Process pressure transmitter IPT-2x

Slave for electronic differential pressure
Metallic sensor
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Safety instructions for Ex areas

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

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1 About this document

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

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

1.3 Symbols used
- **Information, note, tip:** This symbol indicates helpful additional information and tips for successful work.
- **Note:** This symbol indicates notes to prevent failures, malfunctions, damage to devices or plants.
- **Caution:** Non-observance of the information marked with this symbol may result in personal injury.
- **Warning:** Non-observance of the information marked with this symbol may result in serious or fatal personal injury.
- **Danger:** Non-observance of the information marked with this symbol results in serious or fatal personal injury.
- **Ex applications**
  This symbol indicates special instructions for Ex applications.
  - **List**
    The dot set in front indicates a list with no implied sequence.
  - **Sequence of actions**
    Numbers set in front indicate successive steps in a procedure.
- **Battery disposal**
  This symbol indicates special information about the disposal of batteries and accumulators.
2 For your safety

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

2.2 Appropriate use
IPT-2x is a slave sensor for electronic differential pressure measurement.
You can find detailed information about the area of application in chapter "Product description".
Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

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

2.4 General safety instructions
This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.
The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.
For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.
To avoid any danger, the safety approval markings and safety tips on the device must also be observed.

2.5 EU conformity
The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.
The EU conformity declaration can be found on our homepage.
Due to the design of its process fittings, the device does not subject
of EU pressure device directive if it is operated at process pressures
≤ 200 bar.¹)

2.6 Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the follow-
ing text is only available in the English language.
Installations in the US shall comply with the relevant requirements of
the National Electrical Code (ANSI/NFPA 70).
Installations in Canada shall comply with the relevant requirements of
the Canadian Electrical Code.

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

3.1 Configuration

Scope of delivery
The scope of delivery encompasses:
- Pressure transmitter IPT-2x - Slave sensor
- Ready-made connection cable, unassembled cable gland

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

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

Scope of this operating instructions
This operating instructions manual applies to the following instrument versions:
- Hardware from 1.0.0
- Software version from 1.0.0

Note:
You can find the hardware and software version of the instrument as follows:
- On the type plate of the electronics module
- In the adjustment menu under "Info"

Type label
The type label contains the most important data for identification and use of the instrument:
### 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 electronic differential pressure measurement is suitable for the measurement of the following process variables:

- Level
- Flow
- Differential pressure
- Density
- Interface
- Level, density-compensated

### Electronic differential pressure

The IPT-2x slave sensor is combined with a sensor from the instrument series for electronic differential pressure measurement.
The sensors are connected via a screened four-wire cable. The measured value from the slave sensor is read in and factored into the calculations. Power supply and parameter adjustment are carried out through the master sensor.

**Information:**
The sensor versions "Relative pressure climate-compensated" as well as "Double chamber housing" are not suitable for connection of a slave sensor.

You can find further information in chapter "Combination Master - Slave" of this operating instructions.

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

**Piezoresistive sensor element**
Measuring ranges up to 40 bar: piezoresistive sensor element with internal transmission liquid is used.
Strain gauge (DMS) sensor element
For measuring ranges above 100 bar, a strain gauge (DMS) sensor element (dry system) is used.

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.
3 Product description

**Pressure types**

**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".

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

1. Process diaphragm
2. Isolating liquid
3. FeNi adapter
4. Ceramic-capacitive measuring cell
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 humidity 20 ... 85 %

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

4.1 General instructions

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

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

These are mainly:
- Active measuring component
- Process fitting
- Process seal

Process conditions in particular are:
- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

Protection against moisture

Protect your instrument against moisture ingress through the following measures:
- Use a suitable connection cable (see chapter "Connecting to power supply")
- Tighten the cable gland or plug connector
- Lead the connection cable downward in front of the cable entry or plug connector

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

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

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

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

Screwing in

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

See chapter "Dimensions" for wrench size.
Warning:
The housing or the electrical connection may not be used for screwing in! Depending on the device version, tightening can cause damage, e. g. to the rotation mechanism of the housing.

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

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

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

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

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

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

Fig. 6: Temperature ranges
1 Process temperature
2 Ambient temperature
4.2 Ventilation and pressure compensation

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

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

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

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

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

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

Filter element - Position

![Diagram showing the position of the filter element for non-Ex and Ex-ia versions](image)

Fig. 7: Position of the filter element - non-Ex, Ex-ia version

1 Plastic, stainless steel housing (precision casting)
2 Aluminium housing
3 Stainless steel housing (electropolished)
4 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.
Instruments with absolute pressure have a blind plug mounted instead of the filter element.

**Instruments with Second Line of Defense**

The process assembly of instruments with Second Line of Defense (gastight leadthrough) is completely encapsulated. An absolute pressure measuring cell is used so that no ventilation is required.

**Filter element - Position IP69K version**

Instruments with absolute pressure have a blind plug mounted instead of the filter element.
4.3 Combination Master - Slave

In principle, any sensor combination within the instrument series is allowed. The following requirements must be fulfilled:

- Configuration, Master sensor suitable for electronic differential pressure
- Pressure type is identical for both sensors, i.e. relative pressure/relative pressure or absolute pressure/absolute pressure
- Master sensor measures the higher pressure
- Measurement setup as shown in the following chapters

The measuring range of each sensor is selected such that it fits the measuring loop. For this, the max. recommended turn down must be noted. See chapter "Technical data". It is absolutely necessary the the measuring ranges of Master and Slave correspond.

**Measurement result = Measured value of Master (total pressure) - measured value of Slave (static pressure)**

Depending on the application, individual combinations can result, see following examples:

**Example - large vessel**  
**Data**  
Application: Level measurement  
Medium: Water  
Vessel height: 12 m, hydrostatic pressure = 12 m x 1000 kg/m³ x 9.81 m/s² = 117.7 kPa = 1.18 bar  
Superimposed pressure: 1 bar  
Total pressure: 1.18 bar + 1 bar = 2.18 bar

**Instrument selection**  
Nominal measuring range Master: 2.5 bar  
Nominal measuring range Slave: 1 bar  
Turn Down: 2.5 bar/1.18 bar = 2.1 : 1

**Example - small vessel**  
**Data**  
Application: Level measurement  
Medium: Water  
Vessel height: 500 mm, hydrostatic pressure = 0.50 m x 1000 kg/m³ x 9.81 m/s² = 4.9 kPa = 0.049 bar  
Superimposed pressure: 350 mbar = 0.35 bar  
Total pressure: 0.049 bar + 0.35 bar = 0.399 bar

**Instrument selection**  
Nominal measuring range Master: 0.4 bar  
Nominal measuring range Slave: 0.4 bar  
Turn Down: 0.4 bar /0.049 bar = 8.2 : 1

**Example - orifice in pipeline**  
**Data**  
Application: Differential pressure measurement  
Medium: Gas  
Static pressure: 0.8 bar
Differential pressure on orifice: 50 mbar = 0.050 bar
Total pressure: 0.8 bar + 0.05 bar = 0.85 bar

**Instrument selection**
Nominal measuring range Master: 1 bar
Nominal measuring range Slave: 1 bar
Turn Down: 1 bar/0.050 bar = 20 : 1

**Output measured values**
The measuring result (level, pressure difference) as well as measured value Slave (static or superimposed pressure) are output by the sensor. Depending on the instrument version, output as 4 … 20 mA signal or digitally via HART, Profibus PA or Foundation Fieldbus.

**4.4 Level measurement**
The master/slave combination is suitable for level measurement in a pressurized vessel

Keep the following in mind when setting up the measuring system:
- Mount the master sensor below the min. level
- Do not mount the master sensor close to the filling stream or emptying area
- Mount the master sensor so that it is protected against pressure shocks from the stirrer
- Mount the slave sensor above the max. level

![Measurement setup, level measurement in pressurized vessel](image)

**Fig. 11: Measurement setup, level measurement in pressurized vessel**
1  IPT-2x
2  IPT-2x, slave sensor
4.5  **Differential pressure measurement**

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

Take note of the following instructions for the measurement setup, for example in gases:

- Mount the instruments above the measuring point

Possible condensation can then drain off into the process line.

![Measurement setup for differential pressure measurement of gases in pipelines](image)

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

1. IPT-2x
2. IPT-2x, slave sensor

4.6  **Interface measurement**

The master/slave combination is suitable for interface measurement.  

Requirements for a functioning measurement are:

- Vessel with changing level
- Products with steady density
- Interface always between the measurement points
- Total level always above the upper measurement point

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

### 4.7 Density measurement

**Measurement setup**

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

- Vessel with changing level
- Distance between the measurement points as large as possible
- Level always above the upper measuring point
The mounting distance $h$ of the two sensors should be at least 10 %, better 20 %, of the final value of the sensor measuring range. A bigger distance increases the accuracy of the density measurement.

Slight density changes cause only slight changes of the measured differential pressure. The measuring range must hence be selected accordingly.

The density measurement is possible in open as well as in closed vessels.

### 4.8 Density-compensated level measurement

The master/slave combination is suitable for density-compensated level measurement.

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

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

![Fig. 14: Measurement setup for density measurement, $h =$ distance between the two measuring points](image)

1. IPT-2x
2. IPT-2x, slave sensor
The mounting distance $h$ of the two sensors should be at least 10\%, better 20\%, of the final value of the sensor measuring range. A bigger distance increases the accuracy of the density compensation.

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

The density-compensated level measurement is only possible in open, i.e. unpressurized vessels.
4.9 External housing

Fig. 16: 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
The voltage supply and the signal transmission are carried out via the four-wire, screened connection cable from the master sensor. You can find the data for this signal circuit in chapter "Technical data".

Cable screening and grounding
The shielding of the cable between master and slave sensor must be connected on both ends to ground potential. In the sensor, the shielding 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).

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 connection to the Master sensor is carried out through spring-loaded terminals in the respective housing. For this, use the supplied, confectioned cable. Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings.
In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the terminal opening is then free. When the screwdriver is released, the terminal closes again.

**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.

You can find further information on the max. wire cross-section under "Technical data - Electromechanical data".

**Connection procedure**

Proceed as follows:

1. Unscrew the housing lid
2. Loosen compression nut of the cable gland and remove blind plug
3. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) insulation from the individual wires or use supplied connection cable
4. Insert the cable into the sensor through the cable entry

**Fig. 17: Connection steps 5 and 6**

5. Insert the wire ends into the terminals according to the wiring plan
6. Check the hold of the wires in the terminals by lightly pulling on them
7. Connect the shielding to the internal ground terminal, connect the external ground terminal to potential equalisation
8. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
9. Unscrew the blind plug on the Master, screw in the supplied cable gland
10. Connection cable to Master, see steps 3 to 8
11. Screw the housing lid back on
The electrical connection is finished.

### 5.3 Single chamber housing

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

![Wiring plan IPT-2x Slave sensor](image)

**Fig. 18: Wiring plan IPT-2x Slave sensor**

1. To the Master sensor
2. Ground terminal for connection of the cable screening

### 5.4 External housing with version IP68 (25 bar)

![Overview](image)

**Fig. 19: IPT-2x in IP68 version 25 bar with axial cable outlet, external housing**

1. Transmitter
2. Connection cable
3. External housing

2) Connect shielding here. Connect ground terminal on the outside of the housing to ground as prescribed. The two terminals are galvanically connected.
5 Connecting to power supply

Electronics and connection compartment for power supply

Fig. 20: 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. 21: 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

5.5  Connection example

Connection between master and sensor is carried out according to the table:

<table>
<thead>
<tr>
<th>Master sensor</th>
<th>Slave sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 5</td>
<td>Terminal 5</td>
</tr>
<tr>
<td>Terminal 6</td>
<td>Terminal 6</td>
</tr>
<tr>
<td>Terminal 7</td>
<td>Terminal 7</td>
</tr>
<tr>
<td>Terminal 8</td>
<td>Terminal 8</td>
</tr>
</tbody>
</table>

3) Connect shielding here. Connect ground terminal on the outside of the housing to ground as prescribed. The two terminals are galvanically connected.
6 Set up with the display and adjustment module

6.1 Parameter adjustment - Extended adjustment

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

Main menu

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

- **Setup**: Settings, e.g., for measurement loop name, application, units, position correction, adjustment, signal output
- **Display**: Settings, e.g., for language, measured value display, lighting
- **Diagnosis**: Information, e.g., on instrument status, pointer, measurement reliability, simulation
- **Additional adjustments**: PIN, date/time, reset, copy function
- **Info**: Instrument name, hardware and software version, date of manufacture, sensor features

In the main menu item "Setup", the individual submenu items should be selected one after the other and provided with the correct parameter values.

The following submenu points are available:

In the following section, the menu items from the menu "Setup" for electronic differential pressure measurement are described in detail. Depending on the selected application, different sections are relevant.

**Information:**

Further menu items of the menu "Setup" as well as the complete menus "Display", "Diagnosis", "Additional adjustments" and "Info" are described in the operating instructions of the respective master sensor.

6.1.1 Setup

In this menu item you activate/deactivate the slave sensor for electronic differential pressure and select the application.
6 Set up with the display and adjustment module

The IPT-2x in conjunction with a slave sensor can be used for flow, differential pressure, density and interface measurement. The default setting is differential pressure measurement. Switchover is carried out in the adjustment menu.

If you have connected a slave sensor, you confirm this with "Activate".

**Note:**
It is absolutely necessary to activate the slave sensor to have the applications displayed in the electronic differential pressure measurement menus.

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, you determine the units for the "Min. adjustment/Zero" and "Max. adjustment/Span" as well as the static pressure.

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 unit is determined in the menu item "Peak value temperature".

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.

There are the following possibilities for a position correction with a master/slave combination:

- Automatic correction for both sensors
- Manual correction for the Master (differential pressure)
- Manual correction for the Slave (static pressure)
With a master/slave combination in the application "Density-compensated level measurement" there are the following additional options for the position correction:

- Automatic correction, master (level)
- Manual correction for the Master (level)

During an automatic position correction, the current measured value is accepted as the correction value. This value must not be influenced/corrupted by product coverage or static pressure.

In case of a manual position correction, the offset value is 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 any number of times.

**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. A superimposed pressure is detected by the slave sensor and automatically compensated. See the following example:
6 Set up with the display and adjustment module

Fig. 24: 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
3. IPT-2x
4. IPT-2x, slave sensor

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.

**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 [-].
6 Set up with the display and adjustment module

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.

Min. adjustment flow

Proceed as follows:

1. Select the menu item "Setup" with [-->] and confirm with [OK].

Now select with [-->] the menu item "Min. 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

With flow in two directions (bidirectional) a negative differential pressure is also possible. The maximum negative pressure must then be entered for the min. adjustment. For linearization, select "bidirectional" or "bidirectional-extracted by root" accordingly, see menu item "Linearization".

The min. adjustment is finished.
6 Set up with the display and adjustment module

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

**Max. adjustment flow**

Proceed as follows:

1. Select with [-] the menu item Max. 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].

The max. adjustment is finished.

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

**Zero adjustment differential pressure**

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.

**Span adjustment differential pressure**

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]. The span adjustment is finished.

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

**Distance density**

Proceed as follows:

1. Select in the menu item "Setup" with [->] "Adjustment" and confirm with [OK]. Now confirm the menu item "Distance" with [OK].

2. Edit the sensor distance with [OK] and set the cursor to the requested position with [->].

3. Set the distance with [+] and save with [OK].

The adjustment of the distance is hence finished.

**Min. adjustment density**

Proceed as follows:

1. Select the menu item "Setup" with [->] 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 with [+] and save with [OK].

4. Enter the min. density corresponding to the percentage value.

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

The min. adjustment for density is finished.

**Max. adjustment density**

Proceed as follows:

1. Select the menu item "Setup" with [->] 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 with [+] and save with [OK].

The cursor jumps now to the density value.
4. Enter the max. density value corresponding to the percentage value.
The max. adjustment for density is finished.

**Distance interface**
Proceed as follows:
1. Select in the menu item "Setup" with [->] "Adjustment" and confirm with [OK]. Now confirm the menu item "Distance" with [OK].

![Distance Interface](image)

2. Edit the sensor distance with [OK] and set the cursor to the requested position with [->].
3. Set the distance with [+] and save with [OK].
The adjustment of the distance is hence finished.

**Min. adjustment interface**
Proceed as follows:
1. Select the menu item "Setup" with [->] and confirm with [OK].
Now select with [->] the menu item "Min. adjustment" and confirm with [OK].

![Min. Adjustment Interface](image)

2. Edit the percentage value with [OK] and set the cursor to the requested position with [->].
3. Set the requested percentage value with [+] and save with [OK].
The cursor jumps now to the height value.
4. Enter the min. height of the interface corresponding to the percentage value.
5. Save settings with [OK] and move with [ESC] and [->] to the max. adjustment.
The min. adjustment for interface is thus finished.

**Max. adjustment interface**
Proceed as follows:
1. Select the menu item "Setup" with [->] and confirm with [OK].
Now select with [->] the menu item "Max. adjustment" and confirm with [OK].

![Max. Adjustment Interface](image)

2. Edit the percentage value with [OK] and set the cursor to the requested position with [->].
3. Set the requested percentage value with [+] and save with [OK].
The cursor jumps now to the height value.
6 Set up with the display and adjustment module

4. Enter the max. height of the interface corresponding to the percentage value.

The max. adjustment for interface is finished.

**Distance level density-compensated**

Proceed as follows:

- Select in the menu item "Setup" with [->] "Adjustment" and confirm with [OK]. Now confirm the menu item "Distance" with [OK].

![Distance adjustment interface]

- Edit the sensor distance with [OK] and set the cursor to the requested position with [->].
- Set the distance with [+] and save with [OK].

The adjustment of the distance is hence finished.

**Min. adjustment level density-compensated**

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].

![Min. adjustment interface]

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

Proceed as follows:

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

![Max. adjustment interface]

2. Edit the percentage value with [OK] and set the cursor to the requested position with [->].
3. Set the requested percentage value (e.g. 100 %) with [+] and save with [OK]. The cursor jumps now to the pressure value.
6 Set up with the display and adjustment module

4. Enter the value for the full vessel (e.g. 10 m) 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.

**Linearisation**

A linearization is necessary for all applications in which the measured process variable does not increase linearly with the measured value. This applies for example to the flow measured via the differential pressure or the vessel volume measured via the level. Corresponding linearization curves are preprogrammed for such cases. They represent the correlation between the measured value percentage and process variable. 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".4)

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 overfill 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.

**AI FB1**

Since the parameter adjustment of the Function Block 1 (FB1) is very comprehensive, it was divided into various submenu items.

**AI FB1 - Channel**

In menu item "Channel" you determine the input signal for further processing in AI FB 1.

As input signals, the output values of Transducer Block (TB) can be selected.

4) The device assumes an approximately constant temperature and static pressure and calculates the flow rate from the measured differential pressure using the characteristic curve extracted by root.
6.1.2 Display

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

The default setting for the displayed value is "Differential pressure".

Display value 1 and 2 - 4 ... 20 mA

Display format 1 and 2

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

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

Display value 1 and 2 - bus systems

Display format 1 and 2

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

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

6.1.3 Diagnostics

The respective min. and max. measured values for the differential pressure and static pressure are stored in the sensor. In menu item "Peak value, pressure", both values are displayed.

In another window you can carry out a reset of the peak values separately.
### Simulation 4 ... 20 mA/HART

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 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.

### Simulation bus systems

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 digital signal. The status message along with the Asset Management function is "Maintenance".

**Note:**
Without manual deactivation, the sensor terminates the simulation automatically after 60 minutes.
6.1.4 Additional adjustments

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

The following selection is possible depending on the selected application:

- Flow
- Height - Interface
- Density
- Differential pressure
- Static pressure
- Percent
- Scaled
- Percent linearized
- Measuring cell temperature (ceramic measuring cell)
- Electronics temperature

Characteristics values DP flow element

In this menu item, the units for the DP flow element are determined and the selection of mass or volume flow is carried out.

Furthermore the adjustment for the volume or mass flow at 0 % or 100 % is carried out.

The device automatically adds the flow in the selected unit. With appropriate adjustment and bidirectional linearization, the flow rate is counted both positively and negatively.
Diagnosis, asset management and service

7.1 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 Rectify faults

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

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.

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.

7.3 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
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.

7.4 Exchanging the electronics module
In case of a defect, the user can replace the electronics module with another one of identical type.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

If there is no electronics module available on site, one can be ordered from the agency serving you.

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
7 Diagnosis, asset management and service

- 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

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

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

8.2 Disposal

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

WEEE directive

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

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

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

Materials and weights

Materials, wetted (piezoresistive/strain gauge measuring cell)

<table>
<thead>
<tr>
<th>Process fitting</th>
<th>316L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaphragm standard</td>
<td>316L</td>
</tr>
<tr>
<td>Diaphragm from measuring range 25 bar, Elgiloy (2.4711) with not flush version</td>
<td></td>
</tr>
<tr>
<td>Seal ring, O-ring</td>
<td>FKM (VP2/A), EPDM (A+P 70.10-02), FFKM (Perlast G75S), FEPM (Fluoraz SD890)</td>
</tr>
</tbody>
</table>

Seal for process fitting (in the scope of delivery)
- Thread G½ (EN 837) Klingersil C-4400

Materials, wetted (ceramic/metalllc measuring cell)

<table>
<thead>
<tr>
<th>Process fitting</th>
<th>316L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaphragm</td>
<td>Alloy C276 (2.4819), gold-coated 20 µ, gold/rhodium-coated 5 µ/1 µ</td>
</tr>
</tbody>
</table>

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

Materials for applications in foodstuffs

Surface quality, hygienic process fittings, typ. \( R_a < 0.8 \mu m \)

Seal below wall mounting plate with 3A approval EPDM

Materials, non-wetted parts

Type label support on connection cable PE hard

Isolating liquid ceramic/metalllc measuring cell KN 92 medical white oil (FDA conform)

Internal transmission liquid piezoresistive measuring cell Synthetic oil, Halocarbon oil (6) (7)

Housing
- Plastic housing Plastic PBT (Polyester)

5) Not on instruments with SIL qualification.

6) Synthetic oil for measuring ranges up to 40 bar, FDA listed for the food processing industry. For measuring ranges up to 100 bar dry measuring cell.

7) Halocarbon oil: Generally in oxygen applications, not with vacuum measuring ranges, not with absolute measuring ranges < 1 bar. abs.
Aluminium die-cast housing
- Aluminium die-casting AlSi10Mg, powder-coated (Basis: Polyester)
- Stainless steel housing
- 316L
- Cable gland
- PA, stainless steel, brass
- Sealing, cable gland
- NBR
- Blind plug, cable gland
- PA
- Seal between housing and housing lid
- Silicone SI 850 R, NBR silicone-free
- Inspection window housing cover
- Polycarbonate (UL-746-C listed), glass
- Ground terminal
- 316L

External housing
- Housing
- Plastic PBT (Polyester), 316L
- Socket, wall mounting plate
- Plastic PBT (Polyester), 316L
- Seal between base and wall mounting plate
- EPDM (fixed connected)

Inspection window in housing cover
- Polycarbonate, UL746-C listed (with Ex-d version: glass)
Seal, housing lid
- Silicone SI 850 R, NBR silicone-free
Ground terminal
- 316Ti/316L

Connection cable to the master sensor
- 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)
- 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)

---

8) Glass with Aluminium and stainless steel precision casting housing
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.\(^9\)

### Nominal measuring ranges and overload capability in bar/kPa

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum pressure</td>
</tr>
<tr>
<td><strong>Gauge pressure</strong></td>
<td></td>
</tr>
<tr>
<td>0 … +0.4 bar/0 … +40 kPa</td>
<td>+1.2 bar/+120 kPa</td>
</tr>
<tr>
<td>0 … +1 bar/0 … +100 kPa</td>
<td>+3 bar/+300 kPa</td>
</tr>
<tr>
<td>0 … +2.5 bar/0 … +250 kPa</td>
<td>+7.5 bar/+750 kPa</td>
</tr>
<tr>
<td>0 … +5 bar/0 … +250 kPa</td>
<td>+15 bar/+1500 kPa</td>
</tr>
<tr>
<td>0 … +10 bar/0 … +1000 kPa</td>
<td>+30 bar/+3000 kPa</td>
</tr>
<tr>
<td>0 … +16 bar/0 … +1600 kPa</td>
<td>+48 bar/+5000 kPa</td>
</tr>
<tr>
<td>0 … +25 bar/0 … +2500 kPa</td>
<td>+75 bar/+7500 kPa</td>
</tr>
<tr>
<td>0 … +40 bar/0 … +4000 kPa</td>
<td>+120 bar/+12 MPa</td>
</tr>
<tr>
<td>0 … +60 bar/0 … +6000 kPa</td>
<td>+180 bar/+18 MPa</td>
</tr>
<tr>
<td>0 … +100 bar/0 … +10 MPa</td>
<td>+200 bar/+20 MPa</td>
</tr>
<tr>
<td>0 … +160 bar/0 … +10 MPa</td>
<td>+320 bar/+20 MPa</td>
</tr>
<tr>
<td>0 … +250 bar/0 … +25 MPa</td>
<td>+500 bar/+20 MPa</td>
</tr>
<tr>
<td>0 … +400 bar/0 … +40 MPa</td>
<td>+800 bar/+80 MPa</td>
</tr>
<tr>
<td>0 … +600 bar/0 … +60 MPa</td>
<td>+1200 bar/+120 MPa</td>
</tr>
<tr>
<td>0 … +1000 bar/0 … +100 MPa</td>
<td>+1500 bar/+150 MPa</td>
</tr>
<tr>
<td>-1 … 0 bar/-100 … 0 kPa</td>
<td>+3 bar/+300 kPa</td>
</tr>
<tr>
<td>-1 … +1.5 bar/-100 … +150 kPa</td>
<td>+7.5 bar/+750 kPa</td>
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<tr>
<td>-1 … +40 bar/-100 … +4000 kPa</td>
<td>+120 bar/+12 MPa</td>
</tr>
<tr>
<td>-0.2 … +0.2 bar/-20 … +20 kPa</td>
<td>+1.2 bar/+120 kPa</td>
</tr>
<tr>
<td>-0.5 … +0.5 bar/-50 … +50 kPa</td>
<td>+3 bar/+300 kPa</td>
</tr>
</tbody>
</table>

| **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 … 5 bar/0 … 500 kPa  | 15 bar/1500 kPa     | 0 bar abs.       |
| 0 … 10 bar/0 … 1000 kPa | 30 bar/3000 kPa     | 0 bar abs.       |
| 0 … 16 bar/0 … 1600 kPa | 50 bar/5000 kPa     | 0 bar abs.       |

\(^9\) Data on overload capability apply for reference temperature.
### Nominal range and Overload capability

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<td>Maximum pressure</td>
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<tr>
<td>0 ... 25 bar/0 ... 2500 kPa</td>
<td>75 bar/+7500 kPa</td>
</tr>
<tr>
<td>0 ... 40 bar/0 ... 4000 kPa</td>
<td>120 bar/+12 MPa</td>
</tr>
</tbody>
</table>

### 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.\(^{10}\)

### Nominal measuring ranges and overload capability in bar/kPa

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<td>+35 bar/+3500 kPa</td>
</tr>
<tr>
<td>0 ... +2.5 bar/0 ... +250 kPa</td>
<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
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<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
<td>0 ... +25 bar/0 ... +2500 kPa</td>
<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
<td>-1 ... 0 bar/-100 ... 0 kPa</td>
<td>+35 bar/+3500 kPa</td>
</tr>
<tr>
<td>-1 ... +1.5 bar/-100 ... +150 kPa</td>
<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
<td>-1 ... +10 bar/-100 ... +1000 kPa</td>
<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
<td>-1 ... +25 bar/-100 ... +2500 kPa</td>
<td>+50 bar/+5000 kPa</td>
</tr>
<tr>
<td>-0.2 ... +0.2 bar/-20 ... +20 kPa</td>
<td>+20 bar/+3000 kPa</td>
</tr>
<tr>
<td>-0.5 ... +0.5 bar/-50 ... +50 kPa</td>
<td>+35 bar/+3500 kPa</td>
</tr>
<tr>
<td><strong>Absolute pressure</strong></td>
<td></td>
</tr>
<tr>
<td>0 ... 1 bar/0 ... 100 kPa</td>
<td>35 bar/3500 kPa</td>
</tr>
<tr>
<td>0 ... 2.5 bar/0 ... 250 kPa</td>
<td>50 bar/5000 kPa</td>
</tr>
<tr>
<td>0 ... 10 bar/0 ... 1000 kPa</td>
<td>50 bar/5000 kPa</td>
</tr>
<tr>
<td>0 ... 25 bar/0 ... 2500 kPa</td>
<td>50 bar/5000 kPa</td>
</tr>
</tbody>
</table>

### Nominal measuring ranges and overload capacity in psi

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum pressure</td>
</tr>
<tr>
<td><strong>Gauge pressure</strong></td>
<td></td>
</tr>
<tr>
<td>0 ... +1.5 psig</td>
<td>+220 psig</td>
</tr>
<tr>
<td>0 ... +5 psig</td>
<td>+435 psig</td>
</tr>
</tbody>
</table>

\(^{10}\) Data on overload capability apply for reference temperature.
### Nominal range

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum pressure</td>
</tr>
<tr>
<td>0 ... +15 psig</td>
<td>+510 psig</td>
</tr>
<tr>
<td>0 ... +30 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>0 ... +150 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>0 ... +300 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>-14.5 ... 0 psig</td>
<td>+510 psig</td>
</tr>
<tr>
<td>-14.5 ... +20 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>-14.5 ... +150 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>-14.5 ... +300 psig</td>
<td>+725 psig</td>
</tr>
<tr>
<td>-3 ... +3 psig</td>
<td>+290 psi</td>
</tr>
<tr>
<td>-7 ... +7 psig</td>
<td>+525 psig</td>
</tr>
</tbody>
</table>

### Absolute pressure

<table>
<thead>
<tr>
<th>Absolute pressure</th>
<th>Maximum pressure</th>
<th>Minimum pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ... 15 psi</td>
<td>525 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 ... 30 psi</td>
<td>725 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 ... 150 psi</td>
<td>725 psig</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 ... 300 psi</td>
<td>725 psig</td>
<td>0 psi</td>
</tr>
</tbody>
</table>

### Adjustment ranges

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

#### Level (min./max. adjustment)
- Percentage value: -10 ... 110 %
- Pressure value: -120 ... 120 %

#### Flow (min./max. adjustment)
- Percentage value: 0 or 100 % fix
- Pressure value: -120 ... 120 %

#### Differential pressure (zero/span adjustment)
- Zero: -95 ... +95 %
- Span: -120 ... +120 %

#### Density (min./max. adjustment)
- Percentage value: -10 ... 100 %
- Density value: according to the measuring ranges in kg/dm³

#### Interface (min./max. adjustment)
- Percentage value: -10 ... 100 %
- Level value: according to the measuring ranges in m

#### Max. permissible Turn Down
Unlimited (recommended 20 : 1)

### Dynamic behaviour output
Dynamic characteristics depending on medium and temperature
Fig. 26: 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

<table>
<thead>
<tr>
<th></th>
<th>IPT-2x</th>
<th>IPT-2x - IP68 (25 bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead time</td>
<td>( \leq 25 \text{ ms} )</td>
<td>( \leq 50 \text{ ms} )</td>
</tr>
<tr>
<td>Rise time (10 ... 90 %)</td>
<td>( \leq 55 \text{ ms} )</td>
<td>( \leq 150 \text{ ms} )</td>
</tr>
<tr>
<td>Step response time (t(_i): 0 s, 10 ... 90 %)</td>
<td>( \leq 80 \text{ ms} )</td>
<td>( \leq 200 \text{ ms} )</td>
</tr>
</tbody>
</table>

Damping (63 % of the input variable) \( 0 \ldots 999 \text{ s, adjustable via menu item "Damping"} \)

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

Reference conditions according to DIN EN 61298-1
- Temperature \(+18 \ldots +30 \text{ °C (}+64 \ldots +86 \text{ °F)}\)
- Relative humidity \(45 \ldots 75 \%\)
- Air pressure \(860 \ldots 1060 \text{ mbar/86 \ldots 106 kPa (}12.5 \ldots 15.4 \text{ psi)}\)

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 depending on the process fitting and the chemical seal

- Piezoresistive/strain gauge measuring cell
- Ceramic/metallurgical measuring cell \( < 5 \text{ mbar/0.5 kPa (0.07 psig)} \)

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

<table>
<thead>
<tr>
<th>Accuracy class</th>
<th>Non-linearity, hysteresis and repeatability with TD 1 : 1 up to 5 : 1</th>
<th>Non-linearity, hysteresis and repeatability with 5 : 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.075 %</td>
<td>&lt; 0.075 %</td>
<td>&lt; 0.015 % x TD</td>
</tr>
<tr>
<td>0.1 %</td>
<td>&lt; 0.1 %</td>
<td>&lt; 0.02 % x TD</td>
</tr>
<tr>
<td>0.2 %</td>
<td>&lt; 0.2 %</td>
<td>&lt; 0.04 % x TD</td>
</tr>
</tbody>
</table>

### Influence of the product temperature

#### Thermal change zero signal and output span

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

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

**Piezoresistive/strain gauge measuring cell**

![Graph: Basic temperature error $F_{T\text{Basis}}$ at TD 1 : 1](image)

*Fig. 27: Basic temperature error $F_{T\text{Basis}}$ 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

<table>
<thead>
<tr>
<th>Accuracy class</th>
<th>0.075 %, 0.1 %</th>
<th>0.2 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor FMZ</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

#### 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.

<table>
<thead>
<tr>
<th>Turn down</th>
<th>TD 1 : 1</th>
<th>TD 2.5 : 1</th>
<th>TD 1 : 1</th>
<th>TD 10 : 1</th>
<th>TD 20 : 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor FTD</td>
<td>1</td>
<td>1.75</td>
<td>3</td>
<td>5.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>
Ceramic/Metal measuring cell - Standard

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

### Additional factor through measuring cell version

<table>
<thead>
<tr>
<th>Measuring cell version</th>
<th>Measuring cell - Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.075 %, 0.1 %</td>
</tr>
<tr>
<td>Factor FMZ</td>
<td>1</td>
</tr>
</tbody>
</table>

### Additional factor through Turn Down

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

\[ F_{TD} = 0.5 \times TD + 0.5 \]

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

<table>
<thead>
<tr>
<th>Turn down</th>
<th>TD 1 : 1</th>
<th>TD 2.5 : 1</th>
<th>TD 5 : 1</th>
<th>TD 10 : 1</th>
<th>TD 20 : 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor FTD</td>
<td>1</td>
<td>1.75</td>
<td>3</td>
<td>5.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>

### 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.\(^1\)

### Long-term stability - Ceramic/metallc measuring cell

<table>
<thead>
<tr>
<th>Time period</th>
<th>Long-term stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>One year</td>
<td>&lt; 0.05 % x TD</td>
</tr>
<tr>
<td>Five years</td>
<td>&lt; 0.1 % x TD</td>
</tr>
</tbody>
</table>

\(^1\) With ceramic/metallc measuring cell with gold-coated diaphragm, the values must be multiplied with factor 3.
### Time period

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten years</td>
<td>&lt; 0.2 % x TD</td>
</tr>
</tbody>
</table>

### Long-term stability - Piezoresistive/Strain gauge measuring cell

<table>
<thead>
<tr>
<th>Version</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring ranges &gt; 1 bar</td>
<td>&lt; 0.1 % x TD/year</td>
<td></td>
</tr>
<tr>
<td>Measuring ranges &gt; 1 bar, isolating liquid, synthetic oil, diaphragm Elgiloy (2.4711)</td>
<td>&lt; 0.15 % x TD/year</td>
<td></td>
</tr>
<tr>
<td>Measuring range 1 bar</td>
<td>&lt; 0.15 % x TD/year</td>
<td></td>
</tr>
<tr>
<td>Measuring range 0.4 bar</td>
<td>&lt; 0.35 % x TD/year</td>
<td></td>
</tr>
</tbody>
</table>

### Process conditions - Piezoresistive/Strain gauge measuring cell

#### Process temperature

<table>
<thead>
<tr>
<th>Seal</th>
<th>Standard</th>
<th>Extended temperature range</th>
<th>Hygienic fittings</th>
<th>Version for oxygen applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without consideration of the seal(^{12})</td>
<td>-20/-40 ... +105 °C (-4/-40 ... +221 °F)</td>
<td>-20 ... +150 °C (-4 ... +302 °F)</td>
<td>-20 ... +85 °C (-4 ... +185 °F)</td>
<td>-20 ... +150 °C (-4 ... +302 °F)</td>
</tr>
<tr>
<td>FKM (VP2/A)</td>
<td>-20 ... +105 °C (-4 ... +221 °F)</td>
<td>-20 ... +150 °C (-4 ... +302 °F)</td>
<td>-20 ... +85 °C (-4 ... +185 °F)</td>
<td>-20 ... +150 °C (-4 ... +302 °F)</td>
</tr>
<tr>
<td>EPDM (A+P 70.10-02)</td>
<td>-15 ... +105 °C (+5 ... +221 °F)</td>
<td>-15 ... +150 °C (+5 ... +302 °F)</td>
<td>-15 ... +85 °C (+5 ... +185 °F)</td>
<td>-15 ... +150 °C (+5 ... +302 °F)</td>
</tr>
<tr>
<td>FFKM (Perlast G75S)</td>
<td>-5 ... +105 °C (+23 ... +221 °F)</td>
<td>-5 ... +150 °C (+23 ... +302 °F)</td>
<td>-5 ... +85 °C (+23 ... +185 °F)</td>
<td>-5 ... +150 °C (+23 ... +302 °F)</td>
</tr>
</tbody>
</table>

#### Temperature derating

\(^{12}\) Process fittings acc. to DIN 3852-A, EN 837
Fig. 29: Temperature derating IPT-2x, version up to +105 °C (+221 °F)
1  Process temperature
2  Ambient temperature

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\(^{13}\) +150 °C (+302 °F)

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

**Mechanical stress**

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

\(^{13}\) Instrument configuration suitable for vapour
### Process conditions - Ceramic/metallic measuring cell

#### Process temperature

<table>
<thead>
<tr>
<th>Version</th>
<th>Temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$p_{\text{abs}} \geq 50$ mbar</td>
</tr>
<tr>
<td>Standard</td>
<td>-12 ... +150 °C (+10 ... +284 °F)</td>
</tr>
<tr>
<td>Extended temperature range</td>
<td>-12 ... +180 °C (+10 ... +356 °F)</td>
</tr>
<tr>
<td></td>
<td>-12 ... +200 °C (+10 ... +392 °F)</td>
</tr>
</tbody>
</table>

#### Temperature derating

**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 stress\textsuperscript{14)}
Vibration resistance 1 to 4 g at
5 … 200 Hz according to EN 60068-2-6 (vibration with resonance)
Shock resistance 50 g, 2.3 ms according to EN 60068-2-27 (mechanical shock)\textsuperscript{15)}

Ambient conditions

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

Electromechanical data - version IP66/IP67 and IP66/IP68 (0.2 bar)\textsuperscript{16)}

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

Material cable gland/Seal insert

<table>
<thead>
<tr>
<th>Material cable gland/Seal insert</th>
<th>Cable diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 ... 9 mm</td>
</tr>
<tr>
<td>PA/NBR</td>
<td>●</td>
</tr>
</tbody>
</table>

\textsuperscript{14)} Depending on the instrument version.
\textsuperscript{15)} 2 g with housing version stainless steel double chamber
\textsuperscript{16)} IP66/IP68 (0.2 bar), only with absolute pressure.
Material cable gland/Seal insert | Cable diameter
---|---
Brass nickel-plated/NBR | 5...9 mm | 6...12 mm | 7...12 mm
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 IP68 (25 bar)**
Connection cable transmitter - external housing, mechanical data
- Configuration: Wires, strain relief, breather capillaries, screen braiding, metal foil, mantle
- Standard length: 5 m (16.40 ft)
- Max. length: 180 m (590.5 ft)
- Min. bending radius at 25 °C/77 °F: 25 mm (0.985 in)
- Diameter: approx. 8 mm (0.315 in)
- Material: PE, PUR
- Colour: Black, blue

Connection cable transmitter - external housing, electrical data
- Wire cross-section: 0.5 mm² (AWG 20)
- Wire resistance: 0.037 Ω/m (0.012 Ω/ft)

**Interface to the Master sensor**

Connection cable Slave - Master, mechanical data
- Configuration: Cores, strain relief, braided, metal foil, jacket
- Standard length: 5 m (16.40 ft)
- Max. length: 25 m (82.02 ft)
- Min. bending radius (at 25 °C/77 °F): 25 mm (0.985 in)
- Diameter: approx. 8 mm (0.315 in), approx. 6 mm (0.236 in)
- Material: PE, PUR
- Colour: Black

Connection cable Slave - Master, electrical data
- Wire cross-section: 0.34 mm² (AWG 22)
- Wire resistance: < 0.05 Ω/m (0.015 Ω/ft)

**Voltage supply for the complete system through Master**

Operating voltage
- $U_{B_{\text{min}}}$: 12 V DC
- $U_{B_{\text{min}}} \text{ with lighting switched on}$: 16 V DC

---

171 Breather capillaries not with Ex-d version.
- $U_{B\text{ max}}$ Depending on signal output and version of the master sensor

### Potential connections and electrical separating measures in the instrument

Electronics Not non-floating
Reference voltage\(^{16}\) 500 V AC
Conductive connection Between ground terminal and metallic process fitting

### Electrical protective measures

<table>
<thead>
<tr>
<th>Housing material</th>
<th>Version</th>
<th>Protection acc. to IEC 60529</th>
<th>Protection acc. to NEMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic</td>
<td></td>
<td>IP66/IP67</td>
<td>Type 4x</td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td>IP66/IP67</td>
<td>Type 4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP66/IP68 (0.2 bar)</td>
<td>Type 6P</td>
</tr>
<tr>
<td>Stainless steel (electro-polished)</td>
<td>Single chamber</td>
<td>IP66/IP67</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP69K</td>
<td>Type 4x</td>
</tr>
<tr>
<td>Stainless steel (precision casting)</td>
<td></td>
<td>IP66/IP67</td>
<td>Type 4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP66/IP68 (0.2 bar)</td>
<td>Type 4x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP66/IP69K</td>
<td>Type 6P</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Transmitter for external housing</td>
<td>IP68 (25 bar)</td>
<td></td>
</tr>
</tbody>
</table>

Altitude above sea level
- by default up to 2000 m (6562 ft)
- with connected overvoltage protection up to 5000 m (16404 ft) on the master sensor

Pollution degree\(^{19}\) 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 $F_{\text{total}}$ is the sum of the basic deviation $F_{\text{perf}}$ and the long-term stability $F_{\text{stab}}$:

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

The basic deviation $F_{\text{perf}}$ consists of the thermal change of the zero signal and the output span $F_{\text{T}}$ as well as the deviation $F_{\text{Kl}}$:

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

The thermal change of zero signal and output span $F_{\text{T}}$ is specified in chapter "Technical data". The basic temperature error $F_{\text{T}}$ is shown in a graphic. Depending on the measuring cell version and Turn down, this value must be multiplied with the additional factors $F_{\text{MZ}}$ and $F_{\text{TD}}$:

$$F_{\text{T}} \times F_{\text{MZ}} \times F_{\text{TD}}$$

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

\(^{16}\) Galvanic separation between electronics and metal housing parts
\(^{19}\) When used with fulfilled housing protection.
This applies for a digital signal output through HART, Profibus PA or Foundation Fieldbus. With a 4 … 20 mA output, the thermal change of the current output $F_a$ must be added:

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

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

- $F_{\text{total}}$: Total deviation
- $F_{\text{perf}}$: Basic deviation
- $F_{\text{stab}}$: 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 Practical example

#### Data

Level measurement in a small vessel, 500 mm height corresponds to **0.049 bar** (4.9 KPa), superimposed pressure 0.35 bar (35 KPa), medium temperature 40 °C

IPT-2x Master and slave sensor each with nominal measuring range **0.4 bar** (40 KPa), 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**

$$TD = 0.4 \text{ bar/0.049 bar}, \quad TD = 8.2 : 1$$

2. **Determination temperature error $F_T$**

The temperature error $F_T$ consists of the basic temperature error $F_{TBasis}$, the additional factor measuring cell $F_{M2}$, and the additional factor Turn Down $F_{TD'}$

![Diagram](image)

**Fig. 34: Determination of the basic temperature error for the above example:** $F_{TBasis} = 0.15 \%$
Tab. 19: Determination of the additional factor measuring cell for above example: 

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

\[ F_{TD} = 0.5 \times TD + 0.5, \text{ with } TD = 8.2:1 \text{ of above calculation} \]

FD = 0.5 x 8.2 + 0.5 = 4.6

Determination of the temperature error master sensor for above example:

\[ F_T = F_{TBasis} \times F_{MZ} \times F_{TD} \]

\[ F_T = 0.15 \% \times 1 \times 4.6 \]

\[ F_T = 0.69 \% \]

The temperature error of each sensor is hence 0.69 %

3. Determination of deviation and long-term stability

The required values for deviation \( F_{KI} \) and long-term stability \( F_{stab} \) are available in the technical data:

<table>
<thead>
<tr>
<th>Accuracy class</th>
<th>Non-linearity, hysteresis and non-repeatability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TD ≤ 5 : 1</td>
</tr>
<tr>
<td>0.075 %</td>
<td>&lt; 0.075 %</td>
</tr>
<tr>
<td>0.1 %</td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td>0.2 %</td>
<td>&lt; 0.2 %</td>
</tr>
</tbody>
</table>

Tab. 20: Determination of the deviation from the table: 

\[ F_{KI} = 0.02 \% \times TD = 0.02 \% \times 8.2 = 0.16 \% \]

Version

| Measuring ranges > 1 bar                        | < 0.1 % x TD/year |
| Measuring ranges > 1 bar, isolating liquid, synthetic oil, diaphragm Eligiloy (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 |

Determination of the long-term stability from the table, consideration for one year: 
\[ F_{stab} = 0.1 \% \times 8.2 = 0.82 \% \]

4. Calculation of the total deviation

- 1. step: Basic accuracy \( F_{perf} \)

\[ F_{perf} = \sqrt{\left(F_T\right)^2 + \left(F_{KI}\right)^2} \]

\[ F_T = 0.69 \% \]

\[ F_{KI} = 0.16 \% \text{ (calculation of above table)} \]

\[ F_{perf} = \sqrt{(0.69 \%)^2 + (0.16 \%)^2} \]

\[ F_{perf} = 0.71 \% \]

- 2. step: Total deviation \( F_{total} \)

\[ F_{total} = F_{perf} + F_{stab} \]

\[ F_{total} = 0.71 \% + 0.82 \% = 1.53 \% \]
F_{perf} = 0.71 \% \text{ (result of step 1)}
F_{stab} = 0.82 \% \text{ (from top)}
F_{total} = 0.71 \% + 0.82 \% = 1.53 \%

The total deviation of each sensor is hence 1.53 \%.

5. Calculation of the total deviation of the measuring system

Both sensors are included in the calculation of the total deviation of the measuring system. With 4 … 20 mA master sensors the thermal error of the analogue output is also added:

\[
F_{total} = \sqrt{(F_{total-Master})^2 + (F_{total-Slave})^2 + (F_t)^2}
\]

\[
F_{total} = \sqrt{(1.53 \%)^2 + (1.53 \%)^2 + (0.1 \%)^2} = 2.17 \%
\]

The total deviation of the measuring system is hence 2.17 \%.

Deviation in mm: 2.17 \% of 500 mm = 11 mm

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

The thermal change of the current output is in this example is negligible.
9.4 Dimensions

Housing

Fig. 36: 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. 37: 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. 38: IPT-2x, threaded fitting not front-flush

1  G½ manometer connection (EN 837)
2  M20 x 1.5 manometer connection (EN 837)
3  G½ A inside G¼ (ISO 228-1)
4  ½ NPT, inside ¼ NPT (ASME B1.20.1)
5  ½ 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. 39: IPT-2x, threaded fitting front-flush
1 G½ (ISO 228-1) with O-ring
2 G1 (ISO 228-1) with O-ring
3 G1½ (DIN3852-A)
4 M44 x 1.25
5 3 and 4 with temperature adapter and screen sheet for 180 °C/200 °C
6 1½ 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. 40: IPT-2x, hygienic fitting 150 °C (piezoresistive/strain gauge measuring cell)

1 Clamp 2" PN16 (ø64mm) DIN 32676, ISO 2852
2 Hygienic fitting with compression nut F 40 PN 25
3 Varivent N 50-40 PN 25
4 Collar socket DN 40 PN 40, DIN 11851
5 Collar socket DN 50 PN 25 Form A, DIN 11864
6 DRD PN 40

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

1. Clamp 2” PN16 (ø64mm) DIN 32676, ISO 2852
2. Hygienic fitting with compression nut F 40 PN 25
3. Varivent N 50-40 PN 25
4. Collar socket DN 40 PN 40, DIN 11851
5. Collar socket DN 50 PN 25 Form A, DIN 11864
6. DRD PN 40

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)

Fig. 42: 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)

Fig. 43: 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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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.