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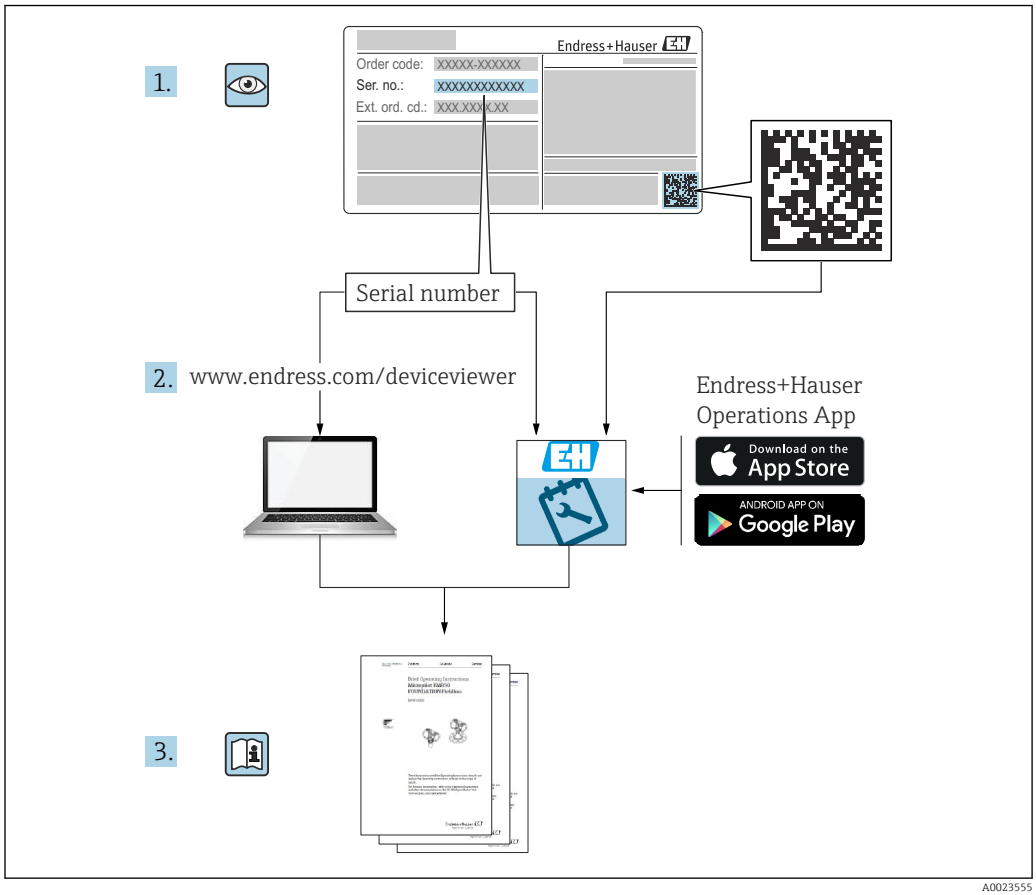
# Operating Instructions
# iTHERM CompactLine TM311

Metric/imperial, compact RTD thermometer, 4-20 mA/IO-Link, for industrial and hygienic applications

IO-Link


Endress+Hauser
People for Process Automation


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XXX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

# Table of contents

# 1 About this document

## 1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

## 1.2 Symbols

### 1.2.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠ CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

### 1.2.2 Electrical symbols

| Symbol | Meaning |
|---|---|
| ⎓ | Direct current |
| ~ | Alternating current |
| ⎓ ~ | Direct current and alternating current |
| ⏚ | **Ground connection**<br>A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system. |
| ⊜ | **Potential equalization connection (PE: Protective earth)**<br>Ground terminals that must be connected to ground prior to establishing any other connections.<br>The ground terminals are located on the interior and exterior of the device:<br>▪ Interior ground terminal: potential equalization connection is connected to the supply network.<br>▪ Exterior ground terminal: device is connected to the plant grounding system. |

### 1.2.3 Symbols for certain types of information

| Symbol | Meaning |
|---|---|
| ✓ | **Permitted**<br>Procedures, processes or actions that are permitted. |
| ✓✓ | **Preferred**<br>Procedures, processes or actions that are preferred. |

| Symbol | Meaning |
|---|---|
|  | **Forbidden**<br>Procedures, processes or actions that are forbidden. |
|  | **Tip**<br>Indicates additional information. |
|  | Reference to documentation |
|  | Reference to page |
|  | Reference to graphic |
|  | Notice or individual step to be observed |
| 1., 2., 3.... | Series of steps |
|  | Result of a step |
|  | Help in the event of a problem |
|  | Visual inspection |

### 1.2.4 Symbols in graphics

| Symbol | Meaning | Symbol | Meaning |
|---|---|---|---|
| 1, 2, 3,... | Item numbers | 1., 2., 3.... | Series of steps |
| A, B, C, ... | Views | A-A, B-B, C-C, ... | Sections |
|  | Hazardous area |  | Safe area (non-hazardous area) |

### 1.2.5 Tool symbols

| Symbol | Meaning |
|---|---|
|  A0011222 | Open-ended wrench |

## 1.3 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

| Document type | Purpose and content of the document |
|---|---|
| Technical Information (TI) | **Planning aid for your device**<br>The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device. |
| Brief Operating Instructions (KA) | **Guide that takes you quickly to the 1st measured value**<br>The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning. |
| Operating Instructions (BA) | **Your reference document**<br>The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal. |
| Description of Device Parameters (GP) | **Reference for your parameters**<br>The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations. |
| Safety instructions (XA) | Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions.<br>The nameplate indicates which Safety Instructions (XA) apply to the device. |
| Supplementary device-dependent documentation (SD/FY) | Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation. |

# 2 Safety Instructions

## 2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

## 2.2 Intended use

The device described in this document is a compact thermometer suitable for temperature measurement in industrial and hygienic processes.

### Improper use

The device must only be used for temperature measurement in industrial and hygienic processes. The manufacturer is not liable for harm caused by improper or non-designated use.

## 2.3 Workplace safety

**⚠ CAUTION**

**Extreme temperatures (hot and cold) can occur at the thermometer and in the terminal head. There is a risk of burning and damage to property.**

- ▶ Wear appropriate protective equipment.

**⚠ CAUTION**

**There is an the increased risk of electric shock if working on and with the device with wet hands:**

- ▶ Wear appropriate protective equipment.

## 2.4 Operational safety

Damage to the device!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

### Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

### Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

## 2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

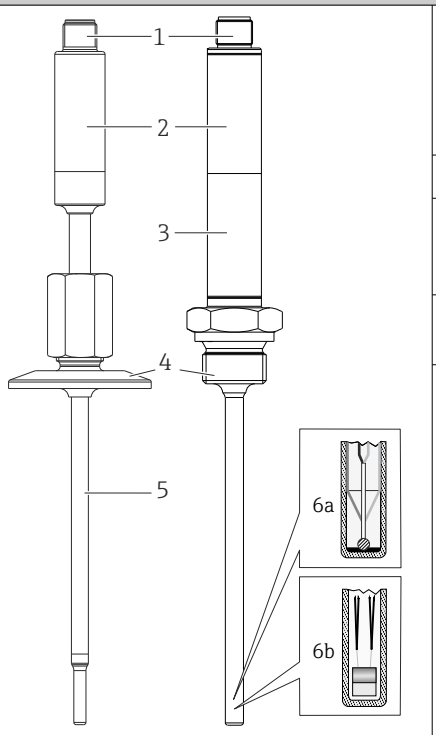
It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

## 2.6 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

# 3 Product description

| Design | | Options |
|---|---|---|
|  | 1: Electrical connection, output signal<br>2: Transmitter housing | **Your benefits:**<br>▪ M12, 4-pin connector, reduced cost and effort, incorrect wiring is prevented<br>▪ Optimum protection, IP69 as standard<br>▪ Compact, integrated transmitter (IO-Link and 4 to 20 mA) |
| | 3: Extension neck | Optionally available if process temperature is too high for the electronics |
| | 4: Process connection<br>→ 🖹 53 | Over 50 different versions for industrial, hygienic and aseptic applications. |
| | 5: Thermowell | ▪ Versions with and without thermowell (insert in direct contact with process)<br>▪ Thermowell diameter 6 mm and optimized tee and elbow thermowells |
| | 6: Insert with:<br>6a: iTHERM TipSens<br>6b: Pt100 (TF), basic | **Your benefits:**<br>▪ **iTHERM TipSens** - insert with shortest response times:<br>  ▪ Insert: Ø3 mm (⅛ in) or Ø6 mm (¼ in)<br>  ▪ Fast, highly accurate measurements, delivering maximum process safety and control<br>  ▪ Quality and cost optimization<br>  ▪ Minimization of necessary immersion length: better product protection thanks to improved process flow<br>▪ **Pt100 (TF), basic**<br>▪ Excellent cost-performance ratio |

# 4 Incoming acceptance and product identification

## 4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

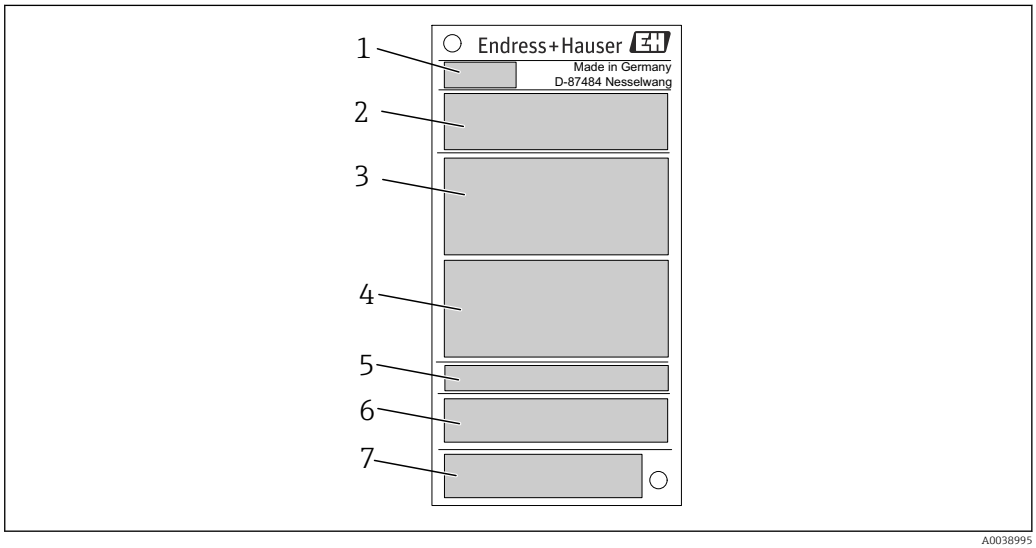
## 4.2 Product identification

The following options are available for the identification of the device:
- Nameplate specifications
- Enter the serial number from the nameplate in the *Device Viewer* www.endress.com/deviceviewer: all data relating to the device and an overview of the Technical Documentation supplied with the device are displayed.

### 4.2.1 Nameplate

**The correct device?**

1. Check the data on the nameplate of the device.
2. Compare against the requirements of the measuring point.




1 *Sample graphic*

1 *Product root, device designation*
2 *Order code, serial number*
3 *Tag name*
4 *Technical values: supply voltage, current consumption, ambient temperature*
5 *Degree of protection*
6 *Pin assignment*
7 *Approvals with symbols: CE mark, EAC*

### 4.2.2 Scope of delivery

The scope of delivery comprises:
- Compact thermometer
- Printed copy of the Brief Operating Instructions
- Accessories ordered

## 4.3 Name and address of manufacturer

| | |
|---|---|
| **Name of manufacturer:** | Endress+Hauser Wetzer GmbH + Co. KG |
| **Address of manufacturer:** | Obere Wank 1, D-87484 Nesselwang or www.endress.com |

## 4.4 Storage and transport

Storage temperature: −40 to +85 °C (−40 to +185 °F).

Avoid the following environmental influences during storage:
- Direct sunlight
- Proximity to hot objects
- Mechanical vibration
- Aggressive media

Maximum relative humidity: < 95%

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging provides the best protection.

# 5 Installation

## 5.1 Installation requirements

For the intended use of the devices described in this document, certain ambient conditions must be met at the installation location. These include the ambient temperature, degree of protection, or climate class. For specifications and further details, as well as the device dimensions, refer to the corresponding Technical Information.

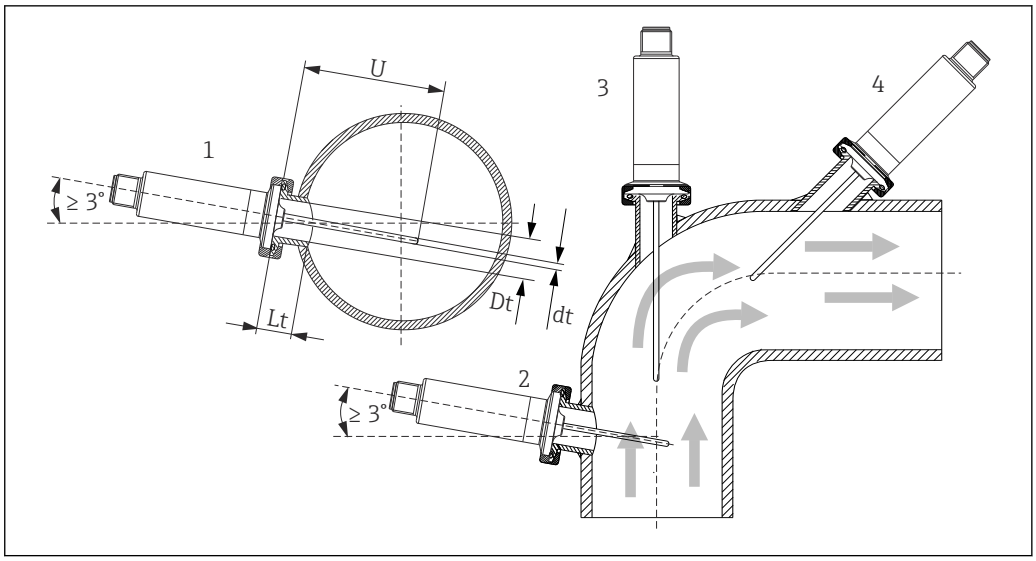
### 5.1.1 Orientation

No restrictions. Ensure self-draining in the process. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.

### 5.1.2 Installation instructions

The immersion length of the compact thermometer can considerably influence the measurement accuracy. If the immersion length is too short, measurement errors can occur as a result of heat dissipation via the process connection and the vessel wall. For installation in a pipe, an immersion length is therefore recommended that ideally corresponds to half the pipe diameter.

Installation possibilities: pipes, tanks or other plant components.




2 *Installation examples*

*1, 2 Perpendicular to the flow direction, installed at a min. angle of 3 °to ensure self-draining*
*3 On elbows*
*4 Inclined installation in pipes with a small nominal diameter*
*U Immersion length*

The requirements of the EHEDG and the 3-A Sanitary Standard must be adhered to.

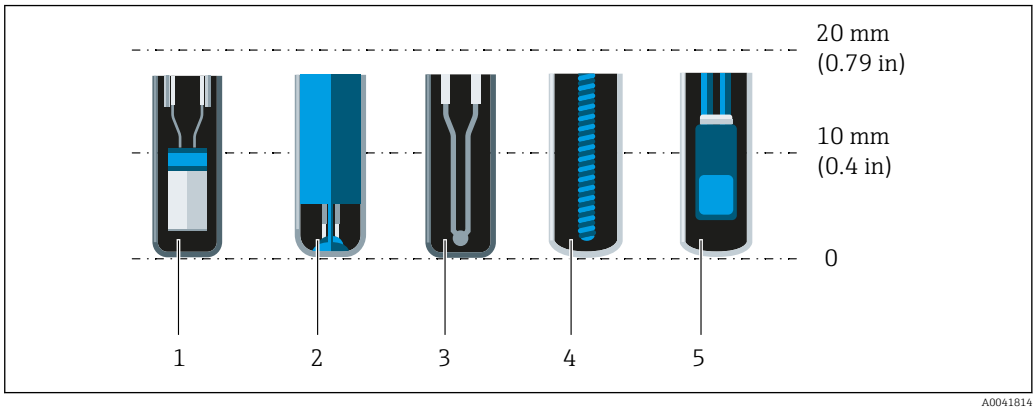
Installation instruction EHEDG/cleanability: Lt ≤ (Dt-dt)

Installation instruction 3-A/cleanability: Lt ≤ 2 (Dt-dt)

The exact position of the sensor element in the thermometer tip must be observed. Available options depend on product and configuration.

Pay attention to the exact position of the sensor element in the thermometer tip.

Available options depend on product and configuration.



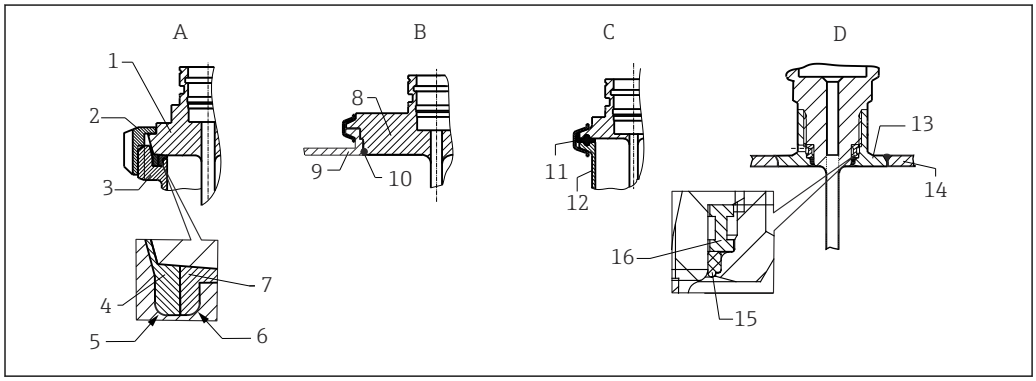

*1 iTHERM StrongSens or iTHERM TrustSens for 5 to 7 mm (0.2 to 0.28 in)*
*2 iTHERM QuickSens for 0.5 to 1.5 mm (0.02 to 0.06 in)*
*3 Thermocouple (not grounded) for 3 to 5 mm (0.12 to 0.2 in)*
*4 Wire-wound sensor for 5 to 20 mm (0.2 to 0.79 in)*
*5 Standard thin-film sensor for 5 to 10 mm (0.2 to 0.39 in)*

To minimize the heat dissipation, 20 to 25 mm of the sensor should extend into the medium beyond the sensor element.

This results in the following recommended minimum immersion lengths:
- iTHERM TrustSens or iTHERM StrongSens 30 mm (1.18 in)
- iTHERM QuickSens 25 mm (0.98 in)
- Wire wound sensor 45 mm (1.77 in)
- Standard thin-film sensor 35 mm (1.38 in)

Special consideration should be given to tee thermowells, as the immersion length is very short on account of their design, and the measurement error is higher as a result. It is therefore recommended to use elbow thermowells with iTHERM QuickSens sensors.

In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to extend far enough into the process to reach beyond the pipe axis. Installation at an angle (4) could be another solution. When determining the immersion or insertion length, all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, process pressure).




3 *Detailed installation instructions for hygiene-compliant installation*

*A Milk pipe connection according to DIN 11851, only in conjunction with EHEDG-certified, self-centering sealing ring*
*1 Sensor with milk pipe connection*
*2 Grooved union nut*
*3 Counterpart connection*
*4 Centering ring*
*5 R0.4*
*6 R0.4*
*7 Sealing ring*
*B Varivent® process connection for VARINLINE® housing*
*8 Sensor with Varivent connection*
*9 Counterpart connection*
*10 O-ring*
*C Clamp according to ISO 2852*
*11 Molded seal*
*12 Counterpart connection*
*D Process connection Liquiphant-M G1", horizontal installation*
*13 Weld-in adapter*
*14 Vessel wall*
*15 O-ring*
*16 Thrust collar*

The counterpieces for the process connections and the seals or sealing rings are not supplied with the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories (see 'Accessories").

**⚠ CAUTION**

**In the event of a defective sealing ring (O-ring) or seal, perform the following steps:**
- ▶ Remove the thermometer.
- ▶ Clean the thread and the O-ring joint/sealing surface.
- ▶ Replace the sealing ring or seal.
- ▶ Perform process cleaning after installation.

For welded connections, perform welding work on the process side as follows:

1. Ensure the surface is honed and mechanically polished, Ra ≤ 0.76 µm (30 µin).
2. Use suitable welding material.
3. Avoid crevices, folds or gaps.
4. Flush-weld or weld with welding radius ≥ 3.2 mm (0.13 in).

Welding work has been carried out properly.

To maintain cleanability, observe the following when installing the thermometer:

1. The installed sensor is suitable for CIP (cleaning in place). Cleaning is carried out in combination with piping or tank. For tank installation, use process connection nozzles to ensure the cleaning assembly directly sprays this area to clean it effectively.
2. The Varivent® connections enable flush-mounted installation.

Cleanability is retained after installation.

### 5.1.3 General installation instructions

If a device temperature of 100 °C is reached, the device generates diagnostic message **S825**. The device generates diagnostic message **F001** or **Failure current** if the device temperature is 125 °C or higher.

#### Ambient temperature range

| | |
|---|---|
| $T_a$ | –40 to +85 °C (–40 to +185 °F) |

#### Process temperature range

The thermometer electronics must be protected against temperatures over 85 °C (185 °F) by an extension neck of the appropriate length.

#### Device version without electronics (order code 020, option A)

| | |
|---|---|
| **Pt100 TF, basic, without extension neck** | –50 to +150 °C (–58 to +302 °F) |
| **Pt100 TF, basic, with extension neck** | –50 to +150 °C (–58 to +302 °F) |
| **iTHERM TipSens, without extension neck** | –50 to +200 °C (–58 to +392 °F) |
| **iTHERM TipSens, with extension neck** | –50 to +200 °C (–58 to +392 °F) |

#### Device version with electronics (order code 020, option B, C)

| | |
|---|---|
| **Pt100 TF, basic, without extension neck** | –50 to +150 °C (–58 to +302 °F) |
| **Pt100 TF, basic, with extension neck** | –50 to +150 °C (–58 to +302 °F) |
| **iTHERM TipSens, without extension neck** | –50 to +150 °C (–58 to +302 °F) |
| **iTHERM TipSens, with extension neck** | –50 to +200 °C (–58 to +392 °F) |

## 5.2 Installing the thermometer

Proceed as follows before installing the device:

1. The permitted loading capacity of the process connections can be found in the relevant standards.
2. The process connection and compression fitting must comply with the maximum specified process pressure.
3. Make sure that the device is installed and secured before applying the process pressure.
4. Adjust the loading capacity of the thermowell to the process conditions.
5. It may be necessary to calculate the static and dynamic load capacity.

It is possible to verify the mechanical loading capacity as a function of the installation and process conditions using the online TW Sizing Module for thermowells in the Endress+Hauser Applicator software https://portal.endress.com/webapp/applicator.

### 5.2.1 Cylindrical threads

NOTICE

**Seals must be used for cylindrical threads.**
In the case of combined thermometer and thermowell assemblies, these seals are already installed (depending on the version ordered).

- The system operator is required to verify the suitability of this seal with regard to the operating conditions.

| Threaded version | Tightening torque [Nm] |
|---|---|
| Compact thermometer with thermowell as tee thermowell or elbow thermowell | 5 Nm |
| Process connection, metal sealing system | 10 Nm |
| Compression fitting, spherical, PEEK seal | 10 Nm |
| Compression fitting, spherical, 316L seal | 25 Nm |
| Compression fitting, cylindrical, Elastosil seal | 5 Nm |

### 5.2.2 Tapered threads

- The operator must verify if additional sealing by means of PTFE tape, hemp or an additional welded seam, for example, is necessary in the case of NPT threads or other tapered threads.

## 5.3 Post-mounting check

| | |
|---|---|
| ☐ | Is the device undamaged (visual inspection)? |
| ☐ | Is the device correctly secured? |
| ☐ | Does the device correspond to the specifications at the measuring point, e.g. ambient temperature, measuring range etc.?→ 🖹 31 |

# 6 Electrical connection

## 6.1 Connection requirements

To comply with the 3-A standard, it must be ensured that the electrical connection cables are smooth, corrosion-resistant, and easy to clean.

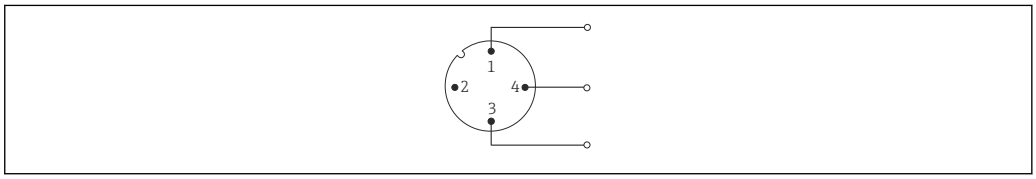
## 6.2 Connecting the measuring instrument

NOTICE

**Damage to the device!**

▶ Tighten the M12 plug to a maximum of 0.4 Nm to avoid damaging the device.

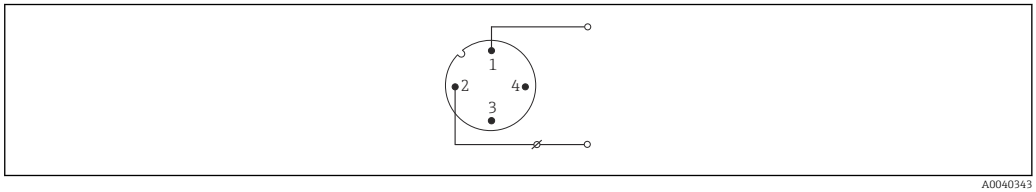
### IO-Link operating mode




*4 Pin assignment, device plug*

*1 Pin 1 - power supply 15 to 30 $V_{DC}$*
*2 Pin 2 - not used*
*3 Pin 3 - power supply 0 $V_{DC}$*
*4 Pin 4 - C/Q (IO-Link or switch output)*

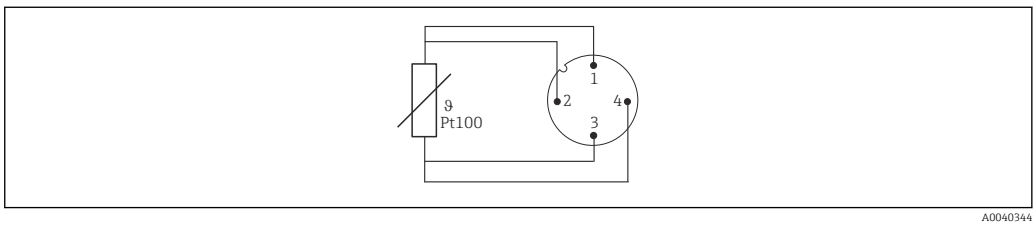
### 4 to 20 mA operating mode




*5 Pin assignment, device plug*

*1 Pin 1 - power supply 10 to 30 $V_{DC}$*
*2 Pin 2 - power supply 0 $V_{DC}$*
*3 Pin 3 - not used*
*4 Pin 4 - not used*

### Without electronics




*6 Pin assignment of device plug: Pt100, 4-wire connection*

## 6.3 Ensuring the degree of protection

The indicated degree of protection is ensured if the M12x1 cable connector meets the required degree of tightness. For compliance with IP69 protection, suitable device connecting cables with straight or elbowed connectors are available → 30.

## 6.4 Post-connection check

| | |
|---|---|
| ❑ | Are the device and cable undamaged (visual check)? |
| ❑ | Do the mounted cables have suitable strain relief? |
| ❑ | Does the supply voltage match the information on the nameplate? |

# 7 Operation options

## 7.1 Protocol-specific data

### 7.1.1 IO-Link information

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. The IO-Link communication interface offers the following options:
- Direct access to the process data
- Direct access to the diagnostic data
- Parameter configuration during operation

*The device supports the following features:*

| | |
|---|---|
| IO-Link specification | Version 1.1 |
| IO-Link Smart Sensor Profile 2nd Edition | Supported:<br>▪ Identification<br>▪ Diagnosis<br>▪ Digital Measuring Sensor (as per SSP type 3.1) |
| SIO mode | Yes |
| Transmission rate | COM2; 38.4 kBaud |
| Minimum period | 10 ms |
| Process data width | 4 byte |
| IO-Link data storage | Yes |
| Block configuration according to V1.1 | Yes |
| Device operational | The device is operational 0.5 s after the supply voltage is applied (first valid measured value after 2 s). |

### 7.1.2 Device description

To integrate field devices into a digital communication system, the IO-Link system requires a description of the device parameters.

This information is contained in the device description (IODD [1]), which is provided to the IO-Link master via generic modules during commissioning of the communication system.

The IODD can be downloaded as follows:
- Endress+Hauser: www.endress.com
- IODDfinder: http://ioddfinder.io-link.com

# 8 System integration

## 8.1 Identification

| | |
|---|---|
| **Device ID** | 0x030100 (196864) |
| **Vendor ID** | 0x0011 (17) |

## 8.2 Process data

When the measuring instrument is operated in digital mode, the state of the switch output and the temperature value are transmitted in the form of process data via IO-Link. The signal is initially transmitted in the SIO mode (Standard IO-Mode). Digital IO-Link communication starts as soon as the IO-Link master sends the "Wake Up" command.
- In the SIO mode, the switch output is switched at pin 4 of the M12 plug. In the IO-Link communication mode, this pin is reserved exclusively for communication.
- The measuring instrument's process data are transmitted cyclically in 32-bit chunks.

| **Byte 1** | | | | | | | | **Byte 2** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| sint16 | | | | | | | | | | | | | | | |
| Temperature (with one decimal place) | | | | | | | | | | | | | | | |

| **Byte 3** | | | | | | | | **Byte 4** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| sint8 | | | | | | | | | | | Enum4 | | | | Bool |
| Scale (-1) | | | | | | | | | | | Measured value status | | | | Switch state |

*Explanation*

| **Process value** | **Values** | **Meaning** |
|---|---|---|
| Temperature | −32 000 to 32 000 | Temperature value with one decimal place<br>Example: a transmitted value of 123 corresponds to a measured temperature value of 12.3 °C |
| | 32764 = No measurement data | Process value if no valid measured value is available |
| | - 32760 = Out of range (-) | Process value if the measured value is below the lower limit value |
| | 32760 = Out of range (+) | Process value if the measured value is above the upper limit value |

1) Input/Output Device Description

| Process value | Values | Meaning |
|---|---|---|
| Scale | -1 | The transmitted measured value must be multiplied by 10exp (Scale) |
| Measured value status [bit 4 - 3] | 0 = Bad | Measured value cannot be used |
| | 1 = Uncertain | Measured value can only be used to a limited extent, e.g.: device temperature is outside the permitted range (S825) |
| | 2 = Manual/Fixed | Measured value can only be used to a limited extent, e.g.: simulation of the measured variable is active (C485) |
| | 3 = Good | Measured value is good |
| Measured value status [bit 2 - 1] | 0 = Not limited | Measured value without limit value violation |
| | 1 = Low limited | Limit value violation at lower end |
| | 2 = High limited | Limit value violation at upper end |
| | 3 = Constant | Measured value is set to a constant value, e.g.: simulation active |
| Switch output [bit 0] | 0 = Off | Switch output opened |
| | 1 = On | Switch output closed |

## 8.3 Reading and writing device data

Device data are always exchanged acyclically and at the request of the IO-Link master via the ISDU communication channel. The IO-Link master can read parameter values or device statuses as described in more detail in section 8.3.1.

### 8.3.1 Specific device data

The default values apply to parameters which are not ordered with customer-specific settings.

| Name | Index (dec) | Index (hex) | Size [byte] | Data type | Access | Default value | Range of values | Data storage |
|---|---|---|---|---|---|---|---|---|
| Application specific tag | 24 | 0x0018 | 32 | String | r/w | – | – | Yes |
| Order code | 1054 | 0x041E | 20 | String | r/- | – | – | – |
| Extended order code | 259 | 0x0103 | 60 | String | r/- | – | – | – |
| Device type | 256 | 0x0100 | 2 | UInteger16 | r/- | 0x93FF | – | – |
| Unit | 5121 | 0x1401 | 1 | UInteger8 | r/w | 32 | 32 = °C<br>33 = °F<br>35 = K | Yes |
| Damping | 7271 | 0x1C67 | 1 | UInteger8 | r/w | 0 s | 0 to 120 s | Yes |
| Sensor offset | 3082 | 0x0C0A | 4 | Float | r/w | 0 °C (32 °F) | −10 to +10 °C (−18 to +18 °F) | Yes |
| Operating mode switch | 2050 | 0x0802 | 2 | UInteger16 | r/w | Hysteresis normally open (0x0C9C) | Window normally open (0x0CFF)<br>Window normally closed (0x0C96)<br>Hysteresis normally open (0x0C9C)<br>Hysteresis normally closed (0x0C99)<br>Off (0x80EC) | Yes |
| Switch point value | 2051 | 0x0803 | 4 | Float | r/w | 100 °C (212 °F) | -1E+20 to 1E+20 | Yes |
| Switchback point value | 2052 | 0x0804 | 4 | Float | r/w | 90 °C (194 °F) | -1E+20 to 1E+20 | Yes |
| Switch delay | 2053 | 0x0805 | 1 | UInteger8 | r/w | 0 s | 0 to 99 s | Yes |

| Name | Index (dec) | Index (hex) | Size [byte] | Data type | Access | Default value | Range of values | Data storage |
|---|---|---|---|---|---|---|---|---|
| Switchback delay | 2054 | 0x0806 | 1 | UInteger8 | r/w | 0 s | 0 to 99 s | Yes |
| 4 mA value | 8218 | 0x201A | 4 | Float | r/w | 0 °C (32 °F) | −50 000 to 50 000 °C | Yes |
| 20 mA value | 8219 | 0x201B | 4 | Float | r/w | 150 °C | −50 000 to 50 000 °C | Yes |
| Current trimming 4mA | 8213 | 0x2015 | 4 | Float | r/w | 4.00 mA | 3.85 to 4.15 mA | Yes |
| Current trimming 20mA | 8212 | 0x2014 | 4 | Float | r/w | 20.00 mA | 19.85 to 20.15 mA | Yes |
| Failure mode | 8234 | 0x202A | 1 | UInteger8 | r/w | 0 = Low alarm | 0 = Low alarm<br>2 = High alarm | Yes |
| Failure current | 8232 | 0x2028 | 4 | Float | r/w | 22.5 mA | 21.5 to 23 mA | Yes |
| Operating time | 6148 | 0x1804 | 4 | UInteger32 | r/- | – | – | Yes |
| Alarm delay | 6147 | 0x1803 | 1 | UInteger8 | r/w | 2 s | 1 to 5 s | Yes |
| Device status | 36 | 0x0024 | 1 | UInteger8 | r/- | – | 0 = Device is OK<br>1 = Maintenance required<br>2 = Out of specification<br>3 = Functional check<br>4 = Failure | – |
| Detailed device status | 37 | 0x0025 | 36 | OctetString | r/- | – | In accordance with IO-Link specification | – |
| Actual diagnostic 1 | 6184 | 0x1828 | 2 | UInteger16 | r/- | – | – | – |
| Actual diagnostic 2 | 6186 | 0x182A | 2 | UInteger16 | r/- | – | – | – |
| Actual diagnostic 3 | 6188 | 0x182C | 2 | UInteger16 | r/- | – | – | – |
| Previous diagnostics 1 | 6214 | 0x1846 | 2 | UInteger16 | r/- | – | – | – |
| Timestamp 1 | 6204 | 0x183C | 4 | UInteger32 | r/- | – | – | – |
| Previous diagnostics 2 | 6216 | 0x1848 | 2 | UInteger16 | r/- | – | – | – |
| Timestamp 2 | 6205 | 0x183D | 4 | UInteger32 | r/- | – | – | – |
| Previous diagnostics 3 | 6218 | 0x184A | 2 | UInteger16 | r/- | – | – | – |
| Timestamp 3 | 6206 | 0x183E | 4 | UInteger32 | r/- | – | – | – |
| Previous diagnostics 4 | 6220 | 0x184C | 2 | UInteger16 | r/- | – | – | – |
| Timestamp 4 | 6207 | 0x183F | 4 | UInteger32 | r/- | – | – | – |
| Previous diagnostics 5 | 6222 | 0x184E | 2 | UInteger16 | r/- | – | – | – |
| Timestamp 5 | 6208 | 0x1840 | 4 | UInteger32 | r/- | – | – | – |
| Current output simulation | 8210 | 0x2012 | 2 | UInteger16 | r/w | 33004 = Off | 33004 = Off<br>33005 = On | – |
| Current output simulation value | 8211 | 0x2013 | 4 | Float | r/w | 3.58 mA | 3.58 to 23 mA | – |
| Sensor simulation | 3109 | 0x0C25 | 1 | UInteger8 | r/w | 0 = Off | 0 = Off<br>1 = On | – |
| Sensor simulation value | 3104 | 0x0C20 | 4 | Float | r/w | 0 °C (32 °F) | -1E+20 to 1E+20 °C | – |
| Switch output simulation | 2056 | 0x0808 | 2 | UInteger16 | r/w | 0 = Disabled | 0 = Disabled<br>33004 = Off<br>33006 = On | – |
| Sensor min value | 3081 | 0x0C09 | 4 | Float | r/- | – | – | – |
| Sensor max value | 3080 | 0x0C08 | 4 | Float | r/- | – | – | – |
| Lower boundary operating time sensor | 3132 | 0x0C3C | 4 | UInteger32 | r/- | – | – | – |
| Lower extended operation time sensor | 3133 | 0x0C3D | 4 | UInteger32 | r/- | – | – | – |

| Name | Index (dec) | Index (hex) | Size [byte] | Data type | Access | Default value | Range of values | Data storage |
|---|---|---|---|---|---|---|---|---|
| Standard operating time sensor | 3134 | 0x0C3E | 4 | UInteger32 | r/- | – | – | – |
| Upper extended operating time sensor | 3135 | 0x0C3F | 4 | UInteger32 | r/- | – | – | – |
| Upper boundary operating time sensor | 3136 | 0x0C40 | 4 | UInteger32 | r/- | – | – | – |
| Device temperature | 4096 | 0x1000 | 4 | Float | r/- | – | – | – |
| Device temperature min | 4107 | 0x100B | 4 | Float | r/- | – | – | – |
| Device temperature max | 4106 | 0x100A | 4 | Float | r/- | – | – | – |
| Lower boundary operating time device | 4109 | 0x100D | 4 | UInteger32 | r/- | – | – | – |
| Lower extended operation time device | 4110 | 0x100E | 4 | UInteger32 | r/- | – | – | – |
| Standard operating time device | 4111 | 0x100F | 4 | UInteger32 | r/- | – | – | – |
| Upper extended operating time device | 4112 | 0x1010 | 4 | UInteger32 | r/- | – | – | – |
| Upper boundary operating time device | 4113 | 0x1011 | 4 | UInteger32 | r/- | – | – | – |
| MDC Descriptor | 16512 | 0x4080 | 11 | Record | r/- | – | – | – |

### 8.3.2 IO-Link-specific device data

| Name | Index (dec) | Index (hex) | Size [byte] | Data type | Access | Default value |
|---|---|---|---|---|---|---|
| Serial number | 21 | 0x0015 | 16 | String | r/- | – |
| Product ID | 19 | 0x0013 | 32 | String | r/- | TM311 |
| Product Name | 18 | 0x0012 | 32 | String | r/- | iTHERM CompactLine TM311 |
| Product Text | 20 | 0x0014 | 32 | String | r/- | Compact thermometer |
| Vendor Name | 16 | 0x0010 | 32 | String | r/- | Endress+Hauser |
| Vendor Text | 17 | 0x0011 | 32 | String | r/- | People for Process Automation |
| Hardware Version | 22 | 0x0016 | 8 | String | r/- | – |
| Firmware version | 23 | 0x0017 | 8 | String | r/- | – |
| Device Access Locks | 12 | 0x000C | 2 | Record | r/w | – |

### 8.3.3 System commands

| Name | Value (dec) | Value (hex) |
|---|---|---|
| Reset factory settings | 130 | 0x82 |
| Activate parametrization lock | 160 | 0xA0 |
| Deactivate parametrization lock | 161 | 0xA1 |
| Reset sensor min/max values | 162 | 0xA2 |
| Reset device temp. min/max values | 163 | 0xA3 |
| IO-Link 1.1 system test command 240 | 240 | 0xF0 |
| IO-Link 1.1 system test command 241 | 241 | 0xF1 |

| Name | Value (dec) | Value (hex) |
|---|---|---|
| IO-Link 1.1 system test command 242 | 242 | 0xF2 |
| IO-Link 1.1 system test command 243 | 243 | 0xF3 |

# 9 Commissioning

## 9.1 Function check

Perform the following checks prior to commissioning the measuring point:

1. Perform the post-mounting check using the checklist→ 14.
2. Perform the post-connection check using the checklist → 16.

## 9.2 Configuring the measuring instrument

IO-Link functions and device-specific parameters are configured via the device's IO-Link communication.

Special configuration kits are available, e.g. the FieldPort SFP20. Every IO-Link device can be configured with it.

IO-Link devices are typically configured via the automation system (e.g. Siemens TIA Portal and Port Configuration Tool). The device supports IO-Link Data Storage, which enables easy device replacement.

## 9.3 Changing parameter configuration settings

If an existing configuration is changed, measuring operation continues.

# 10 Diagnostics and troubleshooting

## 10.1 General troubleshooting

Due to its design, the device cannot be repaired. It is possible to send the device in for inspection.

| Fault | Possible cause | Remedial action |
|---|---|---|
| Device does not respond. | Supply voltage does not match the voltage specified on the nameplate. | ▶ Connect the correct voltage. |
| | Supply voltage has incorrect polarity. | ▶ Correct the polarity of the supply voltage. |
| Device is measuring incorrectly. | The device has been incorrectly configured. | ▶ Check and adjust parameter configuration. |
| | The device has been incorrectly connected. | ▶ Check the pin assignment. |
| | Incorrect device orientation. | ▶ Install the device correctly. |
| | Heat dissipation over the measuring point | ▶ Observe the face-to-face length of the sensor. |

| Fault | Possible cause | Remedial action |
|---|---|---|
| No communication | Communication cable is not connected. | ▶ Check wiring and cables. |
| | Communication cable is incorrectly attached to the IO-Link master. | |
| No transmission of process data. | There is a fault in the device. | ▶ Correct faults that are displayed as a diagnostic event. |

## 10.2 Diagnostic information via communication interface

### 10.2.1 Diagnostic message

The **Device Status** parameter shows the event category of the active diagnostic message with the highest priority. This category is displayed in the diagnostic list.

**Status signals**

The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

The status signals are categorized according to NAMUR Recommendation NE 107: F = Failure, C = Function Check, S = Out of Specification, M = Maintenance Required

| Alphabetic character | Symbol | Event category | Meaning |
|---|---|---|---|
| **F** | ⊗ | Operating error | An operating error has occurred. |
| **C** | ▽ | Service mode | The device is in the service mode (e.g. during a simulation). |
| **S** | ⚠ | Out of specification | The device is being operated outside its technical specifications (e.g. during startup or cleaning processes). |
| **M** | ◈ | Maintenance required | Maintenance is required. |

## 10.3 Overview of the diagnostic information

| Diagnostic message | Diagnostic behavior | IO-Link Event Qualifier | IO-Link Event Code | Event text | Cause | Remedial action |
|---|---|---|---|---|---|---|
| F001 | Alarm | IO-Link error | 0x1817 | Device failure | Device malfunction | 1. Restart the device.<br>2. Replace device. |
| F004 | Alarm | IO-Link error | 0x1818 | Sensor defective | The sensor is defective (sensor failure or sensor short-circuit) | ▶ Replace device. |
| S047 | Warning | IO-Link warning | 0x1819 | Sensor limit reached | Sensor limit reached | 1. Check sensor.<br>2. Check process conditions. |
| C401 | Warning | IO-Link Notification | 0x181F | Factory reset active | Factory reset is active | ▶ Factory reset is active, please wait. |
| C402 | - | - | - | Initialization active | Initialization is in progress. | ▶ Initialization in progress, please wait. |
| C485 | Warning | IO-Link warning | 0x181A | Process variable simulation active | Simulation of the process variable is active. | ▶ Deactivate simulation. |
| C491 | Warning | IO-Link warning | 0x181B | Current output simulation active | Simulation of the current output is active. | ▶ Deactivate simulation. |
| C494 | Warning | IO-Link warning | 0x181C | Switch output simulation active | Simulation of the switch output is active. | ▶ Deactivate simulation. |
| F537 | Alarm | IO-Link error | 0x181D | Configuration invalid | Current range is invalid<br>The difference between the 4mA value and 20mA value must be greater than or equal to 10°C. | 1. Check device configuration.<br>2. Upload and download new configuration. |
| | | | | | Switch points are invalid<br>The switch point must be greater than or equal to the switchback point. | |
| S801 | Warning | IO-Link warning | 0x181E | Supply voltage too low | Supply voltage too low | ▶ Increase supply voltage. |
| S804 [1] | Alarm | - | - | Overload at switch output | Overload at the switch output | 1. Increase load resistance at switch output.<br>2. Check the output.<br>3. Replace device. |
| S825 | Warning | IO-Link warning | 0x1812 | Operating temperature | Operating temperature of the electronics out of specification | 1. Check ambient temperature.<br>2. Check process temperature. |
| S844 [2] | Warning | - | - | Process value out of specification | Process value is outside the specification | 1. Check process value.<br>2. Check application.<br>3. Check sensor. |

1) Diagnosis only possible in SIO mode.
2) Diagnosis only possible in 4-20mA mode.

### 10.3.1 Behavior of the device in the event of a failure

The diagnostic behavior of the device differs depending on the selected operating mode. Irrespective of the operating mode, all the diagnostic messages are saved in the event logbook, where they can be accessed as required.

**IO-Link**

The device displays warnings and failures via IO-Link. All the device warnings and faults are for information purposes only and do not have a safety function. The faults diagnosed by the device are displayed via IO-Link in accordance with NE 107. A distinction must be made between the following types of diagnostic behavior in this context:

- Warning
  The device continues measuring in the event of warning-type diagnostic behavior. The output signal is not affected (exception: simulation of the process variable is active).
- Alarm
  - The device does **not** continue measuring if this type of fault occurs. The output signal assumes its fault state (value in the event of a fault).
  - The PDValid Flag indicates that the process data are invalid.
  - The fault state is displayed via IO-Link.

**Switch output**

- Warning
  The switch output remains in the state defined by the switch points.
- Alarm
  The switch output changes to the **open** state.

**4 to 20 mA**

- Warning
  The current output is not affected.
- Alarm
  The current output adopts the configured failure current.

The behavior of the output in the event of a failure is regulated in accordance with NAMUR NE43.

- The failure current can be set.
- The selected failure current is used for all faults.

## 10.4 Diagnostic list

If several diagnostic events are pending simultaneously, only the three diagnostic messages with the highest priority are shown in the diagnostic list. The main feature of the display priority is the status signal in the following order: F, C, S, M. If several diagnostic events with the same status signal are pending, the priority is defined in numerical order of the event number, e.g. F042 appears before F044 and before S044.

## 10.5 Event logbook

The diagnostic messages are shown in chronological order in the **Event logbook**. In addition, a timestamp is saved with every diagnostic message. This timestamp is referenced to the operating time counter.

# 11 Maintenance

As a general rule, no specific maintenance work is required.

## 11.1 Cleaning

### 11.1.1 Cleaning of surfaces not in contact with the medium

- Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
- Do not use any sharp objects or aggressive cleaning agents that corrode the surfaces (displays, housing, for example) and seals.
- Do not use high-pressure steam.
- Observe the degree of protection of the device.

The cleaning agent used must be compatible with the materials of the device configuration. Do not use cleaning agents with concentrated mineral acids, bases or organic solvents.

### 11.1.2 Cleaning of surfaces in contact with the medium

Note the following for cleaning and sterilization in place (CIP/SIP):
- Use only cleaning agents to which the materials in contact with the medium are sufficiently resistant.
- Observe the permitted maximum medium temperature.

## 11.2 Maintenance services

| Service | Description |
|---|---|
| Calibration | RTD inserts may drift depending on the application. Regular recalibration to verify accuracy is recommended. The calibration can be performed by the manufacturer or by qualified technical staff using calibration devices onsite. |

# 12 Repair

Due to its design, the device cannot be repaired.

## 12.1 Spare parts

Product spare parts that are currently available can be found online at:
www.endress.com/onlinetools

## 12.2 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: https://www.endress.com
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging provides the best protection.

## 12.3 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

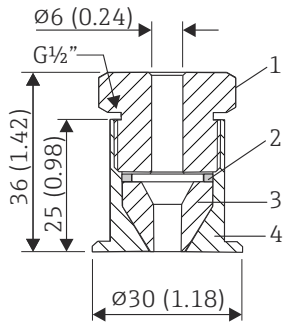
# 13 Accessories

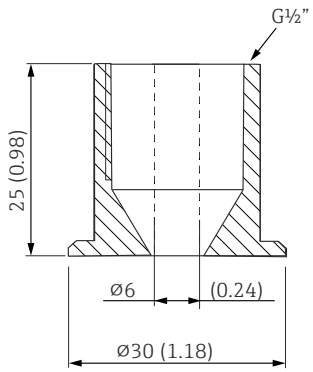
The accessories currently available for the product can be selected at www.endress.com:

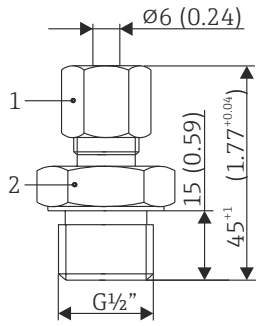
1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

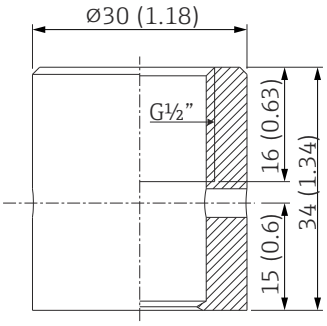
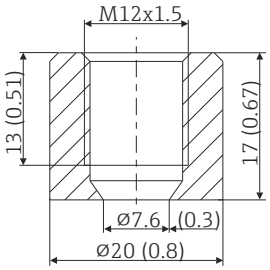
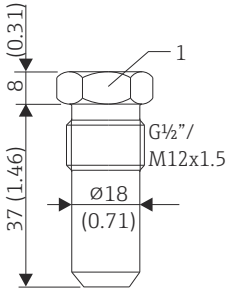
## 13.1 Device-specific accessory

All dimensions in mm (in).

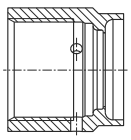
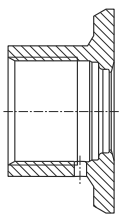
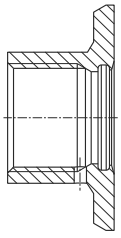
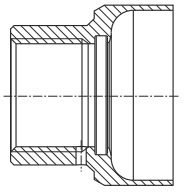
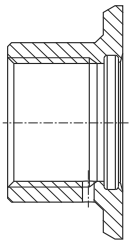
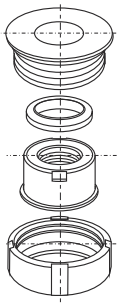
| Accessory | Description |
|---|---|
| Welding boss with sealing taper<br>  <br><br>*1 Pressure screw, 303/304, width across flats 24 mm*<br>*2 Washer, 303/304*<br>*3 Sealing taper, PEEK*<br>*4 Collar welding boss, 316L* | ▪ Collar welding boss movable with sealing taper, washer and pressure screw G½"<br>▪ Material of parts in contact with the process 316L, PEEK<br>▪ Max. process pressure 10 bar (145 psi) |

| Accessory | Description |
|---|---|
| Collar welding boss<br>  <br> | Material of parts in contact with the process 316L |

| Accessory | Description |
|---|---|
| Compression fitting<br>  <br><br>*1 AF14*<br>*2 AF27* | ▪ Movable clamping ring, process connection G½"<br>▪ Material of compression fitting and parts in contact with the process, 316L |

| Accessory | Description |
|---|---|
| Welding boss with sealing taper (metal-metal)<br>  <br>A0006621<br>  <br>A0018236 | ▪ Welding boss for G½" or M12x1.5 thread<br>▪ Metal-sealing; conical<br>▪ Material of parts in contact with the process 316L/1.4435<br>▪ Max. process pressure 16 bar (232 PSI) |
| Dummy plug<br>  <br>A0045726<br>*1 AF22* | ▪ Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss<br>▪ Material: SS 316L/1.4435 |

## 13.1.1 Weld-in adapter

| | | | | | | |
|---|---|---|---|---|---|---|
| **Weld-in adapter** |  <br>A0008246 |  <br>A0008251 |  <br>A0008256 |  <br>A0011924 |  <br>A0008248 |  <br>A0008253 |
| | **G ¾", d=29 for pipe-mounting** | **G ¾", d=50 for vessel-mounting** | **G ¾", d=55 with flange** | **G 1", d=53 without flange** | **G 1", d=60 with flange** | **G 1" adjustable** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Material | 316L (1.4435) | 316L (1.4435) | 316L (1.4435) | 316L (1.4435) | 316L (1.4435) | 316L (1.4435) |
| Roughness µm (µin) process side | ≤1.5 (59.1) | ≤0.8 (31.5) | ≤0.8 (31.5) | ≤0.8 (31.5) | ≤0.8 (31.5) | ≤0.8 (31.5) |

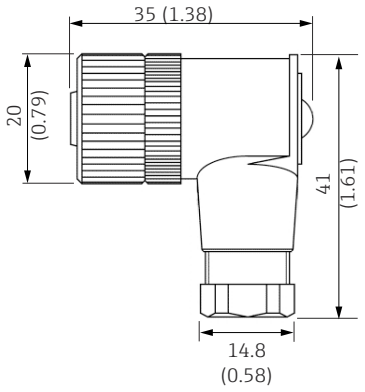
Maximum process pressure for the weld-in adapters:
- 25 bar (362 PSI) at maximum 150 °C (302 °F)
- 40 bar (580 PSI) at maximum 100 °C (212 °F)

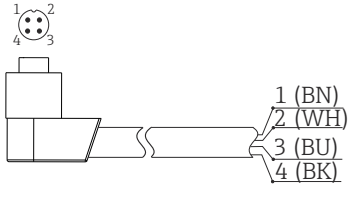
## 13.2 Communication-specific accessory

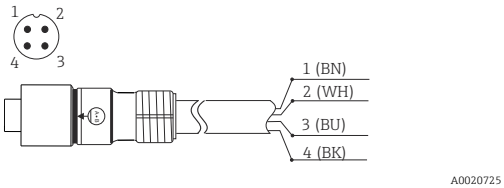
### 13.2.1 IO-Link

| Accessory | Description |
|---|---|
| FieldPort SFP20 | **Mobile configuration tool for all IO-Link devices:**<br>▪ The FieldPort SFP20 is a USB interface for the configuration of IO-Link devices. The FieldPort SFP20 can be connected to a laptop or tablet via a USB cable.<br>▪ A point-to-point connection between the laptop and IO-Link devices is possible with the FieldPort SFP20.<br>▪ M12 connection for IO-Link field devices |
| IO-Link master BL20 | IO-Link master for DIN rails from Turck supports PROFINET, Ethernet/IP and Modbus TCP, including web server for simple configuration. |
| Field Xpert SMT50 | Universal, high-performance tablet PC for device configuration in non-hazardous areas. |

### 13.2.2 Coupling

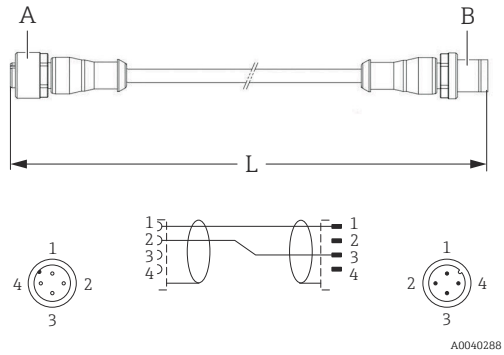
| Accessory | Description |
|---|---|
| ▪ M12x1 coupling; elbowed, for termination of connecting cable by user<br>▪ Connection to M12x1 housing connector<br>▪ Body materials PBT/PA,<br>▪ Union nut GD-Zn, nickel-plated<br>▪ IP67 degree of protection (fully locked)<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −40 to +85 °C |  |

| Accessory | Description |
|---|---|
| ▪ PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling, elbow plug, screw plug, length 5 m (16.4 ft)<br>▪ IP69K protection (optional)<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −25 to +70 °C<br>Wire colors:<br>▪ 1 = BN brown<br>▪ 2 = WH white<br>▪ 3 = BU blue<br>▪ 4 = BK black |  |

| Accessory | Description |
|---|---|
| ▪ PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling nut made of epoxy coated zinc, straight socket contact, screw plug, 5 m (16.4 ft)<br>▪ IP69K protection (optional)<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −20 to +105 °C<br>Wire colors:<br>▪ 1 = BN brown<br>▪ 2 = WH white<br>▪ 3 = BU blue<br>▪ 4 = BK black |  |

### 13.2.3 Adapter cable

Since the IO-Link thermometers have a different pin assignment than 4-20 mA thermometers, the assignment must be adjusted in the event of device changes. To do this, either modify the wiring in the cabinet or use the adapter cable for the pin assignment between the device and the existing wiring.

| Accessory | Description |
|---|---|
| ▪ Cable: PVC; 2-pin; 2 × 0.34 mm² (AWG22) shielded<br>▪ Cable length ~ 100 mm (3.94 in) without socket and connector<br>▪ Color: black<br>▪ Connector 1: M12, 4-pin, A-coded, socket, straight<br>▪ Connector 2: M12, 4-pin, A-coded, connector, straight<br>▪ Metal parts: stainless steel<br>▪ Voltage: max. 60 $V_{DC}$<br>▪ Current carrying capacity: max. 4 A<br>▪ Degree of protection:<br>IP66, IP67 and IP69 in accordance with IEC 60529 (when connected); NEMA 6P<br>▪ Temperature: −40 to +85 °C (−40 to +185 °F) |  <br>*A* *M12 socket*<br>*B* *M12 plug*<br>*L* *200 mm (7.87 in)* |

## 13.3 Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

## 13.4 Service-specific accessories

**Netilion**
With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.

www.netilion.endress.com

**Applicator**
Software for selecting and sizing Endress+Hauser measuring devices:
- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:
https://portal.endress.com/webapp/applicator

**Configurator**
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

The Configurator is available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

## 13.5 System components

**Process indicators from the RIA product family**

Easily readable process indicators with various functions: loop-powered indicators for displaying 4 to 20 mAvalues, display of up to four HART variables, process indicators with control units, limit value monitoring, sensor power supply, and galvanic isolation.

Universal application thanks to international hazardous area approvals, suitable for panel mounting or field installation..

For more information, please refer to: www.endress.com

**RN series active barrier**

Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively.

For more information, please refer to: www.endress.com

# 14 Technical data

## 14.1 Input

Measuring range

| | |
|---|---|
| **Pt100 (TF) basic** | −50 to +150 °C (−58 to +302 °F) |
| **iTHERM TipSens** | −50 to +200 °C (−58 to +392 °F) |

## 14.2 Output

Output signal

Order code 020, option A

| | |
|---|---|
| **Sensor output** | Pt100, 4-wire connection, class A |

Order code 020, option B

| | |
|---|---|
| **Analog output** | 4 to 20 mA; variable measuring range |
| **Digital output** | C/Q (IO-Link or switch output) |

Order code 020, option C

| | |
|---|---|
| **Analog output** | 4 to 20 mA; measuring range 0 to 150 °C (32 to 302 °F) |
| **Digital output** | C/Q (IO-Link or switch output) |

Switching capacity

- 1 × PNP switch output
- Switch status ON Ia ≤ 200 mA; switch status OFF Ia ≤ 10 µA
- Switch cycles>10 000 000
- Voltage drop PNP ≤ 2 V
- Overload protection
  - Automatic load testing of switching current
  - If a current of over 220 mA flows in the ON switch state, the device switches to a safe state
  - Diagnostic message **Overload at switch output**
- Switch functions
  - Hysteresis or window function
  - Normally-closed contact or normally-open contact
- No pull-down resistor is integrated in the device for the switch output.

Switch output

Response time ≤ 100 ms

Failure information

Failure information is generated if the measuring information is missing or not valid. The device displays the three diagnostic messages with the highest priority.

In the IO-Link mode, the device transmits all the failure information digitally.

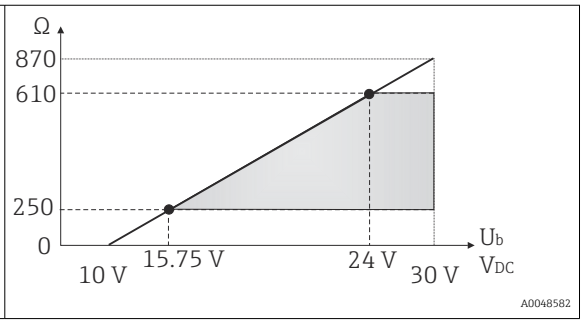
In the 4 to 20 mA mode, the device transmits the failure information according to NAMUR NE43:

| | |
|---|---|
| Switch output | The switch output switches to **open** in the fault state. |

| | |
|---|---|
| Underranging | Linear decrease from 4.0 to 3.8 mA |
| Overranging | Linear increase from 20.0 to 20.5 mA |
| Failure e.g. sensor defective | ≤ 3.6 mA (**low**) or ≥ 21 mA (**high**) can be selected<br>The **high** alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems. |

Load

$R_{b\ max.}$= ($U_{b\ max.}$ - 10 V) / 0.023 A (current output)




Linearization/transmission behavior

Temperature - linear

Damping

| | |
|---|---|
| **Configurable sensor input damping** | 0 to 120 s |
| **Factory setting** | 0 s |

Input current required

- ≤ 3.5 mA for 4 to 20 mA
- ≤ 9 mA for IO-Link

Maximum current consumption

≤ 23 mA for 4 to 20 mA

Switch-on delay

2 s

Protocol-specific data

**IO-Link information**

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. The IO-Link communication interface offers the following options:
- Direct access to the process data
- Direct access to the diagnostic data
- Parameter configuration during operation

*The device supports the following features:*

| | |
|---|---|
| IO-Link specification | Version 1.1 |
| IO-Link Smart Sensor Profile 2nd Edition | Supported:<br>▪ Identification<br>▪ Diagnosis<br>▪ Digital Measuring Sensor (as per SSP type 3.1) |
| SIO mode | Yes |
| Transmission rate | COM2; 38.4 kBaud |
| Minimum period | 10 ms |
| Process data width | 4 byte |
| IO-Link data storage | Yes |
| Block configuration according to V1.1 | Yes |
| Device operational | The device is operational 0.5 s after the supply voltage is applied (first valid measured value after 2 s). |

**Device description**

To integrate field devices into a digital communication system, the IO-Link system requires a description of the device parameters.

This information is contained in the device description (IODD [2]), which is provided to the IO-Link master via generic modules during commissioning of the communication system.

The IODD can be downloaded as follows:
- Endress+Hauser: www.endress.com
- IODDfinder: http://ioddfinder.io-link.com

Write protection for device parameters

Write protection for device parameters is implemented via system commands.

## 14.3 Power supply

Supply voltage

| Electronic version | Supply voltage |
|---|---|
| IO-Link/4 to 20 mA | $U_b$ = 10 to 30 $V_{DC}$, protected against reverse polarity<br><br>IO-Link communication is guaranteed only if the supply voltage is at least 15 V.<br>If the supply voltage is <15 V, the device displays a diagnostic message and deactivates the switch output. |

The device must be operated with a type-examined transmitter power supply unit.

Additional overvoltage protection is required for marine applications.

Power supply failure

- To comply with electrical safety standards CAN/CSA-C22.2 No. 61010-1 or UL 61010-1, the device must be operated using a power supply with a suitably limited current circuit in accordance with UL/EN/IEC 61010-1 Chapter 9.4 or Class 2 as per UL 1310, "SELV or Class 2 circuit".
- Overvoltage behavior (> 30 V)
  The device works continuously up to 35 $V_{DC}$ without any damage. If the supply voltage is exceeded, the specified characteristics are no longer guaranteed.
- Behavior in the event of undervoltage
  If the supply voltage falls below the minimum value ~7 V, the device switches off in a defined manner (status as if not supplied with power).

Electrical connection

According to the 3-A Sanitary Standard and EHEDG, electrical connecting cables must be smooth, corrosion-resistant and easy to clean.

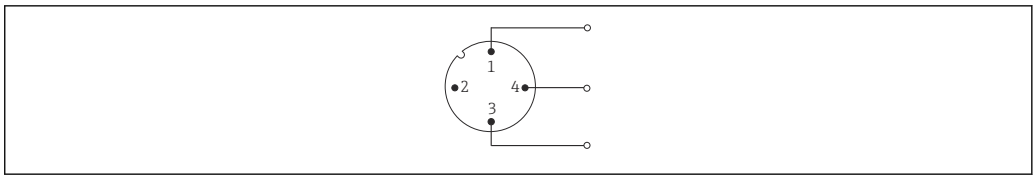
M12 plug with 4 pins and "A" coding, in accordance with IEC 61076-2-101

▶ Do not overtighten the M12 plug, as this could damage the device. Maximum torque: 0.4 Nm (M12 knurl)

In the version with electronics, the device function is defined by the pin assignment of the M12 connector. Communication is either IO-Link or 4 to 20 mA.

**IO-Link operating mode**

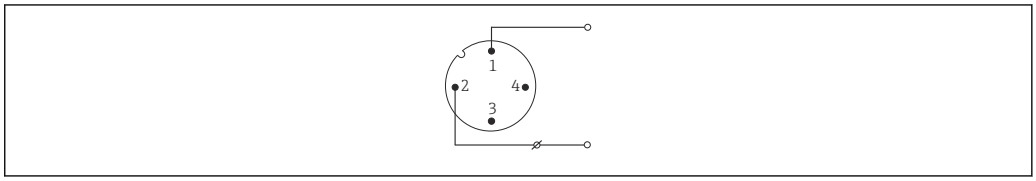
2) Input/Output Device Description




7 *Pin assignment, device plug*

1 *Pin 1 - power supply 15 to 30 $V_{DC}$*
2 *Pin 2 - not used*
3 *Pin 3 - power supply 0 $V_{DC}$*
4 *Pin 4 - C/Q (IO-Link or switch output)*

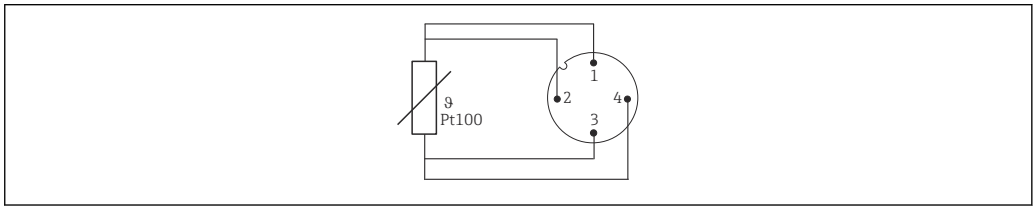
### 4 to 20 mA operating mode




8 *Pin assignment, device plug*

1 *Pin 1 - power supply 10 to 30 $V_{DC}$*
2 *Pin 2 - power supply 0 $V_{DC}$*
3 *Pin 3 - not used*
4 *Pin 4 - not used*

### Without electronics




9 *Pin assignment of device plug: Pt100, 4-wire connection*

## 14.4 Performance characteristics

Reference operating conditions

| | |
|---|---|
| **Adjustment temperature (ice bath)** | 0 °C (32 °F) for sensor |
| **Ambient temperature range** | 25 °C ± 3 °C (77 °F ± 5 °F) for electronics |
| **Supply voltage** | 24 $V_{DC}$ ± 10 % |
| **Relative humidity** | < 95 % |

Maximum measured error

In accordance with DIN EN 60770 and the reference conditions specified above. The measured error data correspond to ±2 σ (Gaussian distribution). The data include non-linearities and repeatability.

Measured error (according to IEC 60751) in °C = 0.15 + 0.002 |T|

|T| = Numerical value of the temperature in °C without regard to algebraic sign.

*Thermometer without electronics*

| Standard | Description | Measuring range | Measured error (±) | |
|---|---|---|---|---|
| | | | Maximum [1] | Based on measured value [2] |
| IEC 60751 | Pt100 Cl. A | −50 to +200 °C (−58 to +392 °F) | 0.55 °C (0.99 °F) | ME = ± (0.15 °C (0.27 °F) + 0.002 * \|T\|) |

1) Maximum measured error for the specified measuring range.
2) Deviations from maximum measured error possible due to rounding.

In order to obtain the maximum tolerances in °F, the results in °C must be multiplied by a factor of 1.8.

*Thermometer with electronics*

| Standard | Description | Measuring range | Measured error (±) | | |
|---|---|---|---|---|---|
| | | | Digital [1] | | D/A [2] |
| | | | Maximum | Based on measured value | |
| IEC 60751 | Pt100 Cl. A | −50 to +200 °C (−58 to +392 °F) | ≤ 0.48 °C (0.86 °F) | ME = ± (0.215 °C (0.39 °F) + 0.134% * (MV - LRV)) | 0.05 % (≙ 8 µA) |

1) Measured value transmitted via IO-Link.
2) Percentages based on the configured span of the analog output signal.

*Thermometer with electronics and sensor-transmitter-matching / increased accuracy*

| Standard | Description | Measuring range | Measured error (±) | | |
|---|---|---|---|---|---|
| | | | Digital [1] | | D/A [2] |
| | | | Maximum | Based on measured value | |
| IEC 60751 | Pt100 Cl. A | −50 to +200 °C (−58 to +392 °F) | ≤ 0.14 °C (025 °F) | ME = ± (0.127 °C (0.23 °F) + 0.0074% * (MV - LRV)) | 0.05 % (≙ 8 µA) |

1) Measured value transmitted via IO-Link.
2) Percentages based on the configured span of the analog output signal.

MV = measured value

LRV = lower range value of the sensor in question

Total measured error of transmitter at current output = $\sqrt{(\text{Measured error digital}^2 + \text{Measured error D/A}^2)}$

*Sample calculation with Pt100, measuring range 0 to +150 °C (+32 to +302 °F), ambient temperature+25 °C (+77 °F), supply voltage24 V and sensor-transmitter matching:*

| | |
|---|---|
| Measured error digital = 0.127 °C (0.229 °F) + 0.0074 % x [150 °C (302 °F) - (−50 °C (−58 °F))]: | 0.14 °C (0.25 °F) |
| Measured error D/A = 0.05 % x 150 °C (302 °F) | 0.08 °C (0.14 °F) |
| | |
| **Measured error digital value (IO-Link):** | 0.14 °C (0.25 °F) |
| **Measured error analog value (current output):** $\sqrt{(\text{Measured error digital}^2 + \text{Measured error D/A}^2)}$ | 0.16 °C (0.29 °F) |

*Sample calculation with Pt100, measuring range 0 to +150 °C (+32 to +302 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:*

| | |
|---|---|
| Measured error digital = 0.215 °C (0.387 °F) + 0.134% x [150 °C (302 °F) - (−50 °C (−58 °F))]: | 0.48 °C (0.86 °F) |
| Measured error D/A = 0.05 % x 150 °C (302 °F) | 0.08 °C (0.14 °F) |

| | |
|---|---|
| Influence of ambient temperature (digital) = (35 - 25) x (0.004 % x 200 °C (360 °F)), at least 0.008 °C (0.014 °F) | 0.08 °C (0.14 °F) |
| Influence of ambient temperature (D/A) = (35 - 25) x (0.003 % x 150 °C (302 °F)) | 0.05 °C (0.09 °F) |
| Influence of supply voltage (digital) = (30 - 24) x (0.004 % x 200 °C (360 °F)), at least 0.008 °C (0.014 °F) | 0.05 °C (0.09 °F) |
| Influence of supply voltage (D/A) = (30 - 24) x (0.003 % x 150 °C (302 °F)) | 0.03 °C (0.05 °F) |
| **Measured error digital value (IO-Link):**<br>$\sqrt{(\text{Measured error digital}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of supply voltage (digital)}^2)}$ | 0.49 °C (0.88 °F) |
| **Measured error analog value (current output):**<br>$\sqrt{(\text{Measured error digital}^2 + \text{Measured error D/A}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of ambient temperature (D/A)}^2 + \text{Influence of supply voltage (digital)}^2 + \text{Influence of supply voltage (D/A)}^2)}$ | 0.50 °C (0.90 °F) |

## Long-term drift

| | 1 month | 3 months | 6 months | 1 year | 3 years | 5 years |
|---|---|---|---|---|---|---|
| Digital output IO-Link | ± 9 mK | ± 15 mK | ± 19 mK | ± 23 mK | ± 28 mK | ± 31 mK |
| Current output<br>Measuring range<br>−50 to +200 °C (−58 to +360 °F) | ± 2.5 µA | ± 4.3 µA | ± 5.4 µA | ± 6.4 µA | ± 8.0 µA | ± 8.8 µA |

## Operating influences

The measurement error data correspond to ±2 σ (Gaussian distribution).

| Standard | Designation | Ambient temperature Influence (+-) per 1 °C (1.8 °F) change | | | Supply voltage Influence (+-) per 1 V change | | |
|---|---|---|---|---|---|---|---|
| | | Digital [1] | | D/A [2] | Digital [1] | | D/A [2] |
| | | Maximum [3] | Based on measured value [4] | | Maximum [3] | Based on measured value [4] | |
| IEC 60751 | Pt100 Cl. A | 0.014 °C (0.025 °F) | 0.004 % * (MV - LRV), min. 0.008 °C (0.0144 °F) | 0.003 % (≙0.48 µA) | 0.014 °C (0.025 °F) | 0.004 % * (MV - LRV), min. 0.008 °C (0.0144 °F) | 0.003 % (≙0.48 µA) |

1) Measured value transmitted via IO-Link.
2) Percentages based on the configured span of the analog output signal.
3) Maximum measurement error for the specified measuring range.
4) Deviations from maximum measurement error possible due to rounding.

MV = measured value

LRV = lower range value of the sensor in question

Total measurement error of transmitter at current output = $\sqrt{(\text{Measurement error digital}^2 + \text{Measurement error D/A}^2)}$

## Device temperature

The displayed device temperature has a maximum measured error of ±8 K.

## Response time $T_{63}$ and $T_{90}$

Tests in water at 0.4 m/s (1.3 ft/s) according to IEC 60751; temperature changes in increments of 10 K. Response times measured for the version without electronics.

*Response time without heat transfer paste*

| Design | Sensor | t63 | $t_{90}$ |
|---|---|---|---|
| 6 mm direct contact, straight tip | Pt100 (TF) basic | 5 s | < 20 s |
| 6 mm direct contact, straight tip | iTHERM TipSens | 1 s | 1.5 s |
| 6 mm thermowell, reduced tip (4.3 × 20 mm) | iTHERM TipSens | 1 s | 3 s |

*Response time with heat transfer paste* [1)]

| Design | Sensor | t63 | $t_{90}$ |
|---|---|---|---|
| 6 mm thermowell, reduced tip (4.3 × 20 mm) | iTHERM TipSens | 1 s | 2.5 s |

1) Between the insert and the thermowell

Electronics response time

Max. 1 s

When recording step responses, it is important to bear in mind that the response times of the sensor might be added to the specified times.

Sensor current

≤ 1 mA

Calibration

**Calibration of thermometers**
Calibration involves comparing the measured values of a device under test (DUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:
- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C
- Calibration compared against a precise reference thermometer

The thermometer to be calibrated must display the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces into which the DUT and the reference thermometer, where necessary, can project to a sufficient degree, are typically used for thermometer calibrations.

**Sensor-transmitter-matching**
The resistance/temperature curve of platinum resistance thermometers is standardized but in practice it is rarely possible to keep to the values precisely over the entire operating temperature range. For this reason, platinum resistance sensors are divided into tolerance classes, such as class A, AA or B as per IEC 60751. These tolerance classes describe the maximum permissible deviation of the specific sensor characteristic curve from the standard curve, i.e. the maximum temperature-dependent characteristic error that is permitted. The conversion of measured sensor resistance values at temperatures in temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.

When temperature transmitters are used, this conversion error can be reduced significantly by sensor-transmitter-matching:
- Calibration at least at three temperatures and determination of the actual temperature sensor characteristic curve
- Adjustment of the sensor-specific polynomial function using appropriate Calendar-van-Dusen (CvD) coefficients
- Configuration of the temperature transmitter with the sensor-specific CvD coefficients for resistance/temperature conversion, and
- another calibration of the reconfigured temperature transmitter with the connected resistance thermometer

The manufacturer offers this sensor-transmitter-matching as a separate service. Furthermore, the sensor-specific polynomial coefficients of platinum resistance thermometers are indicated on every calibration protocol where possible, e.g. at least three calibration points.

For the device, the manufacturer offers standard calibrations at a reference temperature of −50 to +200 °C (−58 to +392 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from your local sales center on

request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device.

## 14.5 Installation

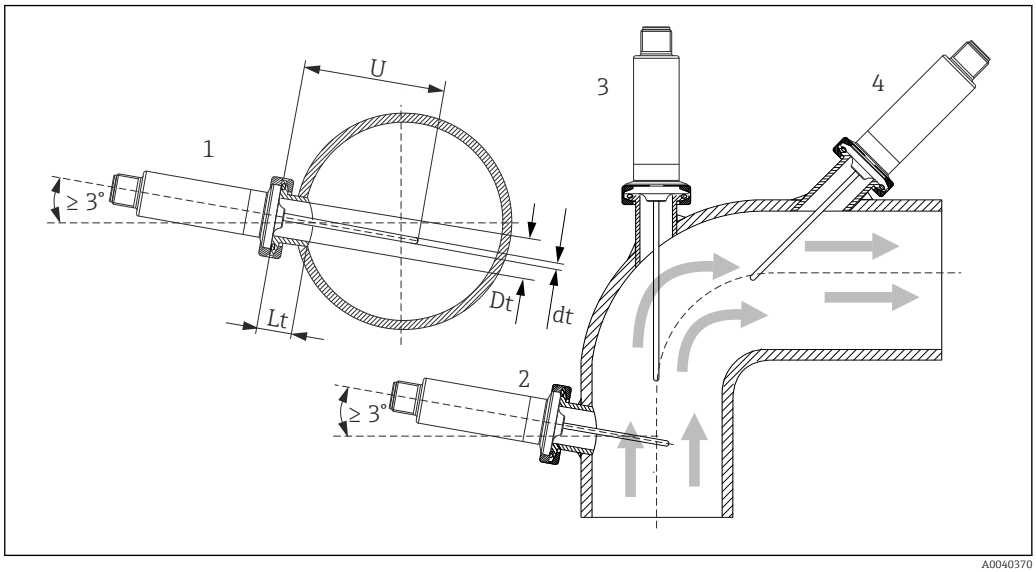
Orientation

No restrictions. Ensure self-draining in the process. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.

Installation instructions

The immersion length of the compact thermometer can considerably influence the measurement accuracy. If the immersion length is too short, measurement errors can occur as a result of heat dissipation via the process connection and the vessel wall. For installation in a pipe, an immersion length is therefore recommended that ideally corresponds to half the pipe diameter.

Installation possibilities: pipes, tanks or other plant components.




10 *Installation examples*

*1, 2 Perpendicular to the flow direction, installed at a min. angle of 3 °to ensure self-draining*
*3 On elbows*
*4 Inclined installation in pipes with a small nominal diameter*
*U Immersion length*

The requirements of the EHEDG and the 3-A Sanitary Standard must be adhered to.

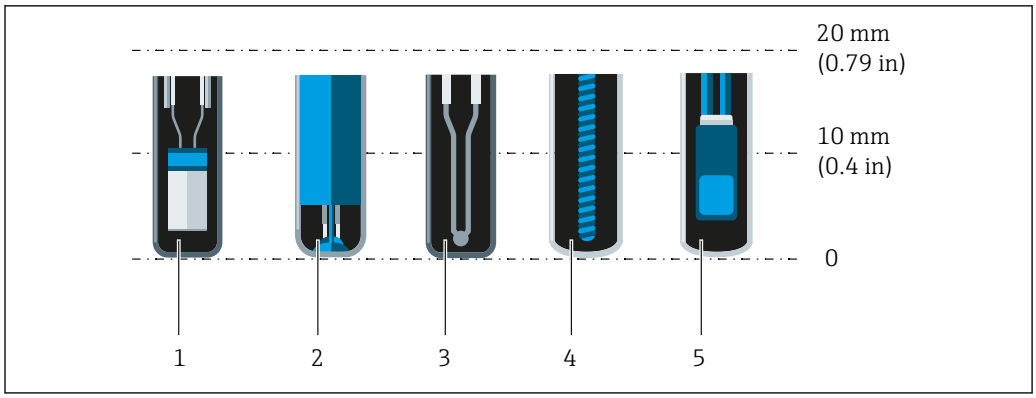
Installation instruction EHEDG/cleanability: Lt ≤ (Dt-dt)

Installation instruction 3-A/cleanability: Lt ≤ 2 (Dt-dt)

The exact position of the sensor element in the thermometer tip must be observed. Available options depend on product and configuration.

Pay attention to the exact position of the sensor element in the thermometer tip.

Available options depend on product and configuration.



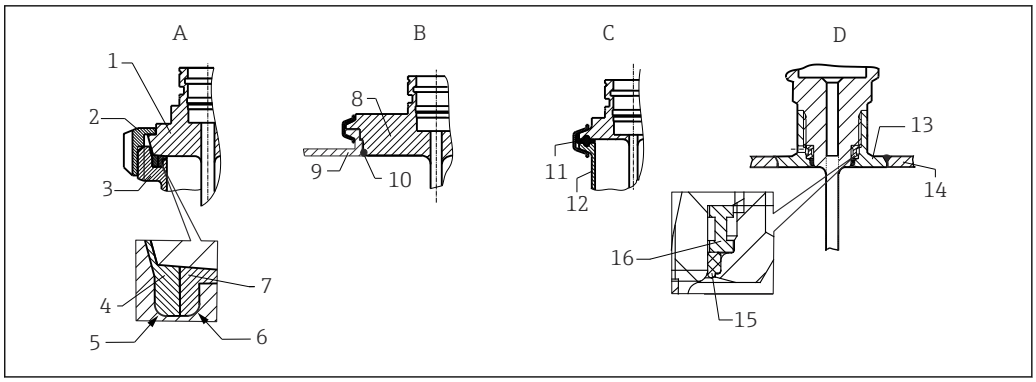

1 *iTHERM StrongSens or iTHERM TrustSens for 5 to 7 mm (0.2 to 0.28 in)*
2 *iTHERM QuickSens for 0.5 to 1.5 mm (0.02 to 0.06 in)*
3 *Thermocouple (not grounded) for 3 to 5 mm (0.12 to 0.2 in)*
4 *Wire-wound sensor for 5 to 20 mm (0.2 to 0.79 in)*
5 *Standard thin-film sensor for 5 to 10 mm (0.2 to 0.39 in)*

To minimize the heat dissipation, 20 to 25 mm of the sensor should extend into the medium beyond the sensor element.

This results in the following recommended minimum immersion lengths:
- iTHERM TrustSens or iTHERM StrongSens 30 mm (1.18 in)
- iTHERM QuickSens 25 mm (0.98 in)
- Wire wound sensor 45 mm (1.77 in)
- Standard thin-film sensor 35 mm (1.38 in)

Special consideration should be given to tee thermowells, as the immersion length is very short on account of their design, and the measurement error is higher as a result. It is therefore recommended to use elbow thermowells with iTHERM QuickSens sensors.

In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to extend far enough into the process to reach beyond the pipe axis. Installation at an angle (4) could be another solution. When determining the immersion or insertion length, all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, process pressure).




11 *Detailed installation instructions for hygiene-compliant installation*

*A Milk pipe connection according to DIN 11851, only in conjunction with EHEDG-certified, self-centering sealing ring*
*1 Sensor with milk pipe connection*
*2 Grooved union nut*
*3 Counterpart connection*
*4 Centering ring*
*5 R0.4*
*6 R0.4*
*7 Sealing ring*
*B Varivent® process connection for VARINLINE® housing*
*8 Sensor with Varivent connection*
*9 Counterpart connection*
*10 O-ring*
*C Clamp according to ISO 2852*
*11 Molded seal*
*12 Counterpart connection*
*D Process connection Liquiphant-M G1", horizontal installation*
*13 Weld-in adapter*
*14 Vessel wall*
*15 O-ring*
*16 Thrust collar*

The counterpieces for the process connections and the seals or sealing rings are not supplied with the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories (see 'Accessories").

**⚠ CAUTION**

**In the event of a defective sealing ring (O-ring) or seal, perform the following steps:**

- ▶ Remove the thermometer.
- ▶ Clean the thread and the O-ring joint/sealing surface.
- ▶ Replace the sealing ring or seal.
- ▶ Perform process cleaning after installation.

For welded connections, perform welding work on the process side as follows:

1. Ensure the surface is honed and mechanically polished, Ra ≤ 0.76 µm (30 µin).
2. Use suitable welding material.
3. Avoid crevices, folds or gaps.
4. Flush-weld or weld with welding radius ≥ 3.2 mm (0.13 in).

Welding work has been carried out properly.

To maintain cleanability, observe the following when installing the thermometer:

1. The installed sensor is suitable for CIP (cleaning in place). Cleaning is carried out in combination with piping or tank. For tank installation, use process connection nozzles to ensure the cleaning assembly directly sprays this area to clean it effectively.

2. The Varivent® connections enable flush-mounted installation.

Cleanability is retained after installation.

## 14.6 Environment

**Ambient temperature range**

| | |
|---|---|
| $T_a$ | –40 to +85 °C (–40 to +185 °F) |

**Storage temperature**

Pack the device so that it is reliably protected against impact when it is stored (and transported). The original packaging offers the best protection.

| | |
|---|---|
| $T_s$ | –40 to +85 °C (–40 to +185 °F) |

**Operating altitude**

Up to 2 000 m (6 600 ft) above sea level

**Climate class**

In accordance with IEC/EN 60654-1, climate class Dx, class 4K4H

**Degree of protection**

As per IEC/EN 60529 IP69

Depends on the degree of protection of the connection cable → 29

**Shock and vibration resistance**

The thermometer meets the requirements of IEC 60751, which specifies shock and vibration resistance of 3 g in the 10 to 500 Hz range.

**Electromagnetic compatibility (EMC)**

EMC according to all relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity.

- Maximum measurement error during EMC tests: < 1 % of the measuring span
- Interference immunity as per IEC/EN 61326 series, requirements for industrial environments
- Interference emission as per IEC/EN 61326 series, Class B equipment

**IO-Link**

In I/O-Link mode, only the requirements of IEC/EN 61131-9 are fulfilled.

The connection between the IO-Link master and thermometer is via an unshielded 3-wire cable, maximum 20 m (65.6 ft) in length.

**4 to 20 mA**

Electromagnetic compatibility complies with all relevant requirements of the IEC/EN 61326 series and NAMUR recommendation EMC (NE21). For more information, see the Declaration of Conformity.

If the connection cable length is 30 m (98.4 ft), a shielded cable must be used.

**Electrical safety**

- Protection class III
- Overvoltage category II
- Pollution level 2

## 14.7 Process

Process temperature range

The thermometer electronics must be protected against temperatures over 85 °C (185 °F) by an extension neck of the appropriate length.

**Device version without electronics (order code 020, option A)**

| | |
|---|---|
| **Pt100 TF, basic, without extension neck** | −50 to +150 °C (−58 to +302 °F) |
| **Pt100 TF, basic, with extension neck** | −50 to +150 °C (−58 to +302 °F) |
| **iTHERM TipSens, without extension neck** | −50 to +200 °C (−58 to +392 °F) |
| **iTHERM TipSens, with extension neck** | −50 to +200 °C (−58 to +392 °F) |

**Device version with electronics (order code 020, option B, C)**

| | |
|---|---|
| **Pt100 TF, basic, without extension neck** | −50 to +150 °C (−58 to +302 °F) |
| **Pt100 TF, basic, with extension neck** | −50 to +150 °C (−58 to +302 °F) |
| **iTHERM TipSens, without extension neck** | −50 to +150 °C (−58 to +302 °F) |
| **iTHERM TipSens, with extension neck** | −50 to +200 °C (−58 to +392 °F) |

Thermal shock

Resistant to thermal shock during the CIP/SIP process with a temperature increase from +5 to +130 °C (+41 to +266 °F)within 2 seconds.

Process pressure range

The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. Maximum possible process pressures for the individual process connections. → 53

It is possible to verify the mechanical loading capacity as a function of the installation and process conditions using the online TW Sizing Module for thermowells in the Endress+Hauser Applicator software. → 26

State of aggregation of the medium

Gaseous or liquid (also with high viscosity, e.g. yogurt).

## 14.8 Mechanical construction

Design, dimensions

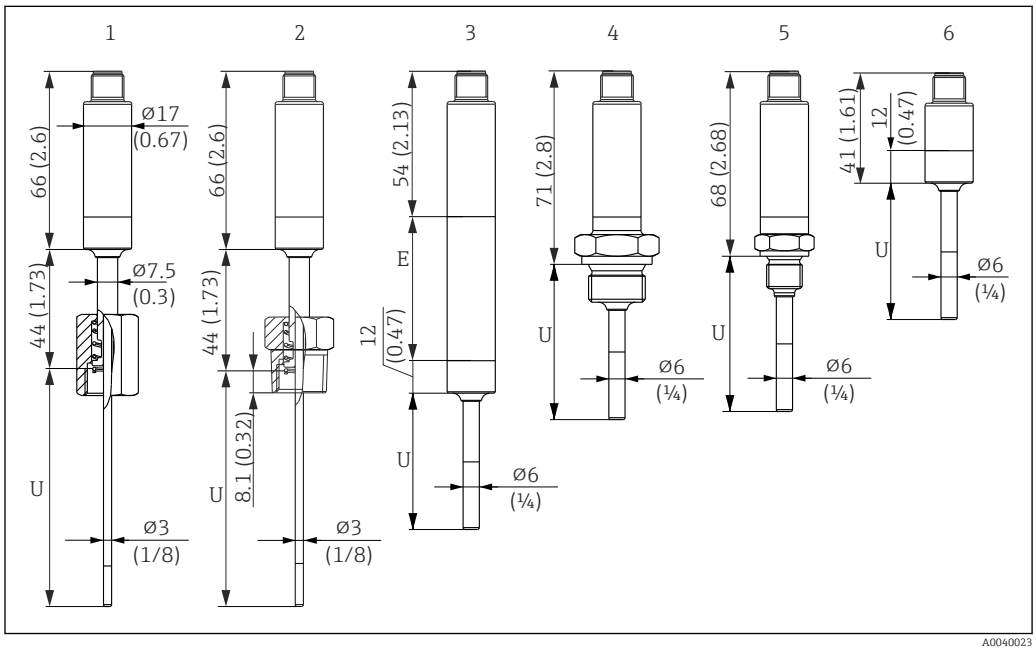
All dimensions in mm (in). The design of the thermometer depends on the thermowell version used:
- Thermometer without a thermowell
- Thermowell diameter 6 mm (¼ in)
- Thermowell version as tee thermowell and elbow thermowell as per DIN 11865/ASME BPE for welding in

Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

*Variable dimensions:*

| Position | Description |
|---|---|
| B | Thermowell bottom thickness |
| E | Extension neck length, optional |
| T | Length of thermowell lagging, pre-defined, depending on the thermowell version |
| U | Variable immersion length, depending on the configuration |

## Without thermowell



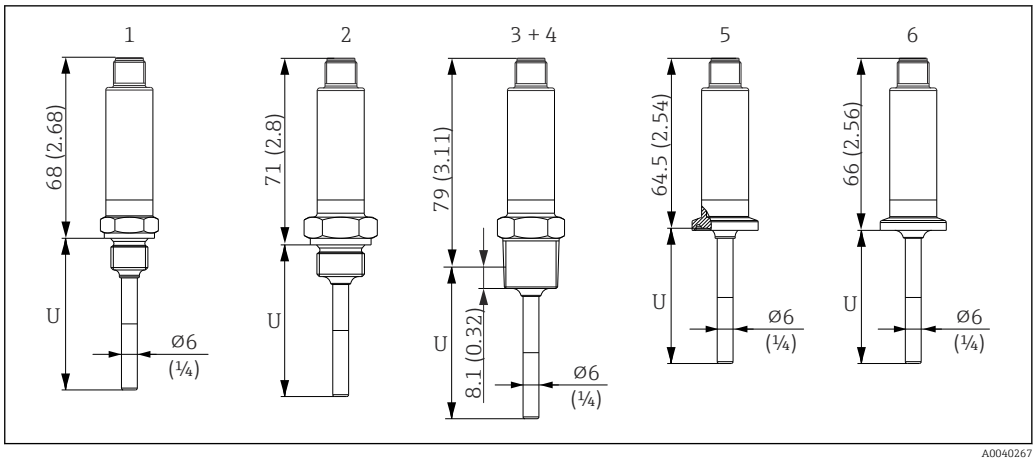

*Unit of measurement mm (in)*

1 *Thermometer with spring-loaded union nut, G3/8" thread 3 mm for existing thermowell*
2 *Thermometer with spring-loaded NPT½" male thread 3 mm for existing thermowell*
3 *Thermometer without process connection for compression fitting, with extension neck*
4 *Thermometer with G½" male thread*
5 *Thermometer with G¼" male thread*
6 *Thermometer without electronics*

When using an extension neck, the overall length of the device always increases by the length in question, E = 50 mm (1.97 in), regardless of the process connection.

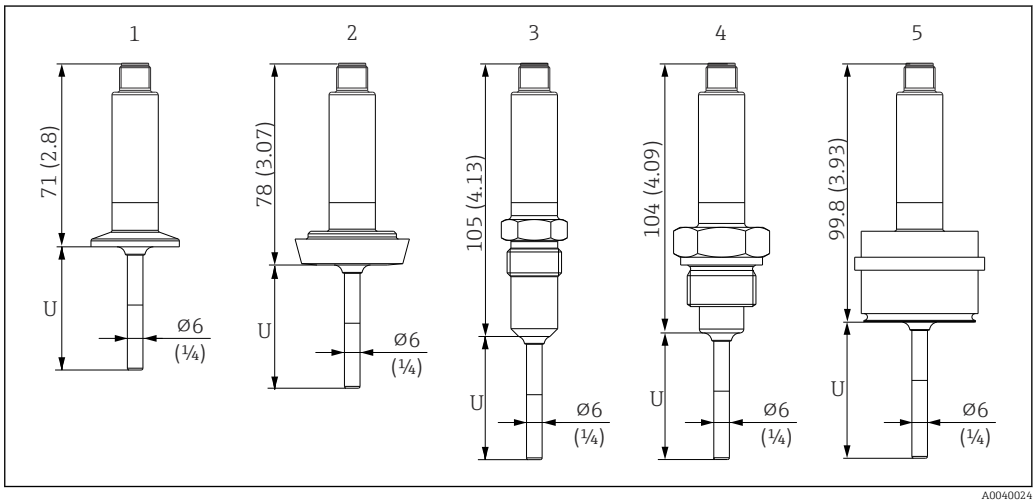
*Pay attention to the following equations when calculating the immersion length U for an existing thermowell:*

| | |
|---|---|
| Version 1 (G3/8" union nut) | $U = U_{(thermowell)} + T_{(thermowell)} + 3\ mm - B_{(thermowell)}$ |
| Version 2 (NPT½" male thread) | $U = U_{(thermowell)} + T_{(thermowell)} - 5\ mm$ (-8 mm screw-in depth + 3mm spring travel) $- B_{(thermowell)}$ |



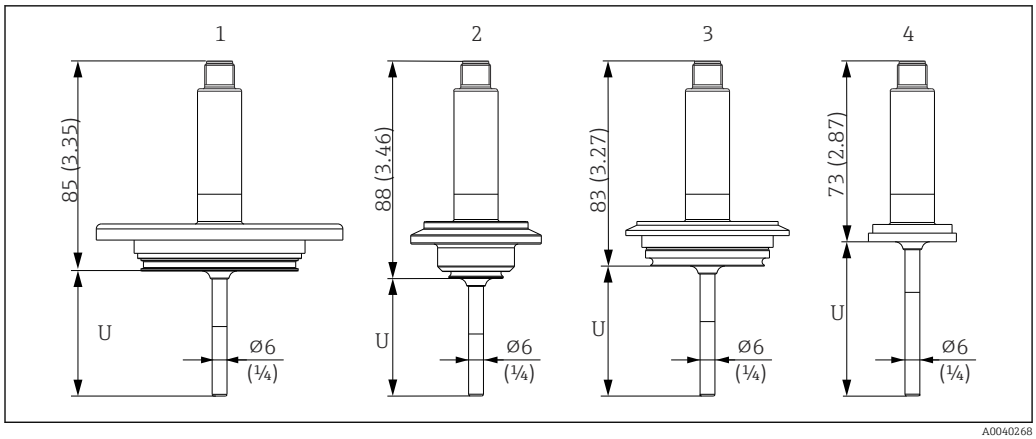

*Unit of measurement mm (in)*

*1 Thermometer with M14 male thread*
*2 Thermometer with M18 male thread*
*3 Thermometer with NPT½" male thread*
*4 Thermometer with NPT¼" male thread*
*5 Thermometer with Microclamp, DN18 (0.75")*
*6 Thermometer with Tri-Clamp, DN18 (0.75")*




*Unit of measurement mm (in)*

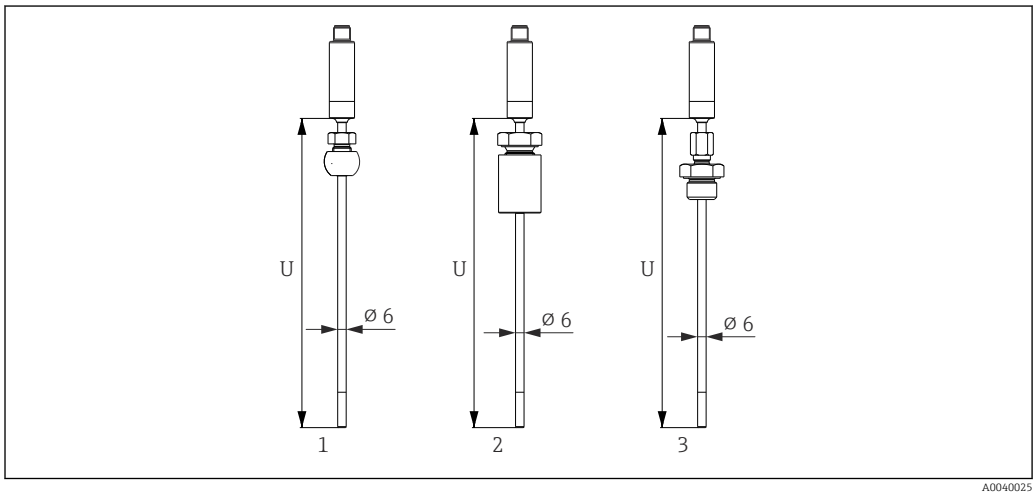
*1 Thermometer with Clamp ISO2852 for DN12 to 21.3, DN25 to 38, DN40 to 51*
*2 Thermometer with milk pipe connection DIN11851 for DN25/DN32/DN40/DN50*
*3 Thermometer with metal sealing system G½"*
*4 Thermometer with G¾" male thread ISO228 for FTL31/33/20/50 Liquiphant adapter*
*5 Thermometer with D45 process adapter*




*Unit of measurement mm (in)*

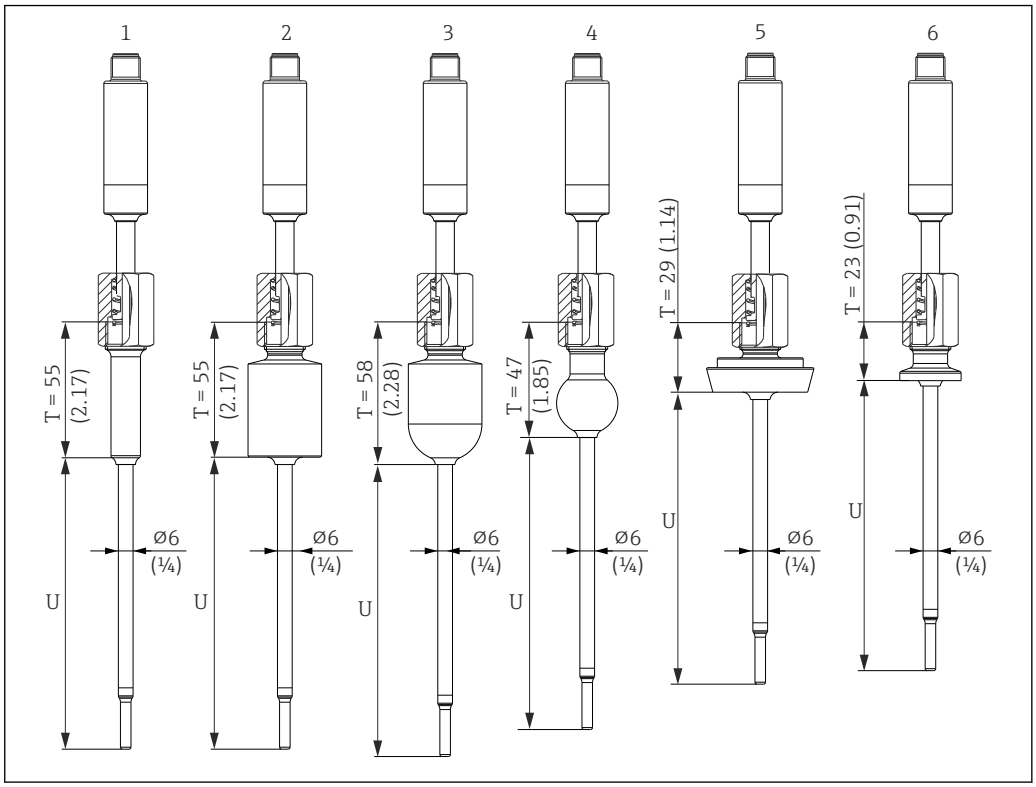
*1 Thermometer with APV Inline, DN50*
*2 Thermometer with Varivent type B, D 31 mm*
*3 Thermometer with Varivent type F, D 50 mm and Varivent type N, D 68 mm*
*4 Thermometer with SMS 1147, DN25/DN38/DN51*

### With compression fitting



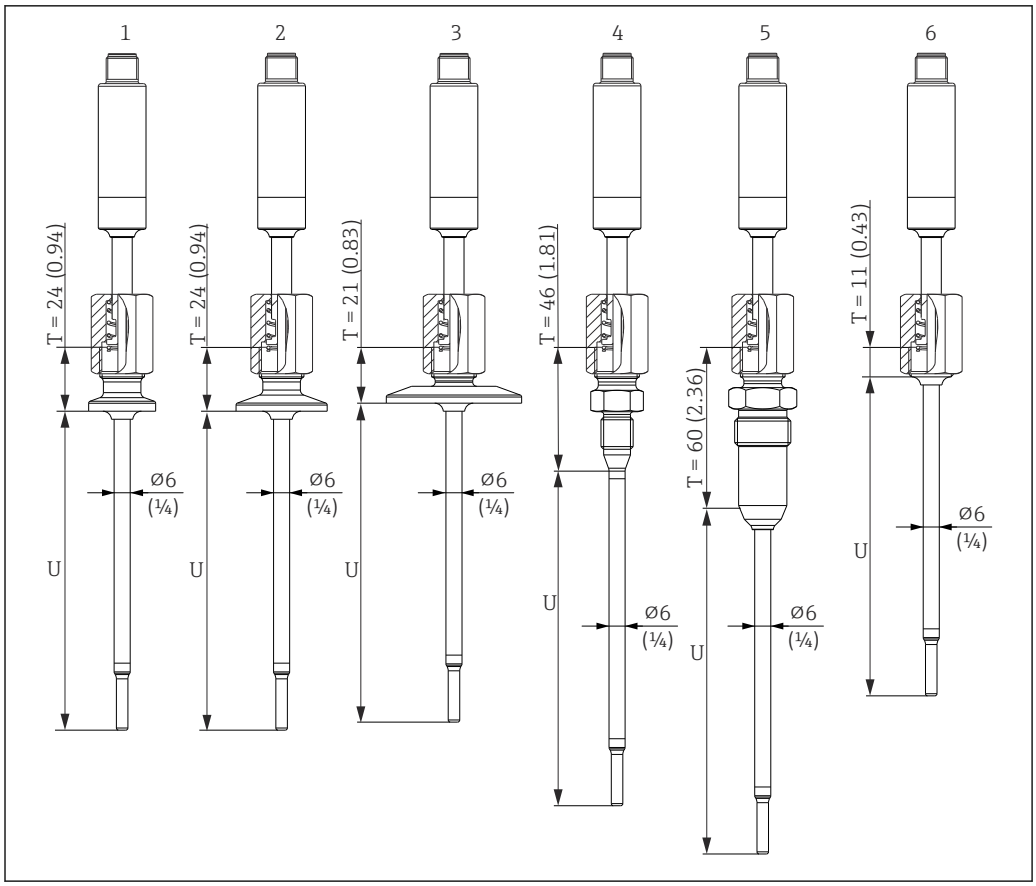

*1 Thermometer with compression fitting TK40 spherical, PEEK/316L, sleeve, Ø 25 mm, for welding in*
*2 Thermometer with compression fittingTK40 cylindrical, ELASTOSIL® sleeve, Ø 25 mm, for welding in*
*3 Thermometer with compression fitting G½" male thread, TK40-BADA3C, 316L*

### With thermowell diameter 6 mm (¼ in)



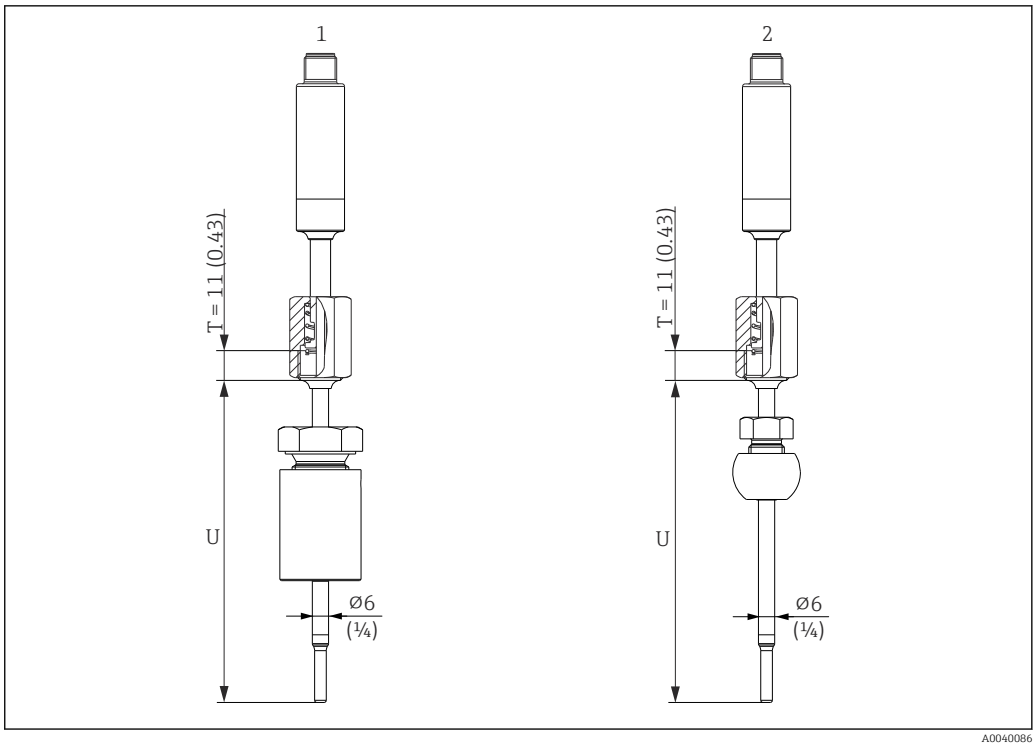

*Unit of measurement mm (in)*

*1 Thermometer with weld-in adapter, cylindrical, D 12 x 40 mm*
*2 Thermometer with weld-in adapter, cylindrical, D 30 x 40 mm*
*3 Thermometer with weld-in adapter, spherical-cylindrical, D 30 x 40 mm*
*4 Thermometer with weld-in adapter, spherical, D 25 mm*
*5 Thermometer with milk pipe connection DIN11851, DN25/DN32/DN40*
*6 Thermometer with Microclamp, DN18 (0.75")*




*Unit of measurement mm (in)*

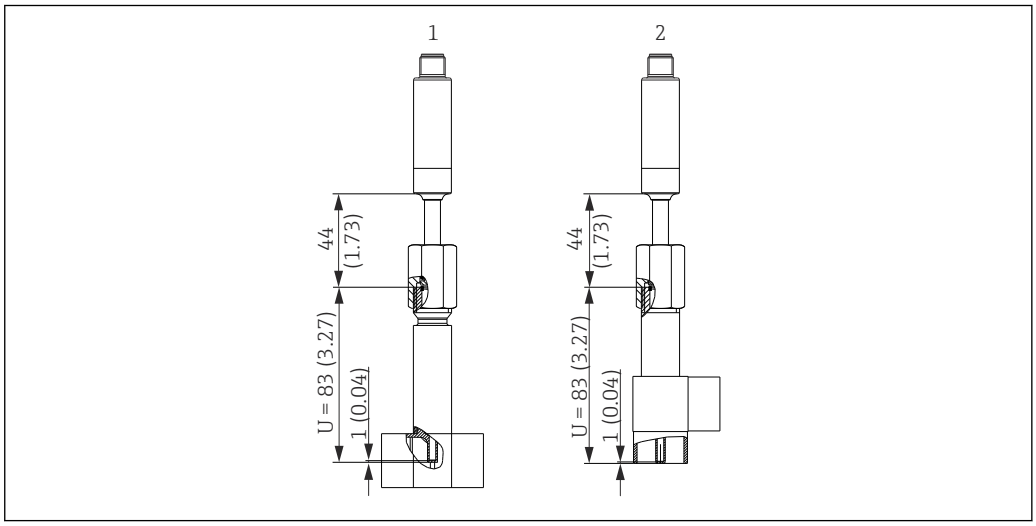
1 *Thermometer with Tri-Clamp version DN18*
2 *Thermometer with Clamp version DN12 to 21.3*
3 *Thermometer with Clamp version DN25 to 38/DN40 to 51*
4 *Thermometer with metal sealing system version, M12 × 1.5*
5 *Thermometer with metal sealing system version, G½"*
6 *Thermometer without process connection*




*Unit of measurement mm (in)*

*1 Thermometer with compression fitting TK40, cylindrical, ELASTOSIL® sleeve, Ø30 mm, for welding in*
*2 Thermometer with compression fitting TK40, spherical, PEEK/316L sleeve, Ø25 mm, for welding in*

### Thermowell version as tee thermowell or elbow thermowell




*Unit of measurement mm (in)*

*1 Thermometer with tee thermowell*
*2 Thermometer with elbow thermowell*

- Pipe sizes as per DIN 11865 series A (DIN), B (ISO) and C (ASME BPE)
- 3-A mark for nominal diameters ≥ DN25
- IP69 protection
- Material 1.4435+316L, delta ferrite content < 0.5%
- Temperature range −60 to +200 °C (−76 to +392 °F)
- Pressure range PN25 as per DIN11865

Due to the short immersion length U in the case of small pipe diameters, the use of iTHERM TipSens inserts is recommended.

## Possible combinations of the thermowell versions with the available process connections

| Process connection and size | Direct contact,6 mm (¼ in) | Thermowell,6 mm (¼ in) |
|---|---|---|
| Without process connection (for installation with compression fitting) | ☑ | ☑ |
| Process adapter D45 | ☑ | - |
| **Compression fitting** | | |
| Thread G½" | ☑ | ☑ |
| Cylindrical Ø30 mm | ☑ | ☑ |
| Spherical Ø25 mm | ☑ | ☑ |
| **Thread** | | |
| G½" | ☑ | - |
| G¼" | ☑ | - |
| M14x1.5 | ☑ | - |
| M18x1.5 | ☑ | - |
| NPT½" | ☑ | - |
| **Weld-in adapter** | | |
| Cylindrical Ø30 x 40 mm | - | ☑ |
| Cylindrical Ø12 x 40 mm | - | ☑ |
| Spherical-cylindrical Ø30 x 40 mm | - | ☑ |
| Spherical Ø25 mm (0.98 in) | - | ☑ |
| **Clamps according to ISO 2852** | | |
| Microclamp/Tri-Clamp DN18 (0.75 in) | ☑ | ☑ |
| DN12 - 21.3 | ☑ | ☑ |
| DN25 -38 (1 - 1.5 in) | ☑ | ☑ |
| DN40 - 51 (2 in) | ☑ | ☑ |
| **Milk pipe connection according to DIN 11851** | | |
| DN25 | ☑ | ☑ |
| DN32 | ☑ | ☑ |
| DN40 | ☑ | ☑ |
| DN50 | ☑ | - |
| **Metal sealing system** | | |
| M12x1 | - | ☑ |
| G½" | ☑ | ☑ |
| **Thread according to ISO 228 for Liquiphant weld-in adapter** | | |
| G¾" for FTL20, FTL31, FTL33 | ☑ | - |
| G¾" for FTL50 | ☑ | - |
| G1" for FTL50 | ☑ | - |
| **APV Inline** | | |
| DN50 | ☑ | - |
| **Varivent®** | | |
| Type B, Ø31 mm | ☑ | - |
| Type F, Ø50 mm | ☑ | - |
| Type N, Ø68 mm | ☑ | - |

| Process connection and size | Direct contact,6 mm (¼ in) | Thermowell,6 mm (¼ in) |
|---|---|---|
| **SMS 1147** | | |
| DN25 | ☑ | - |
| DN38 | ☑ | - |
| DN51 | ☑ | - |

## Weight

0.2 to 2.5 kg (0.44 to 5.5 lbs) for standard versions

## Material

The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant compressive load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

| Description | Short form | Recommended max. temperature for continuous use in air | Properties |
|---|---|---|---|
| AISI 316L (corresponds to 1.4404 or 1.4435) | X2CrNiMo17-13-2, X2CrNiMo18-14-3 | 650 °C (1202 °F) [1] | ▪ Austenitic, stainless steel<br>▪ High corrosion resistance in general<br>▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)<br>▪ Increased resistance to intergranular corrosion and pitting |
| 1.4435+316L, delta ferrite < 1% or < 0.5% | With regard to analytical limits, the specifications of both materials (1.4435 and 316L) are met simultaneously. In addition, the delta ferrite content of the parts in contact with the process is limited to <1% or <0.5%.<br>≤3% for weld seams (in accordance with Basel Standard II) | | |

1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. More information is available from the sales organization.

## Surface roughness

*Specifications for product wetted parts in accordance with EN ISO 21920:*

| | |
|---|---|
| Standard surface, mechanically polished [1] | $R_a$ ≤ 0.76 µm (30 µin) |
| Mechanically polished [1], buffed [2] | $R_a$ ≤ 0.38 µm (15 µin) [3] |
| Mechanically polished [1], buffed and electropolished | $R_a$ ≤ 0.38 µm (15 µin) [3]+ electropolished |

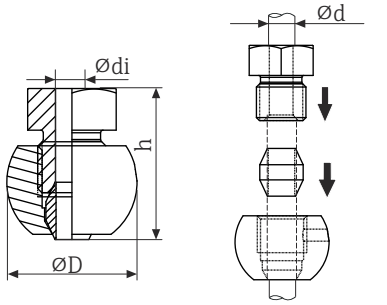
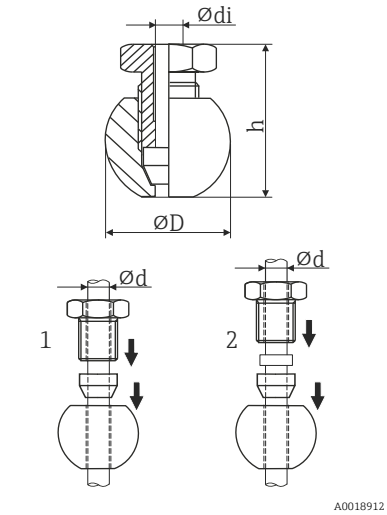
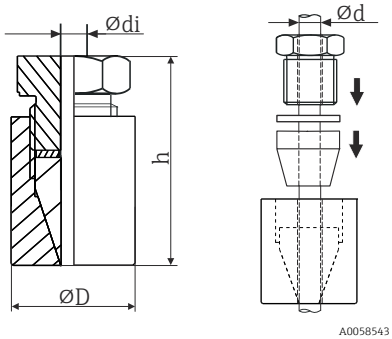
1) Or equivalent treatment that guarantees $R_a$ max.
2) Not compliant with ASME BPE
3) T16% for direct-contact measuring inserts without thermowell, not compliant with ASME BPE

Process connections

The 316L compression fittings can only be used once due to deformation. This applies to all the compression fitting components. A replacement compression fitting must be secured at another point (grooves in thermowell). PEEK compression fittings must never be used at a temperature that is lower than the temperature present when the compression fitting is secured. This is because the fitting would no longer be leak-tight as a result of heat contraction of the PEEK material.

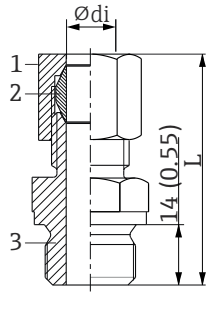
SWAGELOCK or similar fittings are strongly recommended for higher requirements.

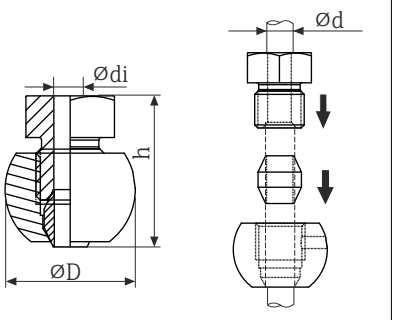
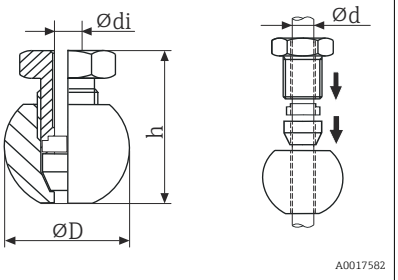
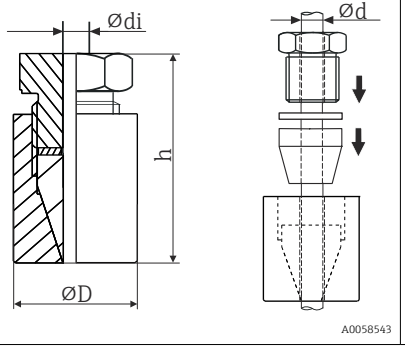
*Compression fitting*

| Model | Type of fitting [1] | Dimensions | | | Technical properties [2] |
|---|---|---|---|---|---|
| | Spherical or cylindrical | Ødi | ØD | h | |
|  | Spherical<br>Sealing taper material<br>316L | 6.3 mm<br>(0.25 in) [3] | 25 mm<br>(0.98 in) | 33 mm<br>(1.3 in) | ▪ $P_{max.}$ = 50 bar (725 psi)<br>▪ $T_{max.}$ for 316L sealing taper = +200 °C (+392 °F), tightening torque = 40 Nm |
| Compression fitting TK40 for weld-in<br>  <br>*1 Movable*<br>*2 Fixed* | Spherical<br>Sealing taper material<br>PEEK<br>Thread G¼" | 6.3 mm<br>(0.25 in) [3] | 25 mm<br>(0.98 in) | 33 mm<br>(1.3 in) | ▪ $P_{max.}$ = 10 bar (145 psi)<br>▪ $T_{max.}$ for PEEK sealing taper = +200 °C (+392 °F), tightening torque = 10 Nm<br>▪ The TK40 PEEK sealing taper is EHEDG tested and 3-A marked |
|  | Cylindrical<br>Material of sealing taper<br>ELASTOSIL®<br>Thread G½" | 6.2 mm<br>(0.24 in) [3]<br>9.2 mm<br>(0.36 in) | 30 mm<br>(1.18 in) | 57 mm<br>(2.24 in) | ▪ $P_{max.}$ = 10 bar (145 psi)<br>▪ $T_{max.}$ for ELASTOSIL® sealing taper = +200 °C (+392 °F), tightening torque = 5 Nm<br>▪ The Elastosil® compression fitting is EHEDG tested and 3-A marked |

1) Options depend on product and configuration
2) All the pressure specifications apply for cyclic temperature load
3) For insert or thermowell diameter Ød = 6 mm (0.236 in).

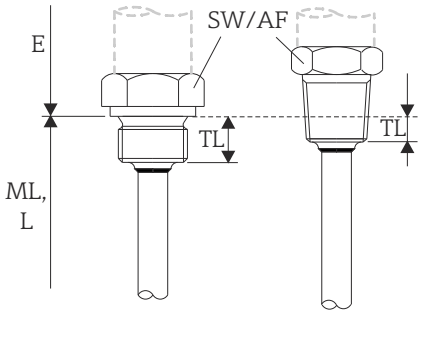
*Compression fitting*

| Type TK40 | Type of fitting | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | ϕdi | L | Width across flats | |
|  *Unit of measurement mm (in)*<br>*1 Nut*<br>*2 Ferrule*<br>*3 Process connection* | G ½" , ferrule material 316L | 6 mm (0.24 in) | Approx. 47 mm (1.85 in) | G ½": 27 mm (1.06 in) | ▪ $P_{max.}$ = 40 bar (104 psi) at T = +200 °C (+392 °F) for 316L material<br>▪ $P_{max.}$ = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L material<br>Tightening torque = 40 Nm |

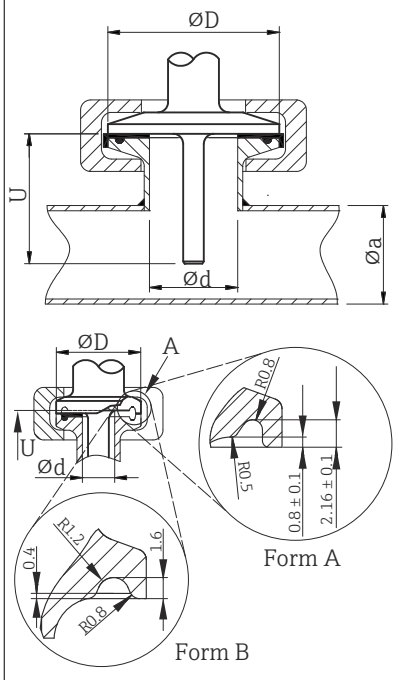
| Type TK40 for weld-in | Type of fitting | Dimensions | | | Technical properties [1] |
|---|---|---|---|---|---|
| | Spherical or cylindrical | ϕdi | ϕD | h | |
|  | Spherical<br>Sealing taper material 316L | 6.3 mm (0.25 in) [2] | 25 mm (0.98 in) | 33 mm (1.3 in) | ▪ $P_{max.}$ = 50 bar (725 psi)<br>▪ $T_{max.}$ for 316L sealing taper = +200 °C (+392 °F), tightening torque = 40 Nm |
|  | Spherical<br>Sealing taper material PEEK<br>Thread G¼" | 6.3 mm (0.25 in) [2] | 25 mm (0.98 in) | 33 mm (1.3 in) | ▪ $P_{max.}$ = 10 bar (145 psi)<br>▪ $T_{max.}$ for PEEK sealing taper = +200 °C (+392 °F), tightening torque = 10 Nm<br>▪ The TK40 PEEK sealing taper is EHEDG tested and 3-A marked |
|  | Cylindrical<br>Sealing taper material Elastosil®<br>Thread G½" | 6.2 mm (0.24 in) [2] | 30 mm (1.18 in) | 57 mm (2.24 in) | ▪ $P_{max.}$ = 10 bar (145 psi)<br>▪ $T_{max.}$ for Elastosil® sealing taper = +200 °C (+392 °F), tightening torque = 5 Nm<br>▪ The TK40 Elastosil sealing taper is EHEDG tested and 3-A marked |

1) All the pressure specifications apply for cyclic temperature load
2) For insert or thermowell diameter Ød = 6 mm (0.236 in).

*Releasable process connection*

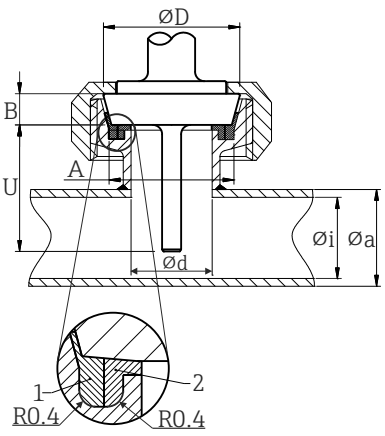
| Threaded process connection Male thread | Type of fitting | | Thread length TL | Width across flats | Max. process pressure |
|---|---|---|---|---|---|
|  12 *Cylindrical (left side) and conical (right side) version* | M | M14x1.5 | 12 mm (0.47 in) | 19 mm (0.75 in) | Maximum static process pressure for threaded process connection: [1]<br>400 bar (5 802 psi) at +400 °C (+752 °F) |
| | | M18x1.5 | 12 mm (0.47 in) | 24 mm (0.95 in) | |
| | G [2] | G ¼" DIN/BSP | 12 mm (0.47 in) | 19 mm (0.75 in) | |
| | | G ½" DIN/BSP | 14 mm (0.55 in) | 27 mm (1.06 in) | |
| | NPT | NPT ¼" | 5.8 mm (0.23 in) | 19 mm (0.75 in) | |
| | | NPT ½" | 8 mm (0.32 in) | 22 mm (0.87 in) | |

1) Maximum pressure specifications only for the thread. The failure of the thread is calculated, taking the static pressure into consideration. The calculation is based on a fully tightened thread (TL = thread length)
2) DIN ISO 228 BSPP

| Type | Version [1] | Dimensions | | Technical properties | Conformity |
|---|---|---|---|---|---|
| | ϕd [2] | ϕD | ϕa | | |
| Clamp according to ISO 2852<br>  <br>Form A: In compliance with ASME BPE Type A<br>Form B: In compliance with ASME BPE Type B and ISO 2852 | Micro clamp [3] DN8-18 (0.5"-0.75") [4], Form A | 25 mm (0.98 in) | - | ▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal<br>▪ With 3-A symbol | - |
| | Tri-clamp DN8-18 (0.5"-0.75") [4], Form B | | - | | Based on ISO 2852 [5] |
| | Clamp DN12-21.3, Form B | 34 mm (1.34 in) | 16 to 25.3 mm (0.63 to 0.99 in) | | ISO 2852 |
| | Clamp DN25-38 (1"-1.5"), Form B | 50.5 mm (1.99 in) | 29 to 42.4 mm (1.14 to 1.67 in) | ▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal<br>▪ 3-A marked and EHEDG certified (in connection with Combifit seal)<br>▪ Can be used with 'Novaseptic Connect (NA Connect)' which enables flush-mount installation | ASME BPE Type B; ISO 2852 |
| | Clamp DN40-51 (2"), Form B | 64 mm (2.52 in) | 44.8 to 55.8 mm (1.76 to 2.2 in) | | ASME BPE Type B; ISO 2852 |
| | Clamp DN63.5 (2.5"), Form B | 77.5 mm (3.05 in) | 68.9 to 75.8 mm (2.71 to 2.98 in) | | ASME BPE Type B; ISO 2852 |
| | Clamp DN70-76.5 (3"), Form B | 91 mm (3.58 in) | > 75.8 mm (2.98 in) | | ASME BPE Type B; ISO 2852 |

1) Options depend on product and configuration
2) Pipes in accordance with ISO 2037 and BS 4825 Part 1
3) Micro clamp (not in ISO 2852); no standard pipes
4) DN8 (0.5") only possible with thermowell diameter = 6 mm (¼ in)
5) Groove diameter = 20 mm

*Releasable process connection*

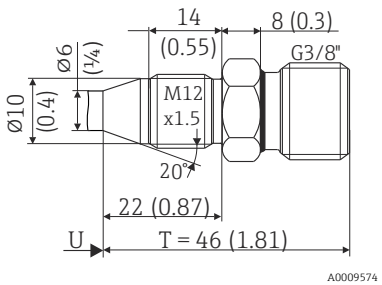
| Type | Technical properties |
|---|---|
| Sanitary connection according to DIN 11851<br>  <br>A0009561<br>*1 Centering ring*<br>*2 Sealing ring* | ▪ 3-A marked and EHEDG certified (only with EHEDG-certified and self-centering sealing ring).<br>▪ ASME BPE compliance |

| Version [1] | Dimensions | | | | | $P_{max.}$ |
|---|---|---|---|---|---|---|
| | ΦD | A | B | Φi | Φa | |
| DN25 | 44 mm (1.73 in) | 30 mm (1.18 in) | 10 mm (0.39 in) | 26 mm (1.02 in) | 29 mm (1.14 in) | 40 bar (580 psi) |
| DN32 | 50 mm (1.97 in) | 36 mm (1.42 in) | 10 mm (0.39 in) | 32 mm (1.26 in) | 35 mm (1.38 in) | 40 bar (580 psi) |
| DN40 | 56 mm (2.2 in) | 42 mm (1.65 in) | 10 mm (0.39 in) | 38 mm (1.5 in) | 41 mm (1.61 in) | 40 bar (580 psi) |
| DN50 | 68 mm (2.68 in) | 54 mm (2.13 in) | 11 mm (0.43 in) | 50 mm (1.97 in) | 53 mm (2.1 in) | 25 bar (363 psi) |

1) Pipes in accordance with DIN 11850

| Model | Type of fitting | Technical properties |
|---|---|---|
| Metal sealing system | Thermowell diameter 6 mm (¼ in) | $P_{max.}$ = 16 bar (232 psi)<br>Maximum torque = 10 Nm (7.38 lbf ft) |

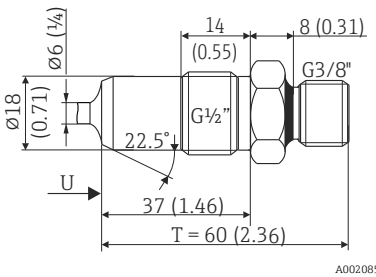
**M12x1.5**



A0009574

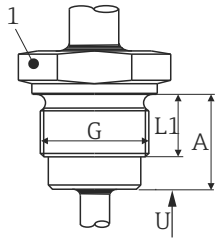
*Unit of measurement mm (in)*

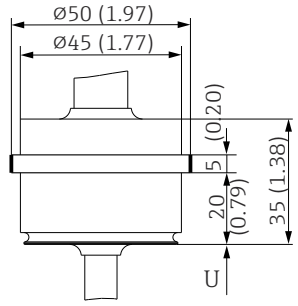
**G½"**



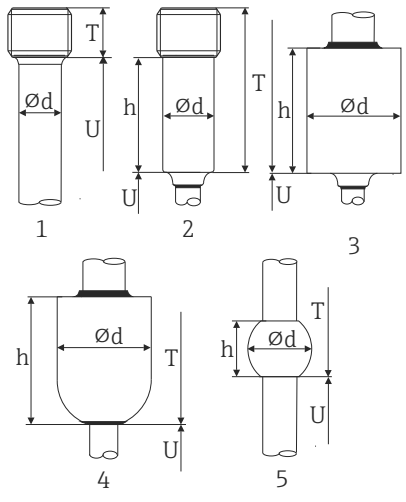
A0020856

*Unit of measurement mm (in)*

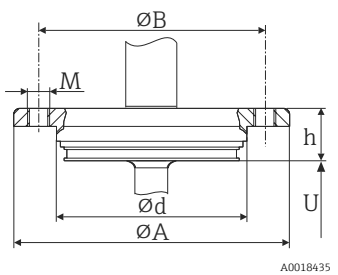
| Type | Version G | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | L1 thread length | A | 1 (SW/AF) | |
| Thread according to ISO 228 (for Liquiphant weld-in adapter)<br>  <br><br>A0009572 | G¾" for FTL20/31/33 adapter | 16 mm (0.63 in) | 25.5 mm (1 in) | 32 | ▪ $P_{max.}$ = 25 bar (362 psi) at max. 150 °C (302 °F)<br>▪ $P_{max.}$ = 40 bar (580 psi) at max. 100 °C (212 °F)<br>▪ For more information about hygienic compliance in conjunction with FTL31/33/50 adapters, see Technical Information TI00426F. |
| | G¾" for FTL50 adapter | | | | |
| | G1" for FTL50 adapter | 18.6 mm (0.73 in) | 29.5 mm (1.16 in) | 41 | |

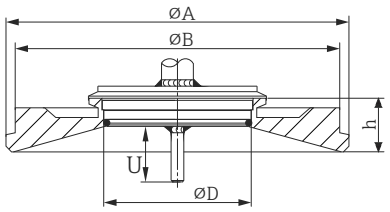
| Type | Version | Technical properties |
|---|---|---|
| Process adapter<br>  <br><br>A0034881<br>*Unit of measurement mm (in)* | D45 | |

*Weld-in*

| Model | Type of fitting [1] | Dimensions | Technical properties |
|---|---|---|---|
| Weld-in adapter<br>  <br><br>A0009569 | 1: Cylindrical [2] | Φd = 12.7 mm (½ in), U = immersion length from lower edge of thread, T = 12 mm (0.47 in) | ▪ $P_{max.}$ depends on the weld-in process<br>▪ With 3-A symbol and EHEDG certification<br>▪ ASME BPE compliance |
| | 2: Cylindrical [3] | Φd x h = 12 mm (0.47 in) x 40 mm (1.57 in), T = 55 mm (2.17 in) | |
| | 3: Cylindrical | Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in) | |
| | 4: Spherical-cylindrical | Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in) | |
| | 5: Spherical | Φd = 25 mm (0.98 in)<br>h = 24 mm (0.94 in) | |

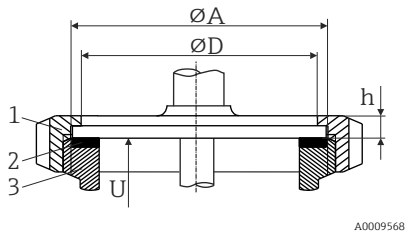
1) Options depend on product and configuration
2) For thermowell Φ12.7 mm (½ in)
3) For thermowell Φ6 mm (¼ in)

| Type | Version | Dimensions | | | | | Technical properties |
|---|---|---|---|---|---|---|---|
| | | ϕd | ϕA | ϕB | M | h | |
| APV Inline   | DN50 | 69 mm (2.72 in) | 99.5 mm (3.92 in) | 82 mm (3.23 in) | 2xM8 | 19 mm (0.75 in) | ▪ $P_{max.}$ = 25 bar (362 psi)<br>▪ 3-A marked and EHEDG certified<br>▪ ASME BPE compliance |

| Type | Type of fitting [1] | Dimensions | | | | Technical properties | |
|---|---|---|---|---|---|---|---|
| | | ϕD | ϕA | ϕB | h | $P_{max.}$ | |
| Varivent®   | Type B | 31 mm (1.22 in) | 105 mm (4.13 in) | - | 22 mm (0.87 in) | 10 bar (145 psi) | ▪ With 3-A symbol and EHEDG certification<br>▪ ASME BPE compliance |
| | Type F | 50 mm (1.97 in) | 145 mm (5.71 in) | 135 mm (5.31 in) | 24 mm (0.95 in) | | |
| | Type N | 68 mm (2.67 in) | 165 mm (6.5 in) | 155 mm (6.1 in) | 24.5 mm (0.96 in) | | |

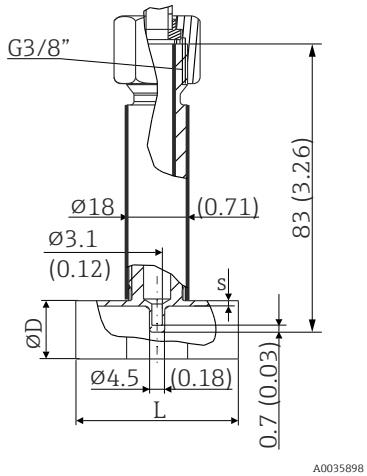
The VARINLINE® housing connection flange is suitable for welding into the conical or torispherical head in tanks or containers with a small diameter (≤ 1.6 m (5.25 ft)) and up to a wall thickness of 8 mm (0.31 in).
Varivent® Type F cannot be used for installations in pipes in combination with the VARINLINE® housing connection flange.

1) Options depend on product and configuration

| Model | Type of fitting | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | ϕD | ϕA | h | |
| SMS 1147   *1 Cap nut* *2 Sealing ring* *3 Counterpart connection* | DN25 | 32 mm (1.26 in) | 35.5 mm (1.4 in) | 7 mm (0.28 in) | $P_{max.}$ = 6 bar (87 psi) |
| | DN38 | 48 mm (1.89 in) | 55 mm (2.17 in) | 8 mm (0.31 in) | |
| | DN51 | 60 mm (2.36 in) | 65 mm (2.56 in) | 9 mm (0.35 in) | |

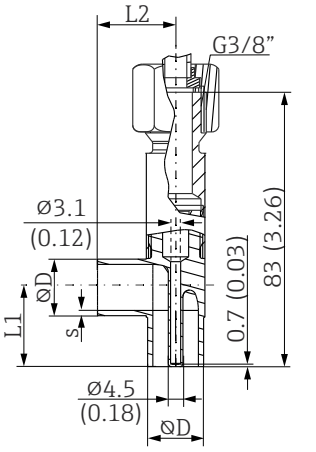
The counterpart connection must fit the sealing ring and fix it in place.

*Tee thermowell, optimized (no welding, no dead legs)*

| Model | Type of fitting [1] | | Dimensions in mm (in) | | | Technical properties |
|---|---|---|---|---|---|---|
| | | | ⌀D | L | s [2] | |
| Tee thermowell for welding in as per DIN 11865 (series A, B and C)   | Series A | DN10 PN25 | 13 mm (0.51 in) | 48 mm (1.89 in) | 1.5 mm (0.06 in) | • $P_{max.}$ = 25 bar (362 psi)<br>• 3-A marked [3] and EHEDG certified [3]<br>• ASME BPE compliance [3] |
| | | DN15 PN25 | 19 mm (0.75 in) | | | |
| | | DN20 PN25 | 23 mm (0.91 in) | | | |
| | | DN25 PN25 | 29 mm (1.14 in) | | | |
| | | DN32 PN25 | 32 mm (1.26 in) | | | |
| | Series B | DN13.5 PN25 | 13.5 mm (0.53 in) | | 1.6 mm (0.063 in) | |
| | | DN17.2 PN25 | 17.2 mm (0.68 in) | | | |
| | | DN21.3 PN25 | 21.3 mm (0.84 in) | | | |
| | | DN26.9 PN25 | 26.9 mm (1.06 in) | | | |
| | | DN33.7 PN25 | 33.7 mm (1.33 in) | | 2 mm (0.08 in) | |
| | Series C | DN12.7 PN25 (½") | 12.7 mm (0.5 in) | | 1.65 mm (0.065 in) | |
| | | DN19.05 PN25 (¾") | 19.05 mm (0.75 in) | | | |
| | | DN25.4 PN25 (1") | 25.4 mm (1 in) | | | |
| | | DN38.1 PN25 (1½") | 38.1 mm (1.5 in) | | | |

1) Options depend on product and configuration
2) Wall thickness
3) Applies to ≥ DN25. The radius ≥ 3.2 mm (⅛ in) cannot be maintained for smaller nominal diameters.

*Elbow thermowell, optimized (no welding, no dead legs)*

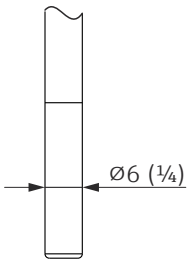
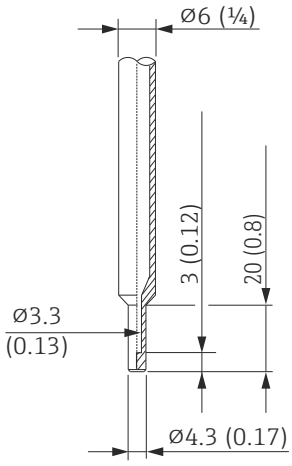
| Model | Type of fitting | | Dimensions | | | | Technical properties |
|---|---|---|---|---|---|---|---|
| | | | ϕD | L1 | L2 | s [1] | |
| Elbow thermowell for welding in as per DIN 11865 (series A, B and C)<br>  <br><br>*Unit of measurement mm (in)* | Series A | DN10 PN25 | 13 mm (0.51 in) | 22 mm (0.86 in) | 24 mm (0.95 in) | 1.5 mm (0.06 in) | ▪ $P_{max.}$ = 25 bar (362 psi)<br>▪ 3-A marked and EHEDG certified for ≥ DN25<br>▪ ASME BPE compliance for ≥ DN25 |
| | | DN15 PN25 | 19 mm (0.75 in) | 25 mm (0.98 in) | | | |
| | | DN20 PN25 | 23 mm (0.91 in) | 27 mm (1.06 in) | | | |
| | | DN25 PN25 | 29 mm (1.14 in) | 30 mm (1.18 in) | | | |
| | | DN32 PN25 | 35 mm (1.38 in) | 33 mm (1.3 in) | | | |
| | Series B | DN13.5 PN25 | 13.5 mm (0.53 in) | 22 mm (0.86 in) | 24 mm (0.95 in) | 1.6 mm (0.063 in) | |
| | | DN17.2 PN25 | 17.2 mm (0.68 in) | 24 mm (0.95 in) | | | |
| | | DN21.3 PN25 | 21.3 mm (0.84 in) | 26 mm (1.02 in) | | | |
| | | DN26.9 PN25 | 26.9 mm (1.06 in) | 29 mm (1.14 in) | | | |
| | | DN33.7 PN25 | 33.7 mm (1.33 in) | 32 mm (1.26 in) | | 2.0 mm (0.08 in) | |
| | Series C | DN12.7 PN25 (½") [2] | 12.7 mm (0.5 in) | 22 mm (0.86 in) | 24 mm (0.95 in) | 1.65 mm (0.065 in) | |
| | | DN19.05 PN25 (¾") | 19.05 mm (0.75 in) | 25 mm (0.98 in) | | | |
| | | DN25.4 PN25 (1") | 25.4 mm (1 in) | 28 mm (1.1 in) | | | |
| | | DN38.1 PN25 (1½") | 38.1 mm (1.5 in) | 35 mm (1.38 in) | | | |

1) Wall thickness
2) Pipe dimensions as per ASME BPE

Shape of tip

**The thermal response time, the reduction of the flow cross-section and the mechanical load that occurs in the process are the criteria that matter when selecting the shape of the tip.**

Advantages of using reduced or tapered thermometer tips:
- A smaller tip shape has less impact on the flow characteristics of the pipe carrying the medium.
- Optimized flow characteristics
- Thermowell stability is increased.

| Direct contact, 6 mm (¼ in) | Thermowell, 6 mm (¼ in) |
|---|---|
|  |  |

## 14.9 User interface

Operating concept

The device-specific parameters are configured via IO-Link. There are specific configuration or operating programs from different manufacturers available to the user for this purpose. The device description file (IODD) is provided for the thermometer.

**IO-Link operating concept**

*Operator-oriented menu structure for user-specific tasks. Guided menus divided by user category:*

- Operator
- Maintenance
- Specialist

*Efficient diagnostic behavior increases measurement reliability*

- Diagnostic messages
- Remedial action
- Simulation options

**IODD download**

http://www.endress.com/download

- Select **Software** as the media type.
- Select **Device Driver** as the software type.
  Select IO-Link (IODD).
- In the "Text Search" field enter the device name.

https://ioddfinder.io-link.com/

Search by
- Manufacturer
- Article number
- Product type

Local operation

There are no operating elements directly on the device. The temperature transmitter is configured via remote operation.

| | |
|---|---|
| Local display | There are no display elements directly on the device. The measured value and diagnostic messages, for instance, can be accessed via IO-Link. |
| Remote operation | IO-Link functions and device-specific parameters are configured via the device's IO-Link communication.<br>Special configuration kits are available, e.g. the FieldPort SFP20. Every IO-Link device can be configured with it.<br><br>IO-Link devices are typically configured via the automation system (e.g. Siemens TIA Portal and Port Configuration Tool). Parameters for device replacement can be stored in the IO-Link master. |

## 14.10 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

| | |
|---|---|
| MTBF | For the transmitter: 327 years, according to Siemens Standard SN29500 |
| Hygiene standard | ▪ EHEDG certificate, type EL CLASS I. EHEDG-certified/tested process connections. → 🖹 53<br>▪ 3-A certificate authorization no. 1144, 3-A Sanitary standard 74-07. Listed process connections. → 🖹 53<br>▪ ASME BPE (latest edition), certificate of conformity can be ordered for indicated options<br>▪ FDA-compliant<br>▪ All surfaces in contact with the medium are free from materials derived from bovine animals or other livestock (ADI/TSE) |
| Materials in contact with food/product (FCM) | The process contact parts (FCM) are in conformity with the following European Regulations:<br>▪ Regulation (EC) No 1935/2004, on materials and articles intended to come into contact with food, article 3, paragraph 1, article 5 and 17.<br>▪ Regulation (EC) No 2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food.<br>▪ Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food. |
| CRN approval | The CRN approval is only available for certain thermowell versions. These versions are identified and displayed accordingly during the configuration of the device.<br><br>Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Download Area under www.endress.com :<br>1. Select the country<br>2. Select Downloads<br>3. In the search area: select Approvals/approval type<br>4. Enter the product code or device<br>5. Start the search |

| | |
|---|---|
| Surface roughness | Free from oil and grease for $O_2$ applications, optional |
| Material resistance | Material resistance - including resistance of housing - to the following Ecolab cleaning/ disinfection agents:<br>▪ P3-topax 66<br>▪ P3-topactive 200<br>▪ P3-topactive 500<br>▪ P3-topactive OKTO<br>▪ And demineralized water |

# 15 Overview of the IO-Link operating menu

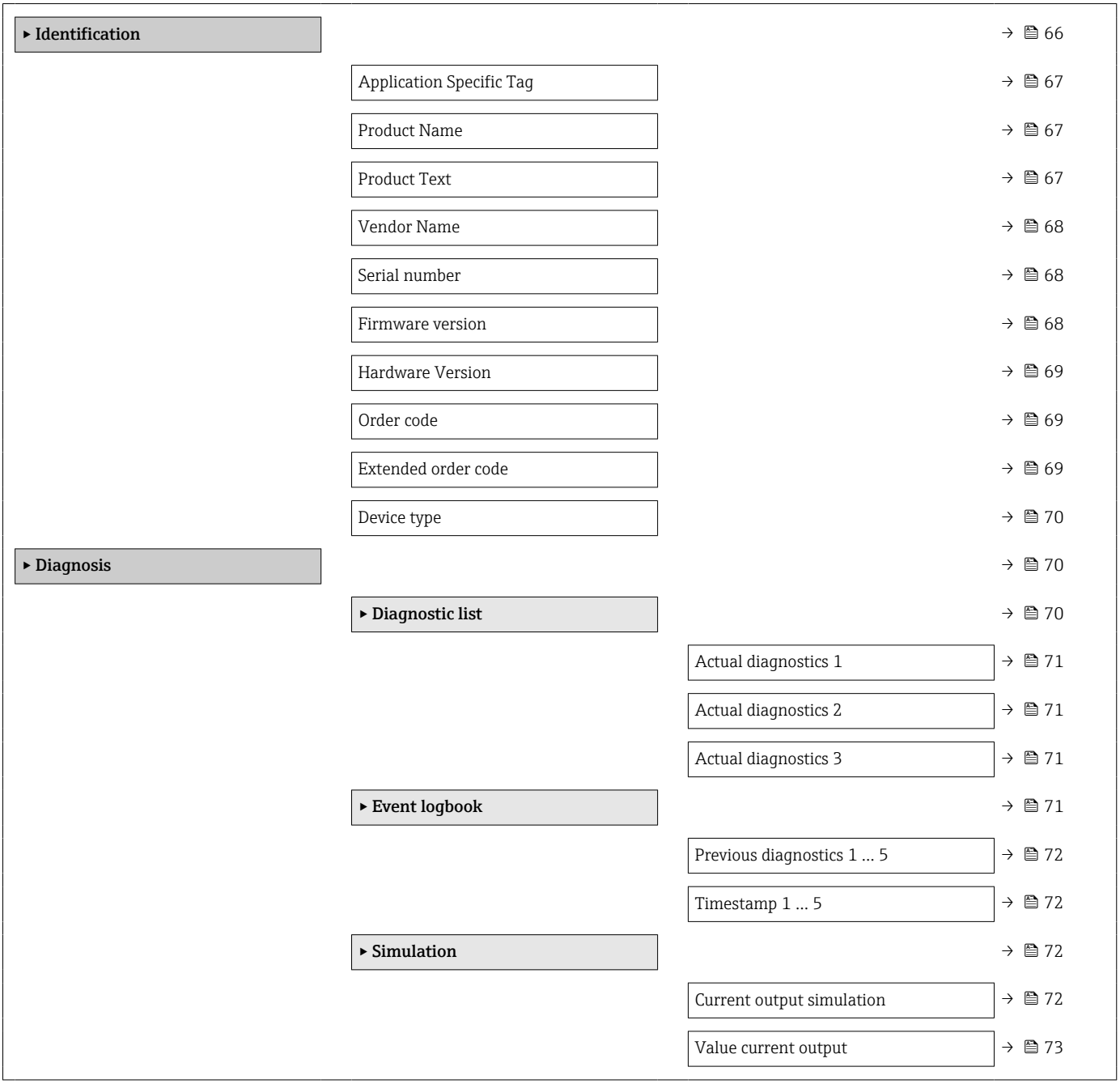
The following tables list all the parameters that are contained in the operating menu.

Depending on the parameter configuration, not all submenus and parameters are available in every device.

**Operation concept**

The IODD operating menu is based on an operation concept with different user roles.

| User role | Meaning |
|---|---|
| Operator | The operator has read access to a limited selection of parameters that are required during operation. |
| Maintenance | The maintenance technician has read and write access to a limited selection of parameters that are required to service and maintain the device. |
| Specialist | The specialist (expert) has read and write access to all the parameters in the device. |



| | | | |
|---|---|---|---|
| | | Sensor simulation | → 73 |
| | | Sensor simulation value | → 74 |
| | | Switch output simulation | → 74 |
| | ▸ **Sensor temperature** | | → 75 |
| | | Sensor max value | → 75 |
| | | Sensor min value | → 76 |
| | | Reset sensor min/max values | → 76 |
| | | Lower boundary operating time sensor | → 76 |
| | | Lower extended operating time sensor | → 77 |
| | | Standard operating time sensor | → 77 |
| | | Upper extended operating time sensor | → 77 |
| | | Upper boundary operating time sensor | → 78 |
| | ▸ **Device temperature** | | → 78 |
| | | Device temperature | → 79 |
| | | Device temperature max | → 79 |
| | | Device temperature min | → 79 |
| | | Reset device temp. min/max values | → 80 |
| | | Lower boundary operating time device | → 80 |
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| | | Upper boundary operating time device | → 81 |
| | ▸ **Measuring data channel** | | → 82 |
| | | MDC Descriptor.Lower limit | → 82 |
| | | MDC Descriptor.Upper limit | → 82 |
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| | | MDC Descriptor.Scale | → 83 |
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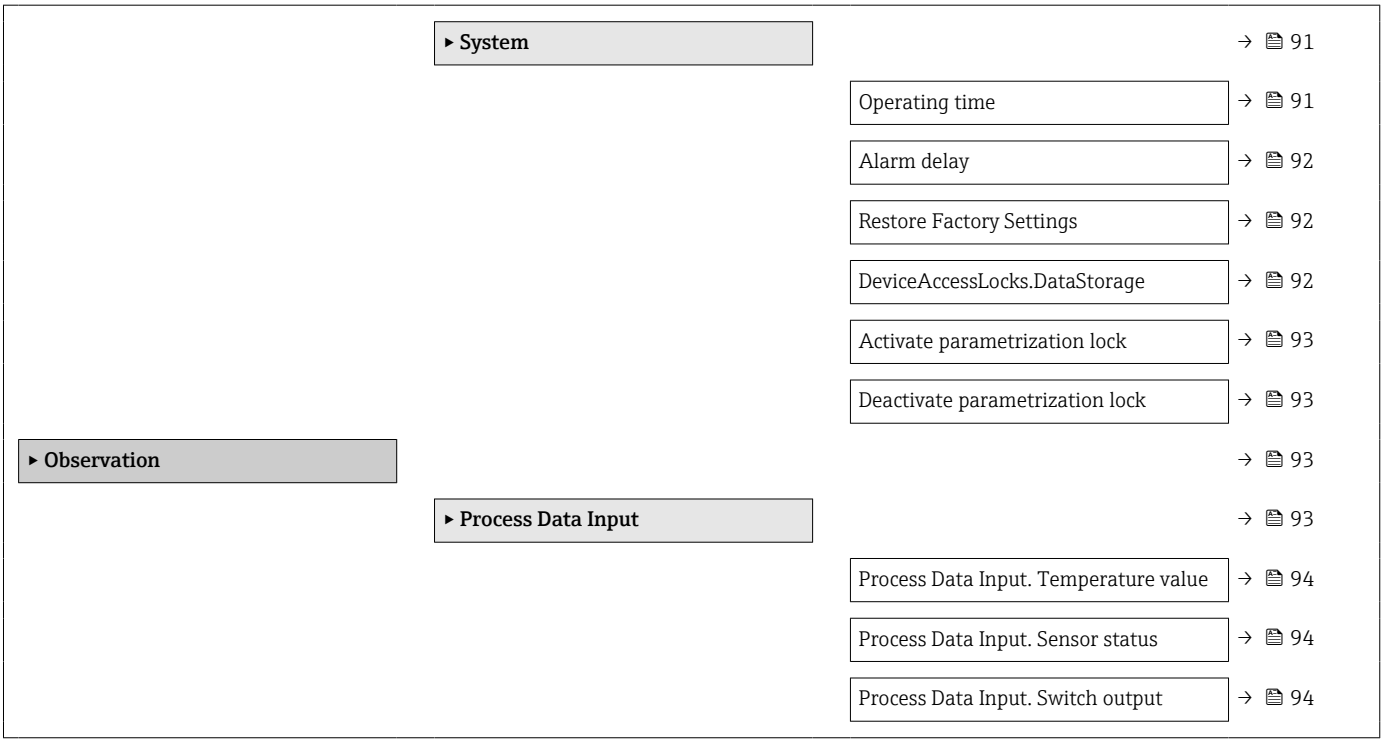
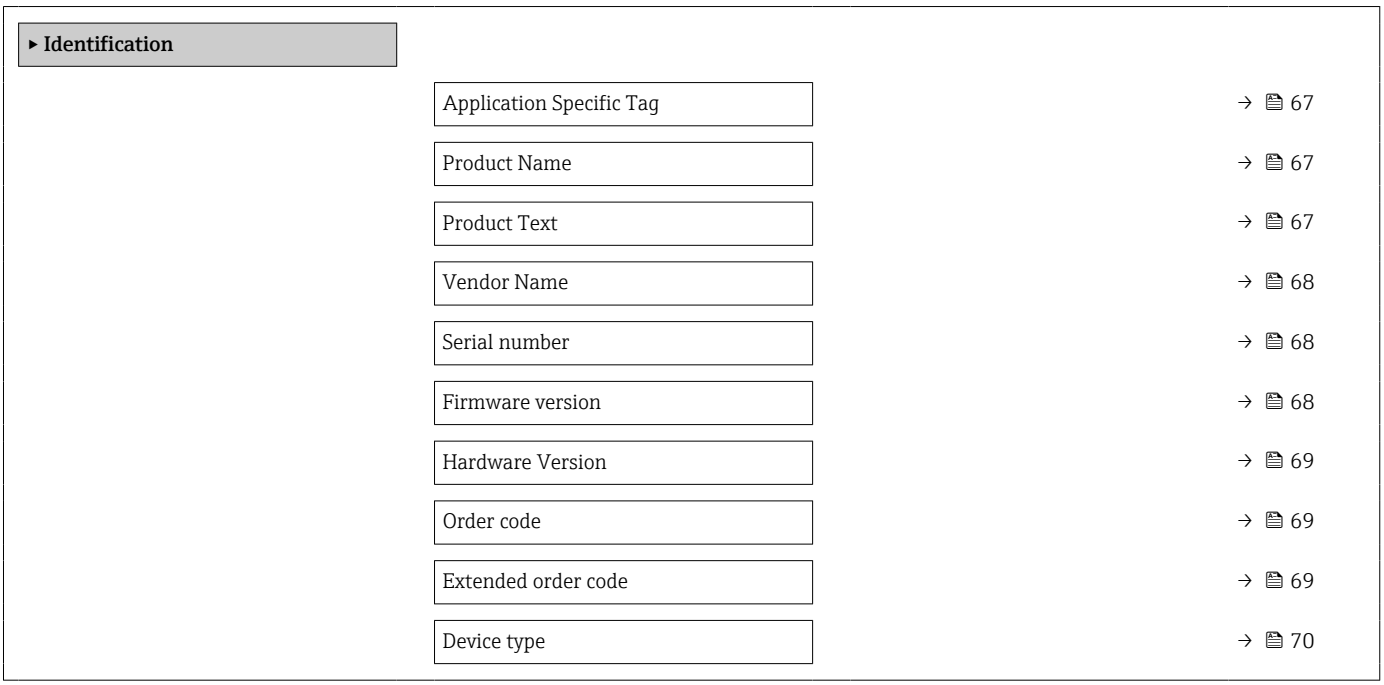
| | ▸ **Application** | | → 84 |
| | | ▸ **Sensor** | → 84 |
| | | ▸ **Switch output** | → 85 |
| | | ▸ **Current output** | → 88 |




## 15.1 Description of device parameters

### 15.1.1 Identification

*Navigation* Identification



## Application Specific Tag

**Navigation** Identification → Application Specific Tag

**Description** Use this function to enter a unique name for the measuring point so it can be identified quickly within the plant.

**User entry** Max. 32 alphanumeric characters

**Factory setting** As per order specifications

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Product Name

**Navigation** Identification → Product Name

**Description** Displays the product name

**User interface** iTHERM CompactLine TM311

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Product Text

**Navigation** Identification → Product Text

**Description** Displays the product text

**User interface** Compact thermometer

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Vendor Name

**Navigation** Identification → Vendor Name

**Description** Displays the manufacturer name

**User interface** Endress+Hauser

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Serial number

**Navigation** Identification → Serial number

**Description** Displays the serial number of the device. It can also be found on the nameplate.

To obtain specific information on the measuring device using the Device Viewer: www.endress.com/deviceviewer

**User interface** Character string comprising numbers, letters and special characters

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Firmware version

**Navigation** Identification → Firmware version

**Description** Displays the firmware version

**User interface** Character string comprising numbers, letters and special characters

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Hardware Version

**Navigation** Identification → Hardware Version

**Description** Displays the hardware version

**User interface** Character string comprising numbers, letters and special characters

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Order code

**Navigation** Identification → Order code

**Description** Displays the order code

**User interface** Character string comprising numbers, letters and special characters

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Extended order code

**Navigation** Identification → Extended order code

**Description** Displays the extended order code.

The extended order code indicates the attributes for all the device features in the product structure.

**User interface** Character string comprising numbers, letters and special characters

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

**Device type**

**Navigation** Identification → Device type

**Description** Displays the device type

**User interface** 37 887 (0x93FF)

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## 15.1.2 Diagnosis

*Navigation* Diagnosis

| | | |
|---|---|---|
| ▸ **Diagnosis** | | |
| | ▸ **Diagnostic list** | → 70 |
| | ▸ **Event logbook** | → 71 |
| | ▸ **Simulation** | → 72 |
| | ▸ **Sensor temperature** | → 75 |
| | ▸ **Device temperature** | → 78 |
| | ▸ **Measuring data channel** | → 82 |

### Diagnostic list

*Navigation* Diagnosis → Diagnostic list

| | | |
|---|---|---|
| ▸ **Diagnostic list** | | |
| | Actual diagnostics 1 | → 71 |
| | Actual diagnostics 2 | → 71 |
| | Actual diagnostics 3 | → 71 |

### Actual diagnostics 1

**Navigation** Diagnosis → Diagnostic list → Actual diagnostics 1

**Description** Displays the diagnostic message with the highest priority that is currently active.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Actual diagnostics 2

**Navigation** Diagnosis → Diagnostic list → Actual diagnostics 2

**Description** Displays the diagnostic message with the second-highest priority that is currently active.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Actual diagnostics 3

**Navigation** Diagnosis → Diagnostic list → Actual diagnostics 3

**Description** Displays the diagnostic message with the third-highest priority that is currently active.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Event logbook

*Navigation* Diagnosis → Event logbook

| | | |
|---|---|---|
| ▸ Event logbook | | |
| | Previous diagnostics 1 … 5 | → 72 |
| | Timestamp 1 … 5 | → 72 |

### Previous diagnostics 1 ... 5

**Navigation** Diagnosis → Event logbook → Previous diagnostics 1 ... 5

**Description** Displays the diagnostic messages that occurred in the past (in chronological order).

**Additional information** *User role*

Specialist

### Timestamp 1 ... 5

**Navigation** Diagnosis → Event logbook → Timestamp 1 ... 5

**Description** Displays the time of the last diagnostic message. The time comes from the operating time counter.

**Additional information** *User role*

Specialist

## Simulation

*Navigation* Diagnosis → Simulation

| ▸ Simulation | | |
|---|---|---|
| | Current output simulation | → 72 |
| | Value current output | → 73 |
| | Sensor simulation | → 73 |
| | Sensor simulation value | → 74 |
| | Switch output simulation | → 74 |

### Current output simulation

**Navigation** Diagnosis → Simulation → Current output simulation

**Description** Use this function to switch simulation of the current output on and off.

**Selection**
- Off
- On

**Factory setting** Off

**Additional information** *Description*

If a simulation is active, a warning to this effect is communicated via IO-Link (C491 - Simulation output). The simulation must be ended actively via the operating menu. If the device is disconnected from the power supply during the simulation and then power is resupplied afterwards, the simulation mode remains active. If the device is disconnected from the power supply a second time and then power is resupplied afterwards, the device resumes operation in the normal mode.

*User role*

- Operator
- Maintenance
- Specialist

## Value current output

**Navigation** Diagnosis → Simulation → Value current output

**Description** Use this function to enter a current value for the simulation. In this way, users can verify the correct adjustment of the current output and the correct function of downstream evaluation units.

**User entry** 3.58 to 23 mA

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Sensor simulation

**Navigation** Diagnosis → Simulation → Sensor simulation

**Description** Use this function to enable the simulation of the process variable.

**Selection**

- Off
- On

**Factory setting** Off

**Additional information** *Description*

If a simulation is active, a warning to this effect is communicated via IO-Link (C485 - Simulation process variable). The simulation must be ended actively via the operating menu. If the device is disconnected from the power supply during the simulation and then power is resupplied afterwards, the simulation mode remains active. If the device is disconnected from the power supply a second time and then power is resupplied afterwards, the device resumes operation in the normal mode.

*User role*

- Operator
- Maintenance
- Specialist

## Sensor simulation value

**Navigation** Diagnosis → Simulation → Sensor simulation value

**Description** Use this function to enter a simulation value for the process variable. Subsequent measured value processing and the signal output use this simulation value. In this way, users can verify whether the measuring device has been configured correctly.

**User entry** −50 to +200 °C

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Switch output simulation

**Navigation** Diagnosis → Simulation → Switch output simulation

**Description** Use this function to enable and configure the simulation of the switch output.

**Selection**

- Disabled
- Off
- On

**Factory setting** Disabled

**Additional information** *Description*

If a simulation is active, a warning to this effect is communicated via IO-Link (C494 - Simulation switch output). The simulation must be ended actively via the operating menu. If the device is disconnected from the power supply during the simulation and then power is resupplied afterwards, the simulation mode remains active. If the device is disconnected from the power supply a second time and then power is resupplied afterwards, the device resumes operation in the normal mode.

*User role*

- Operator
- Maintenance
- Specialist

### Sensor temperature

*Navigation* Diagnosis → Sensor temperature

| ▸ Sensor temperature | |
|---|---|
| Sensor max value | → 75 |
| Sensor min value | → 76 |
| Reset sensor min/max values | → 76 |
| Lower boundary operating time sensor | → 76 |
| Lower extended operating time sensor | → 77 |
| Standard operating time sensor | → 77 |
| Upper extended operating time sensor | → 77 |
| Upper boundary operating time sensor | → 78 |

## Sensor max value

**Navigation** Diagnosis → Sensor temperature → Sensor max value

**Description** Displays the maximum temperature measured in the past at the sensor input (maximum indicator).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Sensor min value

**Navigation** Diagnosis → Sensor temperature → Sensor min value

**Description** Displays the minimum temperature measured in the past at the sensor input (minimum indicator).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Reset sensor min/max values

**Navigation** Diagnosis → Sensor temperature → Reset sensor min/max values

**Description** Resets the lowest and highest temperature value measured at the sensor (reset the minimum/maximum indicators for the sensor temperature).

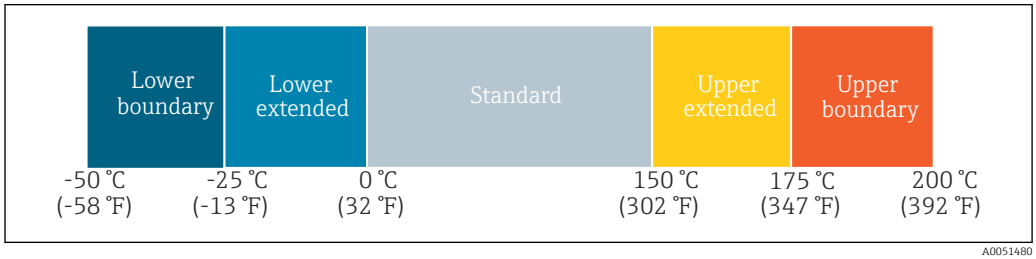
**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Lower boundary operating time sensor

**Navigation** Diagnosis → Sensor temperature → Lower boundary operating time sensor

**Description** Displays the operating time of the sensor in the lower process temperature boundary zone (Lower boundary).



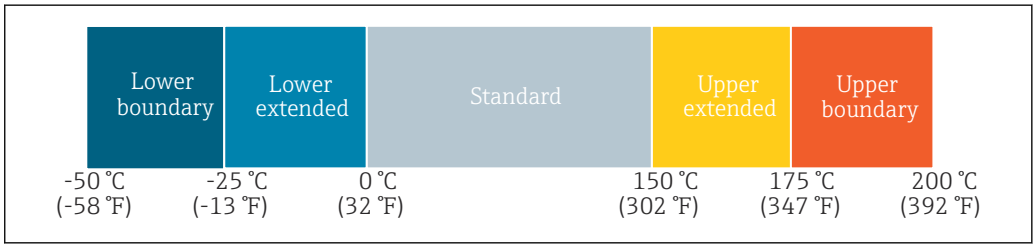

**Additional information** *User role*

Specialist

## Lower extended operating time sensor

**Navigation** Diagnosis → Sensor temperature → Lower extended operating time sensor

**Description** Displays the operating time of the sensor in the lower process temperature range (Lower extended).



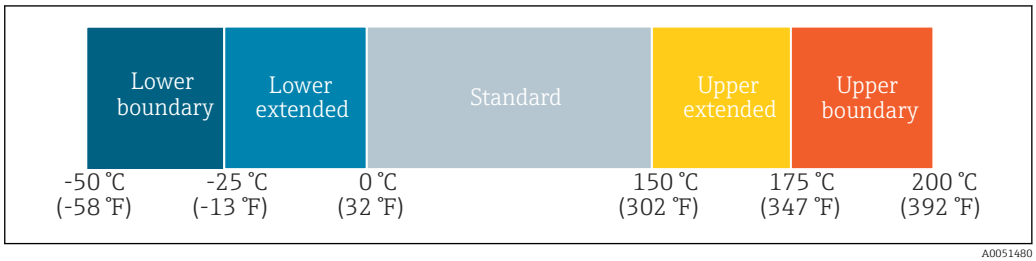

**Additional information** *User role*

Specialist

## Standard operating time sensor

**Navigation** Diagnosis → Sensor temperature → Standard operating time sensor

**Description** Displays the operating time of the sensor in the normal process temperature range (Standard).



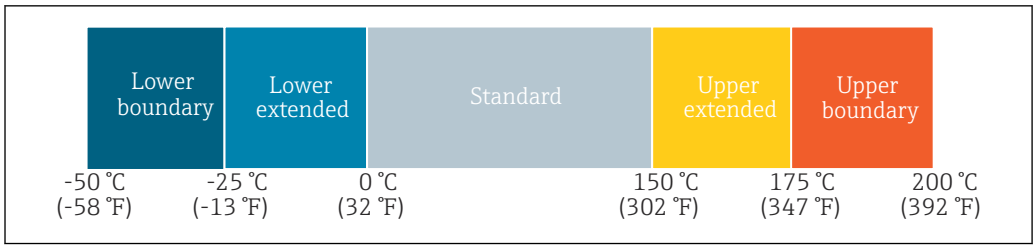

**Additional information** *User role*

Specialist

## Upper extended operating time sensor

**Navigation** Diagnosis → Sensor temperature → Upper extended operating time sensor

**Description** Displays the operating time of the sensor in the upper process temperature range (Upper extended).



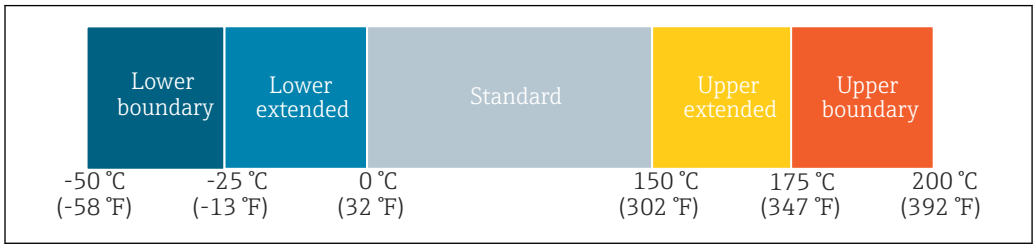

**Additional information** *User role*

Specialist

## Upper boundary operating time sensor

**Navigation** Diagnosis → Sensor temperature → Upper boundary operating time sensor

**Description** Displays the operating time of the sensor in the upper process temperature boundary zone (Upper boundary).




**Additional information** *User role*

Specialist

### Device temperature

*Navigation* Diagnosis → Device temperature

| ▸ Device temperature | |
|---|---|
| Device temperature | → 79 |
| Device temperature max | → 79 |
| Device temperature min | → 79 |
| Reset device temp. min/max values | → 80 |
| Lower boundary operating time device | → 80 |
| Lower extended operating time device | → 80 |
| Standard operating time device | → 81 |

| | | |
|---|---|---|
| | Upper extended operating time device | → 81 |
| | Upper boundary operating time device | → 81 |

## Device temperature

**Navigation** Diagnosis → Device temperature → Device temperature

**Description** Displays the current device temperature (electronics).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Device temperature max

**Navigation** Diagnosis → Device temperature → Device temperature max

**Description** Displays the maximum device temperature measured in the past (maximum indicator).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Device temperature min

**Navigation** Diagnosis → Device temperature → Device temperature min

**Description** Displays the minimum device temperature measured in the past (minimum indicator).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Reset device temp. min/max values

**Navigation** Diagnosis → Device temperature → Reset device temp. min/max values

**Description** Resets the lowest and highest device temperature that has been measured (reset the minimum/maximum indicators for the device temperature).

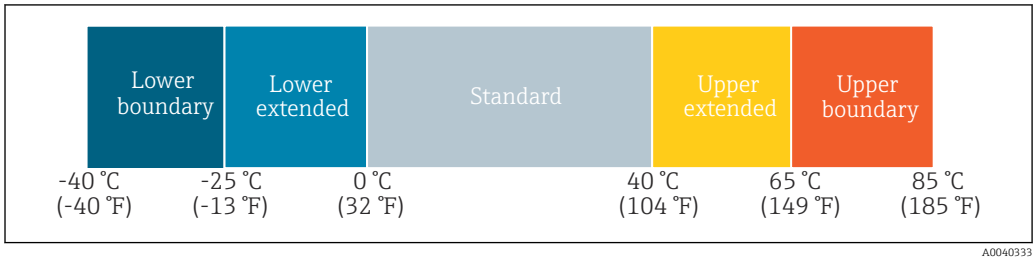
**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Lower boundary operating time device

**Navigation** Diagnosis → Device temperature → Lower boundary operating time device

**Description** Displays the operating time of the device in the lower ambient temperature boundary zone (Lower boundary).



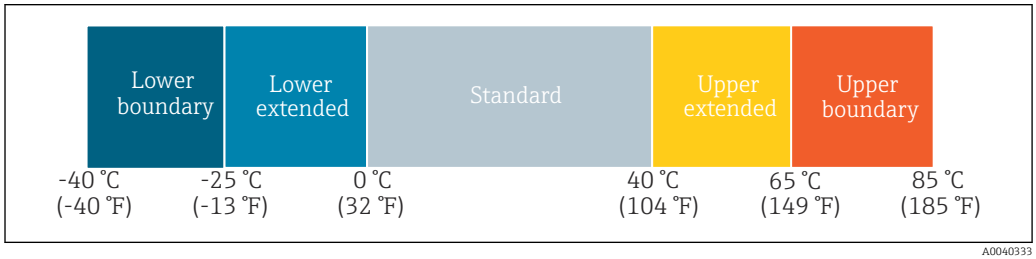

**Additional information** *User role*

Specialist

## Lower extended operating time device

**Navigation** Diagnosis → Device temperature → Lower extended operating time device

**Description** Displays the operating time of the device in the lower ambient temperature range (Lower extended).



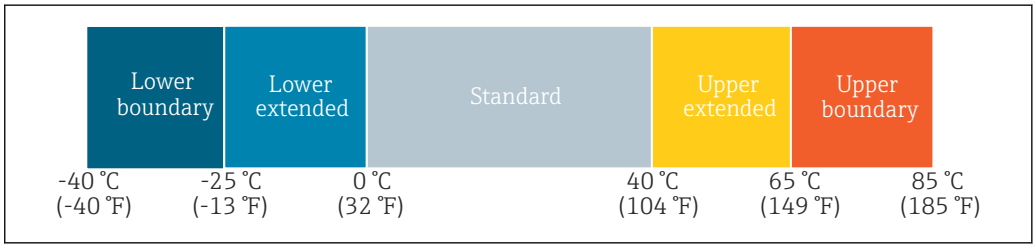

**Additional information** *User role*

Specialist

## Standard operating time device

**Navigation** Diagnosis → Device temperature → Standard operating time device

**Description** Displays the operating time of the device in the normal ambient temperature range (Standard).



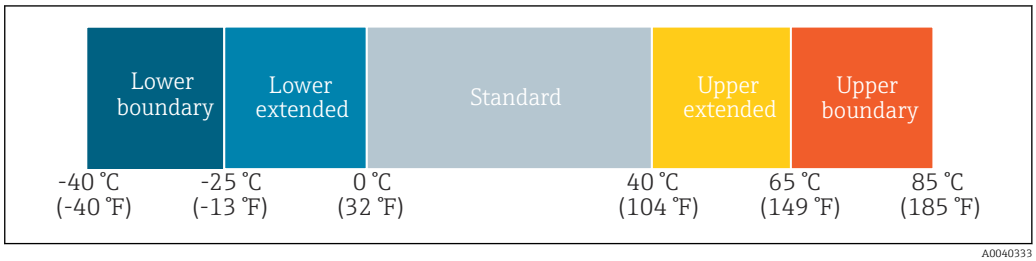

**Additional information** *User role*

Specialist

## Upper extended operating time device

**Navigation** Diagnosis → Device temperature → Upper extended operating time device

**Description** Displays the operating time of the device in the upper ambient temperature range (Upper extended).



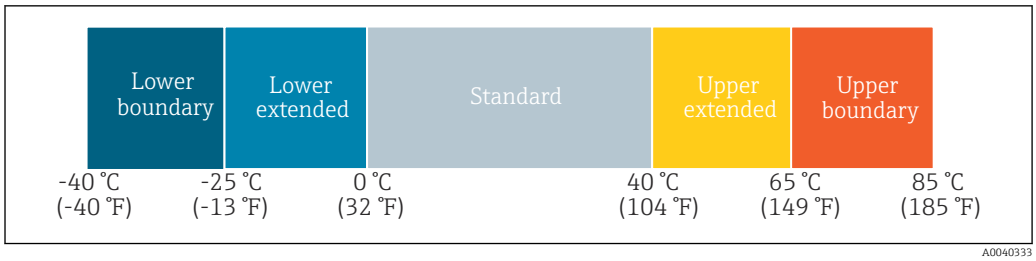

**Additional information** *User role*

Specialist

## Upper boundary operating time device

**Navigation** Diagnosis → Device temperature → Upper boundary operating time device

**Description** Displays the operating time of the device in the upper ambient temperature boundary zone (Upper boundary).

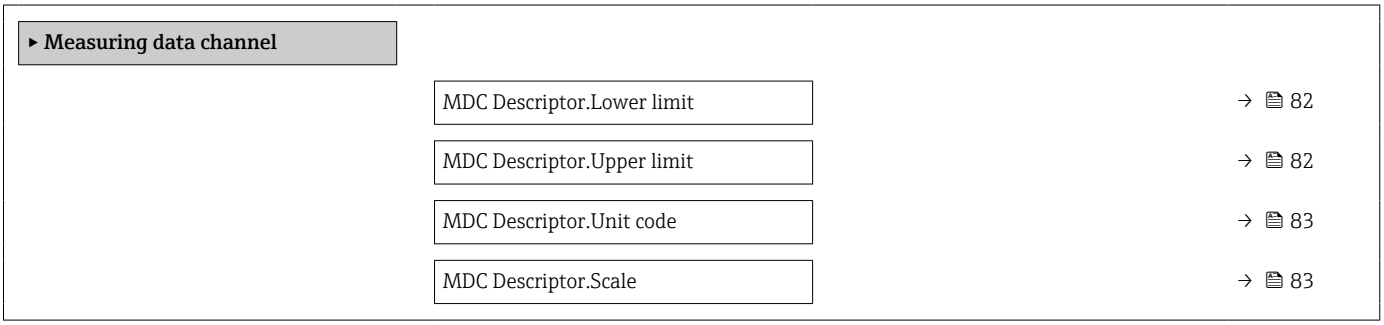



**Additional information** *User role*

Specialist

### Measuring data channel

*Navigation* Diagnosis → Measuring data channel




### MDC Descriptor.Lower limit

**Navigation** Diagnosis → Measuring data channel → MDC Descriptor.Lower limit

**Description** Displays the lower value of the measuring range.

According to Smart Sensor Profile 2nd Edition.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### MDC Descriptor.Upper limit

**Navigation** Diagnosis → Measuring data channel → MDC Descriptor.Upper limit

**Description** Displays the upper value of the measuring range.

According to Smart Sensor Profile 2nd Edition.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

**MDC Descriptor.Unit code**

**Navigation** Diagnosis → Measuring data channel → MDC Descriptor.Unit code

**Description** Displays the unit code for the unit according to IO-Link.

According to Smart Sensor Profile 2nd Edition.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

**MDC Descriptor.Scale**

**Navigation** Diagnosis → Measuring data channel → MDC Descriptor.Scale

**Description** Displays the scaling of the measured value ($10^{scale}$).

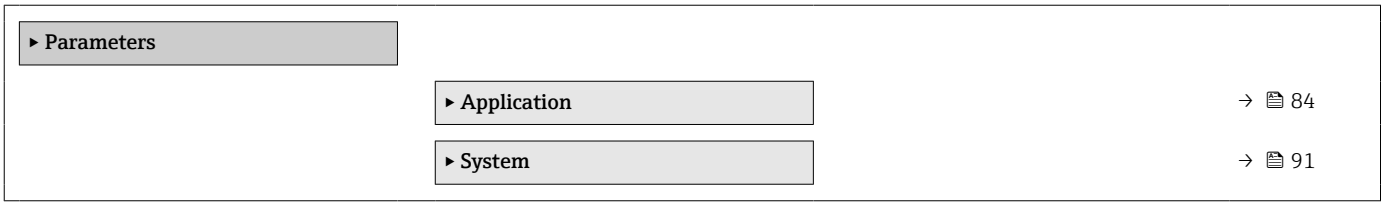
According to Smart Sensor Profile 2nd Edition.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

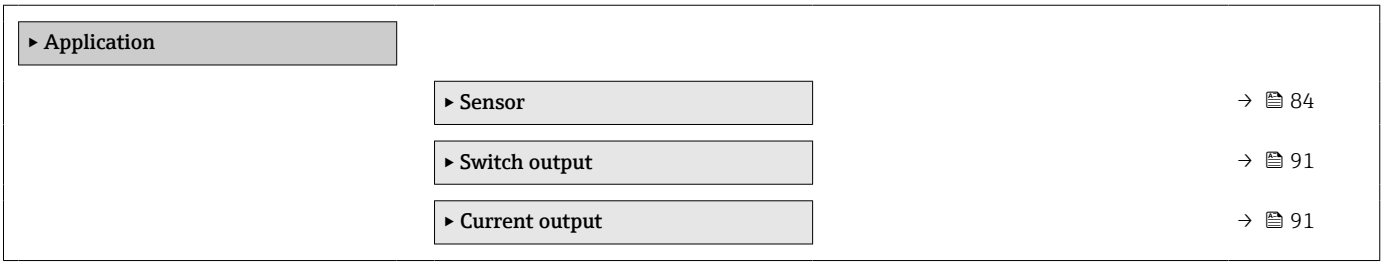
### 15.1.3 Parameters

*Navigation* Parameters



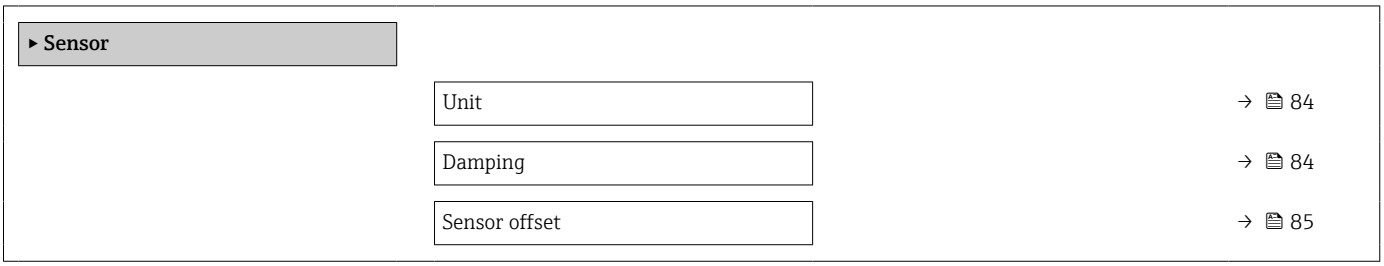
### Application

*Navigation* Parameters → Application




*Sensor*

*Navigation* Parameters → Application → Sensor




### Unit

**Navigation** Parameters → Application → Sensor → Unit

**Description** Use this function to select the engineering unit for all the measured values and parameters.

**Selection**
- °C
- °F
- K

**Factory setting** °C

**Additional information** *User role*
- Operator
- Maintenance
- Specialist

### Damping

**Navigation** Parameters → Application → Sensor → Damping

**Description** Use this function to enter the time constant for measured value damping.

**User entry** 0 to 120 s

**Factory setting** 0 s

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Sensor offset

**Navigation** Parameters → Application → Sensor → Sensor offset

**Description** Use this function to enter the zero point correction (offset) of the sensor measured value. The specified value is added to the measured value.

**User entry** −10 to +10 °C (14 to 50 °F)

**Factory setting** 0 °C

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

*Switch output*

*Navigation* Parameters → Application → Switch output

| ▸ Switch output | | |
|---|---|---|
| | Operating mode | → 86 |
| | Switch point value | → 87 |
| | Switchback point value | → 87 |
| | Switch delay | → 88 |
| | Switchback delay | → 88 |

## Operating mode

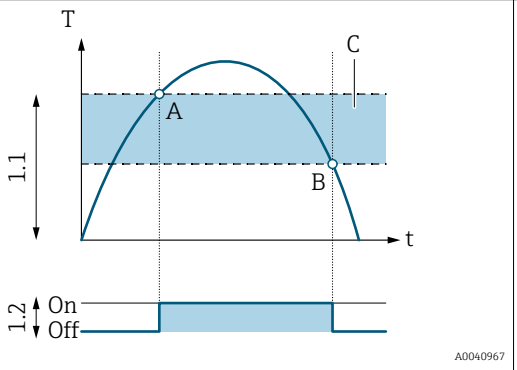
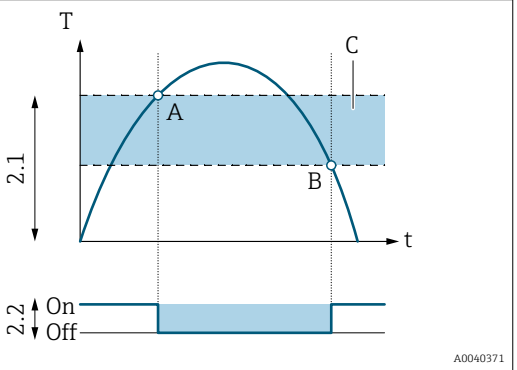
**Navigation** Parameters → Application → Switch output → Operating mode

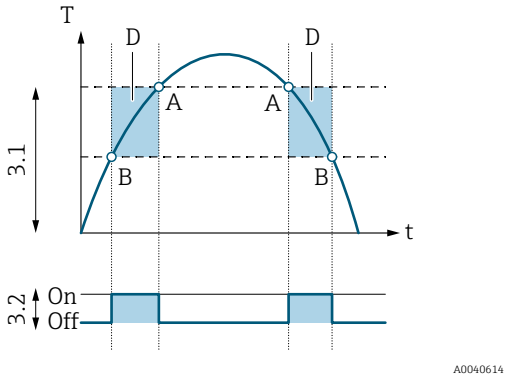
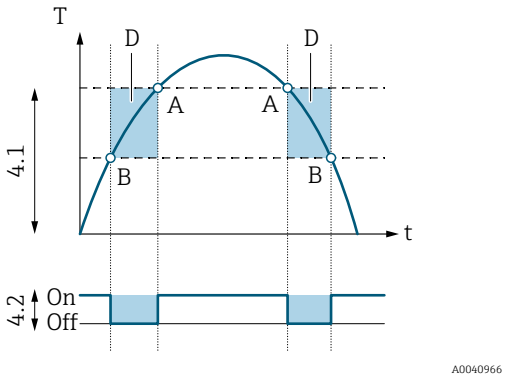
**Description** Use this function to select the switch output.

**Selection**
- Hysteresis normally open
- Hysteresis normally closed
- Window normally open
- Window normally closed
- Off

**Factory setting** Hysteresis normally open (or as per order specifications)

**Additional information** *Selection*
- Hysteresis normally open
  The switch output is specified as a normally open (NO) contact with hysteresis properties (using SP and RSP).
- Hysteresis normally closed
  The switch output is specified as a normally closed (NC) contact with hysteresis properties (using SP and RSP).
- Window normally open
  The switch output is specified as a normally open (NO) contact with window properties (using SP and RSP).
- Window normally closed
  The switch output is specified as a normally closed (NC) contact with window properties (using SP and RSP).
- Off
  The switch function is not active.

| Hysteresis normally open | Hysteresis normally closed |
|---|---|
|  |  |
| *1.1 Input variable*<br>*1.2 Switch output*<br>*A Switch point (SP)*<br>*B Switchback point (RSP)*<br>*C Hysteresis* | *2.1 Input variable*<br>*2.2 Switch output*<br>*A Switch point (SP)*<br>*B Switchback point (RSP)*<br>*C Hysteresis* |

| Window normally open | Window normally closed |
|---|---|
|  |  |
| *3.1 Input variable*<br>*3.2 Switch output*<br>*A Switch point (SP) (upper window limit)*<br>*B Switchback point (RSP) (lower window limit)*<br>*D Window* | *4.1 Input variable*<br>*4.2 Switch output*<br>*A Switch point (SP) (upper window limit)*<br>*B Switchback point (RSP) (lower window limit)*<br>*D Window* |

*User role*

- Operator
- Maintenance
- Specialist

## Switch point value

**Navigation** Parameters → Application → Switch output → Switch point value

**Description** Use this function to enter the switch point (SP) for the hysteresis/upper value for the window function. The value entered must be greater than the switchback point (RSP).

**User entry** Signed floating-point number

**Factory setting** 100 °C

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Switchback point value

**Navigation** Parameters → Application → Switch output → Switchback point value

**Description** Use this function to enter the switchback point (RSP) for the hysteresis/lower switch point for the window function. The value entered must be smaller than the switch point (SP).

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Switch delay

**Navigation** Parameters → Application → Switch output → Switch delay

**Description** Use this function to enter a delay time to prevent constant switching at values around the switch point (SP). If the measured value leaves the switching range during the delay time, the delay time starts again.

**User entry** 0 to 99 s

**Factory setting** 0 s

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Switchback delay

**Navigation** Parameters → Application → Switch output → Switchback delay

**Description** Use this function to enter a delay time to prevent constant switching at values around the switchback point (RSP). If the measured value leaves the switching range during the delay time, the delay time starts again.

**User entry** 0 to 99 s

**Factory setting** 0 s

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

*Current output*

*Navigation* Parameters → Application → Current output

| ▸ Current output |
|---|

| | | |
|---|---|---|
| | 4 mA value | → 89 |
| | 20 mA value | → 89 |
| | Current trimming 4 mA | → 90 |
| | Current trimming 20 mA | → 90 |
| | Failure mode | → 90 |
| | Failure current | → 91 |

## 4 mA value

**Navigation** Parameters → Application → Current output → 4 mA value

**Description** Use this function to enter the temperature value that is to correspond to the 4 mA value. It is possible to invert the current output by changing the assignment of the start/end of the measuring range.

The span between the 4 mA value and the 20 mA value must be at least 10 K.

**User entry** −50 000 to +50 000 °C (−89 968 to +90 032 °F)

**Factory setting** 0 °C

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## 20 mA value

**Navigation** Parameters → Application → Current output → 20 mA value

**Description** Use this function to enter the temperature value that is to correspond to the 20 mA value. It is possible to invert the current output by changing the assignment of the start/end of the measuring range.

The span between the 4 mA value and the 20 mA value must be at least 10 K.

**User entry** −50 000 to +50 000 °C (−89 968 to +90 032 °F)

**Factory setting** 150 °C

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Current trimming 4 mA

**Navigation** Parameters → Application → Current output → Current trimming 4 mA

**Description** Use this function to enter the correction value for the current output at the start of the measuring range at 4 mA.

**User entry** 3.85 to 4.15 mA

**Factory setting** 4.00 mA

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Current trimming 20 mA

**Navigation** Parameters → Application → Current output → Current trimming 20 mA

**Description** Use this function to enter the correction value for the current output at the end of the measuring range at 20 mA.

**User entry** 19.85 to 20.15 mA

**Factory setting** 20.00 mA

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Failure mode

**Navigation** Parameters → Application → Current output → Failure mode

**Description** Use this function to select the signal on alarm level of the current output in the event of an error.

**Selection**

- 0 (Low alarm)
- 2 (High alarm)

**Factory setting** 0

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Failure current

**Navigation** Parameters → Application → Current output → Failure current

**Description** Use this function to enter the current value for a high alarm that the current output adopts in an alarm condition.

**User entry** 21.50 to 23.00 mA

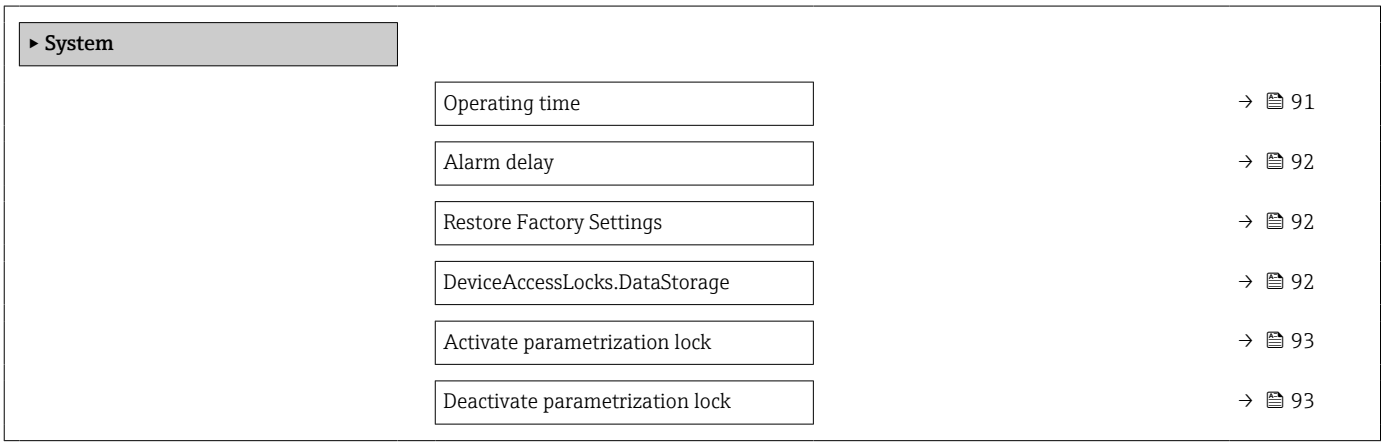
**Factory setting** 22.5 mA

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## System

*Navigation* Parameters → System




### Operating time

**Navigation** Parameters → System → Operating time

**Description** Displays the length of time in hours (h) that the device has been in operation up until now.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Alarm delay

**Navigation** Parameters → System → Alarm delay

**Description** Use this function to enter the delay time during which a diagnostic signal is suppressed before an error message is issued.

**User entry** 0 to 255 s

**Factory setting** 0 s

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Restore Factory Settings

**Navigation** Parameters → System → Restore Factory Settings

**Description** Use this function to reset the entire device configuration to the factory settings.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### DeviceAccessLocks.DataStorage

**Navigation** Parameters → System → DeviceAccessLocks.DataStorage

**Description** Use this function to lock data storage. Standard function of IO-Link.

**Selection**

- Unlocked
- Locked

**Factory setting** Unlocked

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

**Activate parametrization lock**

**Navigation** Parameters → System → Activate parametrization lock

**Description** Use this function to lock the parameterization of the device.

**Additional information** *User role*

- Maintenance
- Specialist

**Deactivate parametrization lock**

**Navigation** Parameters → System → Deactivate parametrization lock

**Description** Use this function to unlock the parameterization of the device.

**Additional information** *User role*

- Maintenance
- Specialist

### 15.1.4 Observation

*Navigation* Observation

| | | |
|---|---|---|
| ▸ **Observation** | | |
| | ▸ **Process Data Input** | → 93 |

**Process Data Input**

*Navigation* Observation → Process Data Input

| | | |
|---|---|---|
| ▸ **Process Data Input** | | |
| | Process Data Input. Temperature value | → 94 |
| | Process Data Input. Sensor status | → 94 |
| | Process Data Input. Switch output | → 94 |

### Process Data Input. Temperature value

**Navigation** Observation → Process Data Input → Process Data Input. Temperature value

**Description** Displays the temperature value that is currently measured.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Process Data Input. Sensor status

**Navigation** Observation → Process Data Input → Process Data Input. Sensor status

**Description** Displays the current sensor status.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

### Process Data Input. Switch output

**Navigation** Observation → Process Data Input → Process Data Input. Switch output

**Description** Displays the current switch status.

**User interface**

- 0 (Off)
- 1 (On)

**Additional information** *User role*

- Operator
- Maintenance
- Specialist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