

Operating Instructions

Process pressure transmitter IPT-2x

GB

4 ... 20 mA/HART
With SIL qualification
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, safety and the exchange of parts. 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.



Disposal

This symbol indicates special instructions for disposal.

2 For your safety

2.1 Authorised personnel

All operations described in this documentation must be carried out only by trained and authorized personnel.

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 operating company 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 operating company 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.

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 us. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by us must be used.

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

2.5 Conformity

The device complies with the legal requirements of the applicable country-specific directives or technical regulations. We confirm conformity with the corresponding labelling.

The corresponding conformity declarations 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 SIL qualification according to IEC 61508

The Safety Integrity Level (SIL) of an electronic system is used to assess the reliability of integrated safety functions.

For detailed specification of the safety requirements, multiple SIL levels are specified according to safety standard IEC 61508. You can find detailed information in chapter " *Functional safety (SIL)*" of the operating instructions.

The instrument meets the specifications of IEC 61508: 2010 (Edition 2). It is qualified for single-channel operation up to SIL2. The instrument can be used homogeneously redundant up to SIL3 in multi-channel architecture with HFT 1.

2.7 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 equipment ²⁾
- NE 43 – Signal level for fault information from measuring transducers
- 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.

2.8 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

A Class 2 power supply unit has to be used for the installation in the USA and Canada.

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
 - Safety Manual (SIL)
 - Documentation instrument parameters (default values)
 - Documentation order-relating instrument parameters (deviation from default values)
 - 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.

Type label

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

- Instrument type
- Information about approvals
- Configuration information
- Technical data
- Serial number of the instrument
- QR code for device identification
- Manufacturer information

Documents and software

Further information can be found on our homepage.

There you will find the documentation and further information about the device.

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

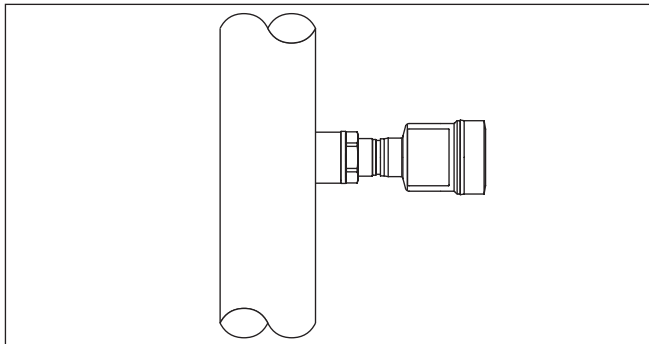


Fig. 1: Process pressure measurement IPT-2x



To reach the Safety Integrity Level (SIL) for the electronic differential pressure, both instruments must be SIL-qualified.

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 isolating liquid is used.

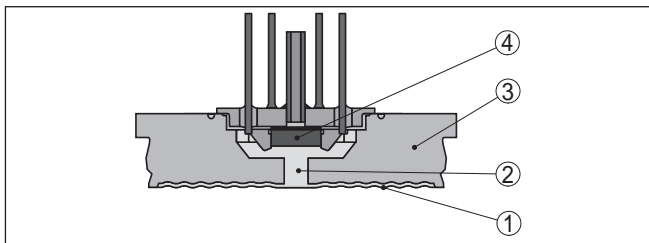


Fig. 2: Configuration of the measuring system with piezoresistive sensor element

- 1 Diaphragm
- 2 Isolating liquid
- 3 Base element
- 4 Sensor element

Strain gauge (DMS) sensor element

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

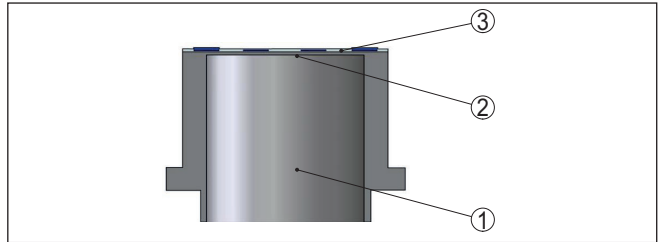


Fig. 3: Configuration of the measuring system with strain gauge (DMS) sensor element

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

Measuring system temperature

A temperature sensor on the respective sensor element for pressure records the current process temperature. The temperature value is output via the display and adjustment module, for example.

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.

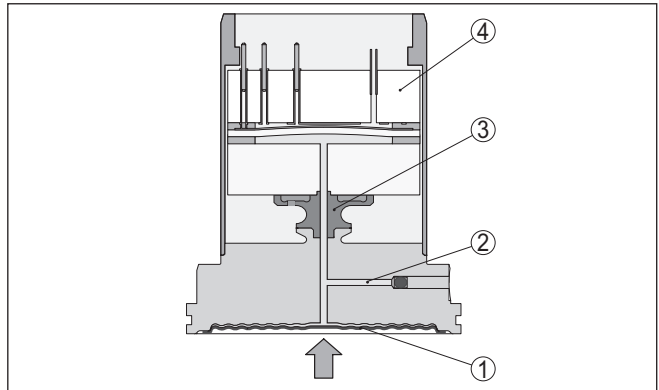


Fig. 4: Configuration of the ceramic/metallic measuring cell

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

Measuring system temperature

Temperature sensors in the ceramic diaphragm and on the ceramic base body of the ceramic measuring cell record the current process temperature. The temperature value is output via the display and adjustment module, for example.

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 Supplementary cleaning procedures

The IPT-2x is also available in the version " *Oil, grease and silicone-free* ". These instruments have passed through a special cleaning procedure to remove oil, grease and paint-wetting impairment substances (PWIS).

The cleaning is carried out on all wetted parts as well as on surfaces accessible from outside. To keep the purity level, the instruments are immediately packed in plastic foil after the cleaning process. The purity level remains as long as the instrument is kept in the closed original packaging.



Caution:

The IPT-2x in this version may not be used in oxygen applications. For this purpose, instruments are available in the special version " *Oil, grease and silicone-free for oxygen applications* ".

3.4 SIL features



The IPT-2x 4 ... 20 mA/HART with SIL qualification differs from the standard instrument in the following points:

- Type label: with SIL logo
- Scope of delivery: with Safety Manual and documentation of the device parameters
- Parameter adjustment: Device status " *Function Check* " is output during the parameter adjustment, the safety function is deactivated
- Measured value output: " *Failure* " is output when the measured value < -20% or > +120% of the nominal measuring range
- Adjustment menu, " *Current output* ": Failure mode 20.5 mA not selectable
- Adjustment menu, " *HART mode* ": Selection " *Analogue current output* " is unmodifiably preset
- Electronics temperature: in case of temperature values outside the permitted range, " *Failure* " is output
- Some diaphragm coatings not permissible



Information:

The measures that must be implemented to use the instrument in safety-instrumented systems are described in the "*Safety Manual*". The SIL function can be deactivated neither by the user nor by service personnel.

3.5 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 moisture 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 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

Avoid damages on the device by lateral forces, for example by vibrations. It is thus recommended to fix the devices with process fitting

thread G½ of plastic at the installation site via a suitable measuring instrument holder.

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



Note:

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*").



Caution:

For devices with measuring ranges > 1000 bar, the permissible test pressure is identical to the MWP. To avoid damage to the device or its metrological properties, this value must not be exceeded even for a short time.

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.

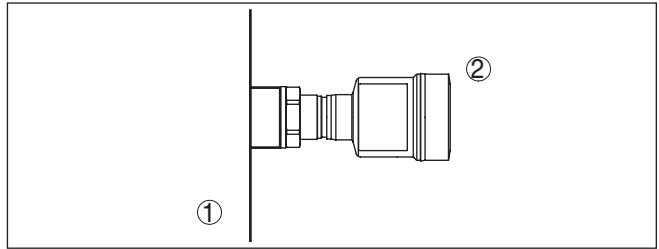


Fig. 5: Temperature ranges

- 1 Process temperature
- 2 Ambient temperature

4.2 Instructions for oxygen applications



Warning:

As an oxidising agent, oxygen can cause or intensify fires. Oils, grease, some plastics and dirt can burn explosively on contact with oxygen. There is a risk of serious personal injury or damage to property.

Therefore, to avoid this, take the following precautions, for example:

- All components of the system - 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"
- Devices for oxygen applications may only be unpacked from the PE foil just before assembly.
- Check whether the marking "O2" is visible on the process fitting after removing the protection for the process fitting
- Avoid any ingress of oil, grease and dirt

4.3 Ventilation and pressure compensation

Filter element - Function

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.

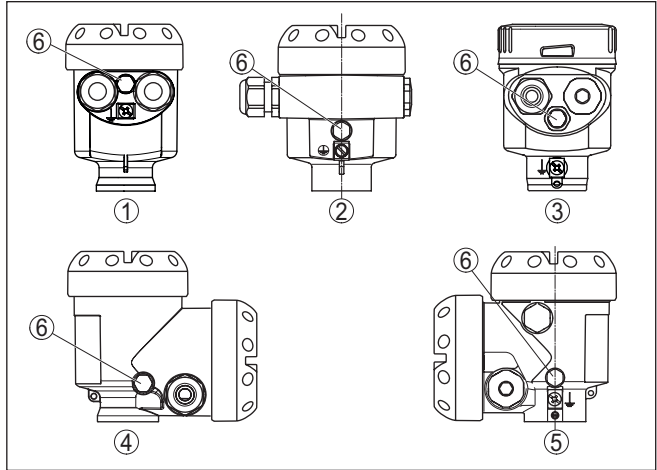
Filter element - Position

Fig. 6: 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.

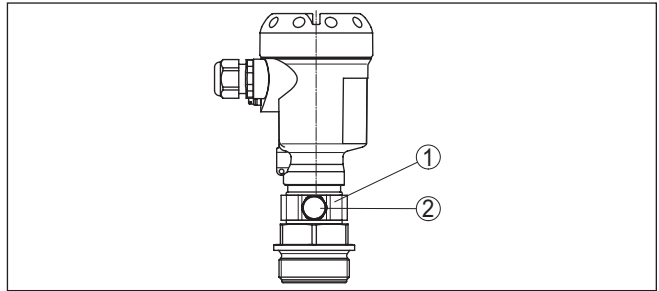


Fig. 7: Position of the filter element - Ex d version

- 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.

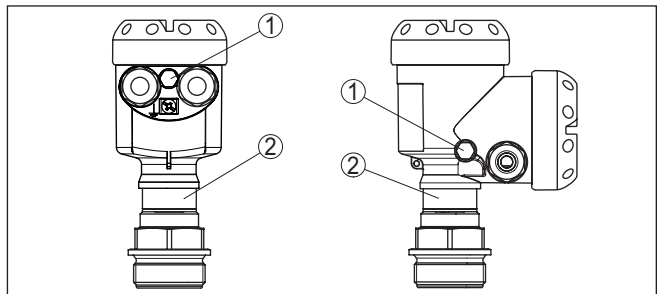


Fig. 8: Position of the filter element - gastight leadthrough

- 1 Filter element
- 2 Gas-tight leadthrough

**Filter element - Position
IP69K version**

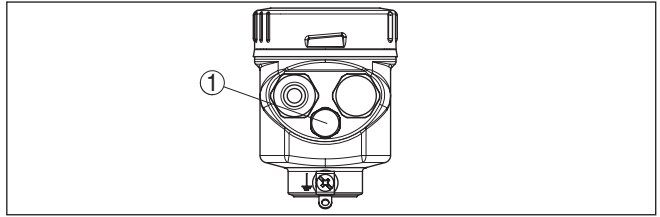


Fig. 9: Position of the filter element - IP69K version

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**

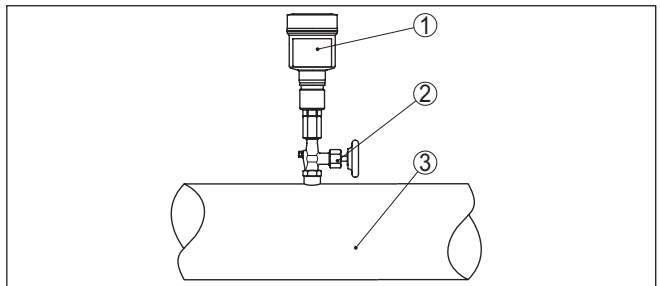


Fig. 10: Measurement setup for process pressure measurement of gases in pipelines

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

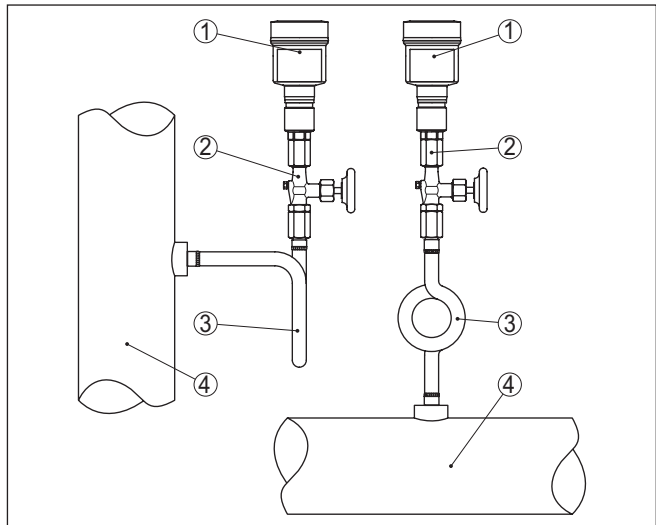


Fig. 11: Measurement setup for process pressure measurement of gases in pipelines

- 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.

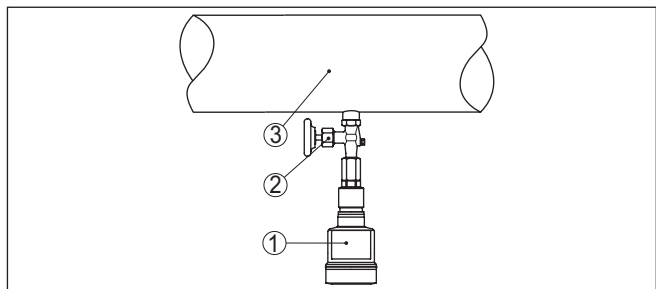


Fig. 12: Measurement setup for process pressure measurement of liquids in pipelines

- 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

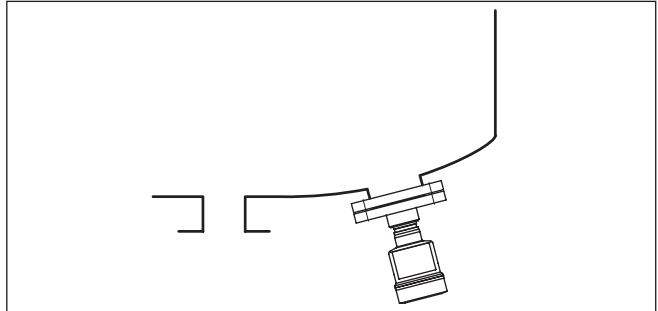


Fig. 13: Measurement setup for level measurement

4.6 External housing

Configuration

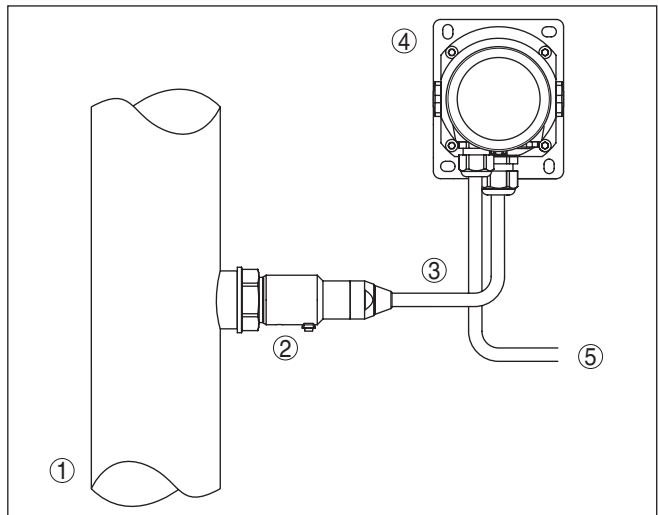


Fig. 14: Configuration, process module, external housing

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

5 Connecting to power supply

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

Power supply and current signal are carried on the same two-wire cable. The operating voltage can differ depending on the instrument version.

The data for power supply are specified in chapter " *Technical data*".

Provide a reliable separation between the supply circuit and the mains circuits according to DIN EN 61140 VDE 0140-1.

Power the instrument via an energy-limited circuit acc. to IEC 61010-1, e.g. via Class 2 power supply unit.

Keep in mind the following additional factors that influence the operating voltage:

- Lower output voltage of the power supply unit under nominal load (e.g. with a sensor current of 20.5 mA or 22 mA in case of fault signal)
- Influence of additional instruments in the circuit (see load values in chapter " *Technical data*")

Connection cable

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

Use cable with round cross section for instruments with housing and cable gland. Use a cable gland suitable for the cable diameter to ensure the seal effect of the cable gland (IP protection rating).

We generally recommend the use of shielded cable for HART multidrop mode.

Cable screening and grounding

If shielded cable is required, we recommend connecting the cable screening on both ends to ground potential. In the sensor, the cable screening is connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the ground potential (low impedance).



In Ex systems, the grounding is carried out according to the installation regulations.

In electroplating plants as well as plants for cathodic corrosion protection it must be taken into account that significant potential differences

exist. This can lead to unacceptably high currents in the cable screen if it is grounded at both ends.



Note:

The metallic parts of the instrument (process fitting, sensor, concentric tube, etc.) are connected with the internal and external ground terminal on the housing. This connection exists either directly via the conductive metallic parts or, in case of instruments with external electronics, via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter " *Technical data*".

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

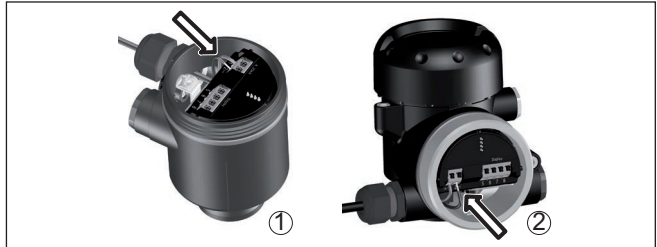


Fig. 15: Connection steps 5 and 6

- 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

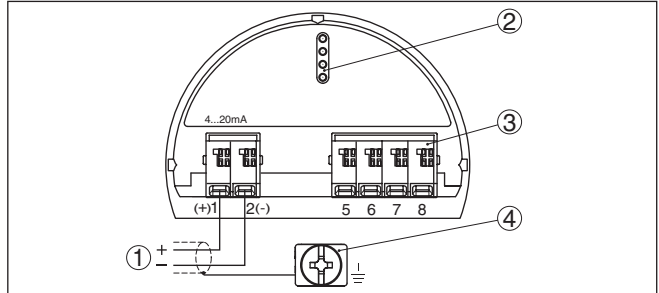


Fig. 16: Electronics and connection compartment - single chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit or Secondary sensor
- 4 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

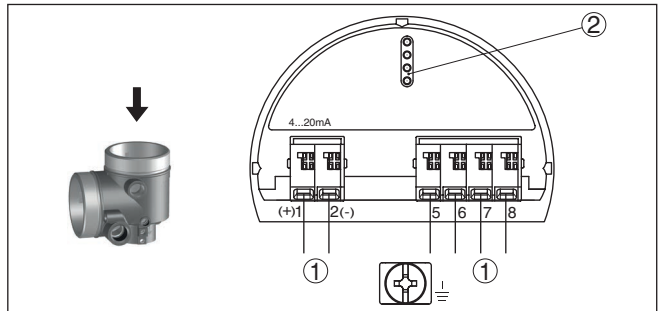


Fig. 17: Electronics compartment - double chamber housing

- 1 Internal connection to the connection compartment
- 2 For display and adjustment module or interface adapter

Connection compartment

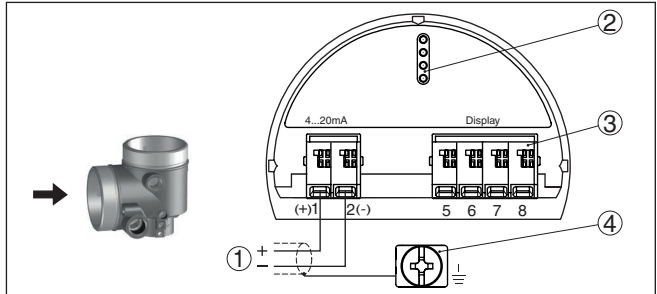


Fig. 18: Connection compartment - double chamber housing

- 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

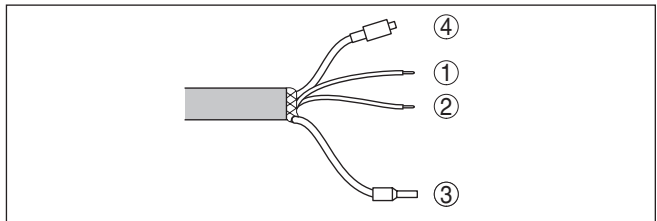


Fig. 19: Wire assignment, connection cable

- 1 Brown (+): to voltage supply or to the processing system
- 2 Blue (-): to voltage supply or to the processing system
- 3 Shielding
- 4 Breather capillaries with filter element

5.6 External housing with version IP68 (25 bar)

Overview

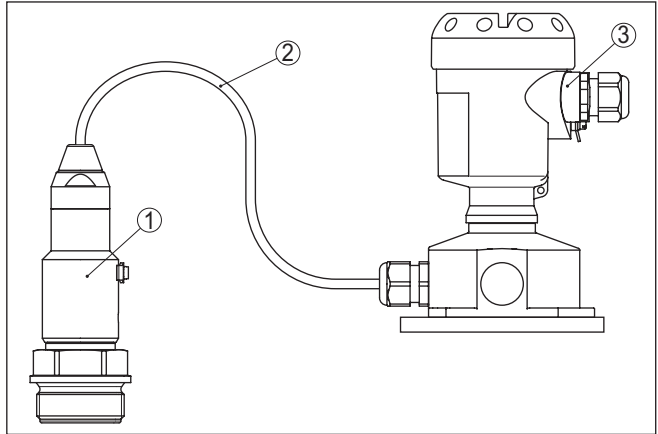


Fig. 20: IPT-2x in IP68 version 25 bar with axial cable outlet, external housing

- 1 Transmitter
- 2 Connection cable
- 3 External housing

Electronics and connection compartment for power supply

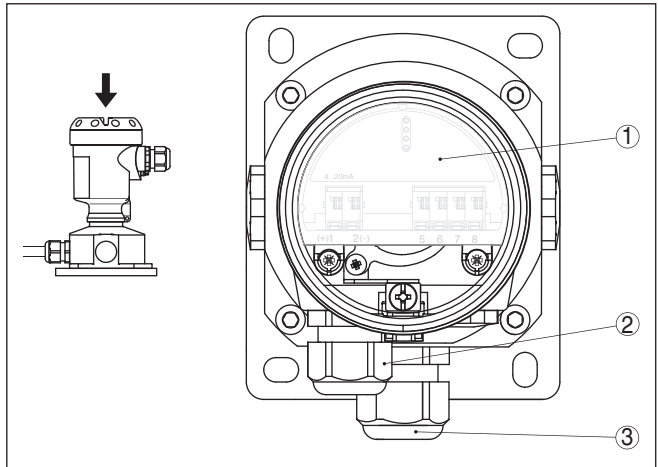


Fig. 21: Electronics and connection compartment

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

Terminal compartment, housing socket

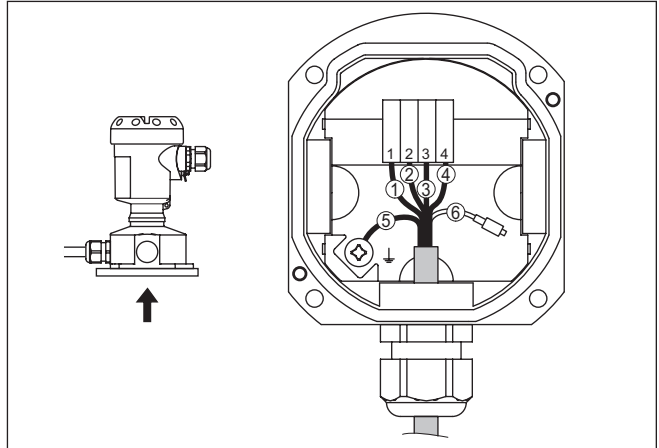


Fig. 22: Connection of the process component in the housing base

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

Electronics and connection compartment

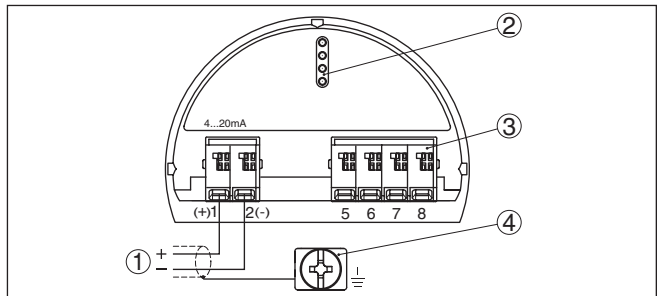


Fig. 23: Electronics and connection compartment - single chamber housing

- 1 Voltage supply, signal output
- 2 For display and adjustment module or interface adapter
- 3 For external display and adjustment unit or Secondary sensor
- 4 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
- The output signal jumps to the set fault current

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 Functional safety (SIL)

6.1 Objective

Background

In case of dangerous failures, processing facilities and machines can cause risks for persons, environment and property. The risk of such failures must be judged by the plant operator. Dependent thereon are measures for risk reduction through error prevention, error detection and fault control.

Plant safety by risk reduction

The part of plant safety depending on the correct functioning of safety-related components for risk reduction is called functional safety. Components used in such safety-instrumented systems (SIS) must therefore execute their intended function (safety function) with a defined high probability.

Standards and safety levels

The safety requirements for such components are described in the international standards IEC 61508 and 61511, which set the standard for uniform and comparable judgement of instrument and plant (or machine) safety and hence contribute to worldwide legal certainty. We distinguish between four safety levels, from SIL1 for low risk to SIL4 for very high risk (SIL = Safety Integrity Level), depending on the required degree of risk reduction.

Properties and requirements

When developing instruments that can be used in safety-instrumented systems, the focus is on avoiding systematic errors as well as determining and controlling random errors.

Here are the most important characteristics and requirements from the perspective of functional safety according to IEC 61508 (Edition 2):

- Internal monitoring of safety-relevant circuit parts
- Extended standardization of the software development
- In case of failure, switching of the safety-relevant outputs to a defined safe state
- Determination of the failure probability of the defined safety function
- Reliable parameterization with non-safe user environment
- Proof test

Safety Manual

The SIL qualification of components is specified in a manual on functional safety (Safety Manual). Here, you can find all safety-relevant characteristics and information the user and the planner need for planning and operating the safety-instrumented system. This document is attached to each instrument with SIL rating and can be also found on our homepage via the search.

6.3 Application area

The instrument can be used, for example, for process pressure and hydrostatic level measurement of liquids in safety-instrumented sys-

tems (SIS) acc. to IEC 61508 and IEC 61511. Note the specifications in the Safety Manual.

The following inputs/outputs are permitted:

- 4 ... 20 mA current output

6.4 Safety concept of the parameterization

The following tools are permitted for parameterization of the safety function:

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



Note:

For operation of the IPT-2x an actual DTM Collection is required. The modification of safety-relevant parameters is only possible with active connection to the instrument (online mode).

Tool for operation and parameterization

Safe parameterization

To avoid possible errors during parameter adjustment in a non-safe user environment, a verification procedure is used that makes it possible to detect parameter adjustment errors reliably. For this, safety-relevant parameters must be verified after they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

Safety-relevant parameters

To prevent unintentional or unauthorized adjustment, the set parameters must be protected from unauthorized access. For this reason the instrument is shipped in locked condition. The PIN in delivery status is "0000".

When shipped with a specific parameter adjustment, the instruments are accompanied by a list with the values deviating from the basic setting.

All safety-relevant parameters must be verified after a change.

The parameter settings of the measurement loop must be documented. You can find a list of all safety-relevant parameters in the delivery status in chapter "*Setup with the display and adjustment module*" under "*Additional adjustments - Reset*". In addition, a list of the safety-relevant parameters can be stored and printed via PACTware/DTM.

Unlock adjustment

For each parameter change, the instrument must be unlocked via a PIN (see chapter "*Parameter adjustment, setup steps - Lock adjustment*"). The device status is indicated in the DTM by the symbol of an unlocked or locked padlock.



In delivery status, the PIN is **0000**.

Unsafe device status



Warning:

If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterisation is terminated correctly. If necessary, other measures must be taken to maintain the safety function.

- Change parameters** All parameters changed by the operator are automatically stored temporarily so that they can be verified in the next step.
- Verify parameters/Lock adjustment** After setup, the modified parameters must be verified (confirm the correctness of the parameters). To do this, you first have to enter the device code. Here the adjustment is locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.
- Then you confirm that the serial number of your instrument has been carried over correctly. This is used to check device communication.
- Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.
- Incomplete process**  **Warning:** If the described process was not carried out completely or correctly (e.g. due to interruption or voltage loss), the instrument remains in an unlocked, and thus unsafe, status.
- Instrument reset**  **Warning:** In case of a reset to basic settings, all safety-relevant parameters will also be reset to default. Therefore all safety-relevant parameters must be checked or readjusted.

7 Set up with the display and adjustment module

7.1 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. 24: Installing the display and adjustment module in the electronics compartment of the single chamber housing

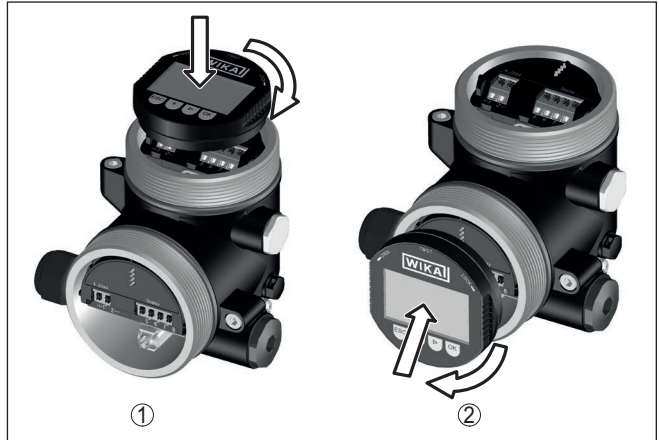


Fig. 25: Installing the display and adjustment module in the double chamber housing

- 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.

7.2 Adjustment system

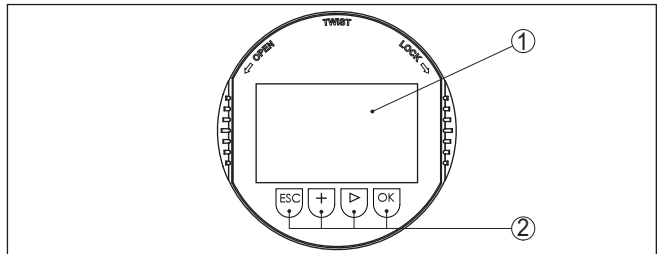


Fig. 26: Display and adjustment elements

- 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.

7.3 Measured value indication

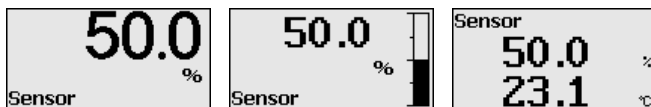
Measured value indication

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 respective 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.



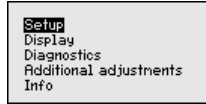
With the "**[->]**" button, you can select the requested language, with "**OK**" you confirm the selection and move to the main menu.

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

7.4 Parameter 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, disable/enable operation

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

Diagnosis: Information, for example, of device status, peak indicator, simulation

Additional adjustments: date/time, reset, copy function

Info: Instrument name, hardware and software version, calibration date, sensor features



Note:

For optimum setting of the measuring point, the individual submenu 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 submenu points are described below.

Operating sequence

A parameter change with SIL qualified instruments must always be carried out as follows:

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

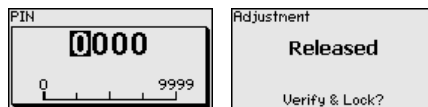
This ensures that all modified parameters have been deliberately changed.

Unlock adjustment

The instrument is shipped in locked condition.

To prevent unintentional or unauthorized adjustment, the instrument is protected (locked) against all parameter changes while in normal operating condition.

For each parameter change you have to enter the PIN of the instrument. In delivery status, the PIN is "0000".



Change parameters

You can find a description below the respective parameter.

Lock adjustment and verify modified parameters

You can find a description below the parameter " *Setup - Lock adjustment*".

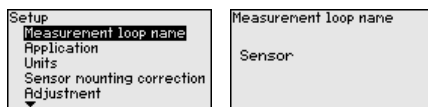
7.4.1 Setup

Measurement loop name In the menu item " *Sensor TAG*" you edit a twelve-digit measurement loop designation.

You can enter an unambiguous designation for the sensor, e.g. the measurement loop name or the tank or product designation. In digital systems and in the documentation of larger plants, a singular designation must be entered for exact identification of individual measuring points.

The available digits include:

- Letters from A ... Z
- Numbers from 0 ... 9
- Special characters +, -, /, -

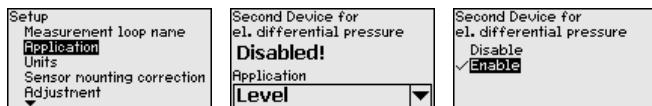
**Application**

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

IPT-2x can be used for process pressure and level measurement. The setting in the delivery status is " *Level*". The mode can be changed in this adjustment menu.

If you have connected **no** Secondary Device, you confirm this with " *Deactivate*".

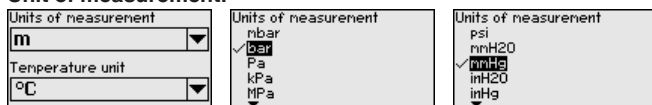
Depending on the selected application, different subchapters in the following adjustment steps are important. There you can find the individual adjustment steps.



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 indicator, temperature" and "in the variables of the digital output signal".

Temperature unit:

Units of measurement m	Temperature unit <input checked="" type="checkbox"/> C <input type="checkbox"/> K <input type="checkbox"/> F
---------------------------	-----------------------------------------------------------------------------------------------------------------------

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.

Setup Application Units Sensor mounting correction Adjustment Damping	Sensor mounting correction Offset = -0.0003 bar 0.0001 bar	Sensor mounting correction Auto.correction Edit
--------------------------------------------------------------------------------------	---------------------------------------------------------------------	-------------------------------------------------------



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 $\pm 50\%$ 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:

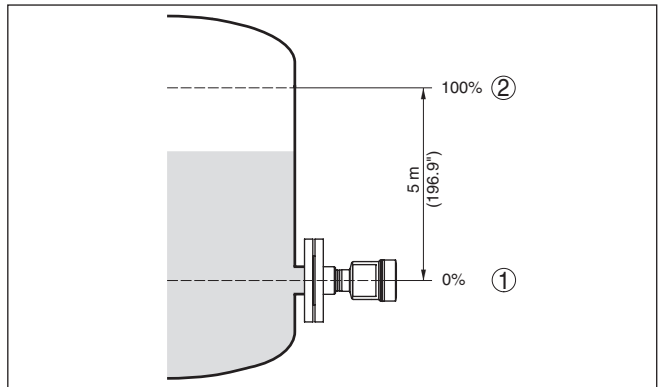


Fig. 27: Parameter adjustment example Min./max. adjustment, level measurement

- 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:

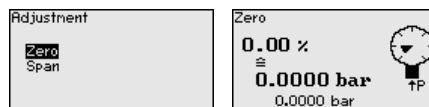
If the adjustment ranges are exceeded, the entered value will not be accepted. Editing can be interrupted with **[ESC]** or corrected to a value within the adjustment ranges.

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

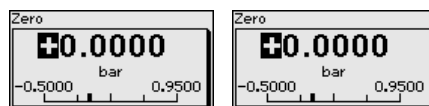
Zero adjustment

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]**.

- Change 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.

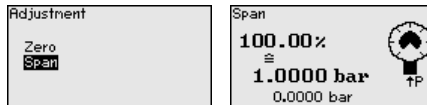
For an adjustment with pressure, simply enter the actual measured value indicated at the bottom of the display.

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]**.

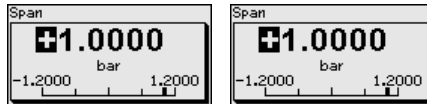
Span adjustment

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]**

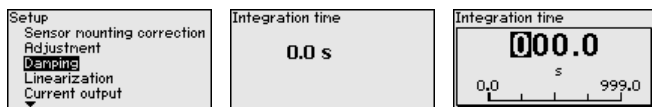
The max. adjustment is finished.

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 a damping of 0 ... 999 s in this menu item. The increment is 0.1 s.

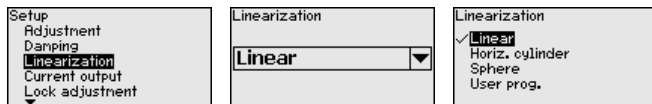
The set damping is effective for level and process pressure measurement as well as for all applications of electronic differential pressure measurement.



The default setting is a damping of 0 s.

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.



Current output (mode)

In the menu item " *Current output mode*" you determine the output characteristics and reaction of the current output in case of fault.

Current output Current output mode Current output min./max.	Current output mode Output characteristic 4 ... 20 mA Failure mode <= 3.6 mA
--------------------------------------------------------------------------	------------------------------------------------------------------------------------------

The default setting is output characteristics 4 ... 20 mA, fault mode < 3.6 mA.

Current output (min./max.)

In the menu item " *Current output Min./Max.*", you determine the reaction of the current output during operation.

Current output Current output mode Current output min./max.	Current output min./max. Min. current 3.8 mA Max. current 20.5 mA
--------------------------------------------------------------------------	-------------------------------------------------------------------------------

The default setting is min. current 3.8 mA and max. current 20.5 mA.

Lock adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.



To avoid possible errors during parameter adjustment in a non-safe environment, a verification procedure is used that enables reliable detection of parameter adjustment errors. In this procedure, safety-relevant parameters are verified before saving them in the instrument.

In addition, as a protection against unintentional or unauthorized adjustment, the instrument is locked against all parameter changes in normal operating condition.

1. Enter PIN

Setup Damping Current output Lock adjustment ----- Measurement loop name	Adjustment Released Verify & Lock?	PIN 0000 0 9999
------------------------------------------------------------------------------------------------	-------------------------------------------------	------------------------------

The instrument is shipped in locked condition. The PIN in the delivery status is "0000".

2. Character string comparison

You then have to carry out the character string comparison. This is used to check the character presentation.

Confirm if the two character strings are identical. The verification texts are provided in German and in the case of all other menu languages, in English.

Zeichenfolgenvergleich Gerät: 1.23+4.56-789.0 Vorgabe: 1.23+4.56-789.0 Zeichenfolge identisch?

3. Serial number acknowledgement

Seriennummer
25153576
Seriennummer korrekt?

Afterwards you confirm that the serial number of your instrument was carried over correctly. This is used to check device communication.

4. Verify parameters

All safety-relevant parameters must be verified after a change:

- SIL parameter 1: Zero adjustment
- SIL parameter 2: Secondary on/off
- Non-SIL parameter 1: Measured value presentation
- Non-SIL parameter 2: Display value 1, unit of the application
- Non-SIL parameter 3: Menu language
- Non-SIL parameter 4: Lighting

Confirm the modified values one after the other.

SIL-Parameter 1 von 2
Parameter OK?

Nicht-SIL-Parameter 1 von 4
Parameter OK?

Acknowledgement
Are number and values of the modified parameters correct?
OK?

If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Bedienung
Gesperrt
Freigegeben?



Otherwise the instrument remains in the released and hence unsafe condition.



Information:

As long as the IPT-2x is powered, the display and adjustment module remains in the actually set adjustment menu. An automatic, time-controlled reset to the measured value indication is not carried out.

7.4.2 Display

Language

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

Display
Menu language
Indication value 1
Indication value 2
Display format
Backlight

Menu language
Deutsch
✓ English
Francais
Espaniol
Pycckuu

The following languages are available:

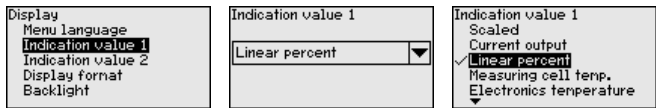
- German
- English
- French
- Spanish
- Russian

- Italian
- Dutch
- Portuguese
- Japanese
- Chinese
- Polish
- Czech
- Turkish

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

Display value 1 and 2

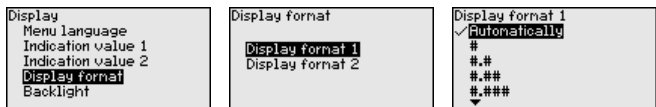
In this menu item, you define which measured value is displayed.



The setting in the delivery status for the display value is " *Lin. percent*".

Display format 1 and 2

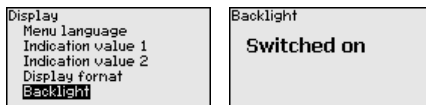
In this menu item you define the number of decimal positions with which the measured value is displayed.



The setting in the delivery status 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*".

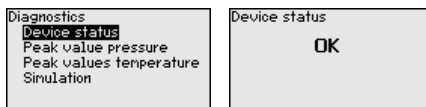


In delivery status, the lighting is switched on.

7.4.3 Diagnostics

Device status

In this menu item, the device status is displayed.

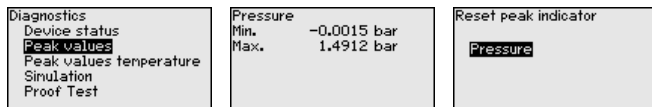


In case of an error, for example error code F017, the fault description, for example " *Adjustment span too small*" and a four-digit number are displayed for service purposes.

Peak indicator, pressure

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

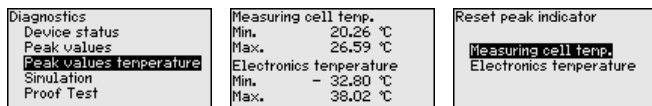
In another window you can carry out a reset of the peak values separately.



Peak indicator, 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 indicator, 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 can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or 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 4 ... 20 mA current value and digital HART signal.



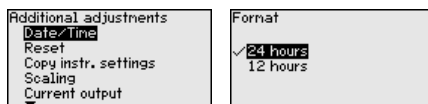
Information:

Without manual deactivation, the sensor terminates the simulation automatically after 60 minutes.

7.4.4 Additional adjustments

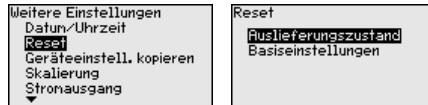
Date/Time

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.

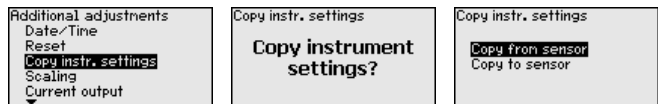
Copy instrument settings

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.

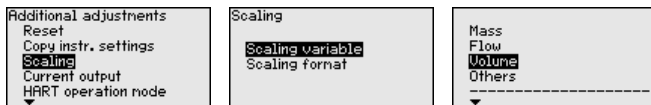


Note:

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.

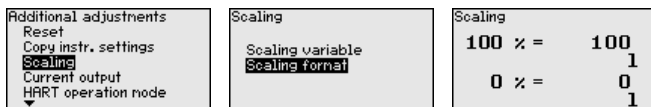
Scaling (1)

In menu item "Scaling" you define the scaling variable and the scaling unit for the level value on the display, e.g. volume in l.



Scaling (2)

In menu item " *Scaling (2)*" you define the scaling format on the display and the scaling of the measured level value for 0 % and 100 %.



Current output

In the menu items " *Current output*" you determine the properties of the current output.

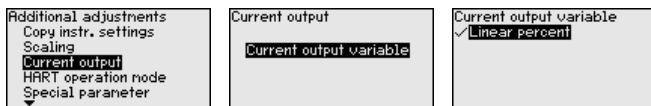
On instruments with integrated additional current output, the properties for each current output are adjusted individually. The following descriptions apply to both current outputs.

SIL The additional current output cannot be used as an output in the sense of a safety-instrumented application (SIL).

Current output 1 and 2 (size)

In menu item " *Current output, variable*" you specify which measured variable the current output refers to.

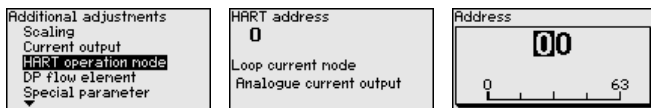
SIL For instruments with SIL qualification, the selection is limited to lin. percent.



HART mode

The sensor is preset to the HART mode " *Analogue current output*".

SIL For instruments with SIL qualification, this parameter cannot be modified.

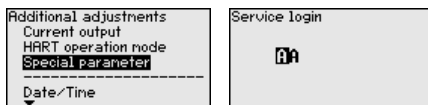


The default setting is " *Analogue current output*" and the address 00.

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.

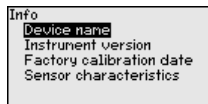
Change the settings of the special parameters only after having contacted our service staff.



7.4.5 Info

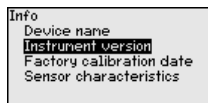
Device name

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



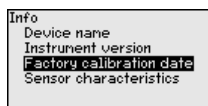
Instrument version

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



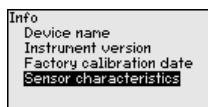
Factory calibration date

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.



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.



7.5 Menu overview

The following tables show the adjustment menu of the instrument. Depending on the instrument version or application, all menu items may not be available or some may be differently assigned.



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

Setup

Menu item	Parameter	Default value
Measurement loop name	19 alphanumeric characters/special characters	Sensor
Application (SIL)	Application	Level
	Secondary sensor for electronic differential pressure	Deactivated

7 Set up with the display and adjustment module

Menu item	Parameter	Default value
Units	Adjustment unit (m, bar, Pa, psi ... user-defined)	mbar (with nominal measuring range ≤ 400 mbar) bar (with nominal measuring ranges ≥ 1 bar)
	Temperature unit ($^{\circ}\text{C}$, $^{\circ}\text{F}$)	$^{\circ}\text{C}$
Position correction (SIL)		0.00 bar
Adjustment (SIL)	Zero/Min. adjustment	0.00 bar 0.00 %
	Span/Max. adjustment	Nominal measuring range in bar 100.00 %
Damping (SIL)	Integration time	1 s
Linearisation	Linear, cylindrical tank, ... user-defined	Linear
Current output (SIL)	Current output - Mode	
	Output characteristics: 4 ... 20 mA, 20 ... 4 mA	4 ... 20 mA
	Failure mode: ≤ 3.6 mA, ≥ 20 mA, last measured value	≤ 3.6 mA
	Current output - Min./Max.	
	Min. current: 3.8 mA, 4 mA	3.8 mA
	Max. current: 20 mA, 20.5 mA	20.5 mA
Lock adjustment (SIL)	Blocked, released	Last setting

Display

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

Diagnostics

Menu item	Parameter	Default value
Device status		No reset
Peak indicator	Pressure	Current pressure measured value
Peak indicator temp.	Temperature	Actual measuring cell and electronic temperature
Simulation	Measured value	Pressure
	Simulations	Not active
Proof test		No reset

Additional adjustments

Menu item	Parameter	Default value
Date/Time		No reset
Reset	Delivery status, basic settings	No reset
Copy instrument settings	Read from sensor, write into sensor	No reset
Scaling	Scaling size	Volume in l
	Scaling format	0 % corresponds to 0 l 100 % corresponds to 0 l Without decimal positions
Current output (SIL)	Current output - Meas. variable	Lin. percent - Level
	Current output - Adjustment	0 ... 100 % correspond to 4 ... 20 mA
Current output 2	Current output - Meas. variable	Measuring cell temperature
	Current output - Adjustment	0 ... 100 % correspond to 4 ... 20 mA
HART mode	HART address, current output	Address 00, analogue current output
Special parameter (SIL)	Service-Login	No reset

Info

Menu item	Parameter
Device name	IPT-2x
Instrument version	Hardware and software version
Factory calibration date	Date
Sensor characteristics	Order-specific characteristics

7.6 Save parameter adjustment 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*".

8 Setup with PACTware

8.1 Connect the PC

Via the interface adapter and HART

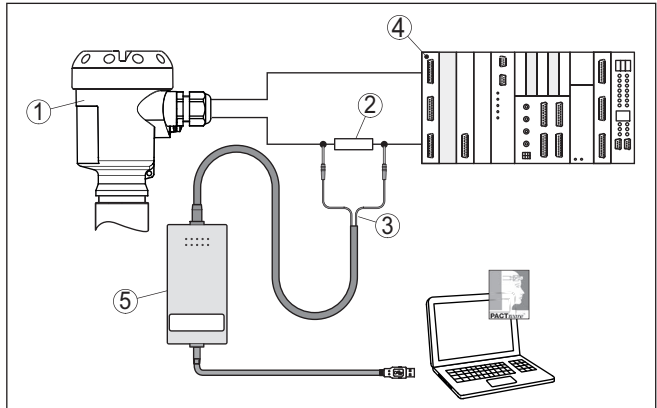


Fig. 28: Connecting the PC via HART to the signal cable

- 1 Sensor
- 2 HART resistance 250 Ω (optional depending on evaluation)
- 3 Connection cable with 2 mm pins and terminals
- 4 Processing system/PLC/Voltage supply
- 5 Interface adapter, for example VEGACONNECT 4



Note:

With power supply units with integrated HART resistance (internal resistance approx. 250 Ω), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGAMET 381, VEGAMET 391. Common Ex separators are also usually equipped with a sufficient current limiting resistance. In such cases, the interface adapter can be connected parallel to the 4 ... 20 mA cable (dashed line in the previous illustration).

8.2 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.

8.3 Save parameter adjustment data

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

9 Diagnosis, asset management and service

9.1 Maintenance

Maintenance

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

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.

Proof test

To identify possible undetected, dangerous failures, the safety function of the instrument must be checked in adequate intervals by a proof test.



During the function test, the safety function must be treated as unsafe. Keep in mind that the function test influences downstream connected devices.

If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures.

You can find detailed information on the proof test in the Safety Manual (SIL).

9.2 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.

9.3 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, detailed error messages are available under menu item "Diagnostics" via the display and adjustment module, PACTware/DTM and EDD.

Status messages

The status messages are divided into the following categories:

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

and explained by pictographs:

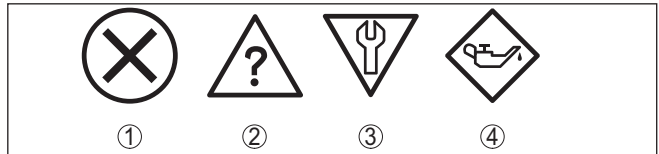


Fig. 29: Pictographs of the status messages

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

Malfunction (Failure):

Due to a malfunction in the instrument, a fault signal 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 active by default. It can be deactivated by the user via PACTware/DTM or EDD.

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. It can be activated by the user via PACTware/DTM or EDD.

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 active by default. It can be deactivated by the user via PACTware/DTM or EDD.

Failure

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F013 No valid measured value available	Gauge pressure or low pressure Measuring cell defective	Exchange measuring cell Send instrument for repair	Byte 5, Bit 0 of Byte 0 ... 5
F017 Adjustment span too small	Adjustment not within specification	Change the adjustment according to the limit values	Byte 5, Bit 1 of Byte 0 ... 5
F025 Error in the linearization table	Index markers are not continuously rising, for example illogical value pairs	Check linearization table Delete table/Create new	Byte 5, Bit 2 of Byte 0 ... 5
F036 no operable sensor software	Failed or interrupted software update	Repeat software update Check electronics version Exchanging the electronics Send instrument for repair	Byte 5, Bit 3 of Byte 0 ... 5
F040 Error in the electronics	Hardware defect	Exchanging the electronics Send instrument for repair	Byte 5, Bit 4 of Byte 0 ... 5
F041 Communication error	No connection to the sensor electronics	Check connection between sensor and main electronics (with separate version)	-
F042 Communication error Secondary sensor	No connection to the Secondary sensor	Check connection between Primary and Secondary sensor	-
F080 General software error	General software error	Disconnect operating voltage briefly	Byte 5, Bit 5 of Byte 0 ... 5
F105 Measured value is determined	The instrument is still in the switch-on phase, the measured value could not yet be determined	Wait for the end of the switch-on phase	Byte 5, Bit 6 of Byte 0 ... 5
F125 Impermissible electronics temperature	Electronics temperature in the non-specified range	Check ambient temperature Insulate electronics Use instrument with higher temperature range	Byte 5, Bit 7 of Byte 0 ... 5
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	Byte 4, Bit 0 of Byte 0 ... 5

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F261 Error in the instrument settings	Error during setup Error when carrying out a reset	Repeat setup Repeat reset	Byte 4, Bit 1 of Byte 0 ... 5
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	Byte 4, Bit 2 of Byte 0 ... 5
F265 Measurement function disturbed	Sensor no longer carries out a measurement	Carry out a reset Disconnect operating voltage briefly	Byte 4, Bit 3 of Byte 0 ... 5
F266 Impermissible voltage supply	Operating voltage below specified range	Check electrical connection If necessary, increase operating voltage	Byte 4, Bit 6 of Byte 0 ... 5

Tab. 6: Error codes and text messages, information on causes as well as corrective measures

Function check

Code Text message	Cause	Rectification	DevSpec State in CMD 48
C700 Simulation active	A simulation is active	Finish simulation Wait for the automatic end after 60 mins.	"Simulation Active" in "Standardized Status 0"
C701 Parameter verification	Parameter verification was interrupted	Finish parameter verification	Bit 13 of Byte 14 ... 24

Out of specification

Code Text message	Cause	Rectification	DevSpec State in CMD 48
S600 Impermissible electronics temperature	Temperature of the electronics in the non-specified range	Check ambient temperature Insulate electronics	Byte 23, Bit 0 of Byte 14 ... 24
S603 Impermissible operating voltage	Operating voltage below specified range	Check electrical connection If necessary, increase operating voltage	-
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	-

Maintenance

Code Text message	Cause	Rectification	DevSpec State in CMD 48
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 0 of Byte 14 ... 24
M501 Error in the non-active linearisation table	Index markers are not continuously rising, for example illogical value pairs	Check linearization table Delete table/Create new	Bit 1 of Byte 14 ... 24
M502 Error in the event memory	Hardware error EEPROM	Exchanging the electronics Send instrument for repair	Bit 2 of Byte 14 ... 24
M504 Error at a device interface	Hardware defect	Exchanging the electronics Send instrument for repair	Bit 3 of Byte 14 ... 24
M507 Error in the instrument settings	Error during setup Error when carrying out a reset	Carry out reset and repeat setup	Bit 4 of Byte 14 ... 24

9.4 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.

4 ... 20 mA signal

Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to eliminate them:

Error	Cause	Rectification
4 ... 20 mA signal not stable	Fluctuating measured value	Set damping
4 ... 20 mA signal missing	Electrical connection faulty	Check connection, correct, if necessary
	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low, load resistance too high	Check, adapt if necessary
Current signal greater than 22 mA, less than 3.6 mA	Sensor electronics defective	Replace device or send in for repair depending on device version

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.

9.5 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

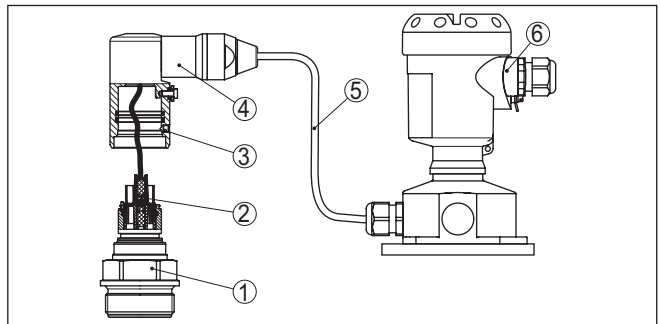


Fig. 30: IPT-2x in IP68 version, 25 bar and lateral cable outlet, external housing

- 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.

9.6 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

10 Dismount

10.1 Dismounting steps

To remove the device, carry out the steps in chapters " *Mounting*" and " *Connecting to power supply*" in reverse.



Warning:

When dismantling, pay attention to the process conditions in vessels or pipelines. There is a risk of injury, e.g. due to high pressures or temperatures as well as aggressive or toxic media. Avoid this by taking appropriate protective measures.

10.2 Disposal



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

Remove any batteries in advance, if they can be removed from the device, and dispose of them separately.

If personal data is stored on the old device to be disposed of, delete it before disposal.

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

11 Supplement

11.1 Technical data

Note for approved instruments

The technical data in the respective safety instructions which are included in delivery are valid for approved instruments (e.g. with Ex approval). These data can differ from the data listed herein, for example regarding the process conditions or the voltage supply.

All approval documents can be downloaded from our homepage.

Note for devices with measuring ranges > 1000 bar

For devices with measuring ranges > 1000 bar the technical data in the " *Supplementary instructions for high pressure versions*" in the scope of delivery are applicable. These may deviate from the data listed here, e.g. in the case of measurement deviation, wetted materials or long-term stability.

Materials and weights

Materials, wetted (piezoresistive/strain gauge measuring cell)³⁾

Process fitting	316L, Alloy C276 (2.4819)
Diaphragm	
– Front-flush	316L, Alloy C276 (2.4819) ⁴⁾
– Set back (measuring ranges up to and including 40 bar, from 1600 bar)	316L
– Set back (measuring ranges from 100 bar up to and including 1000 bar)	Elgiloy (2.4711)
Seal ring, O-ring	FKM (VP2/A), EPDM (A+P 70.10-02), FFKM (Perlast G74S), FEPM (Fluoraz SD890)
Seal for process fitting (in the scope of delivery)	
– Thread G $\frac{1}{2}$ (EN 837), G1 $\frac{1}{2}$ (DIN 3852-A)	Aramid/NBR
Surface quality, hygienic process fittings,	$R_a < 0.76 \mu\text{m}$
typ.	

Materials, wetted (ceramic/metallic measuring cell)⁵⁾

Process fitting	316L
Diaphragm	Alloy C276 (2.4819), gold-coated 20 μ , gold/rhodium-coated 5 $\mu/1 \mu$ ⁶⁾
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

³⁾ The medium-wetted parts have a roughness of $R_a < 0.76 \mu\text{m}$. This is ensured by supplier agreements as well as incoming goods inspections in accordance with the AQL sample test plan.

⁴⁾ Alloy C276 (2.4819) with process fitting of Alloy C276 (2.4819)

⁵⁾ The medium-wetted parts have a roughness of $R_a < 0.76 \mu\text{m}$. This is ensured by supplier agreements as well as incoming goods inspections in accordance with the AQL sample test plan.

⁶⁾ Not on instruments with SIL qualification.

Surface quality, hygienic process fittings, $R_a < 0.76 \mu\text{m}$
typ.

Materials, non-wetted parts

Isolating liquid ceramic/metallic measuring cell	KN 92 medical white oil (FDA conform)
Internal isolating liquid piezoresistive measuring cell	Synthetic oil KN 77, Neobee M 20 KN 59 (FDA conform), Halocarbon oil 6.3 KN 21 ^{7) 8)}
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 ⁹⁾
– Ground terminal	316L
External housing - deviating materials	
– Housing and socket	Plastic PBT (Polyester), 316L
– Socket seal	EPDM
– Seal below wall mounting plate ¹⁰⁾	EPDM
– Inspection window housing cover	Polycarbonate (UL-746-C listed)
Ground terminal	316Ti/316L
Connection cable with IP68 (25 bar) version ¹¹⁾	
– Cable cover	PE, PUR
– Type label support on cable	PE hard
Connection cable with IP68 (1 bar) version ¹²⁾	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)

⁷⁾ Isolating liquid with measuring ranges up to 40 bar. With measuring ranges from 100 bar dry measuring cell.

⁸⁾ Halocarbon oil: Generally in oxygen applications, not with vacuum measuring ranges, not with absolute measuring ranges < 1 bar_{abs}.

⁹⁾ Glass with Aluminium and stainless steel (precision casting) housing

¹⁰⁾ Only for 316L with 3A approval

¹¹⁾ Between transmitter and external electronics housing.

¹²⁾ Fix connected to the sensor.

- G1½ front-flush (ceramic/metallic measuring cell) 200 Nm (147.5 lbf ft)

Max. torque, non-metric process fittings

- ½ NPT, inside ¼ NPT ≤ 40 bar/500 psig 50 Nm (36.88 lbf ft)
- ½ NPT, inside ¼ NPT > 40 bar/500 psig 200 Nm (147.5 lbf ft)
- 7/16 NPT for tube ¼" 40 Nm (29.50 lbf ft)
- 9/16 NPT for tube 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. ¹³⁾

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

¹³⁾ Data on overload capability apply for reference temperature.

Nominal range	Overload capability	
	Maximum pressure	Minimum pressure
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
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 psi	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. ¹⁴⁾

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 ... +5 bar/0 ... +500 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 ... +5 bar/-100 ... +500 kPa	+50 bar/+6500 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
-0.05 ... +0.05 bar/-5 ... +5 kPa	+10 bar/+1000 kPa	-1 bar/-100 kPa
-0.2 ... +0.2 bar/-20 ... +20 kPa	+20 bar/+2000 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	+225 psig	-14.5 psig
0 ... +5 psig	+375 psig	-14.5 psig
0 ... +15 psig	+525 psig	-14.5 psig
0 ... +30 psig	+720 psig	-14.5 psig

¹⁴⁾ Data on overload capability apply for reference temperature.

Nominal range	Overload capability	
	Maximum pressure	Minimum pressure
0 ... +75 psig	+720 psig	-14.5 psig
0 ... +150 psig	+720 psig	-14.5 psig
0 ... +300 psig	+720 psig	-14.5 psig
-14.5 ... 0 psig	+510 psig	-14.5 psig
-14.5 ... +20 psig	+720 psig	-14.5 psig
-14.5 ... +75 psig	+975 psig	-14.51 psig
-14.5 ... +150 psig	+725 psig	-14.5 psig
-14.5 ... +300 psig	+725 psig	-14.5 psig
-0.7 ... +0.7 psig	+225 psi	-14.5 psig
-3 ... +3 psig	+190 psi	-14.5 psig
-7 ... +7 psig	+525 psig	-14.5 psig
Absolute pressure		
0 ... 15 psi	525 psi	0 psi
0 ... 30 psi	+720 psig	0 psi
0 ... 150 psi	+720 psig	0 psi
0 ... 300 psi	+720 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)

Max. permissible turn down with SIL applications 10 : 1

Switch-on phase

Start-up time with operating voltage U_b

- ≥ 12 V DC ≤ 9 s
- < 12 V DC ≤ 22 s

Starting current (for run-up time) ≤ 3.6 mA

Output variable

For details on the operating voltage see chapter "Voltage supply"

Output signal	4 ... 20 mA/HART
Range of the output signal	3.8 ... 20.5 mA/HART (default setting)
Fulfilled HART specification	7.3
Signal resolution	0.3 μ A
Fault signal, current output (adjustable)	≤ 3.6 mA, ≥ 21 mA, last measured value ¹⁵⁾
Max. output current	21.5 mA
Load	See load resistance under Power supply
Starting current	≤ 10 mA for 5 ms after switching on, ≤ 3.6 mA
Damping (63 % of the input variable), adjustable	0 ... 999 s
HART output values according to HART 7 (default setting) ¹⁶⁾	
– First HART value (PV)	Linear percentage value
– Second HART value (SV)	Measuring cell temperature (ceramic measuring cell)
– Third HART value (TV)	Pressure
– Fourth HART value (QV)	Electronics temperature

Dynamic behaviour output

Dynamic characteristics depending on medium and temperature

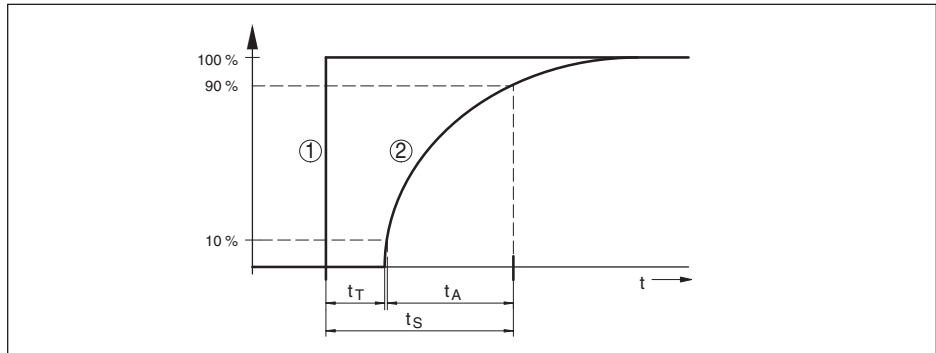


Fig. 31: Behaviour in case of sudden change of the process variable. t_T : dead time; t_A : rise time; t_S : jump response time

- 1 Process variable
- 2 Output signal

	IPT-2x	IPT-2x, IP68 (25 bar), connection cable > 25 m (82.01 ft)
Dead time	≤ 25 ms	≤ 50 ms
Rise time (10 ... 90 %)	≤ 55 ms	≤ 150 ms
Step response time (ti: 0 s, 10 ... 90 %)	≤ 80 ms	≤ 200 ms

¹⁵⁾ Last measured value not possible with SIL.

¹⁶⁾ The output values can be assigned individually.

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 +18 ... +30 °C (+64 ... +86 °F)
- Relative humidity 45 ... 75 %
- Air pressure 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psi)

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

- Piezoresistive/strain gauge measuring cell depending on the process fitting and the chemical seal
- Ceramic/metallic measuring cell < 5 mbar/0.5 kPa (0.07 psig)

Deviation in the current output due to strong, high-frequency electromagnetic fields acc. to EN 61326-1 < ±150 µA

Deviation (according to IEC 60770-1)

Applies to the **digital** signal output (HART, Profibus PA, Foundation Fieldbus) as well as to the **analogue** current output 4 ... 20 mA and refers to the set span. Turn down (TD) is the ratio "nominal measuring range/set span".

The deviation corresponds to the value F_{ki} in chapter " *Calculation of the total deviation* ". The value results out of the accuracy class and the respective turn down.

Accuracy class ¹⁷⁾	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 medium or ambient temperature

Thermal change zero signal and output span through product temperature

Applies to the **digital** signal output (HART, Profibus PA, Foundation Fieldbus) as well as to the **analogue** current output 4 ... 20 mA and refers to the set span. Turn down (TD) is the ratio "nominal measuring range/set 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

¹⁷⁾ Different availability depending on measuring range and process fitting

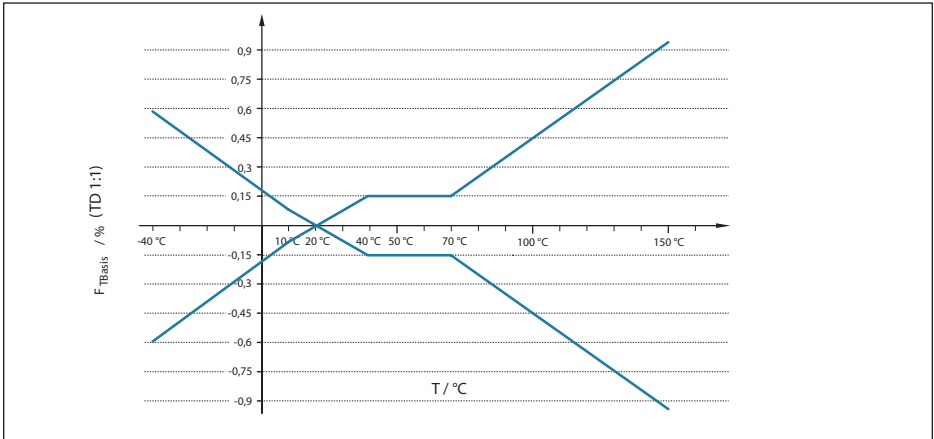


Fig. 32: Basic temperature error F_{TBasis} at TD 1 : 1

The basic temperature error in % from the above graphic can increase due to the additional factors such as accuracy class (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

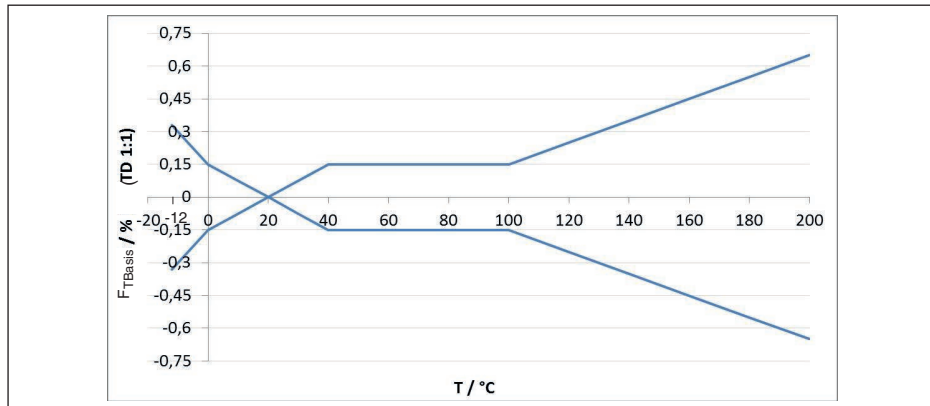
The additional factor F_{TD} through Turn down is calculated according to the following formula:

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

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 F_{TD} 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

Thermal change current output through ambient temperature

Applies also to the **analogue** 4 ... 20 mA current output and refers to the set span.

Thermal change, current output < 0.05 %/10 K, max. < 0.15 %, each with -40 ... +80 °C (-40 ... +176 °F)

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
	$p_{\text{abs}} \geq 1 \text{ mbar}$		$p_{\text{abs}} \geq 1 \text{ mbar}$	$p_{\text{abs}} \geq 10 \text{ mbar}$	$p_{\text{abs}} \geq 10 \text{ mbar}$
Without consideration of the seal ¹⁹⁾	-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 G74S)	-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)
FEPM (Fluoraz SD890)	-5 ... +105 °C (+23 ... +221 °F)	-	-	-	-5 ... +60 °C (+23 ... +140 °F)

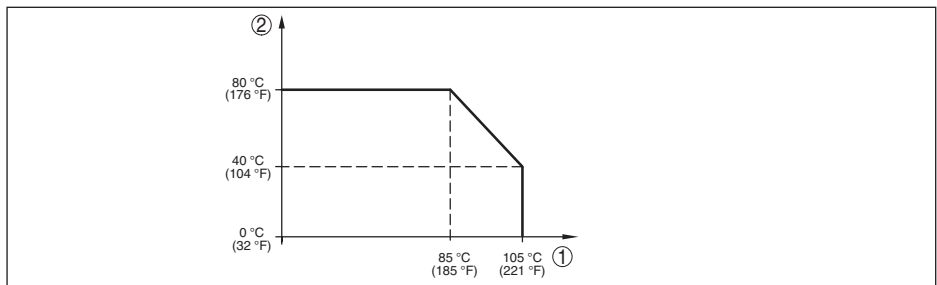
Temperature derating

Fig. 35: Temperature derating IPT-2x, version up to +105 °C (+221 °F)

- 1 Process temperature
- 2 Ambient temperature

¹⁹⁾ Process fittings acc. to DIN 3852-A, EN 837

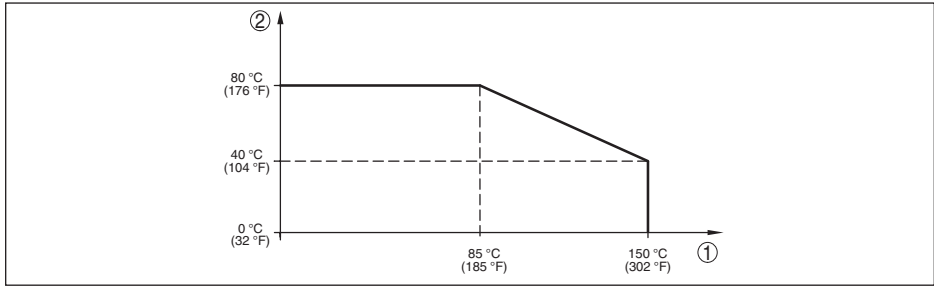


Fig. 36: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
- 2 Ambient temperature

SIP process temperature (SIP = Sterilization in place)

Vapour stratification for 2 h²⁰⁾ +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	Stainless steel double chamber	All housing versions	Stainless steel double chamber
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

Process conditions - Ceramic/metallic measuring cell

Process temperature

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

Temperature derating

²⁰⁾ Instrument configuration suitable for vapour

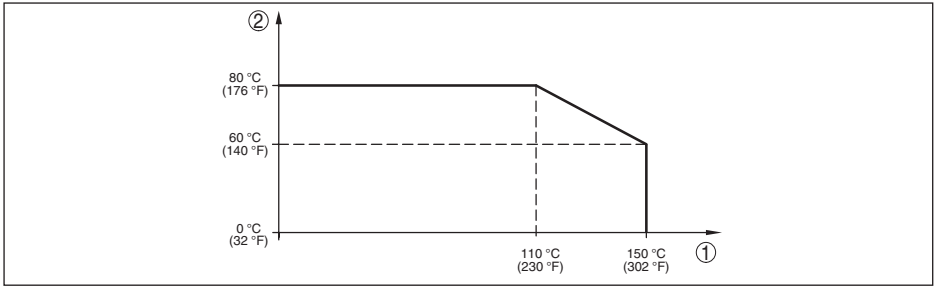


Fig. 37: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
- 2 Ambient temperature

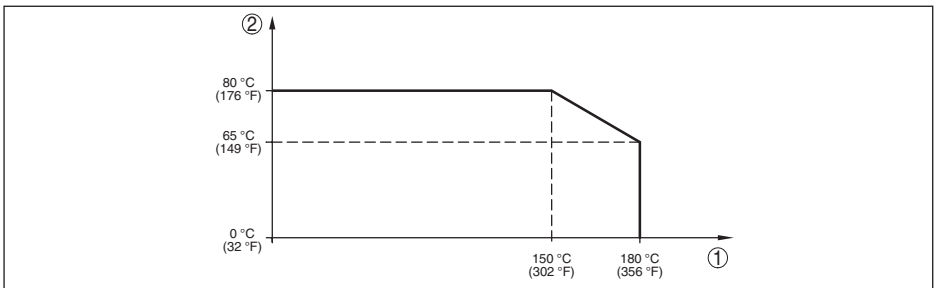


Fig. 38: Temperature derating IPT-2x, version up to +180 °C (+356 °F)

- 1 Process temperature
- 2 Ambient temperature

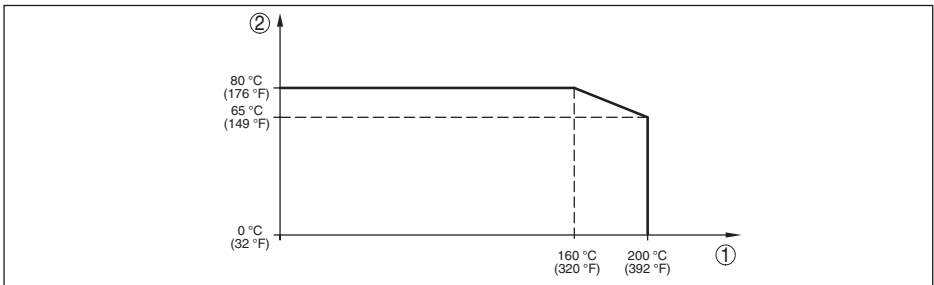


Fig. 39: Temperature derating IPT-2x, version up to +200 °C (+392 °F)

- 1 Process temperature
- 2 Ambient temperature

Process pressure

Permissible process pressure

see specification " *Process pressure*" on the type label

Mechanical stress²¹⁾

²¹⁾ Depending on the instrument version

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) ²²⁾

Electromechanical data - version IP66/IP67 and IP66/IP68 (0.2 bar)²³⁾

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 mm ² (AWG 24 ... 14)
– Stranded wire with end sleeve	0.2 ... 1.5 mm ² (AWG 24 ... 16)

Electromechanical data - version IP66/IP68 (1 bar)

Connection cable, mechanical data

– Configuration	Wires, strain relief, breather capillaries, 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 _w	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 ²⁴⁾
– Standard length	5 m (16.40 ft)

²²⁾ 2 g with housing version stainless steel double chamber

²³⁾ IP66/IP68 (0.2 bar), only with absolute pressure.

²⁴⁾ Breather capillaries not with Ex d version.

– 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

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	50 m	●
4 ... 20 mA/HART SIL		
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
Availability of the temperature values	
– Indication	Via the display and adjustment module
– Output	Via the respective output signal

Voltage supply

Operating voltage U_B	9.6 ... 35 V DC
Operating voltage U_B with lighting switched on	16 ... 35 V DC
Reverse voltage protection	Integrated
Permissible residual ripple	
– for U_N 12 V DC ($9.6 \text{ V} < U_B < 14 \text{ V}$)	$\leq 0.7 V_{\text{eff}}$ (16 ... 400 Hz)
– for U_N 24 V DC ($18 \text{ V} < U_B < 35 \text{ V}$)	$\leq 1.0 V_{\text{eff}}$ (16 ... 400 Hz)
Load resistor	
– Calculation	$(U_B - U_{\text{min}})/0.022 \text{ A}$
– Example - with $U_B = 24 \text{ V DC}$	$(24 \text{ V} - 9.6 \text{ V})/0.022 \text{ A} = 655 \Omega$

Potential connections and electrical separating measures in the instrument

Electronics	Non-floating
Galvanic separation	
– between electronics and metallic parts of the device	Reference voltage 500 V AC
Conductive connection	Between ground terminal and metallic process fitting

Electrical protective measures ²⁵⁾

Housing material	Version	Protection acc. to IEC 60529	Protection acc. to NEMA
Plastic	Single chamber	IP66/IP67	Type 4X
	Double chamber		
Aluminium	Single chamber	IP66/IP67 IP66/IP68 (0.2 bar) IP66/IP68 (1 bar)	Type 4X Type 6P 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

²⁵⁾ Protection rating IP66/IP68 (0.2 bar) only in conjunction with absolute pressure, as no air compensation is possible when the sensor is completely flooded

Housing material	Version	Protection acc. to IEC 60529	Protection acc. to NEMA
Stainless steel (precision casting)	Single chamber	IP66/IP67 IP66/IP68 (0.2 bar) IP66/IP68 (1 bar)	Type 4X Type 6P 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 degree ²⁶⁾ 2

Protection rating (IEC/EN 61010-1) II

11.2 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} in turn consists of the thermal change of the zero signal and the output span F_T (temperature error) as well as the deviation F_{Kl} :

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

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:

$$F_T \times \text{FMZ} \times \text{FTD}$$

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

This applies initially to the digital signal output through HART, Profibus PA, Foundation Fieldbus or Modbus.

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

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

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_{Kl} : Deviation
- F_a : Thermal change of the current output

²⁶⁾ When used with fulfilled housing protection.

- FMZ: Additional factor measuring cell version
- FTD: Additional factor Turn down

11.3 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

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

2. Determination temperature error F_T

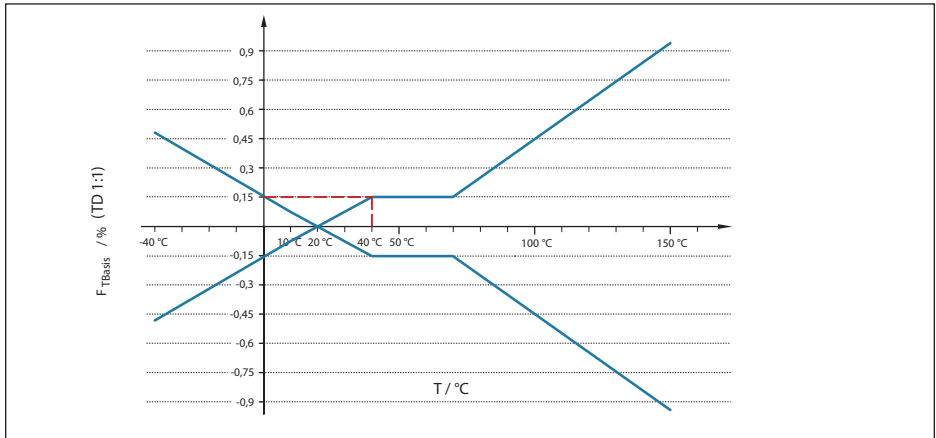


Fig. 40: Determination of the basic temperature error for the above example: $F_{TBasis} = \mathbf{0.15 \%}$

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

Tab. 30: Determination of the additional factor measuring cell for above example: $F_{MZ} = \mathbf{1}$

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

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

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

$$F_T = \mathbf{0.26 \%}$$

3. Determination of deviation and long-term stability

Accuracy class	Non-linearity, hysteresis and non-repeatability	
	TD ≤ 5 : 1	TD > 5 : 1
0.075 %	< 0.075 %	< 0.015 % x TD
0.1 %	< 0.1 %	< 0.02 % x TD
0.2 %	< 0.2 %	< 0.04 % x TD

Tab. 32: 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. 33: Determination of the long-term stability from the table, consideration for one year: $F_{stab} = 0.1 \%$ x TD/year

4. Calculation of the total deviation - HART signal

- 1. step: Basic deviation 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}

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

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

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

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

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

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

5. Calculation of the total deviation - 4 ... 20 mA signal

- 1. step: Basic deviation F_{perf}

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

$$F_T = 0.26 \%$$

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

$$F_a = 0.15 \%$$

$$F_{perf} = \sqrt{(0.26 \%)^2 + (0.1 \%)^2 + (0.15 \%)^2}$$

$$F_{perf} = 0.32 \%$$

- 2. step: Total deviation F_{total}

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

$$F_{\text{stab}} = (0.05 \% \times \text{TD})$$

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

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

$$F_{\text{total}} = 0.32 \% + 0.25 \% = 0.57 \%$$

The total deviation of the measurement is hence 0.57 %.

Deviation in bar: 0.57 % of 4 bar = 0.023 mbar

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

11.4 Dimensions

Plastic housing

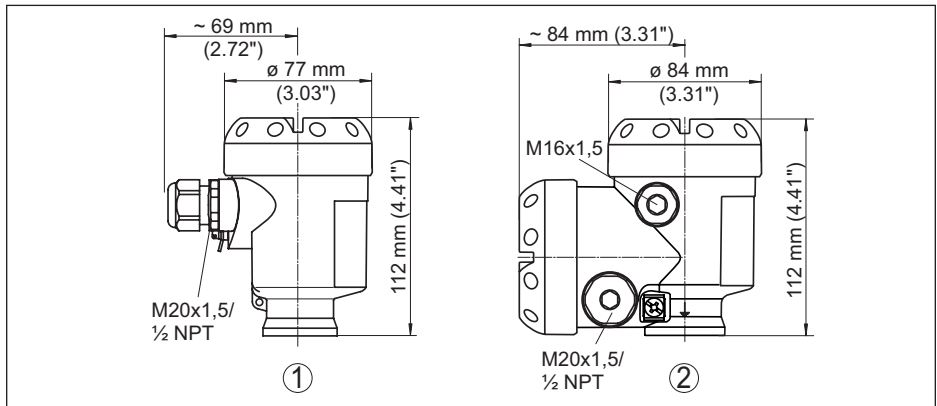


Fig. 41: Housing versions in protection IP66/IP67 (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

- 1 Plastic single chamber
- 2 Plastic double chamber

Aluminium housing

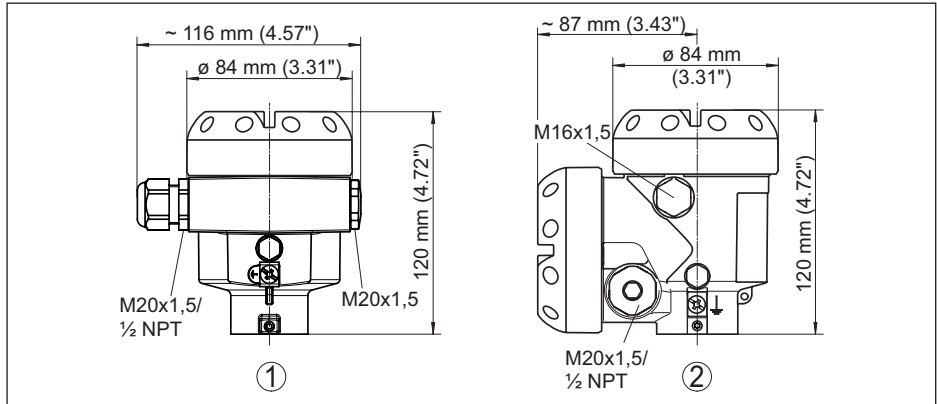


Fig. 42: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

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

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

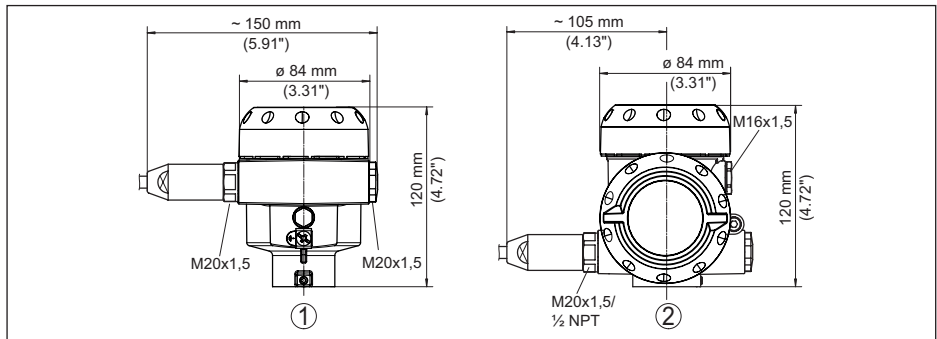


Fig. 43: Housing version with protection rating IP66/IP68 (1 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

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

Stainless steel housing

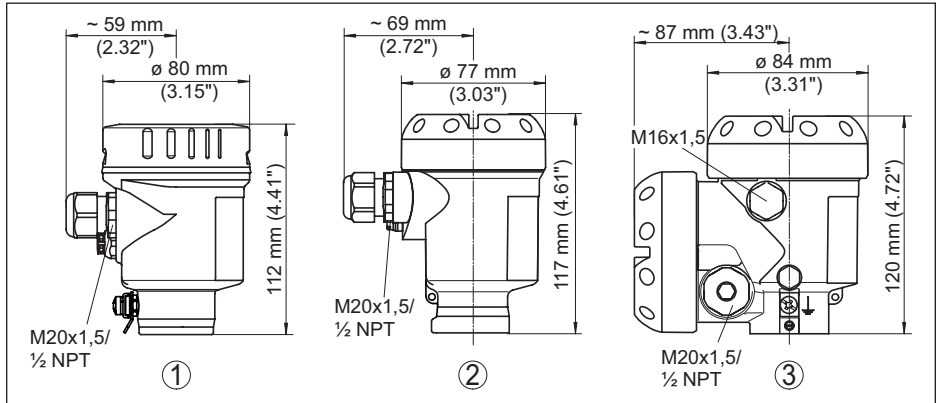


Fig. 44: Housing versions with protection rating IP66/IP68 (0.2 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

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

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

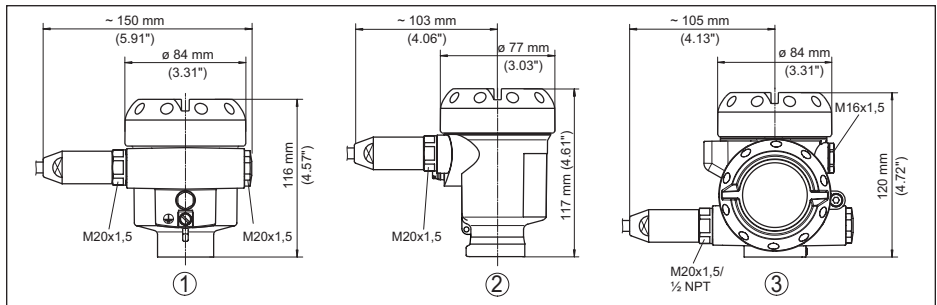


Fig. 45: Housing version with protection rating IP66/IP68 (1 bar), (with integrated display and adjustment module the housing is 9 mm/0.35 in higher)

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

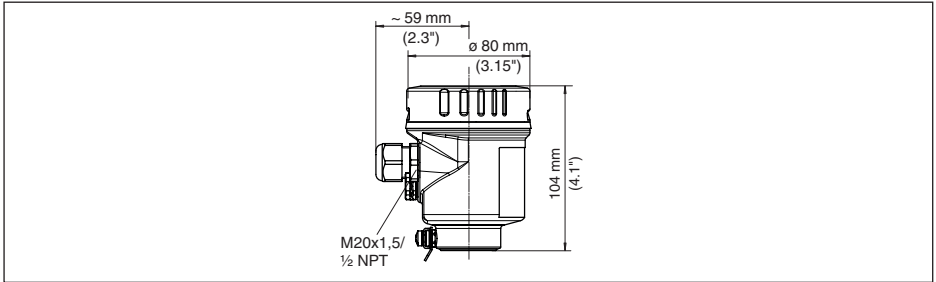
Stainless steel housing with protection rating IP69K

Fig. 46: 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

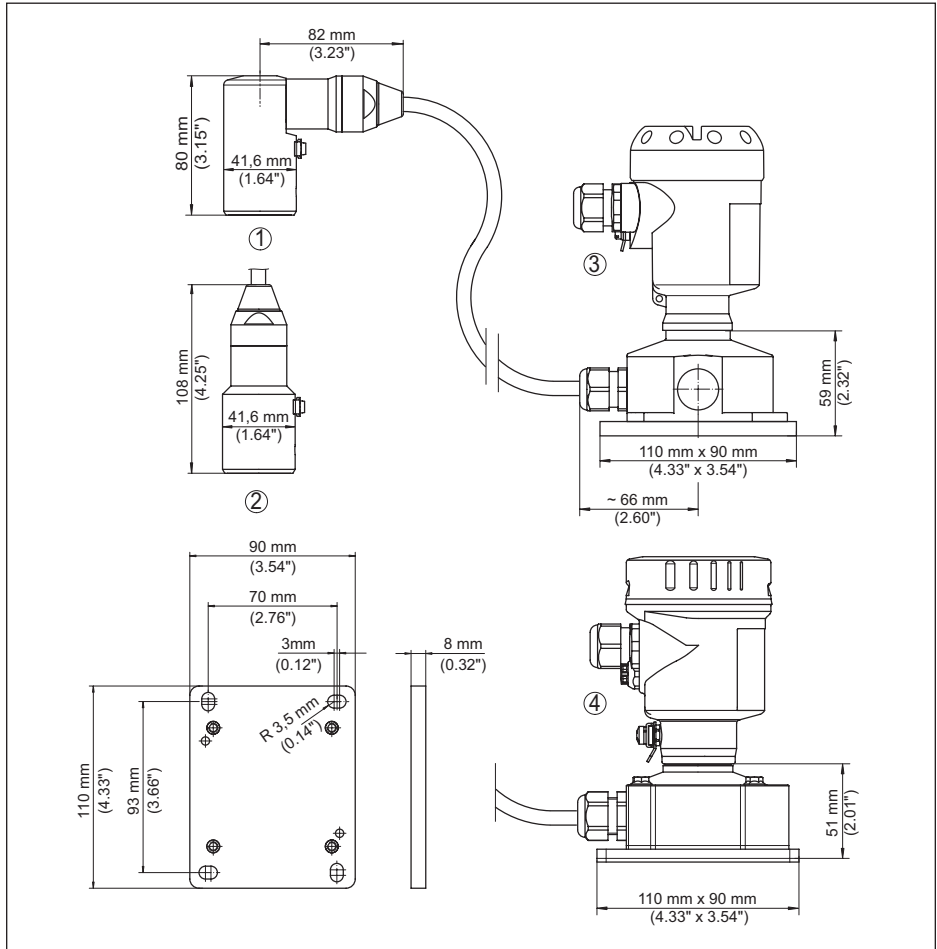


Fig. 47: IP68 (25 bar) version with external housing

- 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

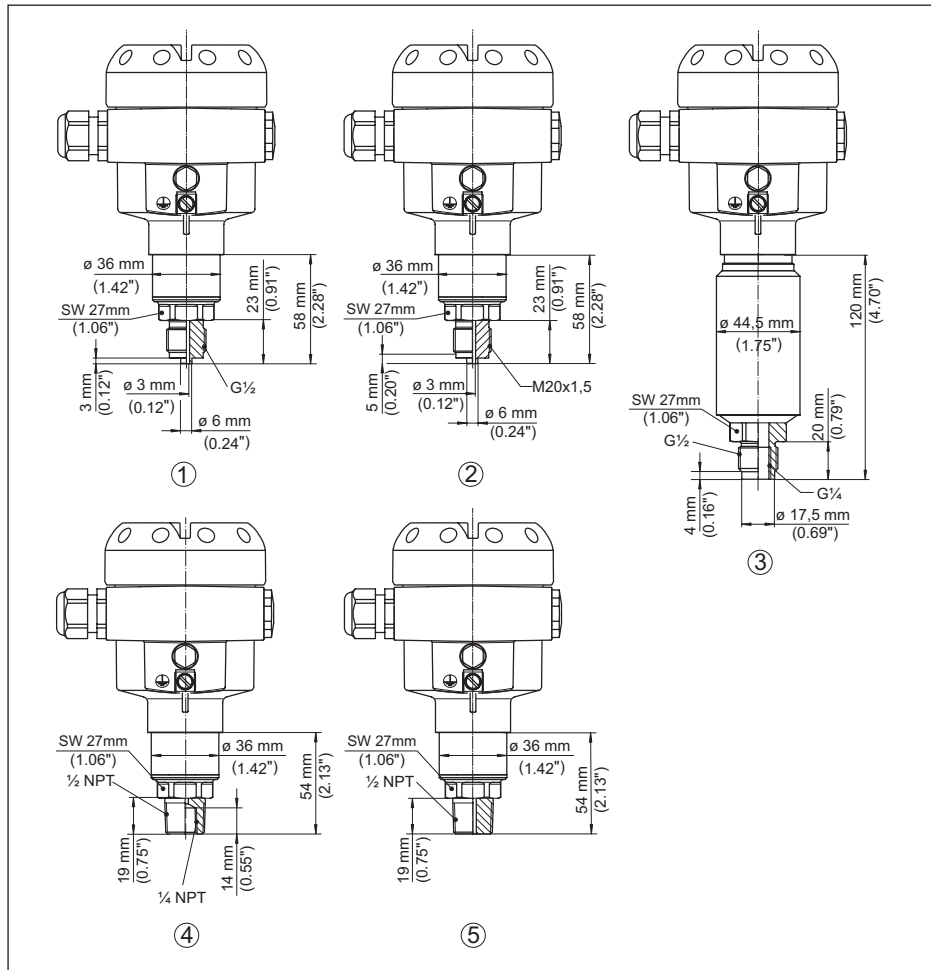


Fig. 48: IPT-2x, threaded fitting not front-flush

- 1 $G\frac{1}{2}$ (EN 837); manometer connection
- 2 $M20 \times 1.5$ (EN 837); manometer connection
- 3 $G\frac{1}{2}$, 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

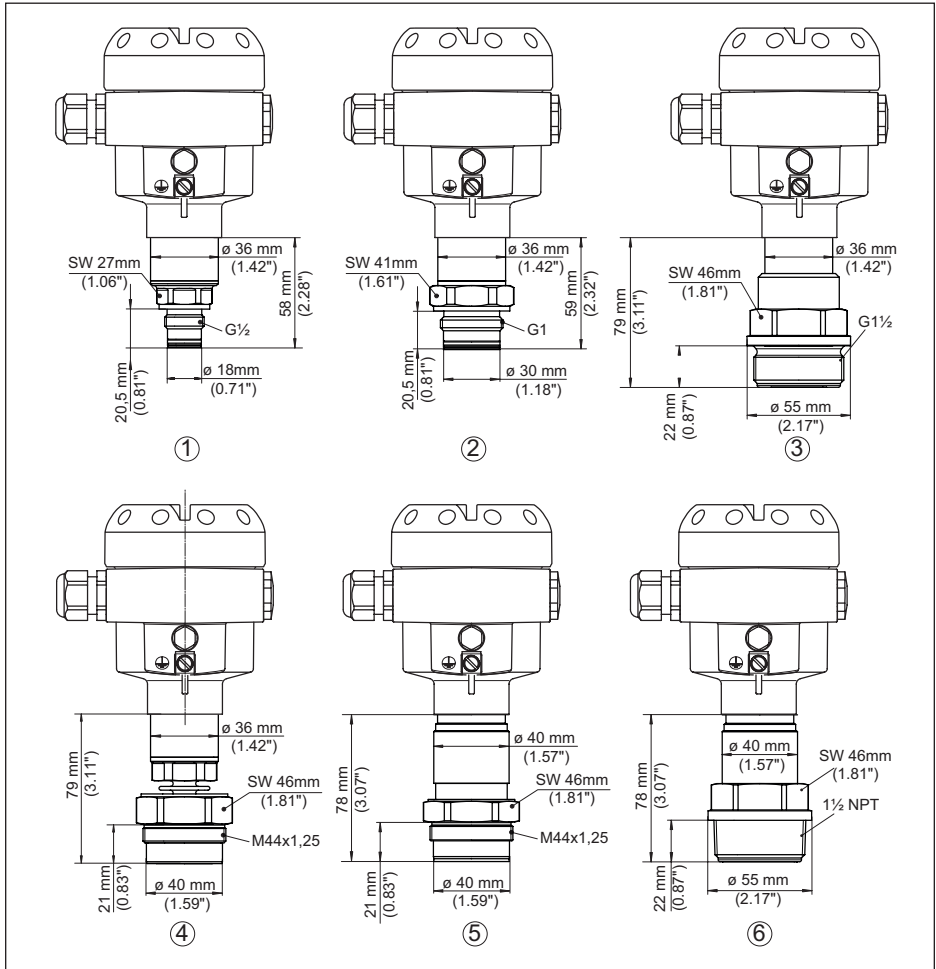


Fig. 49: IPT-2x, threaded fitting front-flush

- 1 G $\frac{1}{2}$ (ISO 228-1) with O-ring
- 2 G1 (ISO 228-1) with O-ring
- 3 G $\frac{1}{2}$ (DIN 3852-A)
- 4 M44 x 1.25 (DIN 13); pressure screw: Aluminium
- 5 M44 x 1.25 (DIN 13); pressure screw: 316L
- 6 1 $\frac{1}{2}$ NPT (ASME B1.20.1)

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

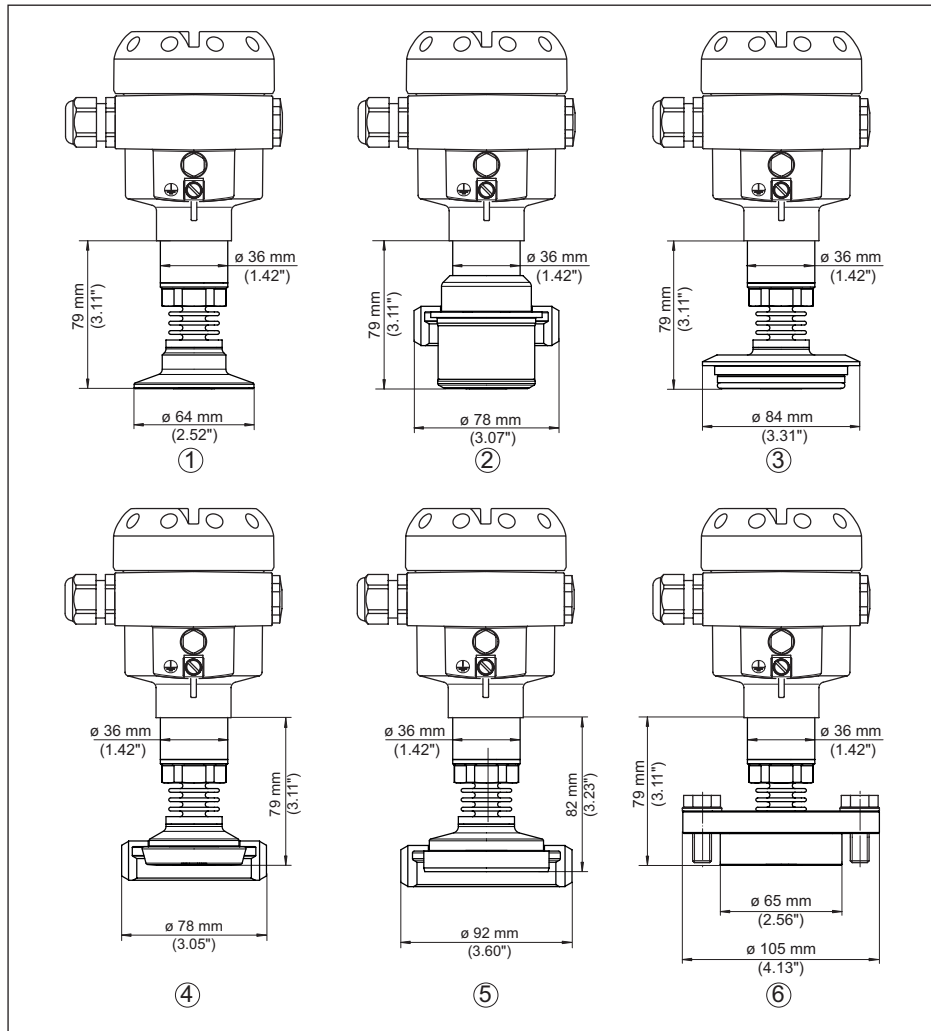


Fig. 50: IPT-2x, hygienic fitting +150 °C (piezoresistive/strain gauge measuring cell)

- 1 Clamp 2" PN 16 (ø 64 mm), (DIN 32676, ISO 2852)
- 2 Hygienic fitting with compression nut F40 PN 25
- 3 Varivent N50-40 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)

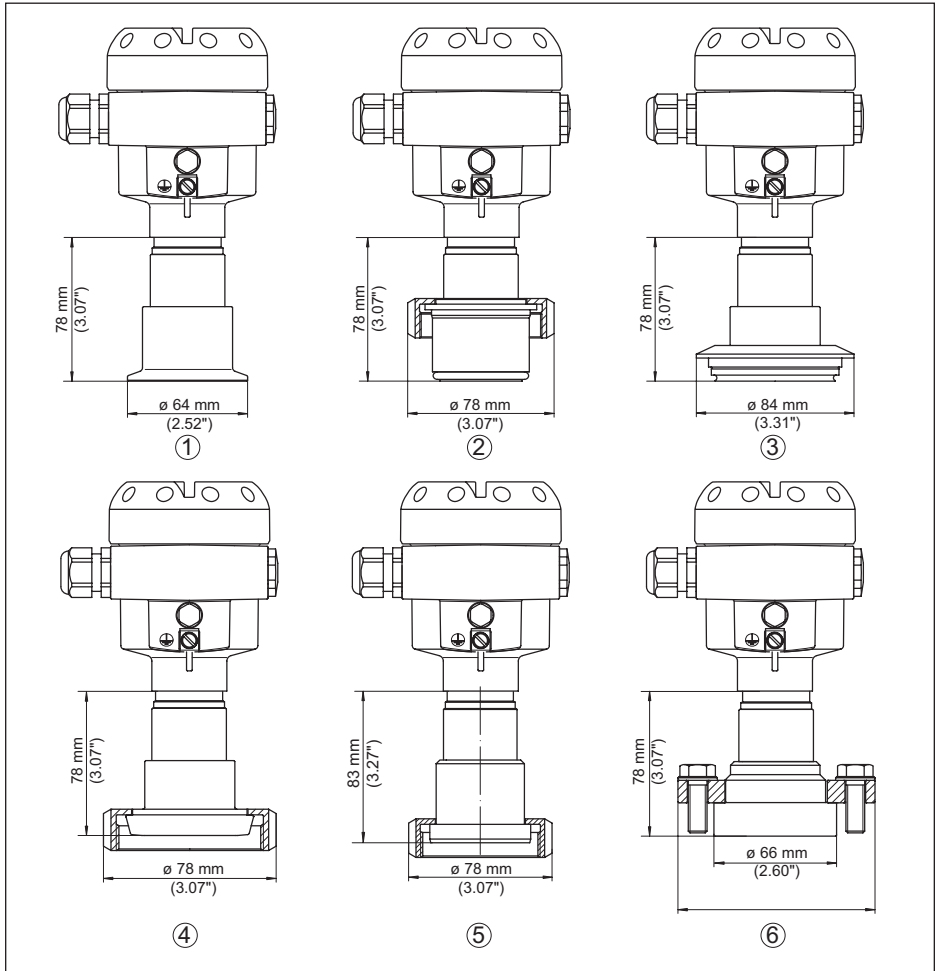


Fig. 51: IPT-2x, hygienic fitting +150 °C (metallic/ceramic measuring cell)

- 1 Clamp 2" PN 16 (ø 64 mm), (DIN 32676, ISO 2852)
- 2 Hygienic fitting with compression nut F40 PN 25
- 3 Varivent N50-40 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)

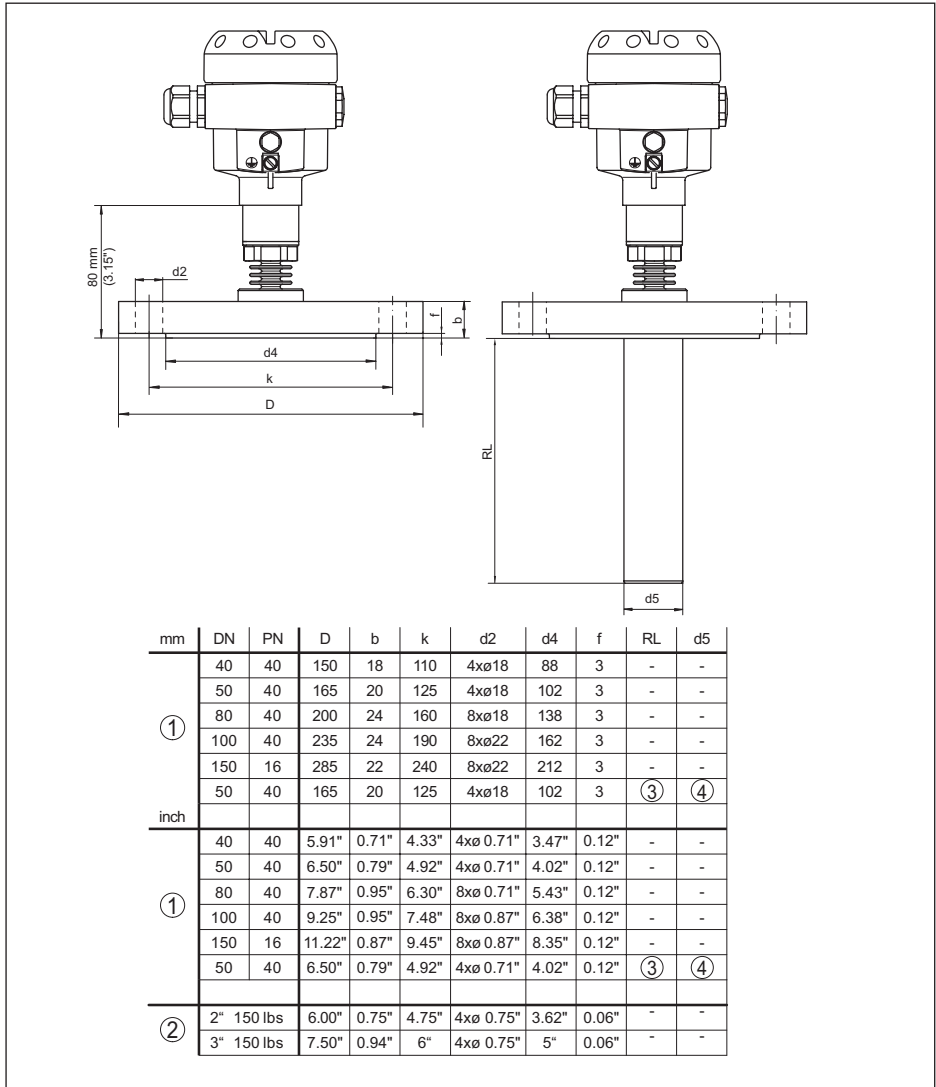
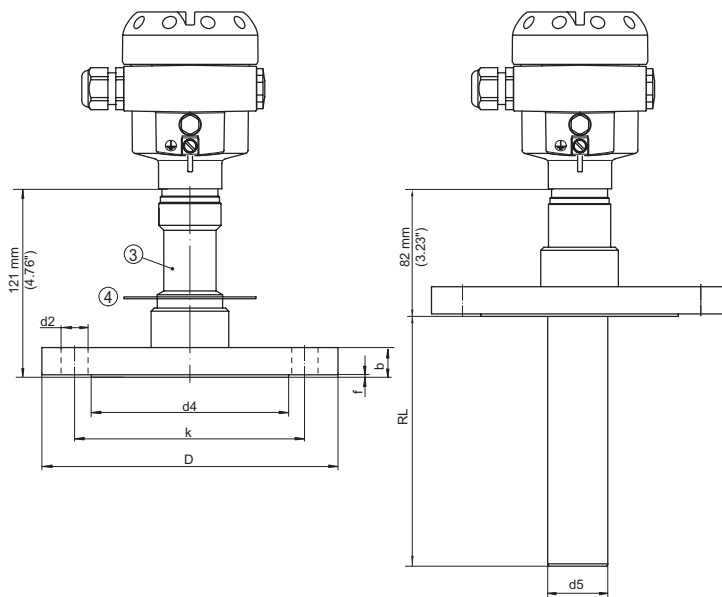


Fig. 52: IPT-2x, flange connection +150 °C (piezoresistive/strain gauge measuring cell)

- 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. 53: 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

11.5 Trademark

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

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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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