 % x TD/year |

Tab. 32: Determination of the long-term stability from the table, consideration for one year: $F_{stab} = 0.1 \% \times TD/year$

4. Calculation of the total deviation - digital signal outputs

- 1. step: Basic accuracy F_{perf}

$$F_{perf} = \sqrt{(F_T)^2 + (F_{KI})^2}$$

$$F_T = 0.26 \%$$

$$F_{KI} = 0.1 \%$$

$$F_{perf} = \sqrt{(0.26 \%)^2 + (0.1 \%)^2}$$

$$F_{perf} = 0.28 \%$$

- 2. step: Total deviation F_{total}

$$F_{total} = F_{perf} + F_{stab}$$

$$F_{perf} = 0.28 \% \text{ (result of step 1)}$$

$$F_{stab} = (0.1 \% \times TD)$$

$$F_{stab} = (0.1 \% \times 2.5)$$

$$F_{\text{stab}} = 0.25 \%$$

$$F_{\text{total}} = 0.28 \% + 0.25 \% = 0.53 \%$$

The total deviation of the measurement is hence 0.53 %.

Deviation in bar: 0.53 % of 4 bar = 0.021 mbar

The example shows that the measurement error in practice can be considerably higher than the basic accuracy. Reasons are temperature influence and Turn down.

10.5 Dimensions

Plastic housing

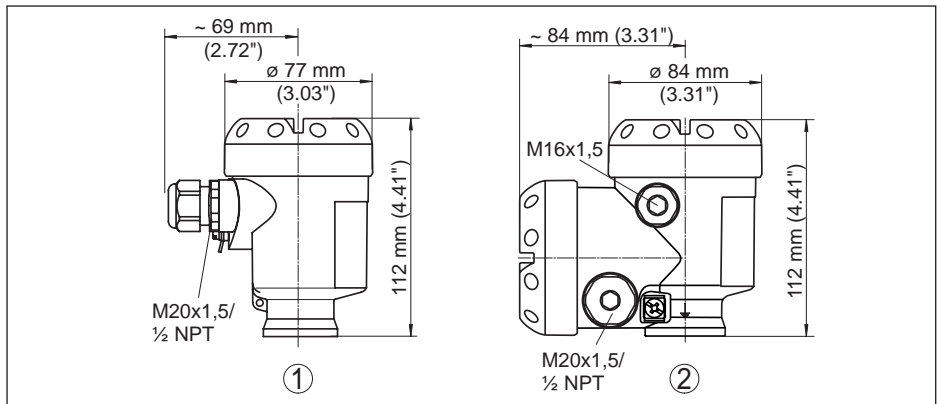


Fig. 40: Housing versions in protection IP66/IP67 (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Plastic single chamber
- 2 Plastic double chamber

Aluminium housing

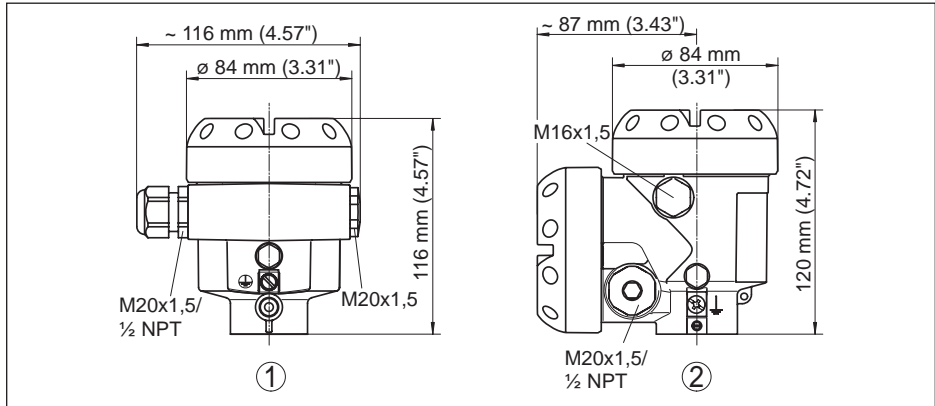


Fig. 41: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Aluminium - single chamber
- 2 Aluminium - double chamber

Aluminium housing with protection rating IP66/IP68 (1 bar)

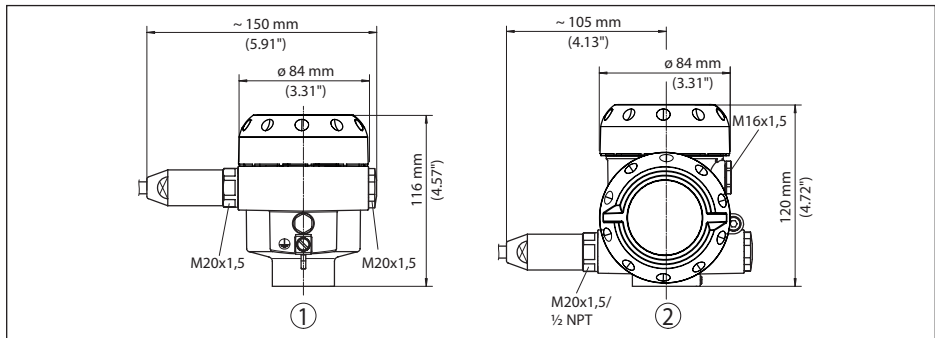


Fig. 42: Housing version with protection rating IP66/IP68 (1 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Aluminium - single chamber
- 2 Aluminium - double chamber

Stainless steel housing

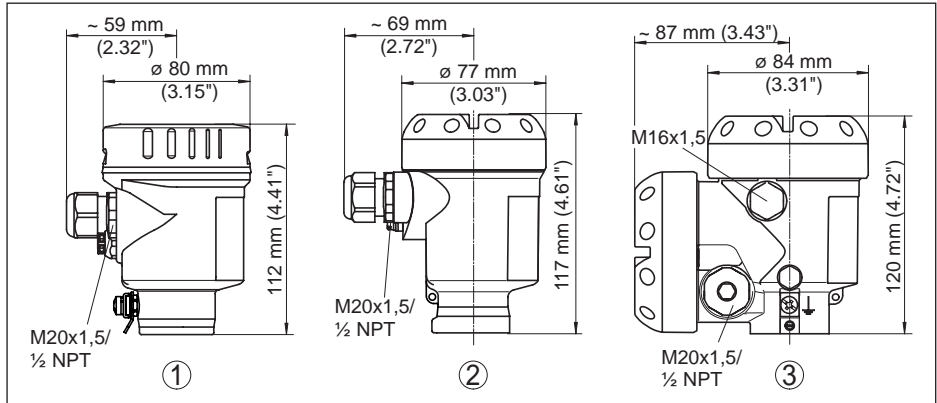


Fig. 43: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Stainless steel single chamber (electropolished)
- 2 Stainless steel single chamber (precision casting)
- 2 Stainless steel double chamber housing (precision casting)

Stainless steel housing with protection rating IP66/IP68 (1 bar)

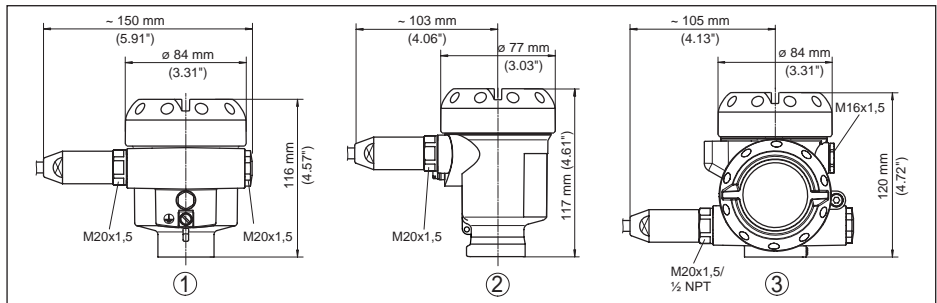


Fig. 44: Housing version with protection rating IP66/IP68 (1 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Stainless steel single chamber (electropolished)
- 2 Stainless steel single chamber (precision casting)
- 2 Stainless steel double chamber housing (precision casting)

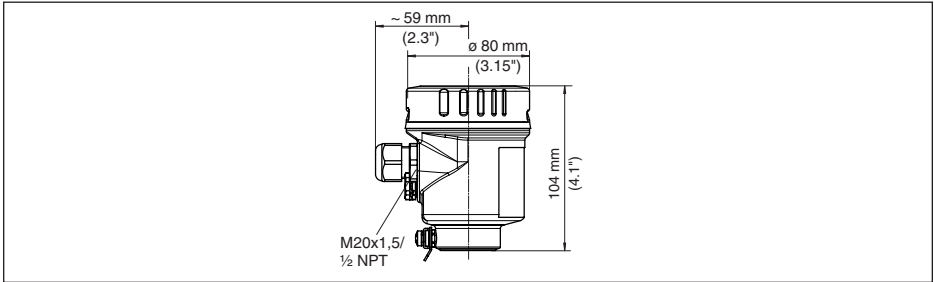
Stainless steel housing with protection rating IP69K

Fig. 45: Housing version with protection rating IP69K (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Stainless steel single chamber (electropolished)

External housing with IP68 (25 bar) version

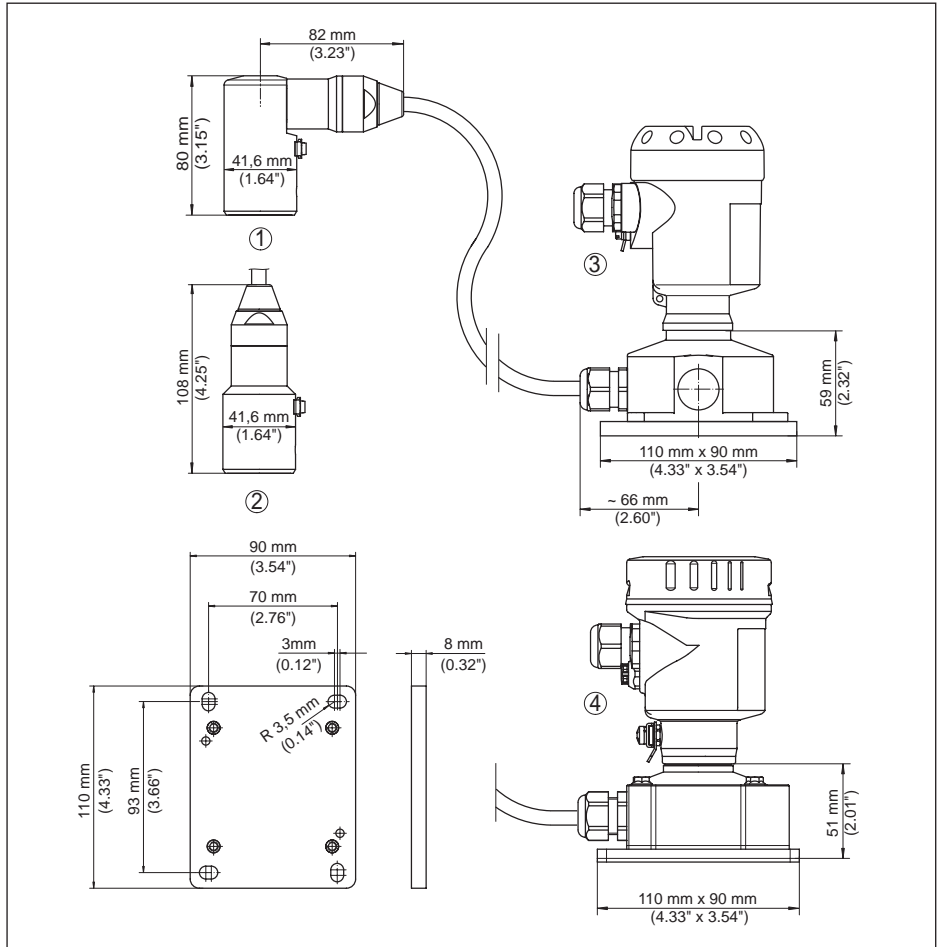


Fig. 46: IP68 (25 bar) version with external housing

- 1 Lateral cable outlet
- 2 Axial cable outlet
- 3 Plastic single chamber
- 4 Stainless steel single chamber (electropolished)

IPT-2x, threaded fitting not front-flush

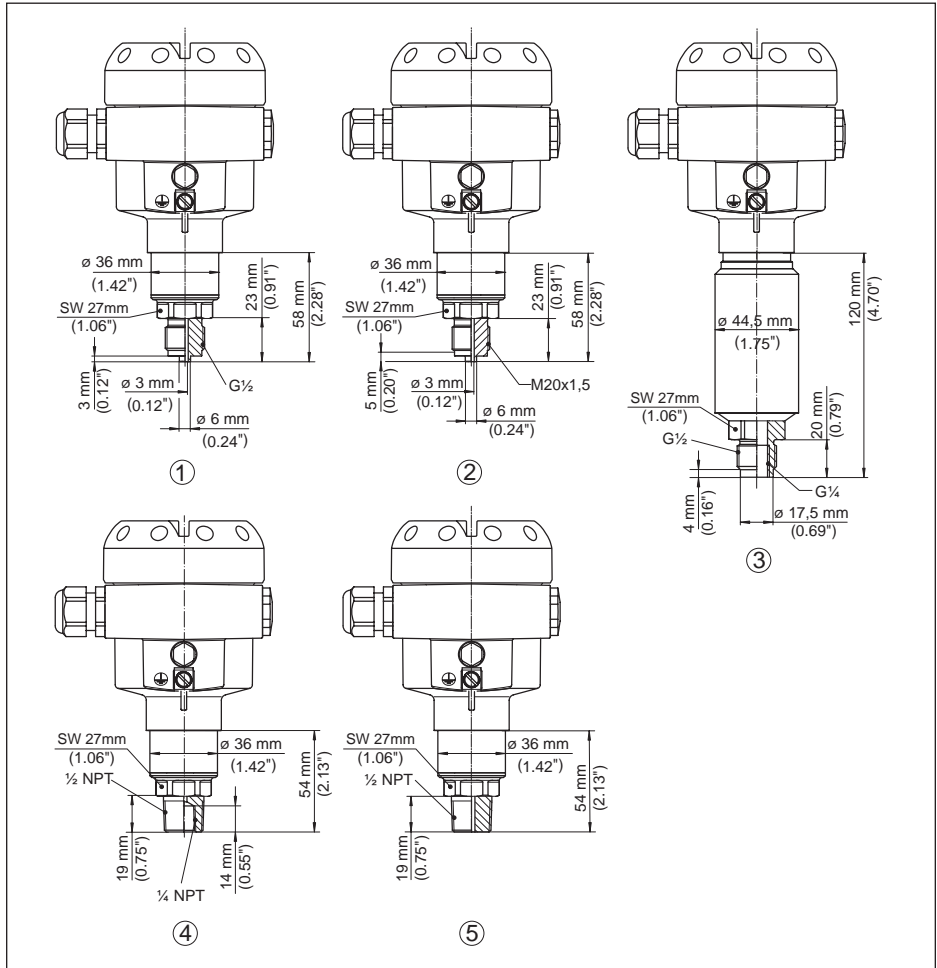


Fig. 47: IPT-2x, threaded fitting not front-flush

- 1 $G\frac{1}{2}$ manometer connection (EN 837)
- 2 $M20 \times 1.5$ manometer connection (EN 837)
- 3 $G\frac{1}{2}$ A inside $G\frac{1}{4}$ (ISO 228-1)
- 4 $\frac{1}{2}$ NPT, inside $\frac{1}{4}$ NPT (ASME B1.20.1)
- 5 $\frac{1}{2}$ NPT PN 1000

IPT-2x, threaded fitting front-flush

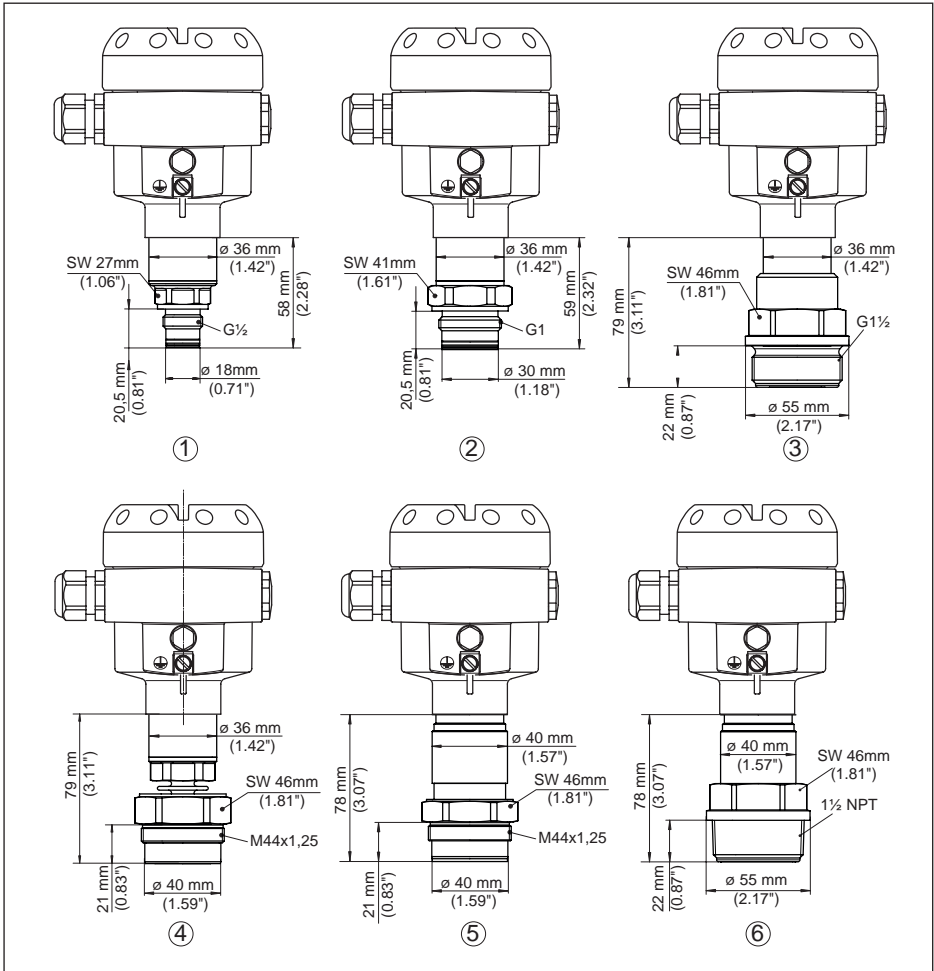


Fig. 48: IPT-2x, threaded fitting front-flush

- 1 G½ (ISO 228-1) with O-ring
- 2 G1 (ISO 228-1) with O-ring
- 3 G1½ (DIN3852-A)
- 4 M44 x 1.25 DIN 13; pressure screw: Aluminium
- 5 M44 x 1.25 DIN 13; pressure screw: 316L
- 6 1½ NPT (ASME B1.20.1)

IPT-2x, hygienic fitting 150 °C (piezoresistive/strain gauge measuring cell)

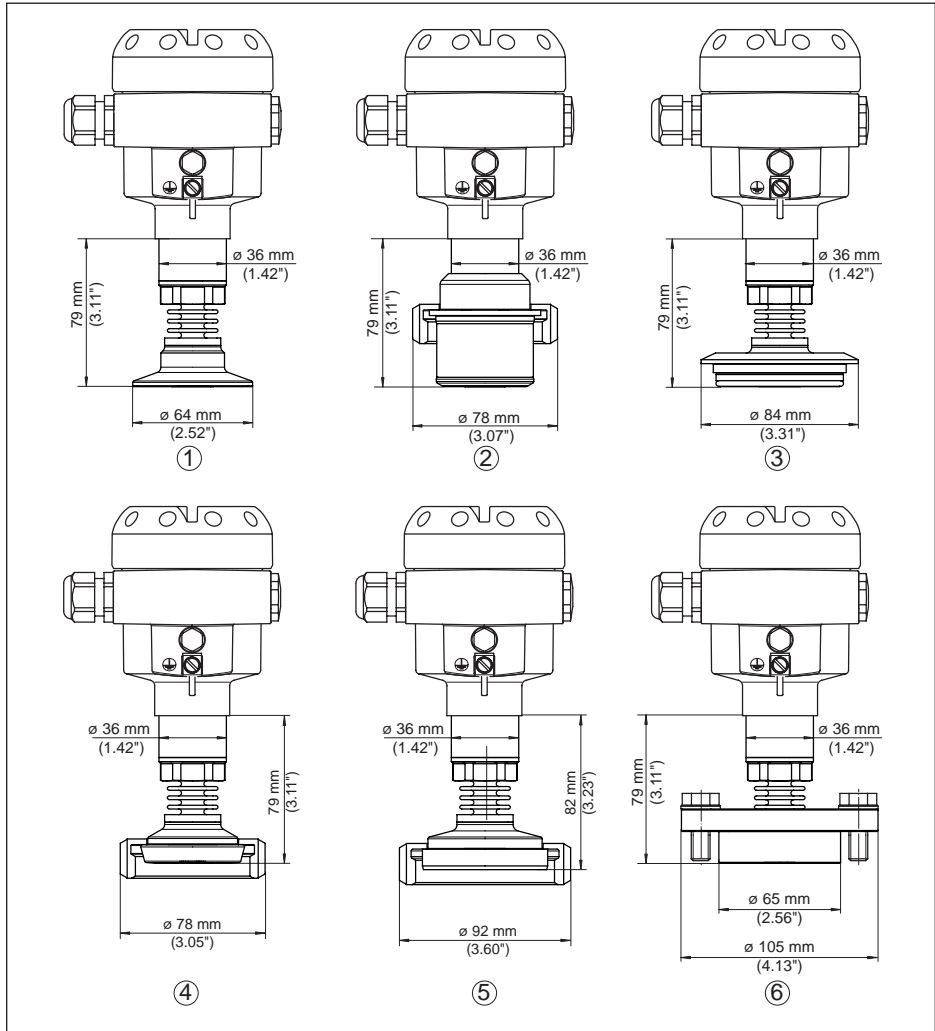


Fig. 49: IPT-2x, hygienic fitting 150 °C (piezoresistive/strain gauge measuring cell)

- 1 Clamp 2" PN16 ($\varnothing 64$ mm) DIN 32676, ISO 2852
- 2 Hygienic fitting with compression nut F 40 PN 25
- 3 Varivent N 50-40 PN 25
- 4 Collar socket DN 40 PN 40, DIN 11851
- 5 Collar socket DN 50 PN 25 Form A, DIN 11864
- 6 DRD PN 40

IPT-2x, hygienic fitting 150 °C (metallic/ceramic measuring cell)

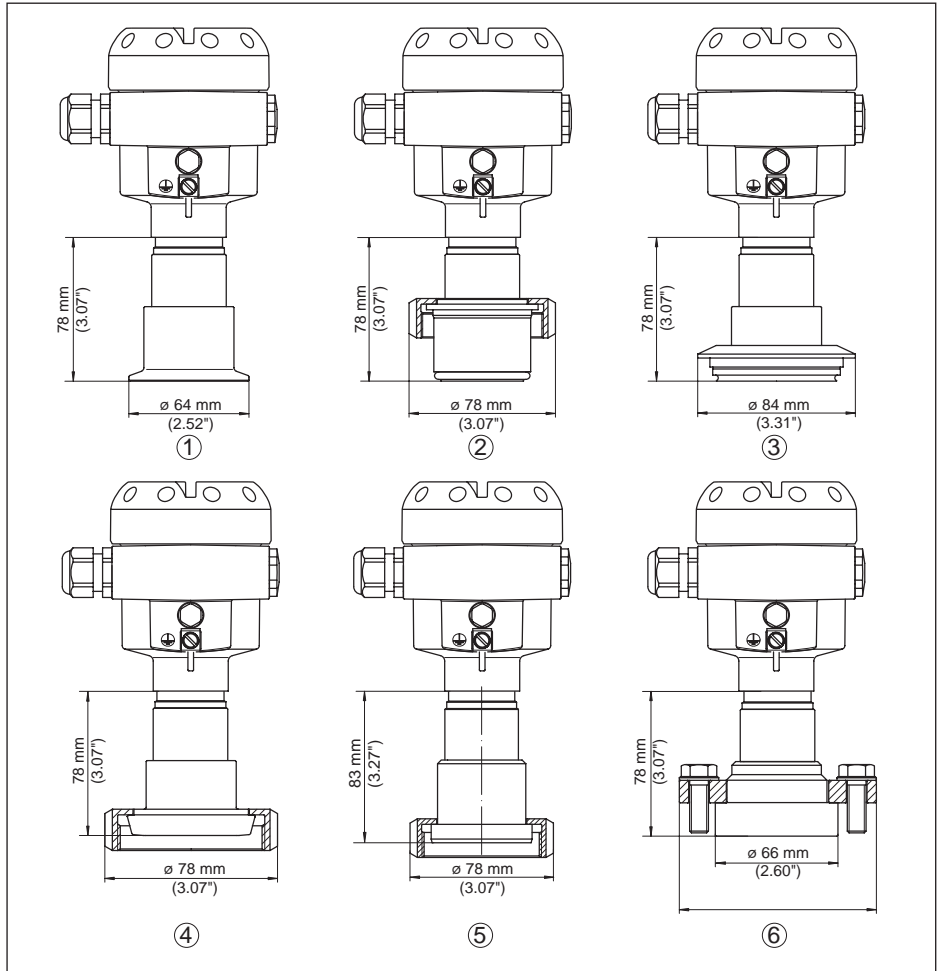


Fig. 50: IPT-2x, hygienic fitting 150 °C (metallic/ceramic measuring cell)

- 1 Clamp 2" PN16 ($\varnothing 64$ mm) DIN 32676, ISO 2852
- 2 Hygienic fitting with compression nut F 40 PN 25
- 3 Varivent N 50-40 PN 25
- 4 Collar socket DN 40 PN 40, DIN 11851
- 5 Collar socket DN 50 PN 25 Form A, DIN 11864
- 6 DRD PN 40

IPT-2x, flange connection 150 °C (piezoresistive/strain gauge measuring cell)

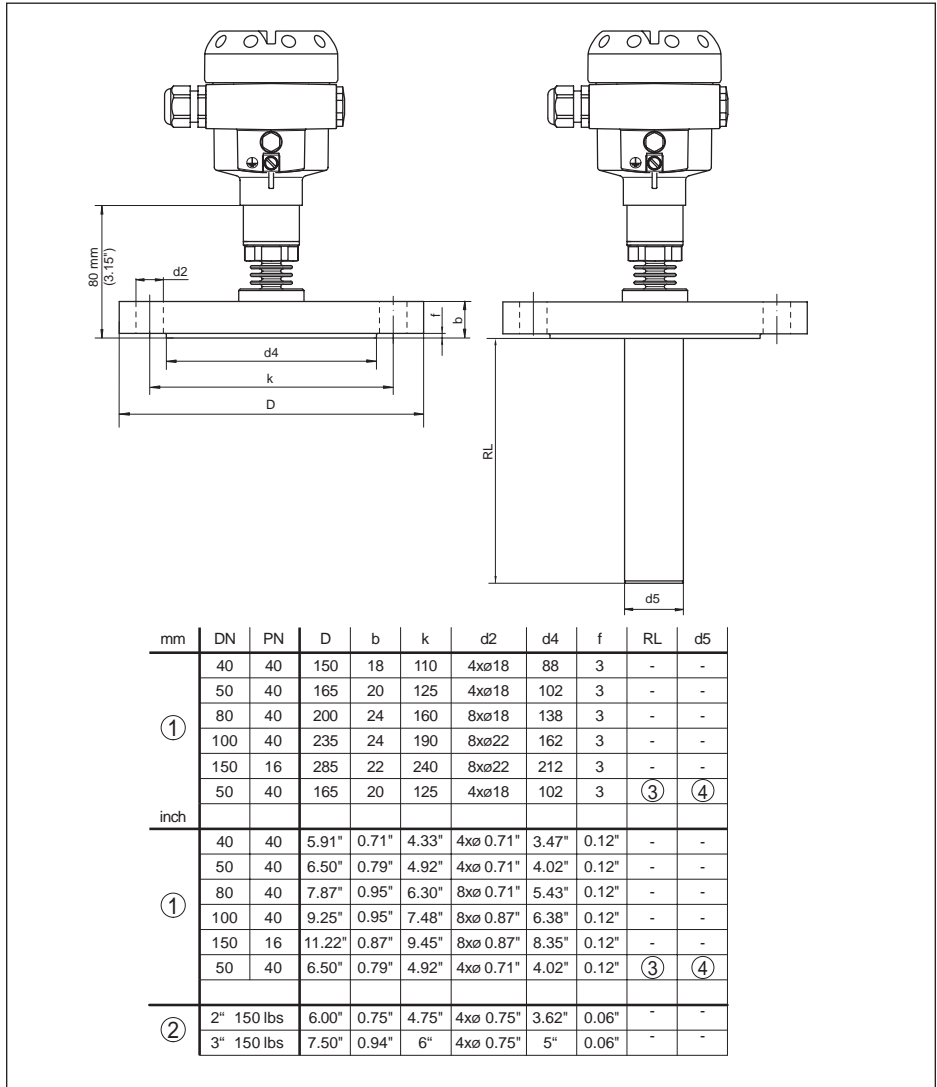
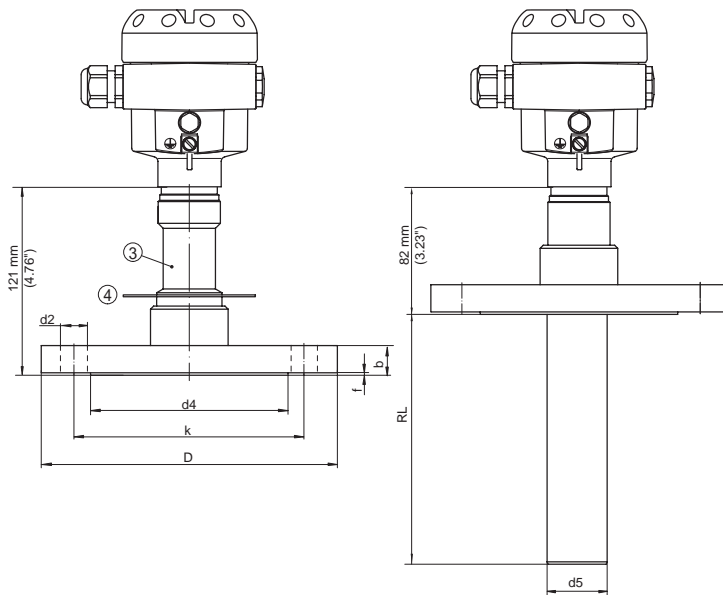


Fig. 51: IPT-2x, flange connection 150 °C (piezoresistive/strain gauge measuring cell)

- 1 Flange connection according to DIN 2501
- 2 Flange connection according to ASME B16.5
- 3 Order-specific
- 4 Order-specific

IPT-2x, flange connection 180 °C/200 °C (ceramic/metallic measuring cell)



| | mm | DN | PN | D | b | k | d2 | d4 | f | RL | d5 |
|---|------|-----|---------|--------|-------|-------|-----------|-------|-------|----|----|
| ① | | 40 | 40 | 150 | 18 | 110 | 4xø18 | 88 | 3 | - | - |
| | | 50 | 40 | 165 | 20 | 125 | 4xø18 | 102 | 3 | - | - |
| | | 80 | 40 | 200 | 24 | 160 | 8xø18 | 138 | 3 | - | - |
| | | 100 | 40 | 235 | 24 | 190 | 8xø22 | 162 | 3 | - | - |
| | | 150 | 40 | 300 | 28 | 250 | 8xø26 | 218 | 3 | - | - |
| | | 50 | 40 | 165 | 20 | 125 | 4xø18 | 102 | 3 | ⑤ | ⑥ |
| ① | inch | | | | | | | | | | |
| | | 40 | 40 | 5.91" | 0.71" | 4.33" | 4xø 0.71" | 3.47" | 0.12" | - | - |
| | | 50 | 40 | 6.50" | 0.79" | 4.92" | 4xø 0.71" | 4.02" | 0.12" | - | - |
| | | 80 | 40 | 7.87" | 0.95" | 6.30" | 8xø 0.71" | 5.43" | 0.12" | - | - |
| | | 100 | 40 | 9.25" | 0.95" | 7.48" | 8xø 0.87" | 6.38" | 0.12" | - | - |
| | | 150 | 40 | 11.81" | 1.10" | 9.84" | 8xø 1.02" | 8.58" | 0.12" | - | - |
| ② | | 50 | 40 | 6.50" | 0.79" | 4.92" | 4xø 0.71" | 4.02" | 0.12" | ⑤ | ⑥ |
| | | 2" | 150 lbs | 5.91" | 0.77" | 4.75" | 4xø 0.75" | 3.62" | 0.12" | - | - |
| | | 3" | 150 lbs | 7.48" | 0.96" | 6" | 4xø 0.75" | 5" | 0.12" | - | - |

Fig. 52: IPT-2x, flange connection 180 °C/200 °C (ceramic/metallic measuring cell)

- 1 Flange connection according to DIN 2501
- 2 Flange connection according to ASME B16.5
- 3 Temperature adapter up to 180 °C
- 4 Temperature screen sheet up to 200 °C
- 5 Order-specific
- 6 Order-specific

10.6 Trademark

All the brands as well as trade and company names used are property of their lawful proprietor/originator.

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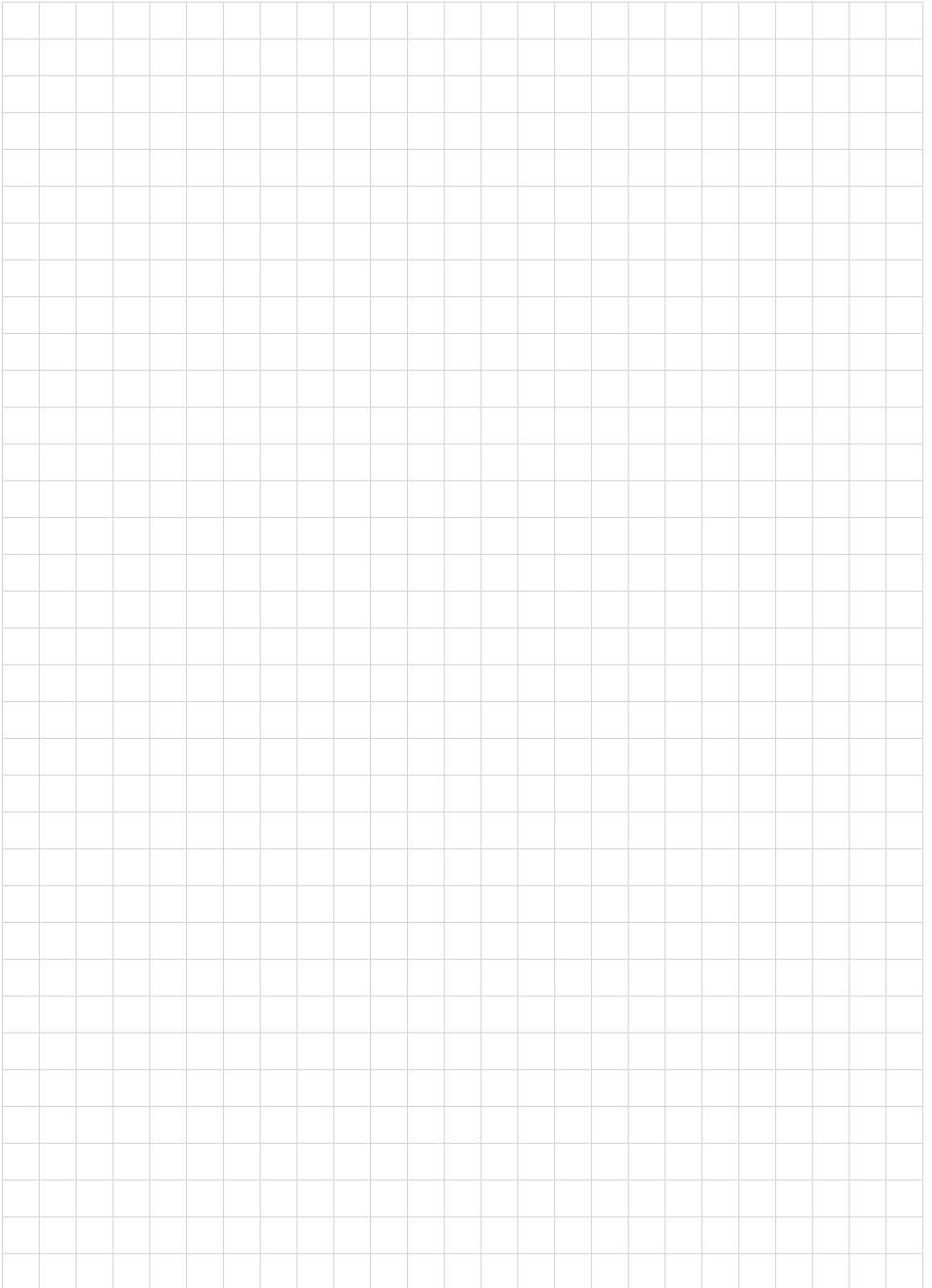
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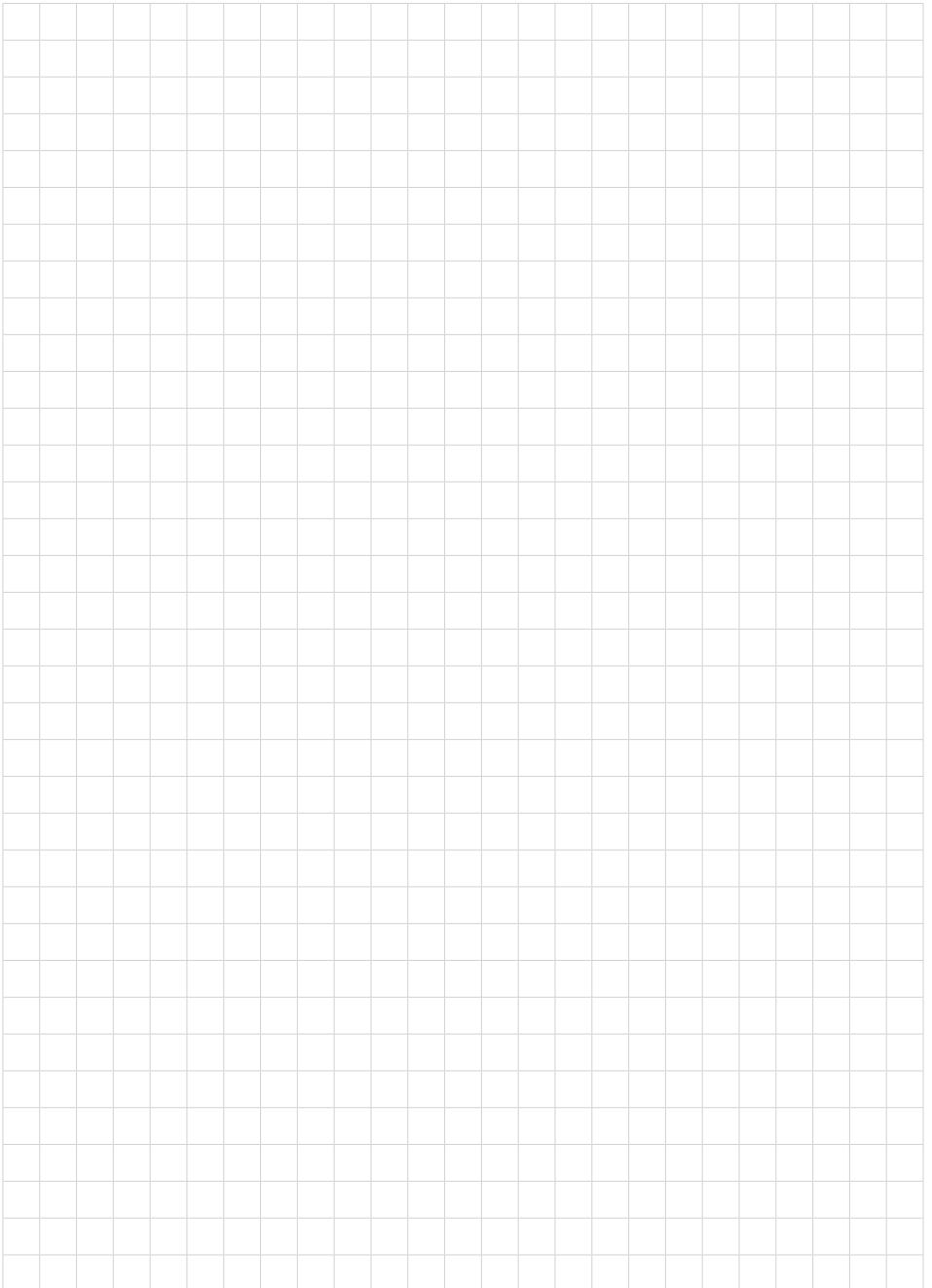
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Printing date:

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.



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