Process pressure transmitter CPT-2x

4 … 20 mA/HART
Ceramic 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 manual.

Editing status: 2018-03-05
1 About this document

1.1 Function
This operating instructions manual 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, tip, note**
  This symbol indicates helpful additional information.
- **Caution**: If this warning is ignored, faults or malfunctions can result.
- **Warning**: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
- **Danger**: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.
- **Ex applications**
  This symbol indicates special instructions for Ex applications.
  - **List**
    The dot set in front indicates a list with no implied sequence.
  - **Action**
    This arrow indicates a single action.
- **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 specialist personnel authorised by the plant operator. During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use
The CPT-2x is a pressure transmitter for process pressure and hydrostatic level measurement.

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

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

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

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

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

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 and their meaning read in this operating instructions manual.
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.

2.6 Permissible process pressure

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" as well as on the type label.

The permissible process pressure range is specified on the type label with "Process pressure", see chapter "Configuration". This applies even if a measuring cell with a measuring range (order-related) higher than the permissible pressure range of the process fitting is installed.

A temperature derating, e.g. with flanges, can limit the permissible process pressure range.

2.7 NAMUR recommendations

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

The device fulfils the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for fault information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 - Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.8 Installation and operation in the USA and Canada

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

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

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

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

3.1  Configuration

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

![Type label layout](image)

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

1  Instrument type  
2  Field for approvals  
3  Signal output and voltage supply  
4  Protection rating  
5  Measuring range  
6  Permissible process conditions  
7  Material wetted parts  
8  Product code  
9  Order number  
10  Serial number of the instrument  
11  Symbol of the device protection class  
12  ID numbers, instrument documentation  
13  Reminder to observe the instrument documentation

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.0
- Software from 1.3.2

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"

Scope of delivery

The scope of delivery encompasses:

- Instrument CPT-2x
- Documentation
  - Operating instructions CPT-2x
  - Characteristics test certificate
  - Instructions for optional instrument features
  - Ex-specific "Safety instructions" (with Ex versions)
3.2 Principle of operation

Measured variables

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

- Process pressure
- Level

Application area

CPT-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.

Depending on the process fitting and measurement setup, measured products can be also viscous or contain abrasive substances.

Measuring system pressure

Sensor element is the measuring cell with robust ceramic diaphragm. The process pressure deflects the ceramic diaphragm and causes a capacitance change in the measuring cell. This capacitance change is converted into an electrical signal and outputted as measured value via the output signal.
The measuring cell is available in two sizes: ø 28 mm and ø 17.5 mm.

**Use of ø 28 mm for example with:**
- Thread G½ EN 837 (manometer connection)
- Thread G1½, M44x1.25 and greater
- Flanges and hygienic fittings DN 32 and greater
- Measuring ranges 25 mbar and 100 bar

**Use of ø 17.5 mm for example with:**
- Thread G½ ISO 228-1 (front-flush), thread G¾ DIN 3852-E, thread G1 ISO 228-1
- Thread G1 suitable for PASVE
- Thread M30 x 1.5
- Flanges and hygienic fittings DN 25 and smaller

**Measuring system temperature**

A temperature sensor in the ceramic diaphragm of the ø 28 mm or on the ceramic base of the ø 17.5 mm measuring cell detects the actual process temperature. The temperature value is outputted via:
- The display and adjustment module
- The current output or the digital signal output

Extreme process temperature jumps are also immediately detected by the ø 28 mm measuring cell. The values are compared with that of an additional temperature measurement on the ceramic base body. Within only a few measuring cycles the intelligent sensor electronics compensates unavoidable measurement deviations due to temperature shocks. Such shocks cause (depending on the set damping) only slight, brief changes to the output signal.

**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 is evacuated and encapsulated. The ambient pressure is not compensated and does hence influence the measured value.

**Seal concepts**

The following presentations show examples for the installation of the ceramic measuring cell into the process fitting and the different seal concepts.

**Recessed installation**

The recessed installation is particularly suitable for applications with gases, vapours and clear liquids. The measuring cell seal is positioned laterally as well as in addition in front.

![Recessed installation diagram](image)

Fig. 4: Recessed installation of the measuring cell (example: manometer connection G½)

1. Measuring cell
2. Seal for the measuring cell
3. Additional, front seal for measuring cell
4. Diaphragm
5. Process fitting
6. Seal for the process fitting

**Front-flush mounting with single seal**

The front-flush installation is particularly suitable for applications with viscous and abrasive media and in case of buildup. The measuring cell seal is positioned laterally.

![Front-flush installation diagram](image)

Fig. 5: Front-flush installation of the measuring cell (example: thread G1½)

1. Seal for the process fitting
2. Measuring cell
3. Seal for the measuring cell
4. Process fitting
5. Diaphragm
### Completely front-flush mounting with single seal

The completely front-flush mounting is particularly suitable for applications in the paper industry. The diaphragm is in the pulp flow, is hence cleaned and protected against buildup.

![Fig. 6: Front-flush installation of the measuring cell (example: M30 x 1.5)](image)

1. Measuring cell
2. Seal for the measuring cell
3. Seal for the process fitting
4. Process fitting
5. Diaphragm

### Front-flush mounting with double seal

The front-flush installation is particularly suitable for applications with viscous media. The additional, front sealing protects the glass joint of the measuring cell against chemical attack and the measuring cell electronics against diffusion of aggressive gases from the process.

![Fig. 7: Front-flush installation of the measuring cell with double seal (example: flange connection with extension)](image)

1. Measuring cell
2. Seal for the measuring cell
3. Process fitting
4. Additional, front seal for measuring cell
5. Diaphragm

### Installation in hygienic fitting

The front-flush, hygienic installation of the measuring cell is particularly suitable for food applications. The sealings are installed gap-free. The form seal of the measuring cell protects also the glass joint.
Installation in hygienic fitting acc. to 3-A

The front-flush, hygienic installation of the measuring cell acc. to 3A is particularly suitable for food applications. The sealings are installed gap-free. The additional front sealing for the measuring cell protects also the glass joint. A hole in the process fitting is used for leakage detection.

Fig. 8: Hygienic installation of the measuring cell (example: hygienic fitting with compression nut)

1 Measuring cell
2 Form seal for the measuring cell
3 Gap-free seal for process fitting
4 Process fitting
5 Diaphragm

Fig. 9: Hygienic installation of the measuring cell acc. to 3-A (example: Clamp connection)

1 Measuring cell
2 Seal for the measuring cell
3 Process fitting
4 Additional, front seal for measuring cell
5 Diaphragm
6 Hole for leakage detection

3.3 Supplementary cleaning procedures

The CPT-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 CPT-2x in this version may not be used in oxygen applications. For this purpose, instruments are available in the special version "Oil and grease-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 of standard instruments 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

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

You can find detailed information on the process conditions in chapter "Technical data" as well as on the type label.

Suitability for the process conditions

The instrument is suitable for standard and extended ambient conditions acc. to IEC/EN 61010-1.

Suitability for the ambient conditions

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
- When mounting horizontally, turn the housing so that the cable gland or plug connector point downward
- 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.

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

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

Protection against moisture

Screwing in

On instruments with threaded fitting, the hexagon must be tightened with a suitable wrench. For the proper wrench size see chapter "Dimensions".

Warning:

The housing must not be used to screw the instrument in! Applying tightening force can damage internal parts 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".
4 Mounting

**Process pressure range - 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. 10: Temperature ranges](image)

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

Fig. 11: 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 IP 66/IP 68 (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. 12: 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.
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. 13: Position of the filter element - gastight leadthrough](image)

1. Filter element
2. Gas-tight leadthrough

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

**4.3  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. 15: Measurement setup for process pressure measurement of gases in pipelines
1 CPT-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. 16: Measurement setup with process pressure measurement of gases in pipelines
1 CPT-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 °C on the transmitter is ensured.
4 Mounting

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

1. CPT-2x
2. Blocking valve
3. Pipeline

4.4 Level measurement

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. 18: Measurement setup for level measurement
4.5 External housing

**Configuration**

Fig. 19: Configuration, process module, external housing

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

**Mounting**

1. Mark the holes according to the following drilling template
2. Fasten wall mounting plate with 4 screws

Fig. 20: Drilling template - wall mounting plate
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 personnel authorised by the plant operator
- If overvoltage surges are expected, overvoltage arresters should be installed

Warning:
Connect only in the complete absence of line voltage.

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)
- 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 screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

Make sure that the cable used has the required temperature resistance and fire safety for max. occurring ambient temperature

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

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 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.

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.

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”.

**Cable screening and grounding**

If screened cable is required, we recommend connecting the cable screen on both ends to ground potential. In the sensor, the screen must be 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.

**Information:**

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”.

**Version IP 68 (25 bar)**

The IP 68 (25 bar) version of CPT-2x consists of a process assembly and an external electronics. The serial number is stored in the process assembly and is also available on the type labels of the two components.

After connecting and applying the voltage supply, the serial number will be loaded automatically from the process assembly and displayed on the display and adjustment module.
5 Connecting to power supply

**Fig. 21: Combination process assembly and external electronics**

1. Process module
2. Type label, process assembly
3. External electronics
4. Type label, external electronics

**Note:**
Keep in mind while connecting that the process assembly and the external electronics must have the same serial number. Otherwise the serial numbers on the type label and the display and adjustment module do not correspond.

### 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
5 Connecting to power supply

Fig. 22: Connection steps 5 and 6

1. Single chamber housing
2. Double chamber housing

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

**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.

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

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

The electrical connection is finished.

### 5.3 Single chamber housing

The following illustration applies to the non-Ex, Ex-ia and Ex-d version.
5 Connecting to power supply

Electronics and terminal compartment

![Diagram of electronics and terminal compartment]

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

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

5.4 Double chamber housing

Ex

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

Electronics compartment

![Diagram of electronics compartment]

Fig. 24: Electronics compartment - double chamber housing

1 Internal connection to the terminal compartment
2 For display and adjustment module or interface adapter
5 Connecting to power supply

Terminal compartment

![Terminal compartment - double chamber housing](image)

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

5.5 Housing IP 66/IP 68 (1 bar)

![Wire assignment in permanently connected connection cable](image)

1 Brown (+) and blue (-) to power supply or to the processing system
2 Shielding
5.6 External housing with version IP 68 (25 bar)

Overview

Fig. 27: CPT-2x in IP 68 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. 28: Electronics and terminal compartment

1 Electronics module
2 Cable gland for voltage supply
3 Cable gland for connection cable, transmitter
5 Connecting to power supply

Terminal compartment, housing socket

![Diagram of terminal compartment](image)

Fig. 29: Connection of the process component in the housing base
1 Yellow
2 White
3 Red
4 Black
5 Shielding
6 Breather capillaries

Electronics and terminal compartment

![Diagram of electronics and terminal compartment](image)

Fig. 30: Electronics and connection compartment external housing
1 Voltage supply/Signal output
2 For display and adjustment module or interface adapter
3 For external display and adjustment unit or Slave sensor
4 Ground terminal for connection of the cable screen

5.7 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 5 s:

- Internal check of the electronics
- Indication of a status message on the display or PC
- Output signal at instruments with current output jumps to the set fault current
Then the actual measured value is outputted to the signal cable. The value takes into account settings that have already been carried out, e.g. default setting.
6 Set up with the display and adjustment module

6.1 Insert display and adjustment module

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

Proceed as follows:

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

Disassembly is carried out in reverse order.

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

*Fig. 31: Installing the display and adjustment module in the electronics compartment of the single chamber housing*
6 Set up with the display and adjustment module

![Image: Installing the display and adjustment module in the double chamber housing]

**Fig. 32: Installing the display and adjustment module in the double chamber housing**

1. In the electronics compartment
2. In the terminal compartment

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

### 6.2 Adjustment system

![Image: Display and adjustment elements]

**Fig. 33: 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 in the quick setup menu
6 Set up with the display and adjustment module

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

Adjustment system

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

Time functions

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

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

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

6.3 Measured value indication

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

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

In the second view, the selected measured value and a corresponding bar graph 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.
6 Set up with the display and adjustment module

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

6.4 Parameter adjustment - Quick setup

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

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

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

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

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

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

6.5 Parameter adjustment - Extended adjustment

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

Main menu

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

- **Setup**: Settings, e.g., for measurement loop name, application, units, position correction, adjustment, signal output
- **Display**: Settings, e.g., for language, measured value display, lighting
- **Diagnostics**: 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

Note:
For optimum adjustment of the measuring point, the individual sub-menu items in the main menu item "Setup" should be selected one
after the other and provided with the correct parameters. If possible, go through the items in the given sequence.

The submenu points are described below.

**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 +, -, /, -

**Setup - Application**

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

CPT-2x can be used for process pressure and level measurement.

Default setting is process pressure measurement. The mode can be changed in this adjustment menu.

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

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

**Setup - Units**

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

**Unit of measurement:**

If the level should be adjusted in a height unit, the density of the medium must also be entered later during the adjustment.
In addition, the temperature unit of the instrument is specified. The selection determines the unit displayed in menu items "Peak value, temperature" and "in the variables of the digital output signal".

**Temperature unit:**

<table>
<thead>
<tr>
<th>Units of measurement</th>
<th>Temperature unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>°F</td>
</tr>
</tbody>
</table>

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.

### Setup - 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.

If the actual measured value should be taken over as correction value during automatic position correction, this value must not be influenced by product coverage or static pressure.

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

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

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

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

### Setup - Adjustment

CPT-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:
6 Set up with the display and adjustment module

Fig. 34: 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.

Setup - 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. Go with [ESC] and [->] to the span adjustment
The zero adjustment is finished.

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

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

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

**Setup - 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.

**Setup - Min. adjustment**
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).
6 Set up with the display and adjustment module

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.

**Setup - 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.

**Setup - Damping**

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

The default setting depends on the sensor type.

**Setup - Linearisation**

A linearisation 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.

**Setup - 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 \(< 3.6 \text{ mA}\).

**Setup - 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 setup - Adjustment**

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

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

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

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

**Caution:**

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

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

**Display - Displayed value 1 and 2**

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

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

**Display - 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 - 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.

**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".

**Diagnostics - Peak values, pressure**

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

In another window you can carry out a reset of the peak values separately.
Diagnostics - Peak values, temperature

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

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

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Measuring cell temp.</th>
<th>Reset peak indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device status</td>
<td>Min. 20.26 °C</td>
<td>Measuring cell temp.</td>
</tr>
<tr>
<td>Peak value pressure</td>
<td>Max. 26.62 °C</td>
<td>Electronics temperature</td>
</tr>
<tr>
<td>Peak values temperature</td>
<td>Min. -32.80 °C</td>
<td>Max. 36.02 °C</td>
</tr>
</tbody>
</table>

Diagnosis - 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 outputted 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.

Additional settings - Date/Time

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

Additional settings - Reset

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

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

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

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

### Reset - Setup

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Parameter</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement loop name</td>
<td></td>
<td>Sensor</td>
</tr>
<tr>
<td>Application</td>
<td>Application</td>
<td>Level</td>
</tr>
<tr>
<td></td>
<td>Slave for electronic differential pressure</td>
<td>Deactivated</td>
</tr>
<tr>
<td>Units</td>
<td>Unit of measurement</td>
<td>mbar (with nominal measuring range ≤ 400 mbar)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bar (with nominal measuring ranges ≥ 1 bar)</td>
</tr>
<tr>
<td></td>
<td>Temperature unit</td>
<td>°C</td>
</tr>
<tr>
<td>Position correction</td>
<td></td>
<td>0.00 bar</td>
</tr>
<tr>
<td>Adjustment</td>
<td>Zero/Min. adjustment</td>
<td>0.00 bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00 %</td>
</tr>
<tr>
<td></td>
<td>Span/Max. adjustment</td>
<td>Nominal measuring range in bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100.00 %</td>
</tr>
<tr>
<td>Damping</td>
<td>Integration time</td>
<td>1 s</td>
</tr>
<tr>
<td>Linearization</td>
<td></td>
<td>Linear</td>
</tr>
<tr>
<td>Current output</td>
<td>Current output - Mode</td>
<td>Output characteristics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 … 20 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reaction when malfunctions occur</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 3.6 mA</td>
</tr>
<tr>
<td></td>
<td>Current output - Min./Max.</td>
<td>3.8 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.5 mA</td>
</tr>
<tr>
<td>Lock adjustment</td>
<td></td>
<td>Released</td>
</tr>
</tbody>
</table>

### Reset - Display

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu language</td>
<td>Selected language</td>
</tr>
<tr>
<td>Displayed value 1</td>
<td>Current output in %</td>
</tr>
<tr>
<td>Displayed value 2</td>
<td>Ceramic measuring cell: Measuring cell temperature in °C</td>
</tr>
<tr>
<td></td>
<td>Metallic measuring cell: Electronics temperature in °C</td>
</tr>
<tr>
<td>Display format 1 and 2</td>
<td>Number of positions after the decimal point, automatically</td>
</tr>
</tbody>
</table>
6 Set up with the display and adjustment module

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backlight</td>
<td>Switched on</td>
</tr>
</tbody>
</table>

**Reset - Diagnosis**

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Parameter</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor status</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Peak value</td>
<td>Pressure</td>
<td>Actual measured value</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>Actual temperature values from measuring cell, electronics</td>
</tr>
<tr>
<td>Simulation</td>
<td></td>
<td>Process pressure</td>
</tr>
</tbody>
</table>

**Reset - Additional settings**

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Parameter</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN</td>
<td></td>
<td>0000</td>
</tr>
<tr>
<td>Date/Time</td>
<td></td>
<td>Actual date/Actual time</td>
</tr>
<tr>
<td>Copy instrument settings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special parameters</td>
<td></td>
<td>No reset</td>
</tr>
<tr>
<td>Scaling</td>
<td>Scaling size</td>
<td>Volume in l</td>
</tr>
<tr>
<td></td>
<td>Scaling format</td>
<td>0 % corresponds to 0 l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 % corresponds to 0 l</td>
</tr>
<tr>
<td>Current output</td>
<td>Current output - Meas. variable</td>
<td>Lin. percent - Level</td>
</tr>
<tr>
<td></td>
<td>Current output - Adjustment</td>
<td>0 ... 100 % correspond to 4 ... 20 mA</td>
</tr>
<tr>
<td>HART mode</td>
<td></td>
<td>Address 0</td>
</tr>
</tbody>
</table>

**Additional settings - Copy instrument settings**

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

- Read from sensor: Read data from sensor and save in the display and adjustment module
- Write to sensor: Save 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.

### Additional settings - 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.

### Additional settings - 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.

### Additional settings - 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 %.

### Additional settings - Current output (size)

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

### Additional settings - 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.

### Additional adjustments - HART mode

The sensor offers the HART modes "Analogue current output" and "Fix current (4 mA)". In this menu item you determine the HART mode and enter the address with Multidrop mode.

In the mode "Fixed current output" up to 63 sensors can be operated on one two-wire cable (Multidrop operation). An address between 0 and 63 must be assigned to each sensor.

If you select the function "Analogue current output" and also enter an address number, you can output a 4 … 20 mA signal in Multidrop mode.

In the mode "Fixed current (4 mA)" a fixed 4 mA signal is output independently of the actual level.

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

### Info - Instrument name

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

### Info - Instrument version

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

### Info - 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.
6 Set up with the display and adjustment module

**Info - 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.

```plaintext
Info
   Device name
   Instrument version
   Factors calibration date
   Sensor characteristics
```

**6.6 Saving the parameterisation data**

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.

**On paper**

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".

**In the display and adjustment module**
7 Setup with PACTware

7.1 Connect the PC

Connecting the PC to the signal cable

![Diagram](image)

Fig. 35: Connecting the PC to the signal cable
1 RS232 connection
2 HART resistor 250 Ω
3 CPT-2x

Necessary components:
- CPT-2x
- PC with PACTware and suitable WIKA DTM
- HART modem
- HART resistance approx. 250 Ω
- Power supply unit

Note:
For power supply units with integrated HART resistance (inner resistance approx. 250 Ω), there is no additional external resistance necessary. Standard Ex separators are often provided with a sufficiently high current limitation resistance. In such cases, the modem can be connected in parallel to the 4 … 20 mA cable.

7.2 Parameter adjustment

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

Note:
Keep in mind that for the setup of model CPT-2x, the current version of the DTM-Collection must be used.

The latest DTM Collection and PACTware version can be downloaded free of charge via the Internet.
7.3 Saving the parameterisation data
We recommend documenting or saving the parameterisation data via PACTware. That way the data are available for multiple use or service purposes.
8 Diagnosis, asset management and service

8.1 Maintenance

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

Precaution measures against buildup

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

Cleaning

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

Take note of the following:

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

8.2 Cleaning - hygienic connection with compression nut

Overview

The hygienic connection with compression nut can be disassembled and the diaphragm cleaned.

The following graphic shows the structure:

![Diagram](image)

Fig. 36: CPT-2x, structure of the hygienic connection with compression nut

1. Hexagon
2. Compression nut
3. Process fitting
4. Process module
5. Form seal for the measuring cell
6. O-ring seal for the process fitting
7. Diaphragm

Procedure

To do so, proceed as follows:

1. Loosen compression nut and remove the pressure transmitter from the welded socket
2. Remove the O-ring seal for the process fitting
3. Clean the diaphragm with brass brush and cleaning detergent
4. Loosen the hexagon and remove the process component from the process fitting
5. Remove the form seal for the measuring cell and remove it by a new one

6. Screw the process component into the process fitting, tighten the hexagon (wrench size see chapter "Dimensions", max. torque see chapter "Technical data")

7. Insert new O-ring seal for the process fitting

8. Install the process pressure transmitter in the welded socket, tighten compression nut

The cleaning is finished.

The pressure transmitter is directly ready for operation, a fresh adjustment is not required.

8.3 Diagnosis memory

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

**Measured value memory**

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

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

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

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

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

**Event memory**

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

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

The data are read out via a PC with PACTware/DTM or the control system with EDD.
8.4 **Asset Management function**

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables, detailed error messages are available under menu item "Diagnostics" via the display and adjustment module, PACTware/DTM and EDD.

### Status messages

The status messages are divided into the following categories:

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

and explained by pictographs:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

*Fig. 37: Pictographs of the status messages*

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

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

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

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

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

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

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

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

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.
### Failure

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
<th>DevSpec State in CMD 48</th>
</tr>
</thead>
<tbody>
<tr>
<td>F013</td>
<td>No valid measured value available</td>
<td>• Gauge pressure or low pressure</td>
<td>• Exchange measuring cell</td>
<td>Bit 0 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Measuring cell defective</td>
<td>• Send instrument for repair</td>
<td></td>
</tr>
<tr>
<td>F017</td>
<td>Adjustment span too small</td>
<td>• Adjustment not within specification</td>
<td>• Change the adjustment according to the limit values</td>
<td>Bit 1 of Byte 0 … 5</td>
</tr>
<tr>
<td>F025</td>
<td>Error in the linearization table</td>
<td>• Index markers are not continuously rising, for example illogical value pairs</td>
<td>• Check linearisation table</td>
<td>Bit 2 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Delete table/Create new</td>
<td></td>
</tr>
<tr>
<td>F036</td>
<td>no operable sensor software</td>
<td>• Failed or interrupted software update</td>
<td>• Repeat software update</td>
<td>Bit 3 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check electronics version</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Exchanging the electronics</td>
<td></td>
</tr>
<tr>
<td>F040</td>
<td>Error in the electronics</td>
<td>• Hardware defect</td>
<td>• Exchanging the electronics</td>
<td>Bit 4 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Send instrument for repair</td>
<td></td>
</tr>
<tr>
<td>F041</td>
<td>Communication error</td>
<td>• No connection to the sensor electronics</td>
<td>• Check connection between sensor and main electronics (with separate version)</td>
<td>Bit 5 of Byte 0 … 5</td>
</tr>
<tr>
<td>F042</td>
<td>Communication error Slave</td>
<td>• No connection to the Slave</td>
<td>• Check connection between Master and Slave</td>
<td>Bit 15 of Byte 0 … 5</td>
</tr>
<tr>
<td>F080</td>
<td>General software error</td>
<td>• General software error</td>
<td>• Disconnect operating voltage briefly</td>
<td>Bit 6 of Byte 0 … 5</td>
</tr>
<tr>
<td>F105</td>
<td>Measured value is determined</td>
<td>• The instrument is still in the start phase, the measured value could not yet be determined</td>
<td>• Wait for the end of the switch-on phase</td>
<td>Bit 7 of Byte 0 … 5</td>
</tr>
<tr>
<td>F113</td>
<td>Communication error</td>
<td>• Error in the internal instrument</td>
<td>• Disconnect operating voltage briefly</td>
<td>Bit 8 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>communication</td>
<td>• Send instrument for repair</td>
<td></td>
</tr>
<tr>
<td>F260</td>
<td>Error in the calibration</td>
<td>• Error in the calibration carried out in the factory</td>
<td>• Exchanging the electronics</td>
<td>Bit 10 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Error in the EEPROM</td>
<td>• Send instrument for repair</td>
<td></td>
</tr>
<tr>
<td>F261</td>
<td>Error in the instrument settings</td>
<td>• Error during setup</td>
<td>• Repeat setup</td>
<td>Bit 11 of Byte 0 … 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Error when carrying out a reset</td>
<td>• Repeat reset</td>
<td></td>
</tr>
</tbody>
</table>
8 Diagnosis, asset management and service

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
<th>DevSpec State in CMD 48</th>
</tr>
</thead>
</table>
| F264  | Installation/Setup error| ● Inconsistent settings (e.g.: distance, adjustment units with application process pressure) for selected application  
● Invalid sensor configuration (e.g.: application electronic differential pressure with connected differential pressure measuring cell) | ● Modify settings  
● Modify connected sensor configuration or application | Bit 12 of Byte 0 … 5 |
| F265  | Measurement function disturbed | ● Sensor no longer carries out a measurement | ● Carry out a reset  
● Disconnect operating voltage briefly | Bit 13 of Byte 0 … 5 |

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

Function check

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
<th>DevSpec State in CMD 48</th>
</tr>
</thead>
</table>
| C700  | Simulation active       | ● A simulation is active | ● Finish simulation  
● Wait for the automatic end after 60 mins. | “Simulation Active” in “Standardized Status 0” |

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

Out of specification

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
<th>DevSpec State in CMD 48</th>
</tr>
</thead>
</table>
| S600  | Impermissible electronics temperature | ● Temperature of the electronics in the non-specified range | ● Check ambient temperature  
● Insulate electronics | Bit 23-0 of Byte 14 … 24 |
| S603  | Impermissible operating voltage | ● Operating voltage below specified range | ● Check electrical connection  
● If necessary, increase operating voltage | Bit 23-1 of Byte 14 … 24 |
| S605  | Impermissible pressure value | ● Measured process pressure below or above the adjustment range | ● Check nominal measuring range of the instrument  
● If necessary, use an instrument with a higher measuring range | Bit 23-2 of Byte 14 … 24 |

Tab. 7: Error codes and text messages, information on causes as well as corrective measures

Maintenance

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
<th>DevSpec State in CMD 48</th>
</tr>
</thead>
</table>
| M500  | Error in the delivery status | ● The data could not be restored during the reset to delivery status | ● Repeat reset  
● Load XML file with sensor data into the sensor | Bit 0 of Byte 14 … 24 |
### 8.5 Rectify faults

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

#### Procedure for fault rectification

The first measures are:
- Evaluation of fault messages via the adjustment device
- Checking the output signal
- Treatment of measurement errors

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

#### Check the 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:

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 ... 20 mA signal not stable</td>
<td>Fluctuating measured value</td>
<td>Set damping</td>
</tr>
<tr>
<td>4 ... 20 mA signal missing</td>
<td>Electrical connection faulty</td>
<td>Check connection, correct, if necessary</td>
</tr>
<tr>
<td></td>
<td>Voltage supply missing</td>
<td>Check cables for breaks; repair if necessary</td>
</tr>
<tr>
<td></td>
<td>Operating voltage too low, load resistance too high</td>
<td>Check, adapt if necessary</td>
</tr>
<tr>
<td>Current signal greater than 22 mA, less than 3.6 mA</td>
<td>Sensor electronics defective</td>
<td>Exchange the instrument or send it in for repair</td>
</tr>
</tbody>
</table>
8 Diagnosis, asset management and service

Reaction after fault rectification

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

8.6 Exchange process module on version IP 68 (25 bar)

On version IP 68 (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.

Ex

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

Fig. 38: CPT-2x in IP 68 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
7. Tighten the fixing screw with the hexagon key wrench

The exchange is finished.

8.7 Instrument repair

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

If a repair is necessary, please proceed as follows:

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

9.1 Dismounting steps

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

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

9.2 Disposal

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

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "Technical data"

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

WEEE directive 2012/19/EU

This instrument is not subject to the WEEE directive 2012/19/EU and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.
10 Supplement

10.1 Technical data

Note for approved instruments

The technical data in the respective safety instructions 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.

Materials and weights

Materials, wetted parts

| Process fitting                        | 316L, PVDF, Alloy C22 (2.4602), Alloy C276 (2.4819), Duplex steel (1.4462), Titanium Grade 2 |
| Diaphragm                              | Sapphire-ceramic® (> 99.9 % Al₂O₃ ceramic) |
| Joining material, diaphragm/base element of measuring cell | Glass (with double and form seal, non-wetted parts) |

Measuring cell seal

- Standard: lateral, recessed (O-ring) FKM (VP2/A, A+P 70.16), EPDM (A+P 75.5/KW75F), FFKM (Kalrez 6375, Perlast G75S, Perlast G75B)
- Hygienic connection with compression nut: in front (form seal) FKM (ET 6067), EPDM (EPDM 7076), FFKM (Chemraz 535), FEPM (Fluoraz SD890)

Seal for process fitting in the scope of delivery

- Thread G½ EN 837 Klingersil C-4400
- Thread G1½ DIN 3852-A Klingersil C-4400
- Hygienic connection with compression nut FKM, EPDM, FFKM, FEPM
- M44 x 1.25 (DIN 13), M30 x 1.5 FKM, FFKM, EPDM

Materials for applications in foodstuffs

Surface quality, hygienic fittings, typ.

- Process fitting $R_a < 0.8 \mu m$
- Ceramic diaphragm $R_a < 0.5 \mu m$

Seal below wall mounting plate with 3A approval EPDM

Materials, non-wetted parts

Housing

- Plastic housing Plastic PBT (Polyester)
- 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 in housing cover Polycarbonate, UL746-C listed (with Ex-d version: 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)

Seal between housing and housing lid Silicone Si 850 R, NBR silicone-free, EPDM (coating-compatible)

Inspection window in housing cover Polycarbonate, UL746-C listed (with Ex-d version: glass)
Ground terminal 316Ti/316L
Connection cable with IP 68 (25 bar) version\(^1\)
- Cable cover PE, PUR
- Type label support on cable PE hard
Connection cable with IP 68 (1 bar) version\(^2\)
PE, PUR

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

Torques
Max. torque for process fitting
- G½, G¾ 30 Nm (22.13 lbf ft)
- Fittings according to 3A with exchangeable sealing 20 Nm (14.75 lbf ft)
- Hygienic fitting with compression nut (hexagon) 40 Nm (29.50 lbf ft)
- G1, M30 x 1.5 50 Nm (36.88 lbf ft)
- G1 for PASVE 100 Nm (73.76 lbf ft)
- G1½ 200 Nm (147.5 lbf ft)

Max. torque for screws
- PMC 1", PMC 1¼" 2 Nm (1.475 lbf ft)
- PMC 1½" 5 Nm (3.688 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
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.

\(^{1}\) Between transmitter and external electronics housing.
\(^{2}\) Fix connected to the sensor.
Nominal measuring ranges and overload capability in bar/kPa

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capacity, max. pressure</th>
<th>Overload capacity, min. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 ... +0.025 bar/0 ... +2.5 kPa (only for measuring cell ø 28 mm)</td>
<td>5 bar/+500 kPa</td>
<td>-0.05 bar/-5 kPa</td>
</tr>
<tr>
<td>0 ... +0.1 bar/0 ... +10 kPa</td>
<td>+15 bar/+1500 kPa</td>
<td>-0.2 bar/-20 kPa</td>
</tr>
<tr>
<td>0 ... +0.4 bar/0 ... +40 kPa</td>
<td>+30 bar/+3000 kPa</td>
<td>-0.8 bar/-80 kPa</td>
</tr>
<tr>
<td>0 ... +1 bar/0 ... +100 kPa</td>
<td>+35 bar/+3500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +2.5 bar/0 ... +250 kPa</td>
<td>+50 bar/+5000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +5 bar/0 ... +500 kPa</td>
<td>+65 bar/+6500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +10 bar/0 ... +1000 kPa</td>
<td>+90 bar/+9000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +25 bar/0 ... +2500 kPa</td>
<td>+125 bar/+12500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +60 bar/0 ... +6000 kPa</td>
<td>+200 bar/+20000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>0 ... +100 bar/0 ... +10000 kPa (only for measuring cell ø 28 mm)</td>
<td>+200 bar/+20000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... 0 bar/-100 ... 0 kPa</td>
<td>+35 bar/+3500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... +1.5 bar/-100 ... +150 kPa</td>
<td>+40 bar/+4000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... +10 bar/-100 ... +1000 kPa</td>
<td>+90 bar/+9000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... +25 bar/-100 ... +2500 kPa</td>
<td>+125 bar/+12500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... +60 bar/-100 ... +6000 kPa</td>
<td>+180 bar/+18000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-1 ... +100 bar/-100 ... +10000 kPa (only for measuring cell ø 28 mm)</td>
<td>+200 bar/+20000 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
<tr>
<td>-0.05 ... +0.05 bar/-5 ... +5 kPa</td>
<td>+7.5 bar/+750 kPa</td>
<td>-0.2 bar/-20 kPa</td>
</tr>
<tr>
<td>-0.2 ... +0.2 bar/-20 ... +20 kPa</td>
<td>+20 bar/+2000 kPa</td>
<td>-0.4 bar/-40 kPa</td>
</tr>
<tr>
<td>-0.5 ... +0.5 bar/-50 ... +50 kPa</td>
<td>+35 bar/+3500 kPa</td>
<td>-1 bar/-100 kPa</td>
</tr>
</tbody>
</table>

Absolute pressure

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capacity, max. pressure</th>
<th>Overload capacity, min. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ... 0.1 bar/0 ... 10 kPa</td>
<td>15 bar/1500 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 1 bar/0 ... 100 kPa</td>
<td>35 bar/3500 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 2.5 bar/0 ... 250 kPa</td>
<td>50 bar/5000 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 5 bar/0 ... 500 kPa</td>
<td>65 bar/+6500 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 10 bar/0 ... 1000 kPa</td>
<td>90 bar/9000 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 25 bar/0 ... 2500 kPa</td>
<td>+125 bar/+12500 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... 60 bar/0 ... 6000 kPa</td>
<td>+200 bar/+20000 kPa</td>
<td>0 bar abs.</td>
</tr>
<tr>
<td>0 ... +100 bar/0 ... +10000 kPa (only for measuring cell ø 28 mm)</td>
<td>200 bar/20000 kPa</td>
<td>0 bar abs.</td>
</tr>
</tbody>
</table>

Nominal measuring ranges and overload capacity in psi

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capacity, max. pressure</th>
<th>Overload capacity, min. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge pressure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Nominal range

<table>
<thead>
<tr>
<th>Nominal range</th>
<th>Overload capacity, max. pressure</th>
<th>Overload capacity, min. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 … +0.4 psig (only for measuring cell ø 28 mm)</td>
<td>+75 psig</td>
<td>-0.725 psig</td>
</tr>
<tr>
<td>0 … +1.5 psig</td>
<td>+225 psig</td>
<td>-2.901 psig</td>
</tr>
<tr>
<td>0 … +5 psig</td>
<td>+375 psig</td>
<td>-11.60 psig</td>
</tr>
<tr>
<td>0 … +15 psig</td>
<td>+525 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +30 psig</td>
<td>+600 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +75 psig</td>
<td>+975 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +150 psig</td>
<td>+1350 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +300 psig</td>
<td>+1500 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +900 psig</td>
<td>+2900 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>0 … +1450 psig (only for measuring cell ø 28 mm)</td>
<td>+2900 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … 0 psig</td>
<td>+525 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +20 psig</td>
<td>+600 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +75 psig</td>
<td>+975 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +150 psig</td>
<td>+1350 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +300 psig</td>
<td>+1500 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +900 psig</td>
<td>+2700 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-14.5 … +1500 psig (only for measuring cell ø 28 mm)</td>
<td>+2900 psig</td>
<td>-14.51 psig</td>
</tr>
<tr>
<td>-0.7 … +0.7 psig</td>
<td>+105 psig</td>
<td>-2.901 psig</td>
</tr>
<tr>
<td>-3 … +3 psig</td>
<td>+300 psi</td>
<td>-5.800 psig</td>
</tr>
<tr>
<td>-7 … +7 psig</td>
<td>+490 psig</td>
<td>-14.51 psig</td>
</tr>
</tbody>
</table>

### Absolute pressure

<table>
<thead>
<tr>
<th>Absolute pressure</th>
<th>Overload capacity, max. pressure</th>
<th>Overload capacity, min. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 … 1.5 psi</td>
<td>225 psig</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 5 psi</td>
<td>435 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 15 psi</td>
<td>525 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 30 psi</td>
<td>600 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … +75 psi</td>
<td>975 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 150 psi</td>
<td>1350 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 300 psi</td>
<td>1500 psi</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … 900 psi</td>
<td>+2900 psig</td>
<td>0 psi</td>
</tr>
<tr>
<td>0 … +1450 psig (only for measuring cell ø 28 mm)</td>
<td>2900 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.
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
Run-up time with operating voltage $U_B$
- $\geq 12$ V DC   $\leq 9$ s
- $< 12$ V DC     $\leq 22$ s
Staring current (for run-up time) $\leq 3.6$ mA

Output variable
For details on the operating voltage see chapter "Voltage supply"
Output signal 4 ... 20 mA/HART
Range of the output signal 3.8 ... 20.5 mA/HART (default setting)
Fulfilled HART specification 7.3
Signal resolution 0.3 μA
Fault signal, current output (adjustable) $\geq 21$ mA, $\leq 3.6$ mA, last valid measured value³)
Max. output current 21.5 mA
Load See load resistance under Power supply
Starting current $\leq 10$ mA for 5 ms after switching on, $\leq 3.6$ mA
Damping (63 % of the input variable), adjustable 0 ... 999 s

HART output values according to HART 7 (default setting)⁴)
- First HART value (PV) Linear percentage value
- Second HART value (SV) Measuring cell temperature (ceramic measuring cell)
- Third HART value (TV) Pressure
- Fourth HART value (QV) Electronics temperature

Dynamic behaviour output
Dynamic characteristics depending on medium and temperature

³) Last valid measured value not possible with SIL.
⁴) The output values can be assigned individually.
Fig. 39: 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>CPT-2x</th>
<th>CPT-2x - IP 68 (25 bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead time</td>
<td>$\leq 25$ ms</td>
<td>$\leq 50$ ms</td>
</tr>
<tr>
<td>Rise time (10 ... 90%)</td>
<td>$\leq 55$ ms</td>
<td>$\leq 150$ ms</td>
</tr>
<tr>
<td>Step response time (ti: 0 s, 10 ... 90%)</td>
<td>$\leq 80$ ms</td>
<td>$\leq 200$ ms</td>
</tr>
</tbody>
</table>

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

**Additional output parameter - Measuring cell temperature**

- Detection area: -60 ... +150 °C (-76 ... +302 °F)
- Resolution: < 0.2 K
- Accuracy:
  - in the range of 0 ... +100 °C (+32 ... +212 °F): ±2 K
  - In the range of -60 ... 0 °C (-76 ... +32 °F) and +100 ... +150 °C (+212 ... +302 °F): typ. ±4 K

- Output of the temperature values:
  - Analogue: Via the additional current output (4 mA = 0 °C, 20 mA = 100 °C)
  - Digital: Depending on the electronics version via the HART, Profibus PA, Foundation Fieldbus or Modbus signal

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

- Reference conditions according to DIN EN 61298-1:
  - Temperature: +15 ... +25 °C (+59 ... +77 °F)
  - Relative humidity: 45 ... 75 %
  - Air pressure: 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)

- Determination of characteristics: Limit point adjustment according to IEC 61298-2
Characteristic curve: Linear
Reference installation position: upright, diaphragm points downward
Influence of the installation position: < 0.2 mbar/20 Pa (0.003 psig)
Deviation in the current output due to strong, high-frequency electromagnetic fields acc. to EN 61326-1: < ±150 μA

**Deviations (according to IEC 60770)**

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 specified values correspond to the value $F_{KL}$ in chapter "Calculation of the total deviation".

<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>0.05 %</td>
<td>&lt; 0.05 %</td>
<td>&lt; 0.01 % 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 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 temperature error $F_T$ in chapter "Calculation of the total deviation (according to DIN 16086)".

**Basic temperature error $F_T$**

![Figure 40: Basic temperature error $F_{T\text{Basic}}$ at TD 1 : 1](image)

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, depending on the accuracy class</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.05 %, 0.1 %</td>
<td>0.2 % (with measuring range 0.1 bar&lt;sub&gt;abs&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Factor FMZ</td>
<td>1</td>
<td>2</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>

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)

The thermal change of the current output corresponds to the value \( F_a \) in chapter "Calculation of the total deviation (according to DIN 16086)".

![Fig. 41: Thermal change, current output](image)

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.

<table>
<thead>
<tr>
<th>Time period</th>
<th>Measuring cell ø 28 mm</th>
<th>Measuring cell ø 17.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All measuring ranges</td>
<td>Measuring range 0 … +0.025 bar (0 … +2.5 kPa)</td>
</tr>
<tr>
<td>One year</td>
<td>&lt; 0.05 % x TD</td>
<td>&lt; 0.1 % x TD</td>
</tr>
<tr>
<td>Five years</td>
<td>&lt; 0.1 % x TD</td>
<td>&lt; 0.2 % x TD</td>
</tr>
<tr>
<td>Ten years</td>
<td>&lt; 0.2 % x TD</td>
<td>&lt; 0.4 % x TD</td>
</tr>
</tbody>
</table>
### 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 IP 66/IP 68 (1 bar)</td>
<td>-20 ... +80 °C (-4 ... +176 °F)</td>
<td>-20 ... +80 °C (-4 ... +176 °F)</td>
</tr>
<tr>
<td>Version IP 68 (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 IP 68 (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>

### Process conditions

#### Process temperature

<table>
<thead>
<tr>
<th>Measuring cell seal</th>
<th>Sensor version</th>
<th>Standard</th>
<th>Extended temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td>FKM</td>
<td></td>
<td>VP2/A</td>
<td>-20 ... +130 °C (-4 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A+P 70.16</td>
<td>-40 ... +130 °C (-40 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Endura V91A</td>
<td>-40 ... +130 °C (-40 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ET 7067</td>
<td>-20 ... +130 °C (-4 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V70SW</td>
<td>-</td>
</tr>
<tr>
<td>EPDM</td>
<td></td>
<td>A+P 75.5/KW75F</td>
<td>-40 ... +130 °C (-40 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ET 7056</td>
<td>-40 ... +130 °C (-40 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E70Q</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fluoraz SD890</td>
<td>-5 ... +130 °C (-22 ... +266 °F)</td>
</tr>
<tr>
<td>FFKM</td>
<td></td>
<td>Kalrez 6375</td>
<td>-20 ... +130 °C (-4 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perlast G75S</td>
<td>-15 ... +130 °C (-5 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perlast G75B</td>
<td>-15 ... +130 °C (-5 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perlast G92E</td>
<td>-15 ... +130 °C (-5 ... +266 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chemraz 535</td>
<td>-30 ... +130 °C (-22 ... +266 °F)</td>
</tr>
</tbody>
</table>

#### Temperature derating

With process fitting PVDF, process temperature max. 100 °C (212 °F).
Fig. 42: Temperature derating CPT-2x, version up to +130 °C (+266 °F)

1. Process temperature
2. Ambient temperature

Fig. 43: Temperature derating CPT-2x, version up to +150 °C (+302 °F)

1. Process temperature
2. Ambient temperature

**SIP process temperature (SIP = Sterilization in place)**

Applies to instruments configurations suitable for vapour, i.e. material measuring cell seal EPDM or FFKM (Perlast G75S).

Vapour stratification up to 2 h +150 °C (+302 °F)

**Process pressure**

Permissible process pressure See specification "process pressure" on the type label

**Mechanical stress**

Vibration resistance 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)⁷

---

⁶) Depending on the instrument version.

⁷) 2 g with housing version stainless steel double chamber
**Electromechanical data - version IP 66/IP 67 and IP 66/IP 68 (0.2 bar)**

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

<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>
<tr>
<td>Brass, nickel-plated/NBR</td>
<td>●</td>
</tr>
<tr>
<td>Stainless steel/NBR</td>
<td>–</td>
</tr>
</tbody>
</table>

Material cable gland/Seal insert: see below table

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 IP 66/IP 68 (1 bar)**

Connection cable, mechanical data
- Configuration: Wires, breather capillaries, strain relief, screen braiding, metal foil, mantle
- Standard length: 5 m (16.4 ft)
- Min. bending radius: 25 mm (0.984 in) with 25 °C (77 °F)
- 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 IP 68 (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)
- Colour PE: Black
- Colour PUR: Blue

---

8) IP 66/IP 68 (0.2 bar), only with absolute pressure.

9) Breather capillaries not with Ex-d version.
Connection cable transmitter - external housing, electrical data
- Wire cross-section 0.5 mm² (AWG 20)
- Wire resistance R' 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]
- Switch Bluetooth On/Off
Protection rating
- unassembled IP 20
- mounted in the housing without lid IP 40
Materials
- Housing ABS
- Inspection window Polyester foil
Functional safety SIL non-reactive

Interface to the external display and adjustment unit
Data transmission Digital (I²C-Bus)
Connection cable Four-wire

<table>
<thead>
<tr>
<th>Sensor version</th>
<th>Configuration, connection cable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cable length</td>
</tr>
<tr>
<td>4 ... 20 mA/HART Modbus</td>
<td>50 m</td>
</tr>
<tr>
<td>Profibus PA, Foundation Fieldbus</td>
<td>25 m</td>
</tr>
</tbody>
</table>

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

Additional output parameter - Electronics temperature
Output of the values
- Indication Via the display and adjustment module
- Analogue Via the current output
- Digital Via the digital output signal (depending on the electronics version)
Range -40 ... +85 °C (-40 ... +185 °F)
Resolution  $< 0.1 \text{ K}$
Accuracy  $\pm 3 \text{ K}$

**Voltage supply**

Operating voltage $U_B$
- Non-Ex instrument  $9.6 \ldots 35 \text{ V DC}$
- Ex-d instrument  $9.6 \ldots 35 \text{ V DC}$

Operating voltage $U_B$ - illuminated display and adjustment module
- Non-Ex instrument  $16 \ldots 35 \text{ V DC}$
- Ex-d instrument  $16 \ldots 35 \text{ V DC}$

Reverse voltage protection  Integrated

Permissible residual ripple - Non-Ex, Ex-ia instrument
- for $U_n$  $12 \text{ V DC}$ ($9.6 \text{ V} < U_B < 14 \text{ V}$)  $\leq 0.7 V_{eff}$ ($16 \ldots 400 \text{ Hz}$)
- for $U_n$  $24 \text{ V DC}$ ($18 \text{ V} < U_B < 35 \text{ V}$)  $\leq 1.0 V_{eff}$ ($16 \ldots 400 \text{ Hz}$)

Load resistor
- Calculation  $(U_B - U_{\text{min}})/0.022 \text{ A}$
- Example - Non-Ex instrument 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  Not non-floating
Reference voltage$^{10)}$  $500 \text{ V AC}$

**Electrical protective measures$^{11)}$**

<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>Single chamber</td>
<td>IP 66/IP 67</td>
<td>Type 4X</td>
</tr>
<tr>
<td></td>
<td>Double chamber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>Single chamber</td>
<td>IP 66/IP 68 (0.2 bar)</td>
<td>Type 6P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP 68 (1 bar)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double chamber</td>
<td>IP 66/IP 68 (0.2 bar)</td>
<td>Type 6P</td>
</tr>
<tr>
<td>Stainless steel (electro-polished)</td>
<td>Single chamber</td>
<td>IP 69K</td>
<td>-</td>
</tr>
<tr>
<td>Stainless steel (precision casting)</td>
<td>Single chamber</td>
<td>IP 66/IP 68 (0.2 bar)</td>
<td>Type 6P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP 68 (1 bar)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double chamber</td>
<td>IP 66/IP 68 (0.2 bar)</td>
<td>Type 6P</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Transmitter, version with external housing</td>
<td>IP 68 (25 bar)</td>
<td>-</td>
</tr>
</tbody>
</table>

Connection of the feeding power supply unit

$^{10)}$ Galvanic separation between electronics and metal housing parts
$^{11)}$ Protection rating IP 66/IP 68 (0.2 bar) only in conjunction with absolute pressure.
Altitude above sea level
- by default up to 2000 m (6562 ft)
- with connected overvoltage protection up to 5000 m (16404 ft)
Pollution degree\(^{(2)}\) 4
Protection rating (IEC/EN 61010-1) II

**Approvals**

Instruments with approvals can have deviating technical data (depending on the version). For such instruments, the corresponding approval documents must be noted.

### 10.2 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 accuracy \(F_{perf}\) and the long-term stability \(F_{stab}\):

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

The basic accuracy \(F_{perf}\) consists of the thermal change of the zero signal and the output span \(F_T\) as well as the deviation \(F_{Kr}\):

\[
F_{perf} = \sqrt{(F_T)^2 + (F_{Kr})^2}
\]

The thermal change of zero signal and output span \(F_T\) is specified in chapter "Technical data". The basic temperature error \(F_T\) is shown in a graphic. Depending on the measuring cell version and Turn down, this value must be multiplied with the additional factors FMZ and FTD:

\[
F_T \times FMZ \times FTD
\]

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

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

With a 4 … 20 mA output, the thermal change of the current output \(F_a\) must be added:

\[
F_{perf} = \sqrt{(F_T)^2 + (F_{Kr})^2 + (F_a)^2}
\]

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

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

### 10.3 Calculation of the total deviation - Practical example

**Data**

Pressure measurement in the pipeline 4 bar (400 KPa)
Product temperature up to 50 °C
CPT-2x with measuring range 10 bar, deviation < 0.2 %, process fitting G1½ (measuring cell ø 28 mm)

\(^{(2)}\) When used with fulfilled housing protection.
1. Calculation of the Turn down
TD = 10 bar/4 bar, TD = 2.5 : 1

2. Determination temperature error $F_T$

Fig. 44: Determination of the basic temperature error for the above example: $F_{T\text{Basis}} = 0.15\%$

<table>
<thead>
<tr>
<th>Measuring cell version</th>
<th>Measuring cell standard, depending on the accuracy class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.05 %, 0.1 %</td>
</tr>
<tr>
<td>Factor FMZ</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 22: Determination of the additional factor measuring cell for above example: $F_{MC} = 3$

<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>

Tab. 23: Determination of the additional factor "turn down" for the above example: $F_{TD} = 1.75$

$F_T = F_{T\text{Basis}} \times F_{MC} \times F_{TD}$

$F_T = 0.15\% \times 3 \times 1.75$

$F_T = 0.79\%$

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>0.05 %</td>
<td>&lt; 0.05 %</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>

<table>
<thead>
<tr>
<th></th>
<th>TD &gt; 5 : 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05 %</td>
<td>&lt; 0.01 % x TD</td>
</tr>
<tr>
<td>0.1 %</td>
<td>&lt; 0.02 % x TD</td>
</tr>
<tr>
<td>0.2 %</td>
<td>&lt; 0.04 % x TD</td>
</tr>
</tbody>
</table>

Tab. 24: Determination of the deviation from table: $F_{ki} = 0.2\%$
<table>
<thead>
<tr>
<th>Time period</th>
<th>Measuring cell Ø 28 mm</th>
<th>Measuring cell Ø 17.5 mm</th>
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<tr>
<td></td>
<td>All measuring ranges</td>
<td>Measuring range</td>
</tr>
<tr>
<td></td>
<td>0 ... +0.025 bar</td>
<td>(0 ... +2.5 kPa)</td>
</tr>
<tr>
<td>One year</td>
<td>&lt; 0.05 % x TD</td>
<td>&lt; 0.1 % x TD</td>
</tr>
<tr>
<td>Five years</td>
<td>&lt; 0.1 % x TD</td>
<td>&lt; 0.2 % x TD</td>
</tr>
<tr>
<td>Ten years</td>
<td>&lt; 0.2 % x TD</td>
<td>&lt; 0.4 % x TD</td>
</tr>
</tbody>
</table>

Tab. 25: Determination of the long-term stability from the table, consideration for one year: $F_{stab} = 0.05 \% \times TD$

4. Calculation of the total deviation - HART signal

- **1. step: Basic accuracy $F_{perf}$**
  
  $F_{perf} = \sqrt{(F_T^2 + (F_{KL})^2)}$
  
  $F_T = 0.79 \%$
  
  $F_{KL} = 0.2 \%$
  
  $F_{perf} = \sqrt{(0.79 \%)^2 + (0.2 \%)^2}$
  
  $F_{perf} = 0.81 \%$

- **2. step: Total deviation $F_{total}$**
  
  $F_{total} = F_{perf} + F_{stab}$
  
  $F_{perf} = 0.81 \%$ (result of step 1)
  
  $F_{stab} = (0.05 \% \times TD)$
  
  $F_{stab} = (0.05 \% \times 2.5)$
  
  $F_{stab} = 0.125 \%$
  
  $F_{total} = 0.81 \% + 0.13 \% = 0.94 \%$

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

- **1. step: Basic accuracy $F_{perf}$**
  
  $F_{perf} = \sqrt{(F_T^2 + (F_{KL})^2 + (F_a)^2)}$
  
  $F_T = 0.79 \%$
  
  $F_{KL} = 0.2 \%$
  
  $F_a = 0.15 \%$
  
  $F_{perf} = \sqrt{(0.79 \%)^2 + (0.2 \%)^2 + (0.15 \%)^2}$
  
  $F_{perf} = 0.83 \%$

- **2. step: Total deviation $F_{total}$**
  
  $F_{total} = F_{perf} + F_{stab}$
  
  $F_{stab} = (0.05 \% \times TD)$
  
  $F_{stab} = (0.05 \% \times 2.5)$
  
  $F_{stab} = 0.13 \%$
  
  $F_{total} = 0.83 \% + 0.13 \% = 0.96 \%$

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

Plastic housing

Fig. 45: Housing versions with protection rating IP 66/IP 67 - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Plastic single chamber
2 Plastic double chamber

Aluminium housing

Fig. 46: Housing versions with protection rating IP 66/IP 67 - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Aluminium - single chamber
2 Aluminium - double chamber
Aluminium housing with protection rating IP 66/IP 68 (1 bar)

![Diagram showing dimensions and features of the aluminium housing.]

Fig. 47: Housing version with protection rating IP 66/IP 68 (1 bar) - with integrated display and adjustment module. The housing is 9 mm/0.35 in higher.

1. Aluminium - single chamber
2. Aluminium - double chamber
Stainless steel housing

Fig. 48: Housing versions with protection rating IP 66/IP 67 - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Stainless steel single chamber (electropolished)
2 Stainless steel single chamber (precision casting)
3 Stainless steel double chamber housing (precision casting)
Stainless steel housing with protection rating IP 66/IP 68 (1 bar)

Fig. 49: Housing version with protection rating IP 66/IP 68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher
1 Stainless steel single chamber (electropolished)
2 Stainless steel single chamber (precision casting)
3 Stainless steel double chamber housing (precision casting)

Stainless steel housing with protection rating IP 69K

Fig. 50: Housing version with protection rating IP 69K - with integrated display and adjustment module the housing is 9 mm/0.35 in higher
1 Stainless steel single chamber (electropolished)
External housing with IP 68 (25 bar) version

Fig. 51: IP 68 version with external housing
1 Lateral cable outlet
2 Axial cable outlet
3 Plastic housing
4 Stainless steel housing, electropolished
CPT-2x, threaded fitting not front-flush

Fig. 52: CPT-2x, threaded fitting not front-flush

1  G½ manometer connection (EN 837)
2  G½ A inside G¼ (ISO 228-1)
3  G½ A inside G¼ A PVDF (ISO 228-1)
4  G½ manometer connection (EN 837) volume-reduced
5  ½ NPT inside ¼ NPT
6  M20 x 1.5 manometer connection (EN 837)

Notes:
For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).
CPT-2x, threaded fitting front-flush

Fig. 53: CPT-2x, threaded fitting front-flush

1 G½ (ISO 228-1)
2 G¾ (DIN 3852-E)
3 G1 A (ISO 228-1)
4 G1½ (DIN 3852-A)
5 G1½ A PVDF (DIN 3852-A-B)
6 1½ NPT (ASME B1.20.1)

For the version with temperature range up to 150 °C/302 °F, the measure of length increases by 28 mm (1.1 in).

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).
CPT-2x, hygienic fitting

Fig. 54: CPT-2x, hygienic fitting
1 Clamp 2"
2 Hygienic connection with compression nut F40
3 DRD
4 Tuchenhagen Varivent DN 32
5 Slotted nut DN 40 according to DIN 11851
6 Slotted nut DN 50 according to DIN 11851
7 Slotted nut DN 50 according to DIN 11864-1

For the version with temperature range up to 150 °C/302 °F, the measure of length increases by 28 mm (1.1 in).

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).
CPT-2x, flange connection

![CPT-2x, flange connection diagram]

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<tr>
<th>mm</th>
<th>DN</th>
<th>PN</th>
<th>D</th>
<th>b</th>
<th>k</th>
<th>d2</th>
<th>d4</th>
<th>f</th>
<th>H</th>
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<td>①</td>
<td>40</td>
<td>40</td>
<td>150</td>
<td>18</td>
<td>110</td>
<td>4xø18</td>
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<td>200</td>
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<td>23.9</td>
<td>152.4</td>
<td>8xø19</td>
<td>127</td>
<td>3.2</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>inch</th>
<th>DN</th>
<th>PN</th>
<th>D</th>
<th>b</th>
<th>k</th>
<th>d2</th>
<th>d4</th>
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<td>40</td>
<td>5.91&quot;</td>
<td>0.71&quot;</td>
<td>4.33&quot;</td>
<td>4xø0.71&quot;</td>
<td>3.46&quot;</td>
<td>0.12&quot;</td>
<td>1.97&quot;</td>
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<tr>
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<td>6.50&quot;</td>
<td>0.79&quot;</td>
<td>4.92&quot;</td>
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<td>0.12&quot;</td>
<td>1.97&quot;</td>
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<td>80</td>
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<td>7.87&quot;</td>
<td>0.95&quot;</td>
<td>6.30&quot;</td>
<td>8xø0.71&quot;</td>
<td>5.43&quot;</td>
<td>0.12&quot;</td>
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<tr>
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<td>2&quot;</td>
<td>150 lbs</td>
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<td>0.75&quot;</td>
<td>4.75&quot;</td>
<td>4xø0.75&quot;</td>
<td>3.62&quot;</td>
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<td>150 lbs</td>
<td>7.5&quot;</td>
<td>0.94&quot;</td>
<td>6&quot;</td>
<td>8xø0.75&quot;</td>
<td>5&quot;</td>
<td>0.13&quot;</td>
<td>2.01&quot;</td>
</tr>
</tbody>
</table>

**Fig. 55: CPT-2x, flange connection**

1  Flange connection according to DIN 2501
2  Flange connection according to ASME B16.5

For the version with temperature range up to 150 °C/302 °F, the measure of length increases by 28 mm (1.1 in).

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).
CPT-2x, extension fitting

Fig. 56: CPT-2x, extension fitting

1 M30 x 1.5 DIN 13; completely front-flush
2 M30 x 1.5 DIN 13; for headbox
3 M44 x 1.25 DIN 13; pressure screw: Aluminium
4 M44 x 1.25 DIN 13; pressure screw: 316L
5 G1, ISO 228-1 suitable for PASVE
6 PMC 1" front-flush PN 6
7 DN 48 with tension flange

For the version with temperature range up to 150 °C/302 °F, the measure of length increases by 28 mm (1.1 in).
For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).

CPT-2x, connection acc. to IEC 61518

Fig. 57: CPT-2x, connection acc. to IEC 61518
1  Oval flange adapter
2  Top flange

For the version with temperature range up to 150 °C/302 °F, the measure of length increases by 28 mm (1.1 in).

For the version with "Second Line of Defense", the measure of length increases by 17 mm (0.67 in).
10.5 **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.