

Process pressure transmitter IPT-2x

GB

4 ... 20 mA
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 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.

2.7 Installation and operation in the USA and Canada

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

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

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

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
 - 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

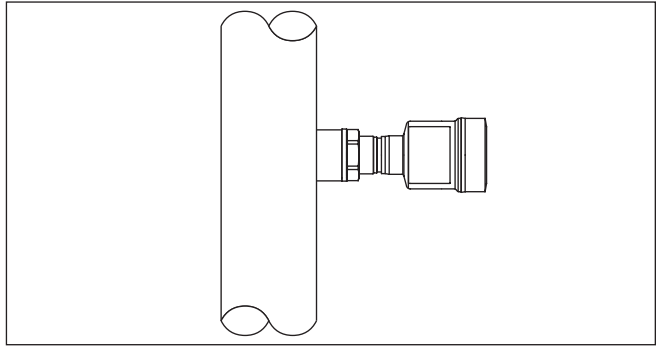


Fig. 1: Process pressure measurement IPT-2x

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.

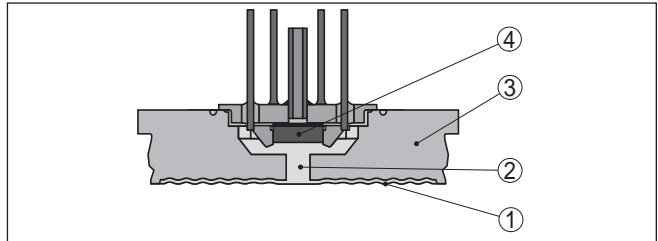


Fig. 2: Configuration of the measuring system with piezoresistive sensor element

- 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.

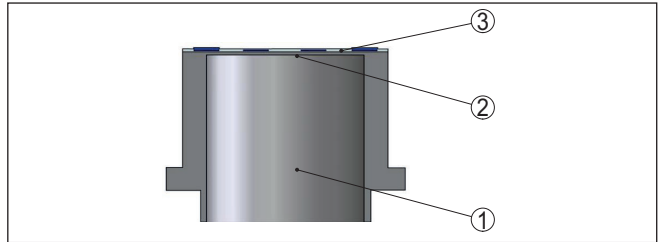


Fig. 3: Configuration of the measuring system with strain gauge (DMS) sensor element

- 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.

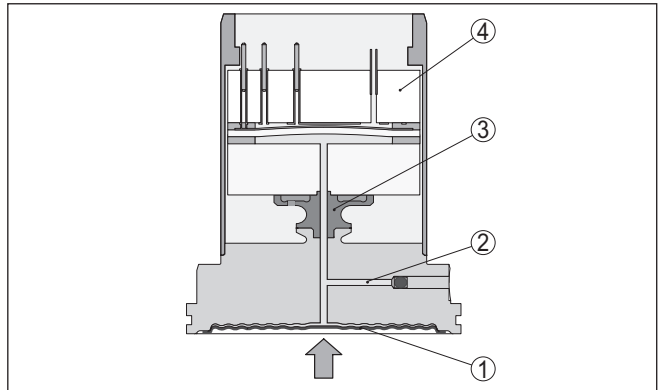


Fig. 4: Configuration of the ceramic/metallic measuring cell

- 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 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.

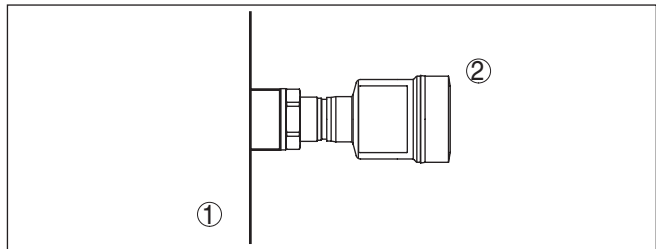


Fig. 5: Temperature ranges

- 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.

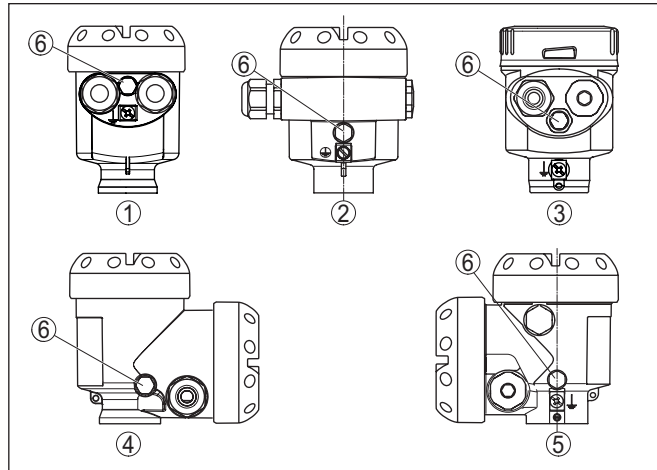
Filter element - Position


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.

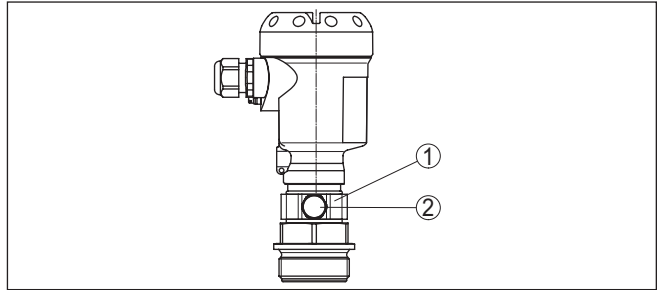


Fig. 7: Position of the filter element - Ex d version

- 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.

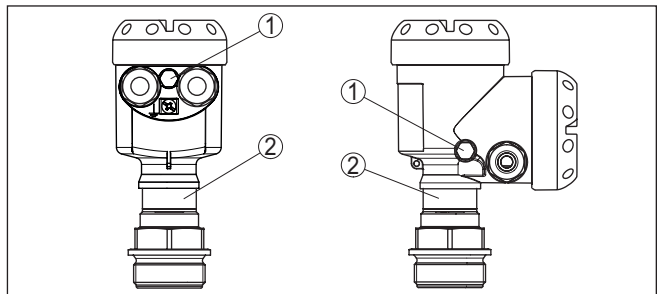


Fig. 8: Position of the filter element - gastight leadthrough

- 1 Filter element
- 2 Gas-tight leadthrough

Filter element - Position IP69K version

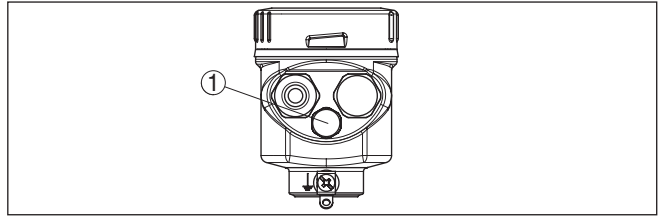


Fig. 9: Position of the filter element - IP69K version

1 Filter element

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

Measurement setup in gases

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.

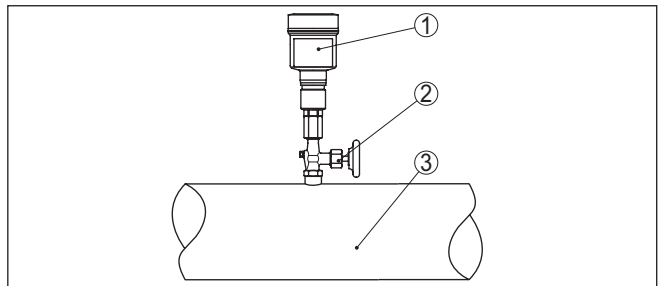


Fig. 10: Measurement setup for process pressure measurement of gases in pipelines

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

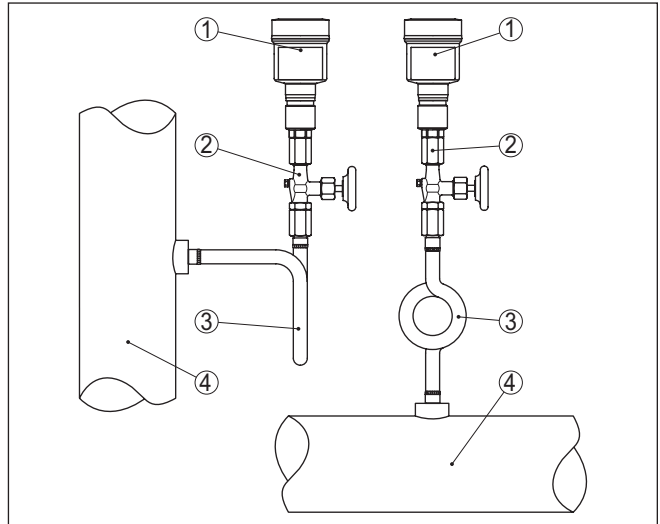


Fig. 11: Measurement setup for process pressure measurement of gases in pipelines

- 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 $< 100\text{ }^{\circ}\text{C}$ 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.

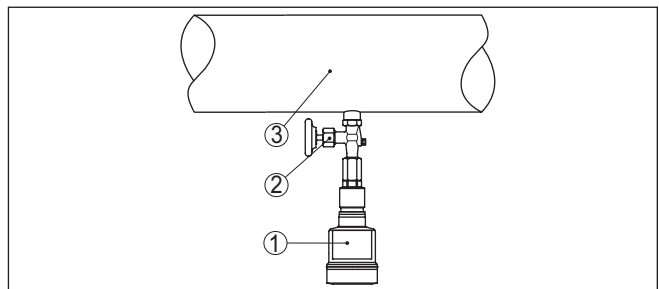


Fig. 12: Measurement setup for process pressure measurement of liquids in pipelines

- 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

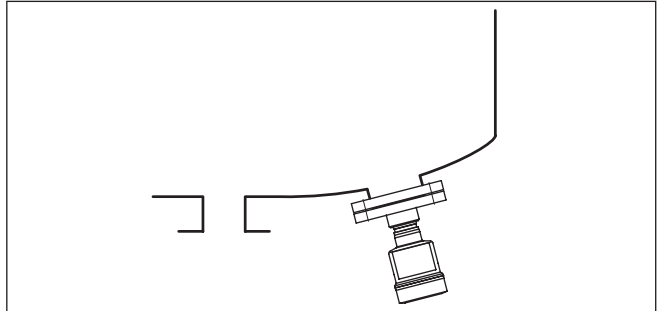


Fig. 13: Measurement setup for level measurement

4.6 External housing

Configuration

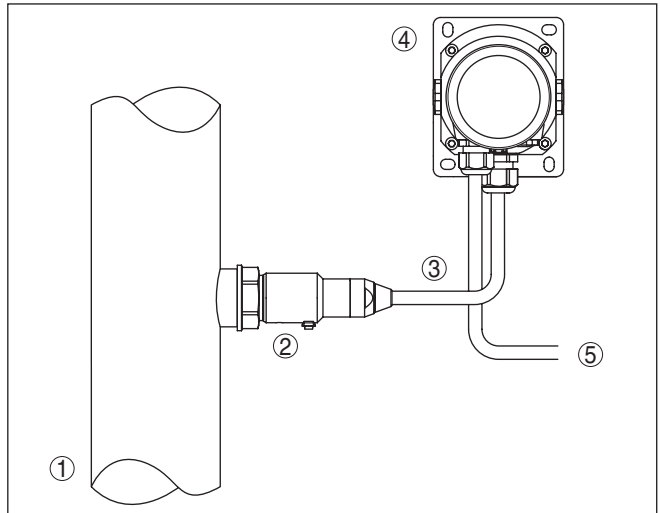


Fig. 14: Configuration, process module, external housing

- 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).

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 - Single chamber housing

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



Information:

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 as well as to the Ex ia version.

Electronics and connection compartment

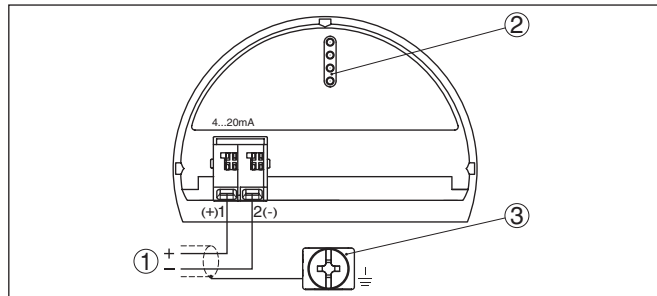


Fig. 16: Electronics and connection compartment - single chamber housing

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

Wire assignment, connection cable

5.4 Housing IP66/IP68 (1 bar)

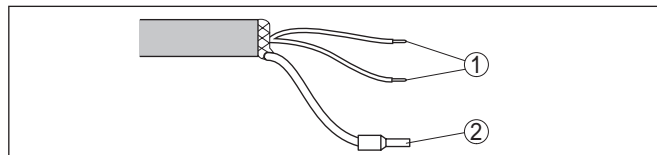


Fig. 17: Wire assignment in permanently connected connection cable

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

5.5 External housing with version IP68 (25 bar)

Overview

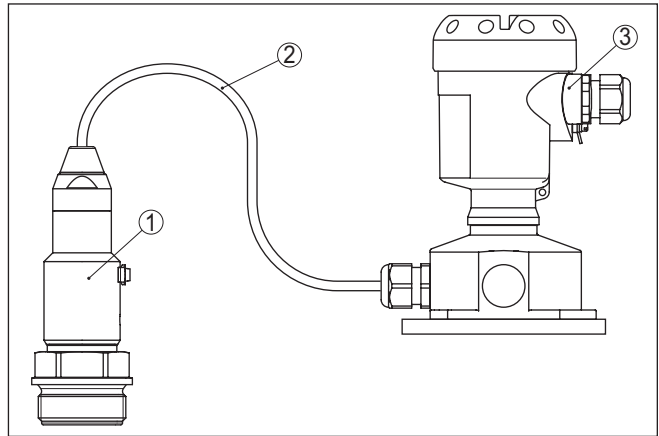


Fig. 18: IPT-2x in IP68 version 25 bar with axial cable outlet, external housing

- 1 Transmitter
- 2 Connection cable
- 3 External housing

Electronics and connection compartment for power supply

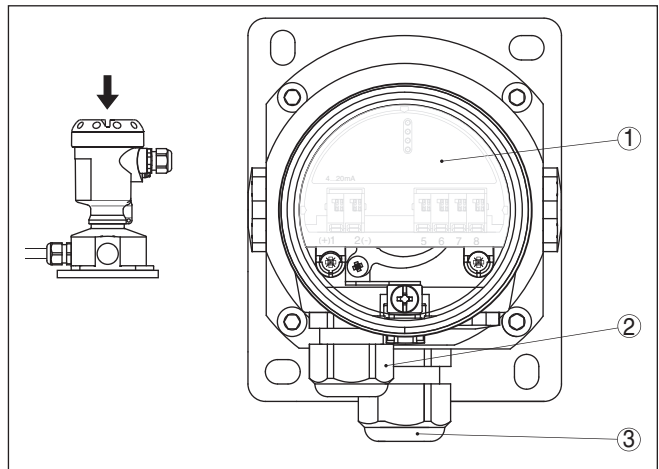


Fig. 19: Electronics and connection compartment

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

Terminal compartment, housing socket

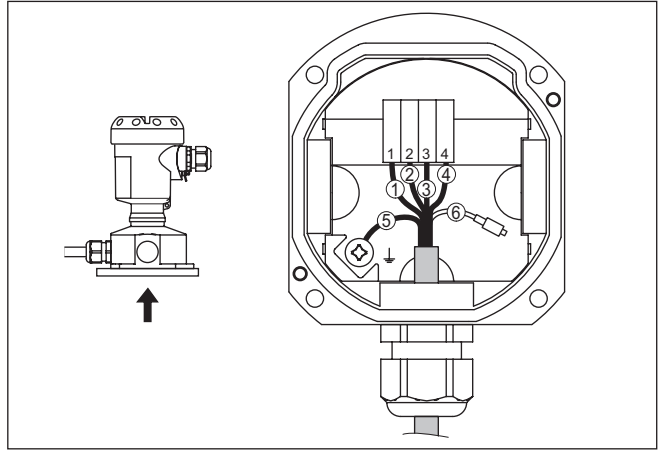


Fig. 20: Connection of the process component in the housing base

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

Electronics and connection compartment

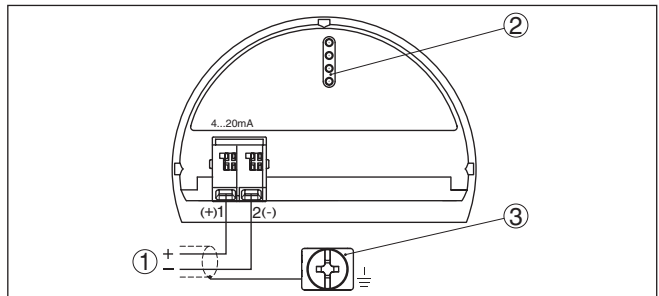


Fig. 21: Electronics and connection compartment - single chamber housing

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

5.6 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 Set up with the display and adjustment module

6.1 Adjustment system

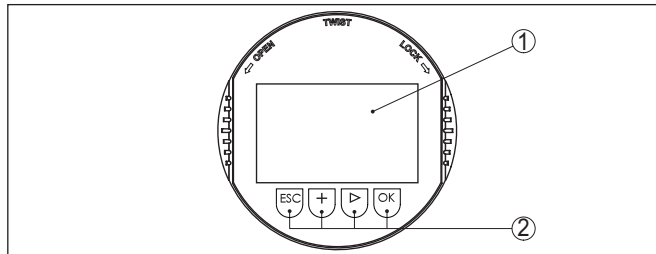


Fig. 22: Display and adjustment elements

- 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.

Measured value indication

6.2 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.

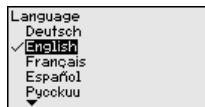
In the third view, the selected measured value as well as a second selectable value, e.g. the temperature, are displayed.



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.

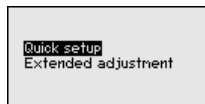


With the **"[→]"** button, you can select the requested language, with **"OK"** you confirm the selection and move to the main menu.

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

6.3 Parameter adjustment - Quick setup

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



Select the individual steps with the **[→]** key.

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

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



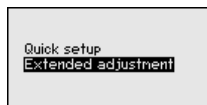
Note:

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

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

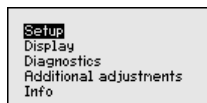
6.4 Parameter adjustment - Extended adjustment

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



Main menu

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



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

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

Diagnostics: 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.

6.4.1 Setup

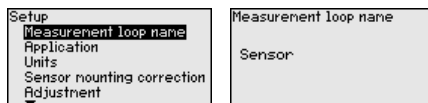
Measurement loop name

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.

Setup Measurement loop name Application Units Sensor mounting correction Adjustment	Second Device for e1. differential pressure Disabled! Application Level	Second Device for e1. differential pressure Disable <input checked="" type="checkbox"/> Enable
---	--	---

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:

Units of measurement m Temperature unit °C	Units of measurement mbar <input checked="" type="checkbox"/> bar Pa kPa MPa	Units of measurement psi mmH2O <input checked="" type="checkbox"/> mmHg inH2O inHg
---	--	--

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".

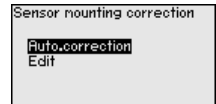
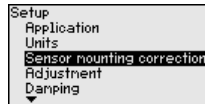
Temperature unit:

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



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:

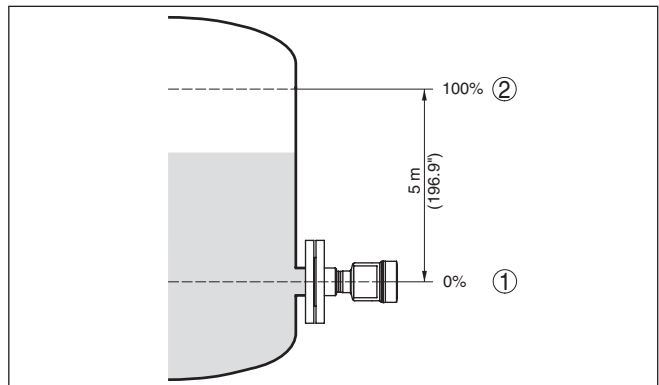


Fig. 23: Parameter adjustment example Min./max. adjustment, level measurement

- 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:

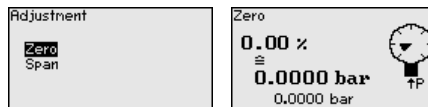
If the adjustment ranges are exceeded, the entered value will not be accepted. Editing can be interrupted with **[ESC]** or corrected to a value within the adjustment ranges.

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

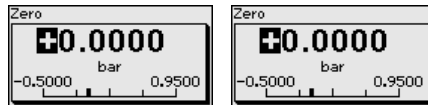
Zero adjustment

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]**.
4. 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.

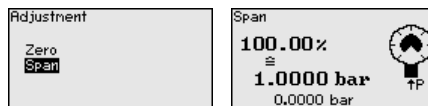
For an adjustment with pressure, simply enter the actual measured value indicated at the bottom of the display.

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]**.

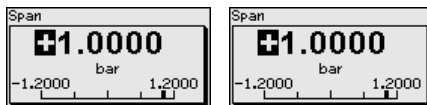
Span adjustment

Proceed as follows:

1. Select with **[>]** the menu item "Span 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]**.

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:

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



2. Edit the percentage value with **[OK]** and set the cursor to the requested position with **[>]**.
3. Set the requested percentage value (e.g. 10 %) with **[+]** and save with **[OK]**. The cursor jumps now to the pressure value.
4. Enter the pressure value corresponding to the min. level (e.g. 0 mbar).
5. Save settings with **[OK]** and move with **[ESC]** and **[>]** to the max. adjustment.

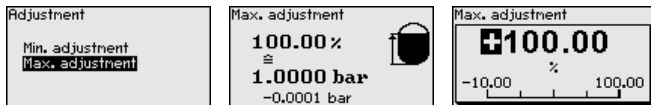
The min. adjustment is finished.

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

Max. adjustment - Level

Proceed as follows:

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



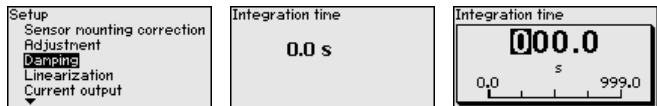
2. Edit the percentage value with **[OK]** and set the cursor to the requested position with **[>]**.
3. Set the requested percentage value (e.g. 90 %) with **[+]** and save with **[OK]**. The cursor jumps now to the pressure value.
4. Enter the pressure value for the full vessel (e.g. 900 mbar) corresponding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

The max. adjustment is finished.

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

Damping

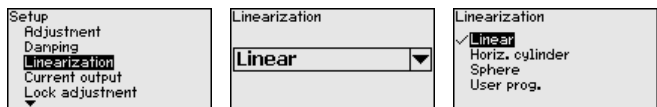
To damp process-dependent measured value fluctuations, set an damping of 0 ... 999 s in this menu item. The increment is 0.1 s.



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.



With flow measurement and selection "Linear" display and output (percentage/current) are linear to "Differential pressure". This can be used, for example, to feed a flow computer.

With flow measurement and selection "Extraction by root" display and output (percentage/current) are linear to "Flow".³⁾

With flow in two directions (bidirectional) a negative differential pressure is also possible. This must already be taken into account in menu item "Min. adjustment flow".



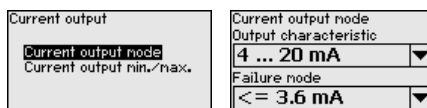
Caution:

Note the following, if the respective sensor is used as part of an over-fill protection system according to WHG:

If a linearisation curve is selected, the measuring signal is no longer necessarily linear to the filling height. This must be considered by the user especially when setting the switching point on the limit signal transmitter.

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.

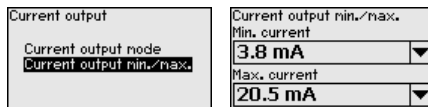


The default setting is output characteristics 4 ... 20 mA, fault mode < 3.6 mA.

³⁾ The device assumes an approximately constant temperature and static pressure and converts the differential pressure into the flow rate via the characteristic curve extracted by root.

Current output (min./max.)

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

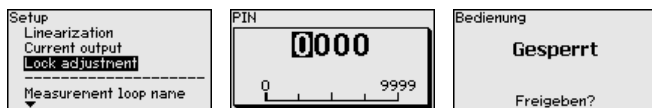


The default setting is min. current 3.8 mA and max. current 20.5 mA.

Lock/Unlock adjustment

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

This is done by entering a four-digit PIN.



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

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

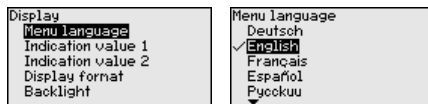
Releasing the sensor adjustment is also possible in any menu item by entering the PIN.

**Caution:**

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

6.4.2 Display**Language**

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



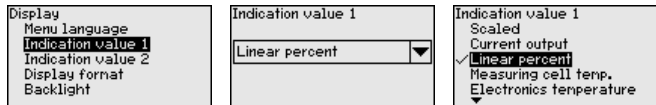
The following languages are available:

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

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

Display value 1 and 2

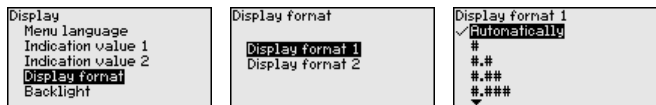
In this menu item, you define which measured value is displayed.



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

Display format 1 and 2

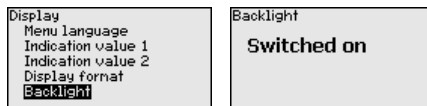
In this menu item you define the number of decimal positions with which the measured value is displayed.



The setting in the delivery status for the display format is " *Automatic*".

Backlight

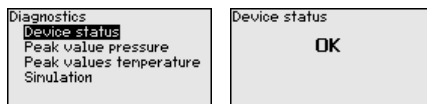
The display and adjustment module has a backlight for the display. In this menu item you can switch on the lighting. You can find the required operating voltage in chapter " *Technical data*".



In delivery status, the lighting is switched on.

6.4.3 Diagnostics**Device status**

In this menu item, the device status is displayed.

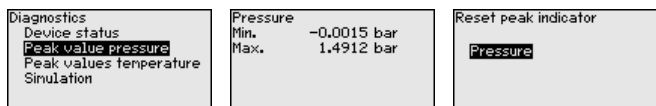


In case of error, e.g. the error code F017, e.g. the error description " *Adjustment span too small*" and a four digit figure are displayed for service purposes. You can find the error codes with description, reason as well as rectification in chapter " *Asset Management*".

Peak indicator, pressure

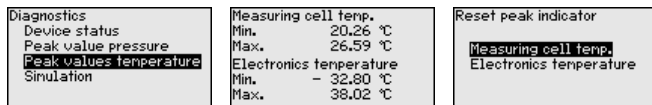
The respective min. and max. measured values are saved in the sensor. The two values are displayed in menu item " *Peak indicator, pressure*".

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

**Peak indicator, temperature**

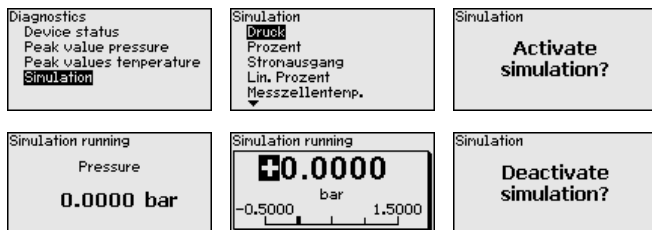
The respective min. and max. measured values of the measuring cell and the electronics temperature are stored in the sensor. In menu item " *Peak indicator, temperature*", both values are displayed.

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. 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 with instruments 4 ... 20 mA/HART in addition as digital HART signal. The status message within the context of the asset management function is "Maintenance".



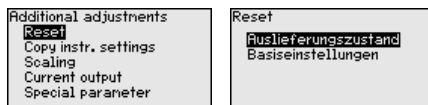
Note:

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

6.4.4 Additional adjustments

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: Resetting of the parameter settings incl. special parameters to the default values of the respective instrument. Any user programmable linearization curve as well as the measured value memory are deleted.

**Note:**

You can find the default values of the device in chapter "Menu overview".

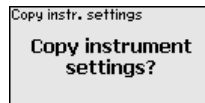
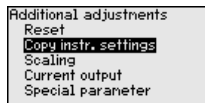
Copy instrument settings

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



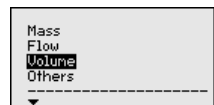
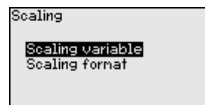
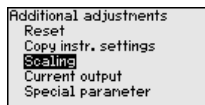
The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.

**Note:**

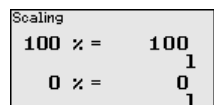
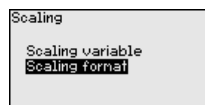
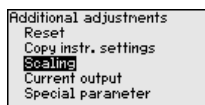
Before the data are saved in the sensor, a safety check is carried out to determine if the data match the sensor. In the process the sensor type of the source data as well as the target sensor are displayed. If the data do not match, a fault message is outputted or the function is blocked. The data are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

Scaling (1)

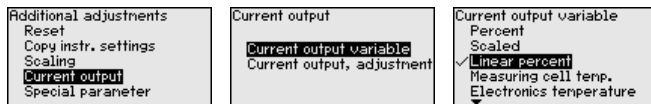
In menu item "Scaling" you define the scaling variable and the scaling unit for the level value on the display, e.g. volume in l.

**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 %.

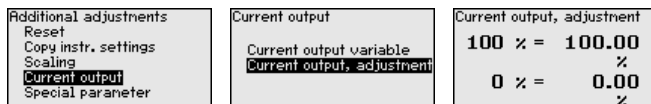
**Current output (meas. variable)**

In menu item "Current output, variable" you specify which measured variable is output via the current output.

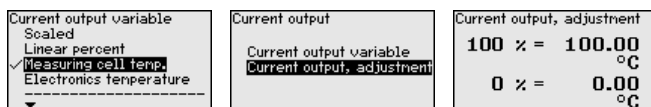


Current output (adjustment)

Depending on the selected measured variable, you assign in the menu item "Current output, adjustment" the measured values that 4 mA (0 %) and 20 mA (100 %) of the current output refer to.



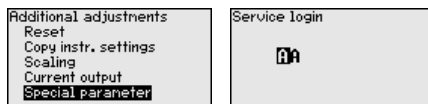
If the measuring cell temperature is selected as measured variable, then e.g. 0 °C refers to 4 mA and 100 °C to 20 mA.



Special parameters

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

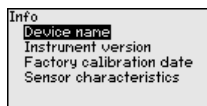
Change the settings of the special parameters only after having contacted our service staff.



6.4.5 Info

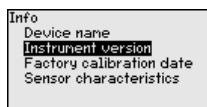
Device name

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.

Info
Device name
Instrument version
Factory calibration date
Sensor characteristics

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.

Info
Device name
Instrument version
Factory calibration date
Sensor characteristics

6.5 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.

Setup

Menu item	Parameter	Default value
Measurement loop name	19 alphanumeric characters/special characters	Sensor
Application	Level, process pressure	Level
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 (°C, °F)	°C
Position correction	Offset	0.00 bar
Adjustment	Zero/Min. adjustment	0.00 bar 0.00 %
	Span/Max. adjustment	Nominal measuring range in bar 100.00 %
Damping	Integration time	1 s
Linearisation	Linear, cylindrical tank, ... user-defined	Linear
Current output	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	Blocked, released	Released

Display

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

Diagnostics

Menu item	Parameter	Default value
Device status		-
Peak indicator	Pressure	Current pressure measured value
Peak indicator temp.	Temperature	Actual measuring cell and electronic temperature
Simulation	Pressure, percent, current output, linearized percent, measuring cell temperature, electronics temperature	Pressure

Additional adjustments

Menu item	Parameter	Default value
Date/Time		Actual date/Actual time
Reset	Delivery status, basic settings	
Copy instrument settings	Read from sensor, store in sensor	
Scaling	Scaling size	Volume in l
	Scaling format	0 % corresponds to 0 l 100 % corresponds to 100 l
Current output	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 (ceramic measuring cell)
	Current output - Adjustment	0 ... 100 °C correspond to 4 ... 20 mA
Special parameters	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

6.6 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*".

7 Diagnostics and servicing

7.1 Maintenance

Maintenance

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

Precaution measures against buildup

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

Cleaning

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

Take note of the following:

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

7.2 Diagnosis function

Failure

Code Text message	Cause	Rectification
F013 No valid measured value available	Gauge pressure or low pressure Measuring cell defective	Exchange measuring cell Send instrument for repair
F017 Adjustment span too small	Adjustment not within specification	Change the adjustment according to the limit values
F025 Error in the linearization table	Index markers are not continuously rising, for example illogical value pairs	Check linearization table Delete table/Create new
F036 no operable sensor software	Failed or interrupted software update	Repeat software update Check electronics version Exchanging the electronics Send instrument for repair
F040 Error in the electronics	Hardware defect	Exchanging the electronics Send instrument for repair
F041 Communication error	No connection to the sensor electronics	Check connection between sensor and main electronics (with separate version)
F080 General software error	General software error	Disconnect operating voltage briefly
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

Code Text message	Cause	Rectification
F113 Communication error	Error in the internal instrument communication	Disconnect operating voltage briefly Send instrument for repair
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
F261 Error in the instrument settings	Error during setup Error when carrying out a reset	Repeat setup Repeat reset
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
F265 Measurement function disturbed	Sensor no longer carries out a measurement	Carry out a reset Disconnect operating voltage briefly

Function check

Code Text message	Cause	Rectification
C700 Simulation active	A simulation is active	Finish simulation Wait for the automatic end after 60 mins.

Out of specification

Code Text message	Cause	Rectification
S600 Impermissible electronics temperature	Temperature of the electronics in the non-specified range	Check ambient temperature Insulate electronics Use instrument with higher temperature range
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
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
M501 Error in the non-active linearization table	Index markers are not continuously rising, for example illogical value pairs	Check linearization table Delete table/Create new
M502 Error in the event memory	Hardware error EEPROM	Exchanging the electronics Send instrument for repair
M504 Error at a device interface	Hardware defect	Exchanging the electronics Send instrument for repair
M507 Error in the instrument settings	Error during setup Error when carrying out a reset	Carry out reset and repeat setup

7.3 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.

7.4 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

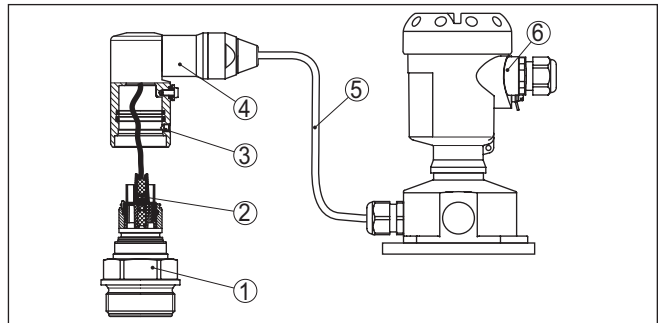


Fig. 24: IPT-2x in IP68 version, 25 bar and lateral cable outlet, external housing

- 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.

7.5 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

8 Dismount

8.1 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.

8.2 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.

9 Supplement

9.1 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)⁴⁾

Process fitting	316L, Alloy C276 (2.4819)
Diaphragm	
– Front-flush	316L, Alloy C276 (2.4819) ⁵⁾
– 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 G1½ (EN 837), G1½ (DIN 3852-A)	Aramid/NBR

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

Materials, wetted (ceramic/metallic measuring cell)⁶⁾

Process fitting	316L
Diaphragm	Alloy C276 (2.4819), gold-coated 20 μm , gold/rhodium-coated 5 μm ⁷⁾
Seal for process fitting (in the scope of delivery)	
– Thread G1½ (DIN 3852-A)	Klingersil C-4400
– Thread M44 x 1.25 (DIN 13)	FKM, FFKM, EPDM

⁴⁾ 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.

⁵⁾ Alloy C276 (2.4819) with process fitting of Alloy C276 (2.4819)

⁶⁾ 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.

⁷⁾ 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 ^{8) 9)}
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 ¹⁰⁾
– Ground terminal	316L
External housing - deviating materials	
– Housing and socket	Plastic PBT (Polyester), 316L
– Socket seal	EPDM
– Seal below wall mounting plate ¹¹⁾	EPDM
– Inspection window housing cover	Polycarbonate (UL-746-C listed)
Ground terminal	316Ti/316L
Connection cable with IP68 (25 bar) version ¹²⁾	
– Cable cover	PE, PUR
– Type label support on cable	PE hard
Connection cable with IP68 (1 bar) version ¹³⁾	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

– G¼, G½	50 Nm (36.88 lbf ft)
– G½ front-flush, G1 front-flush	40 Nm (29.50 lbf ft)
– G1½ front-flush (piezoresistive measuring cell)	40 Nm (29.50 lbf ft)

⁸⁾ Isolating liquid with measuring ranges up to 40 bar. With measuring ranges from 100 bar dry measuring cell.

⁹⁾ Halocarbon oil: Generally in oxygen applications, not with vacuum measuring ranges, not with absolute measuring ranges < 1 bar_{abs}.

¹⁰⁾ Glass with Aluminium and stainless steel (precision casting) housing

¹¹⁾ Only for 316L with 3A approval

¹²⁾ Between transmitter and external electronics housing.

¹³⁾ 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. ¹⁴⁾

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

¹⁴⁾ 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.¹⁵⁾

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

¹⁵⁾ 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)
----------------------------	--------------------------------

Switch-on phase

Start-up time with operating voltage U_R

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

Starting current (for run-up time) $\leq 3.6 \text{ mA}$

Output variable

Output signal	4 ... 20 mA - passive
---------------	-----------------------

Connection technology	Two-wire
-----------------------	----------

Range of the output signal	3.8 ... 20.5 mA (default setting)
Signal resolution	0.3 μ A
Fault signal, current output (adjustable)	≤ 3.6 mA, ≥ 21 mA, last measured value
Max. output current	21.5 mA
Load	See load resistance under Power supply
Damping (63 % of the input variable), adjustable	0 ... 999 s

Dynamic behaviour output

Dynamic characteristics depending on medium and temperature

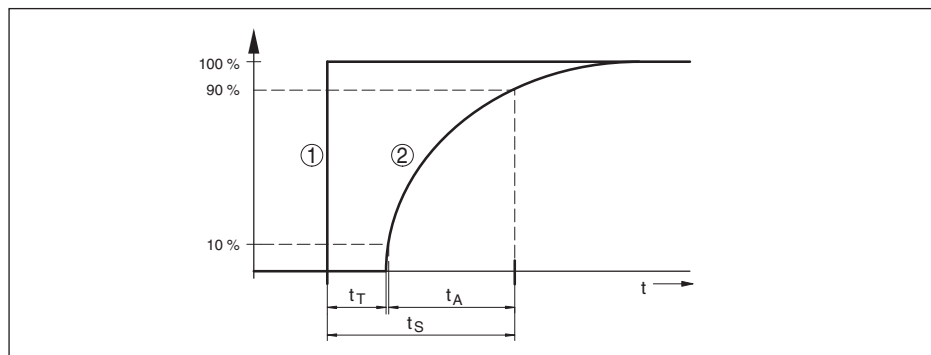


Fig. 25: Behaviour in case of sudden change of the process variable. t_T : dead time; t_A : rise time; t_S : jump response time

- 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 (t_i : 0 s, 10 ... 90 %)	≤ 80 ms	≤ 200 ms

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

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

Reference conditions according to DIN EN 61298-1

– Temperature	+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 < $\pm 150 \mu\text{A}$

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 ¹⁶⁾	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

¹⁶⁾ Different availability depending on measuring range and process fitting

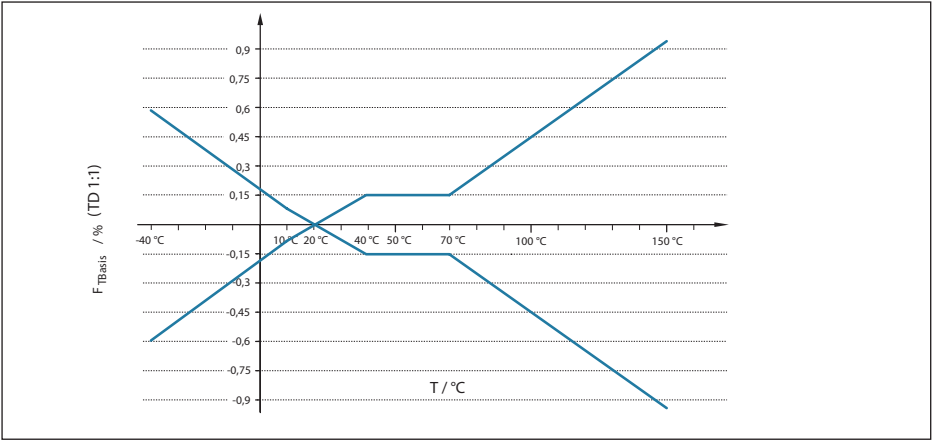


Fig. 26: Basic temperature error F_{TBasis} at TD 1 : 1

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

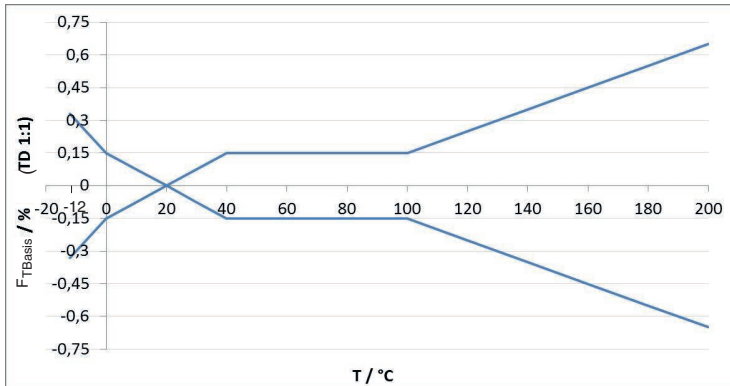


Fig. 27: Basic temperature error F_{TBasis} at TD 1 : 1

The basic temperature error in % from the above graphic can increase due to the additional factors depending on the 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	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)

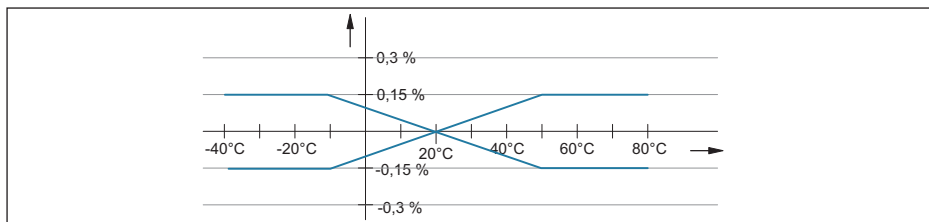


Fig. 28: Thermal change, current output

Long-term stability (according to DIN 16086)

Applies to the respective **digital** signal output (e.g. HART, Profibus PA) as well as to **analogue** current output 4 ... 20 mA under reference conditions. Specifications refer to the set span. Turn down (TD) is the ratio nominal measuring range/set span. ¹⁷⁾

Long-term stability zero signal and output span - ceramic/metallic measuring cell

Time period	
One year	$< 0.05 \% \times \text{TD}$
Five years	$< 0.1 \% \times \text{TD}$
Ten years	$< 0.2 \% \times \text{TD}$

Long-term stability zero signal and output span - Piezoresistive/Strain gauge measuring cell

Measuring range/Version	Piezoresistive measuring cell	Strain gauge measuring cell
Measuring ranges > 1 bar	$< 0.1 \% \times \text{TD/year}$	
Measuring ranges > 1 bar, isolating liquid, synthetic oil, diaphragm Alloy C276	$< 0.15 \% \times \text{TD/year}$	—
Measuring range 1 bar		
Measuring range 0.4 bar		

Long-term drift (according to IEC 61298-2) in hydrogen applications

When used in hydrogen applications, diffusion into the sensor structures over time can cause a signal drift. The extent of the drift depends essentially on factors such as the temperature of the hydrogen, the percentage of hydrogen in the measuring medium as well as the used diaphragm thickness of the pressure sensor. It is recommended to test the suitability of the selected product version accordingly.

Typical long-term drift $\leq 1 \% \times \text{TD/year}$

Maximum long-term drift $\leq 3 \% \times \text{TD/year}$

¹⁷⁾ With ceramic/metallic measuring cell with gold-coated diaphragm, the values must be multiplied with factor 3.

Ambient conditions

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

Process conditions - Piezoresistive/Strain gauge measuring cell**Process temperature**

Seal	Sensor version				
	Standard	Extended temperature range	Hygienic fittings		Version for oxygen applications
	$p_{abs} \geq 1 \text{ mbar}$		$p_{abs} \geq 1 \text{ mbar}$	$p_{abs} \geq 10 \text{ mbar}$	$p_{abs} \geq 10 \text{ mbar}$
Without consideration of the seal ¹⁸⁾	-20/-40 ... +105 °C (-4/-40 ... +221 °F)	—	—	—	-20 ... +60 °C (-4 ... +140 °F)
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)	-20 ... +60 °C (-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)	-20 ... +60 °C (-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)

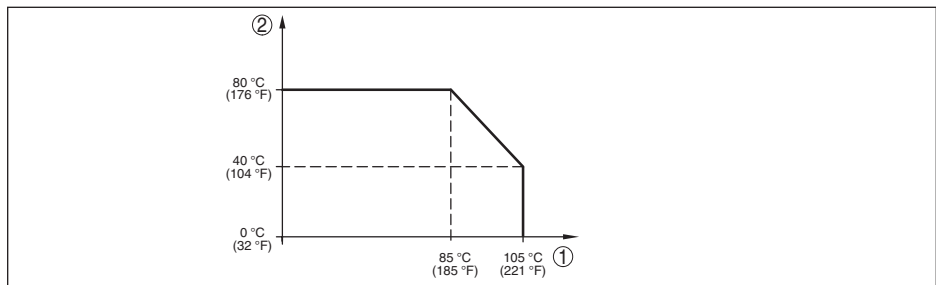
Temperature derating

Fig. 29: Temperature derating IPT-2x, version up to +105 °C (+221 °F)

- 1 Process temperature
2 Ambient temperature

¹⁸⁾ Process fittings acc. to DIN 3852-A, EN 837

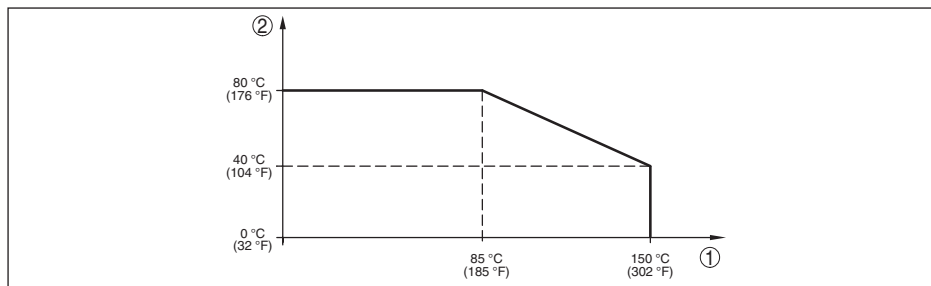


Fig. 30: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
2 Ambient temperature

SIP process temperature (SIP = Sterilization in place)

Vapour stratification for 2 h ¹⁹⁾ +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} ≥ 50 mbar	p _{abs} ≥ 10 mbar	p _{abs} ≥ 1 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

¹⁹⁾ Instrument configuration suitable for vapour

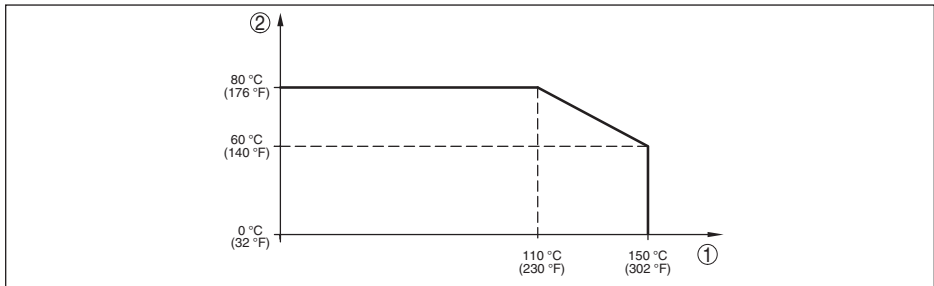


Fig. 31: Temperature derating IPT-2x, version up to +150 °C (+302 °F)

- 1 Process temperature
- 2 Ambient temperature

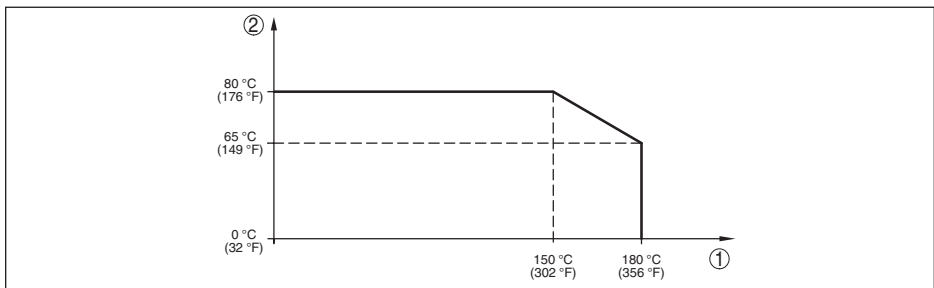


Fig. 32: Temperature derating IPT-2x, version up to +180 °C (+356 °F)

- 1 Process temperature
- 2 Ambient temperature

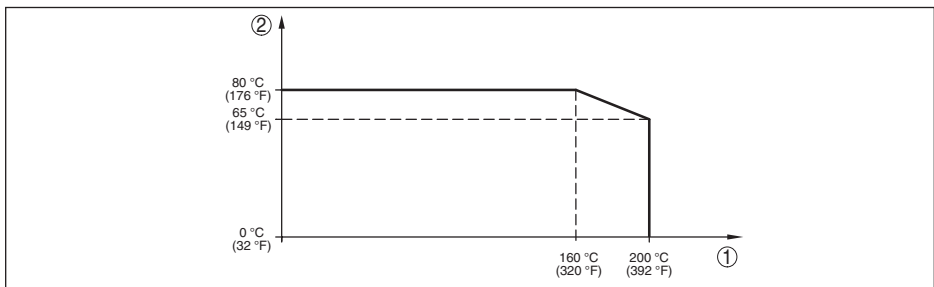


Fig. 33: Temperature derating IPT-2x, version up to +200 °C (+392 °F)

- 1 Process temperature
- 2 Ambient temperature

Process pressure

Permissible process pressure

see specification "Process pressure" on the type label

Mechanical stress²⁰⁾

²⁰⁾ 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) ²¹⁾

Electromechanical data - version IP66/IP67 and IP66/IP68 (0.2 bar) ²²⁾

Options of the cable entry

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

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

Wire cross-section (spring-loaded terminals)

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

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 mm² (AWG 20)
- Wire resistance R' 0.037 Ω/m (0.012 Ω/ft)

Electromechanical data - version IP68 (25 bar)

Connection cable transmitter - external housing, mechanical data

- Configuration Wires, strain relief, breather capillaries, screen braiding, metal foil, mantle ²³⁾
- Standard length 5 m (16.40 ft)

²¹⁾ 2 g with housing version stainless steel double chamber

²²⁾ IP66/IP68 (0.2 bar), only with absolute pressure.

²³⁾ 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

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 Reference voltage 500 V AC of the device

Conductive connection Between ground terminal and metallic process fitting

Electrical protective measures ²⁴⁾

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

Altitude above sea level

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

Pollution degree ²⁵⁾ 4

Protection rating (IEC 61010-1) II

9.2 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_{K1} :

$$F_{\text{perf}} = \sqrt{((F_T)^2 + (F_{K1})^2)}$$

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:

²⁴⁾ 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

²⁵⁾ When used with fulfilled housing protection.

$F_T \times FMZ \times FTD$

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

9.3 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_{Kl} and long-term stability F_{stab} are available in the technical data.

1. Calculation of the Turn down

TD = 10 bar/4 bar, TD = **2.5 : 1**

2. Determination temperature error F_T

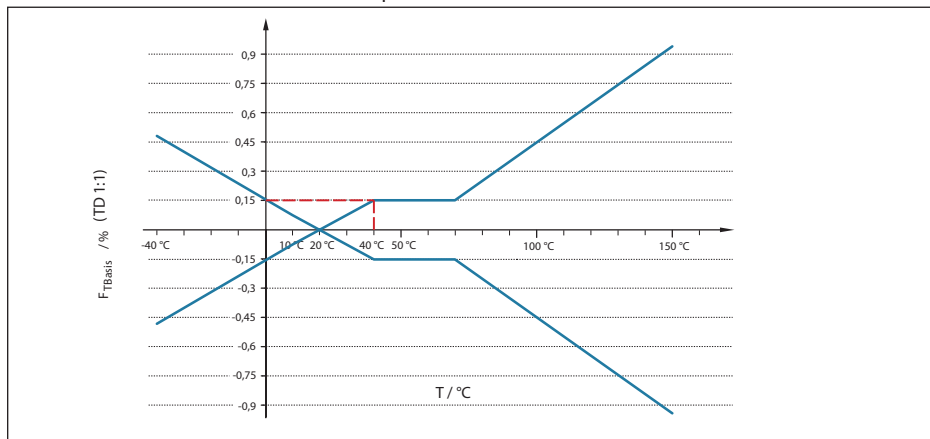


Fig. 34: Determination of the basic temperature error for the above example: $F_{TBasis} = 0.15 \%$

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

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

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

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

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

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

$$F_T = 0.26 \%$$

3. Determination of deviation and long-term stability

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

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

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

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

4. Calculation of the total deviation - 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}

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

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

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

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

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

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.

9.4 Dimensions

Housing

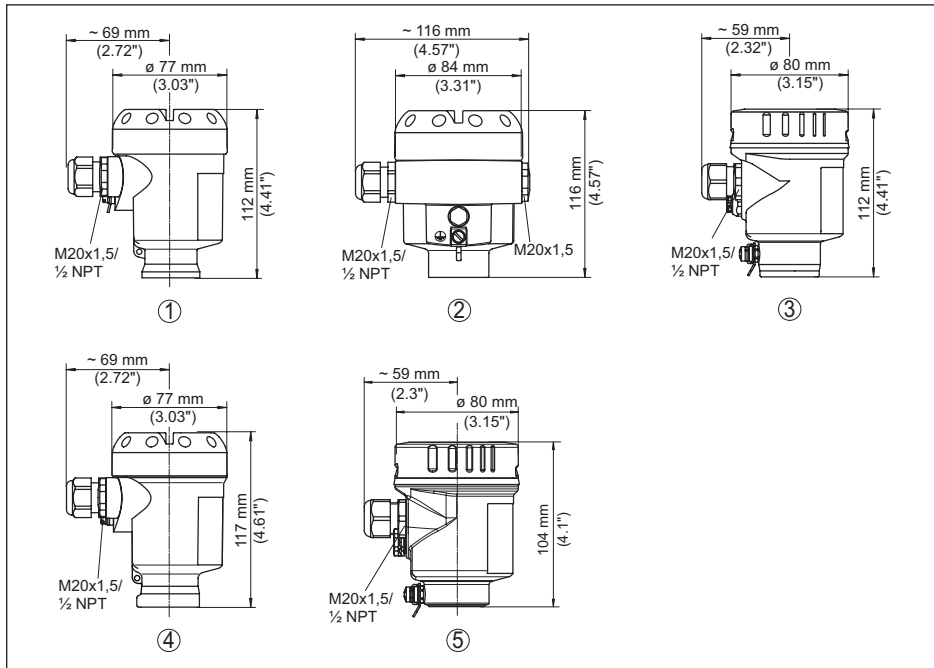


Fig. 35: Housing versions in protection IP66/IP67 and IP66/IP68 (0.2 bar)

- 1 Plastic single chamber (IP66/IP67)
- 2 Aluminium - single chamber
- 3 Stainless steel single chamber (electropolished)
- 4 Stainless steel single chamber (precision casting)
- 5 Stainless steel single chamber (electropolished) IP69K

External housing with IP68 (25 bar) version

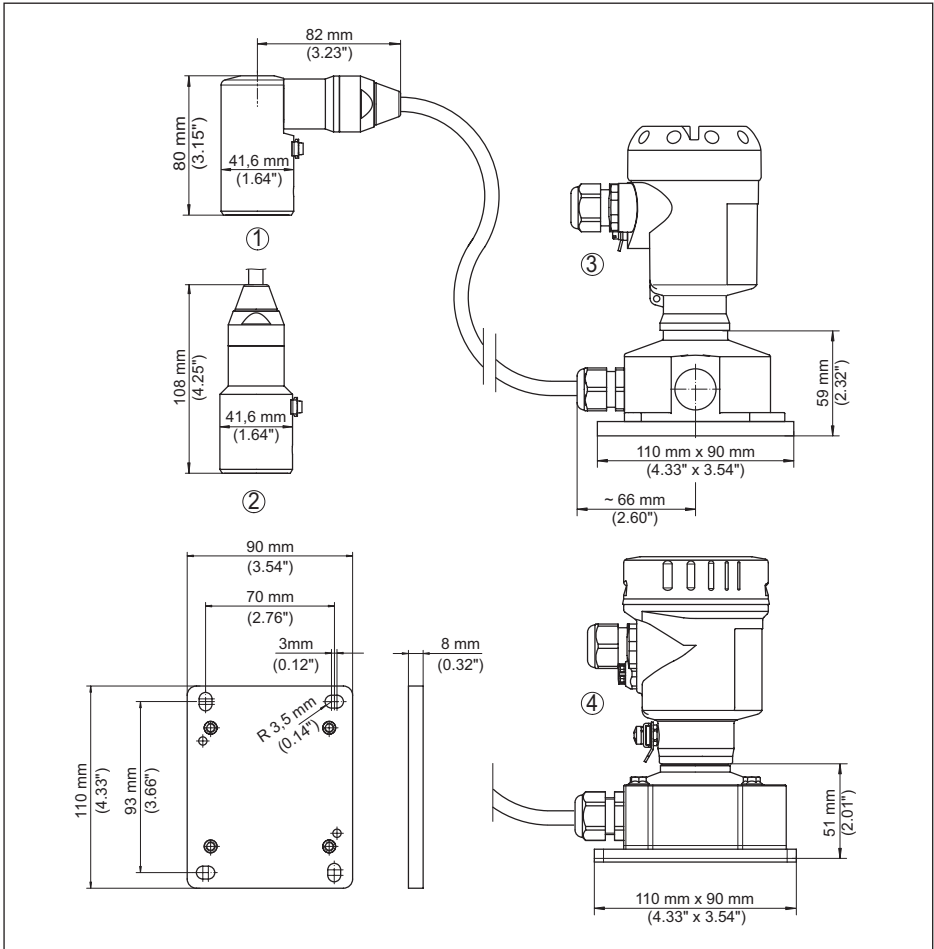


Fig. 36: IP68 version with external housing

- 1 Lateral cable outlet
- 2 Cable outlet axial
- 3 Plastic housing
- 4 Stainless steel housing, electropolished

IPT-2x, threaded fitting not front-flush

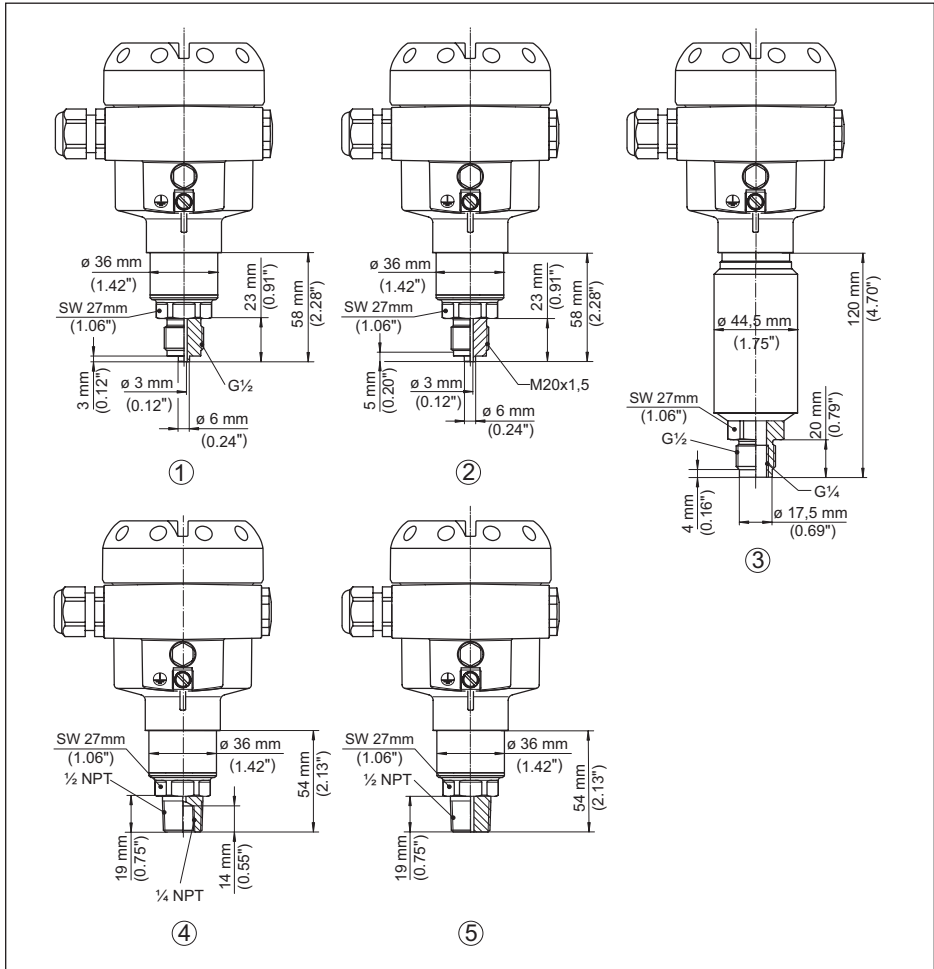


Fig. 37: IPT-2x, threaded fitting not front-flush

- 1 $G\frac{1}{2}$ (EN 837); manometer connection
- 2 M20 x 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

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

IPT-2x, threaded fitting front-flush

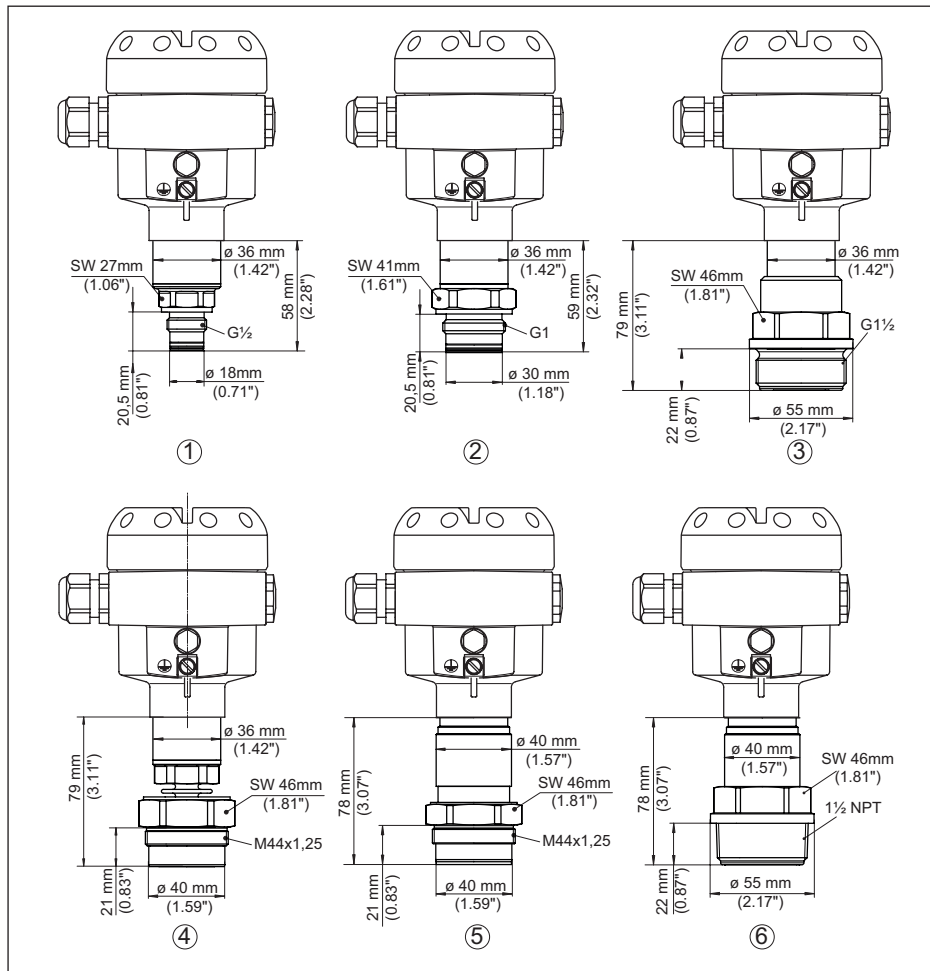


Fig. 38: IPT-2x, threaded fitting front-flush

- 1 $G\frac{1}{2}$ (ISO 228-1) with O-ring
- 2 $G1$ (ISO 228-1) with O-ring
- 3 $G1\frac{1}{2}$ (DIN 3852-A)
- 4 $M44 \times 1.25$
- 5 3 and 4 with temperature adapter and screen sheet for +180 °C/+200 °C
- 6 $1\frac{1}{2}$ NPT (ASME B1.20.1)

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

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

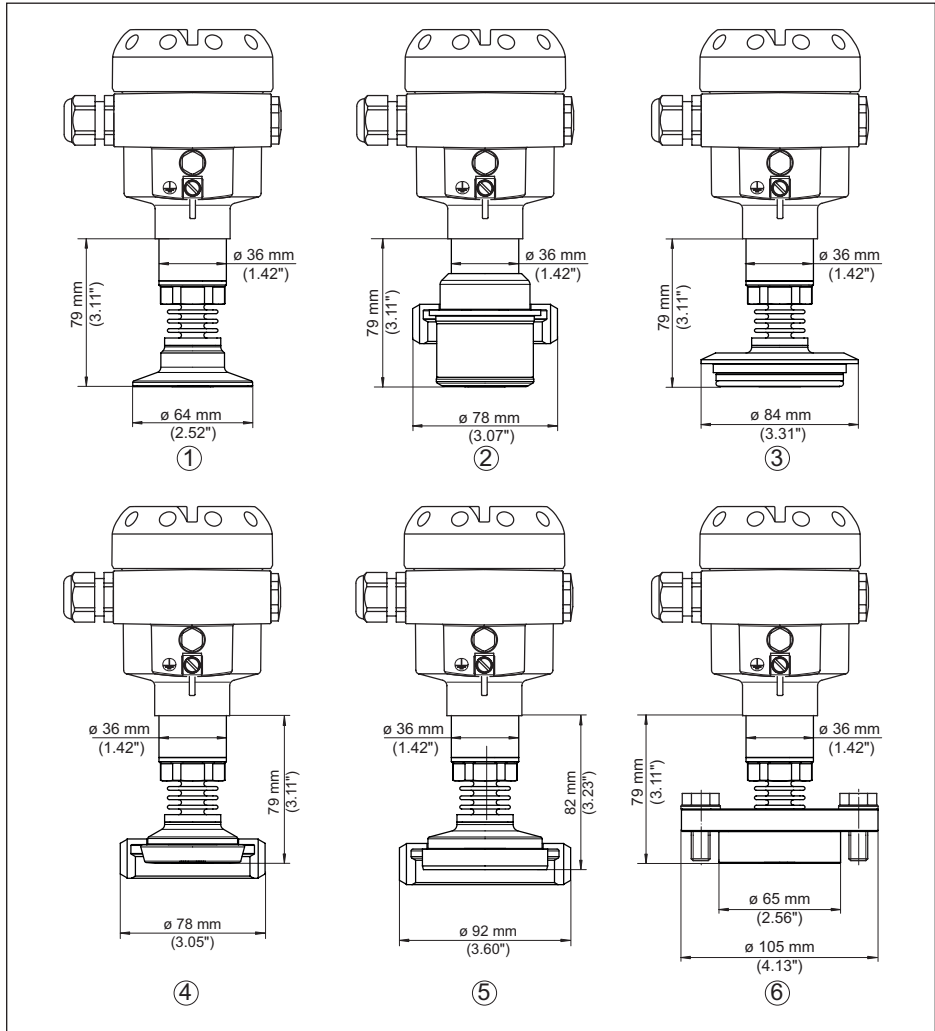


Fig. 39: IPT-2x, hygienic fitting +150 °C (piezoresistive/strain gauge measuring cell)

- 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

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

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

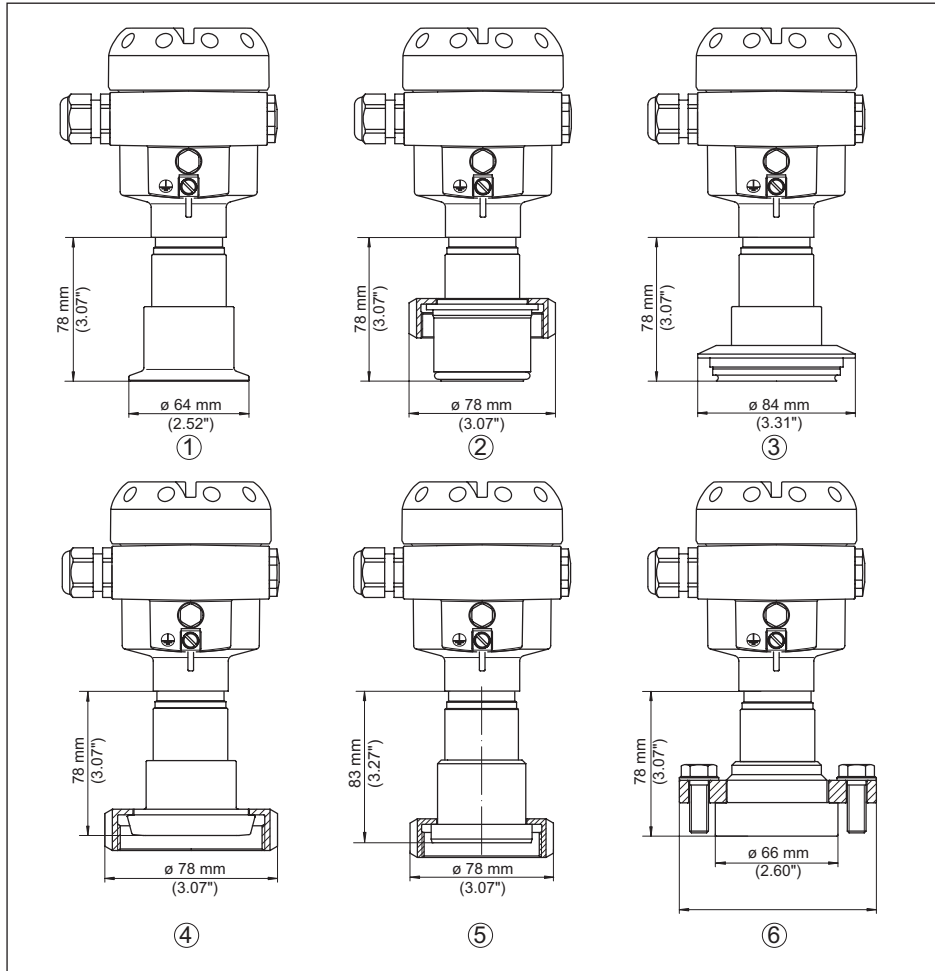
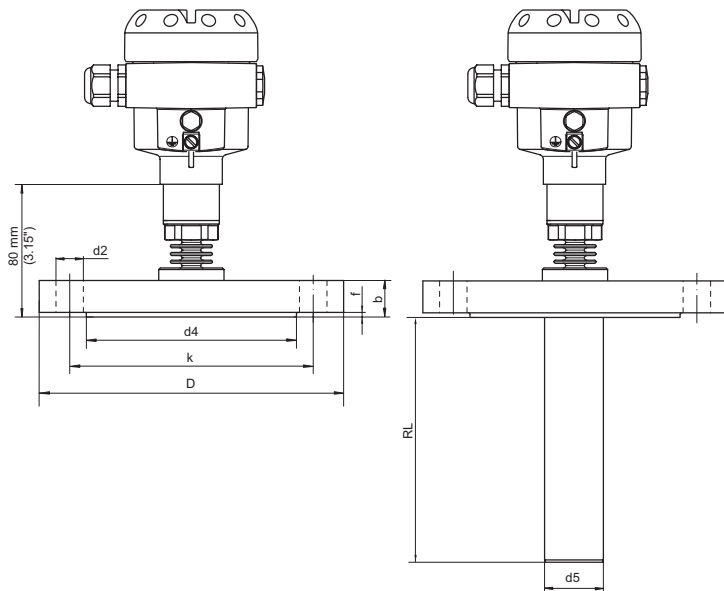


Fig. 40: IPT-2x, hygienic fitting +150 °C (metallic/ceramic measuring cell)

- 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

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

IPT-2x, flange connection +150 °C (piezoresistive/strain gauge 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	16	285	22	240	8xø22	212	3	-	-
	50	40	165	20	125	4xø18	102	3	③	④
inch										
①	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	16	11.22"	0.87"	9.45"	8xø 0.87"	8.35"	0.12"	-	-
	50	40	6.50"	0.79"	4.92"	4xø 0.71"	4.02"	0.12"	③	④
②	2"	150 lbs	6.00"	0.75"	4.75"	4xø 0.75"	3.62"	0.06"	-	-
	3"	150 lbs	7.50"	0.94"	6"	4xø 0.75"	5"	0.06"	-	-

Fig. 41: IPT-2x, flange connection +150 °C (piezoresistive/strain gauge measuring cell)

1 Flange connection according to DIN 2501

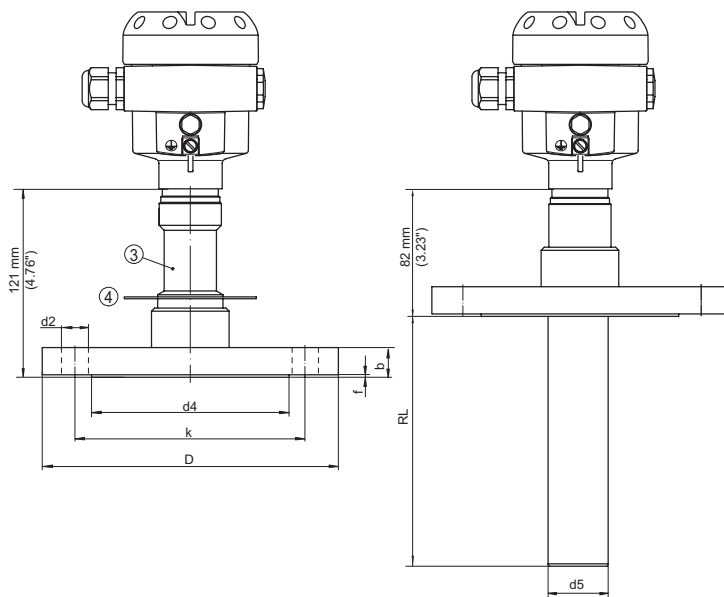
2 Flange connection according to ASME B16.5

3 Order-specific

4 Order-specific

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

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
inch										
①	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"	-	-
	50	40	6.50"	0.79"	4.92"	4xø 0.71"	4.02"	0.12"	⑤	⑥
②	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. 42: 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

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

9.5 Trademark

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

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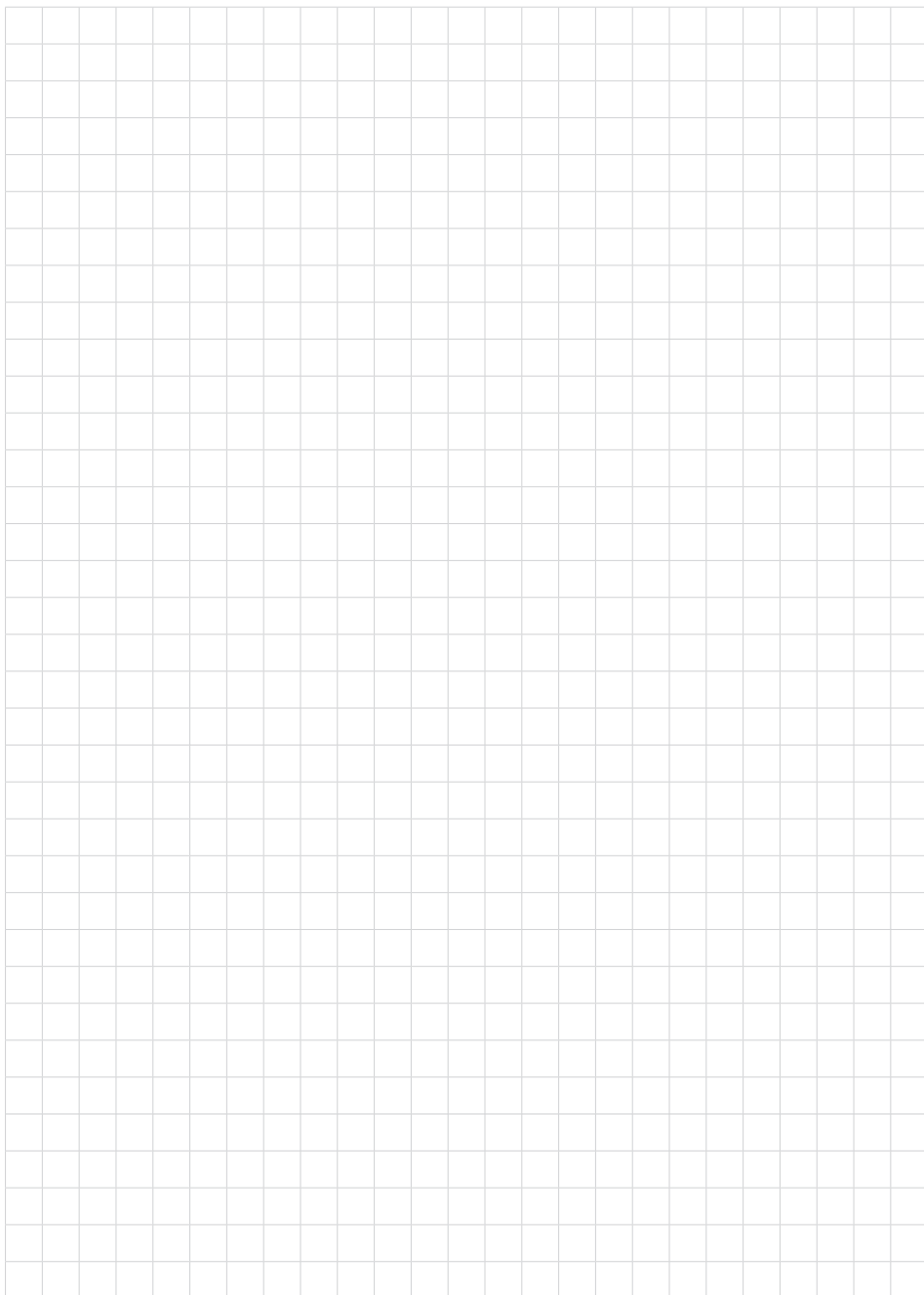
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Printing date:

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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