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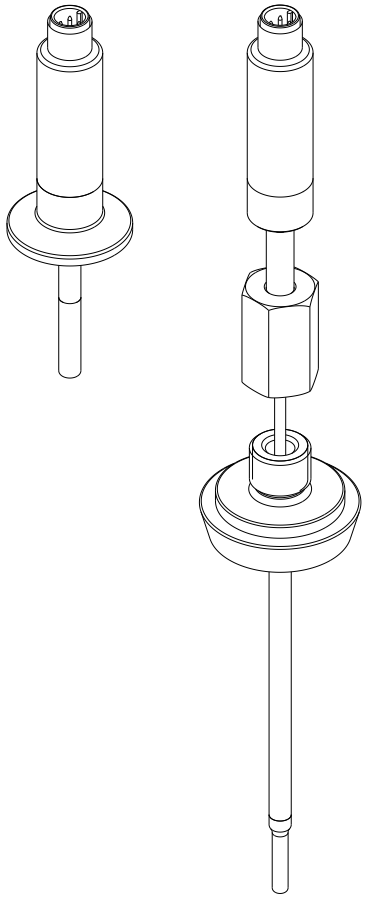
2020-06-29



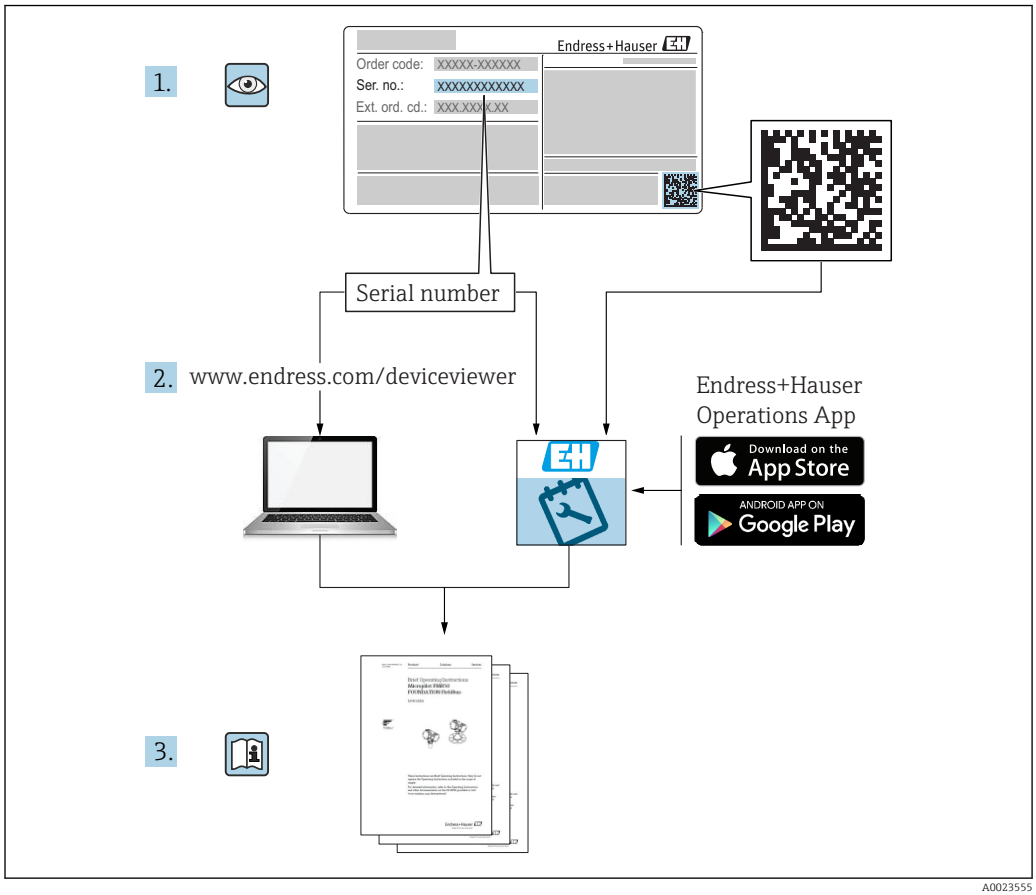
# Operating Instructions
# iTHERM CompactLine TM311

Compact thermometer with IO-Link

IO-Link



Endress+Hauser
People for Process Automation


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX
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 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.

## 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. |
| ⏚ | **Protective Earth (PE)**<br>A terminal which must be connected to ground prior to establishing any other connections.<br>The ground terminals are situated inside and outside the device:<br>▪ Inner ground terminal: Connects the protectiv earth to the mains supply.<br>▪ Outer ground terminal: Connects the device 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. |
| ✗ | **Forbidden**<br>Procedures, processes or actions that are forbidden. |

| Symbol | Meaning |
|---|---|
|  | **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 |
|---|---|
|  <br>A0011222 | Open-ended wrench |

## 1.3 Documentation

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

- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

### 1.3.1 Standard documentation

| Document type | Purpose and content of the document |
|---|---|
| Technical Information | **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 | **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. |

### 1.3.2 Supplementary device-dependent documentation

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

## 1.4 Registered trademarks

IO-Link®
Is a registered trademark. It may only be used in conjunction with products and services by members of the IO-Link Community or by non-members who hold an appropriate license. For more detailed information on the use of IO-Link, please refer to the rules of the IO-Link Community at: www.io.link.com.

# 2 Basic 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 Designated use

- The device is a compact thermometer for industrial temperature measurement.
- The manufacturer is not liable for damage caused by improper or non-designated use.

## 2.3 Operational safety

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

**Conversions to the device**

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
- If, despite this, modifications are required, consult with Endress+Hauser.

**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 repair of an electrical device.
- Use original spare parts and accessories from Endress+Hauser only.

## 2.4 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

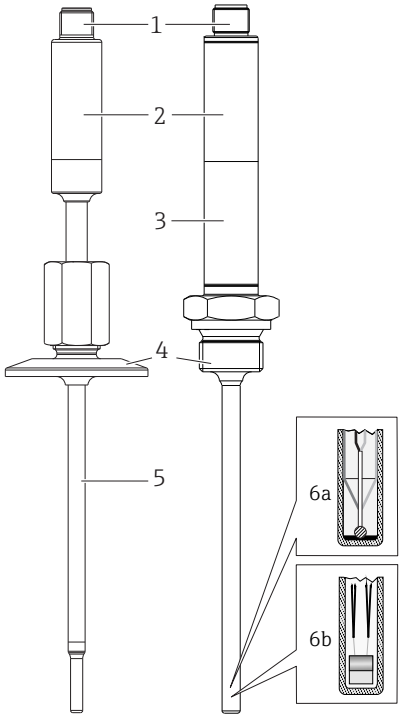
It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

## 2.5 IT security

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

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

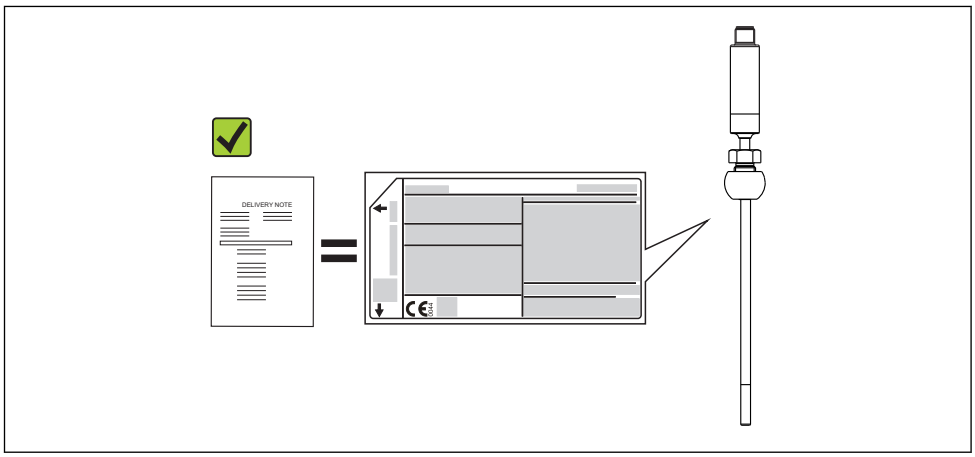
# 3 Product description

| 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>→ 🖹 51 | 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 T-pieces and elbow pieces |
| | 6: Insert with:<br>6a: iTHERM TipSens<br>6b: Pt100 (TF), basic | **Your benefits:**<br>▪ **iTHERM TipSens** - insert with shortest response times:<br>  ▪ Insert: Φ3 mm (⅛ in) or Φ6 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

Proceed as follows on receipt of the device:

1. Check whether the packaging is intact.
2. If damage is discovered:
   Report all damage immediately to the manufacturer.
3. Do not install damaged components, as the manufacturer cannot otherwise guarantee the material resistance or compliance with the original safety requirements, and can also not be held responsible for the consequences that may result.
4. Compare the scope of delivery against the contents of your order.
5. Remove all the packaging material used for transportation.
6. 

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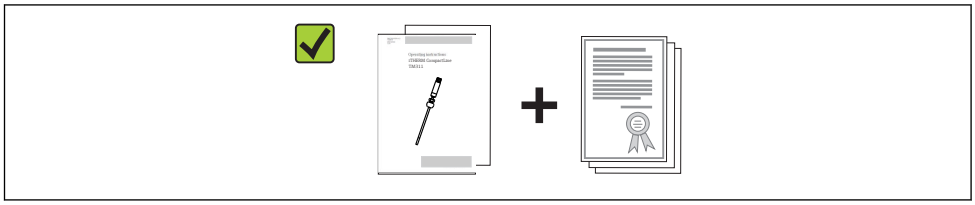
   Do the data on the nameplate match the ordering information on the delivery note?
7. 
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   Are the technical documentation and all other necessary documents provided e.g. certificates?

If one of the conditions is not satisfied, contact your Sales Center.

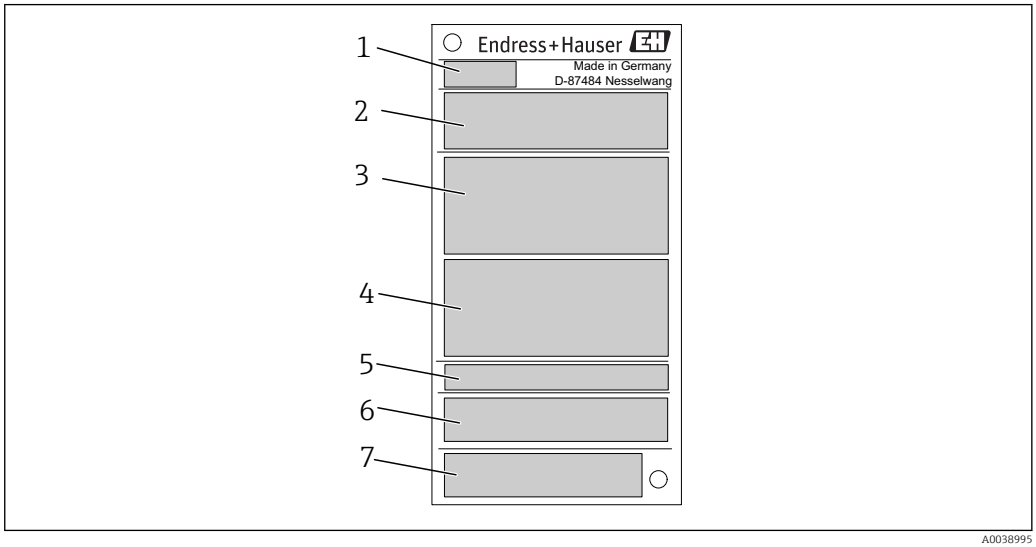
## 4.2 Product identification

The device can be identified in the following ways:
- Nameplate specifications
- Enter the serial number from the nameplate in the *W@M 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: TM311*
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 |
| **Address of manufacturing plant:** | See nameplate |

## 4.4 Storage and transport

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

### 4.4.1 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) |

# 5 Installation

## 5.1 Installation conditions

Information on the conditions that must be present at the installation location in order to ensure designated use (e.g. ambient temperature, degree of protection, climate class etc.), and information on the device dimensions → 38

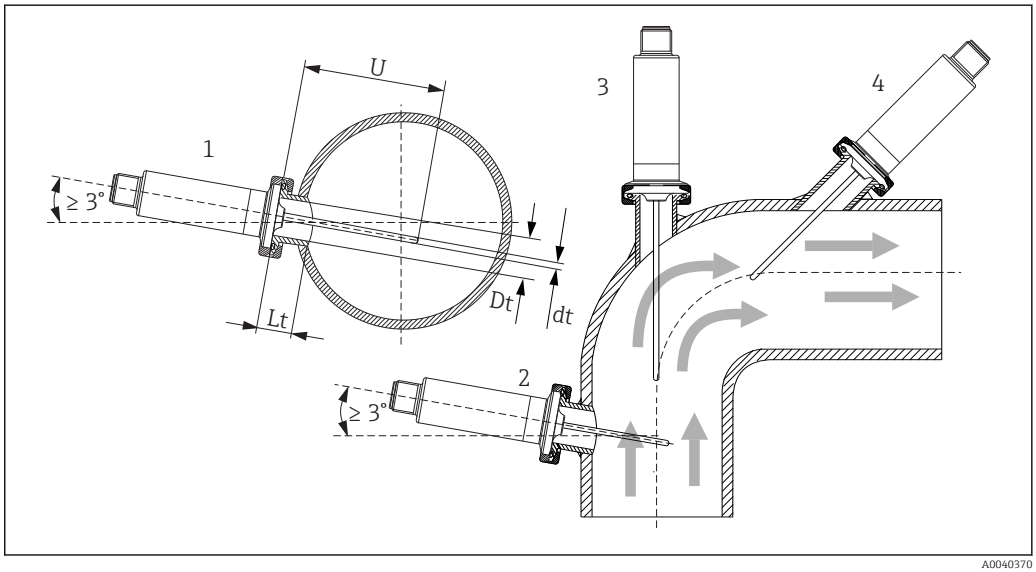
### 5.1.1 Orientation

No restrictions. However, self-draining in the process must be guaranteed. 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 accuracy. If the immersion length is too short, measurement errors can occur as a result of heat conduction via the process connection and the vessel wall. If installing in a pipe, the immersion length should ideally correspond to half of the pipe diameter.

Installation possibilities: pipes, tanks or other plant components.




2 *Installation examples*

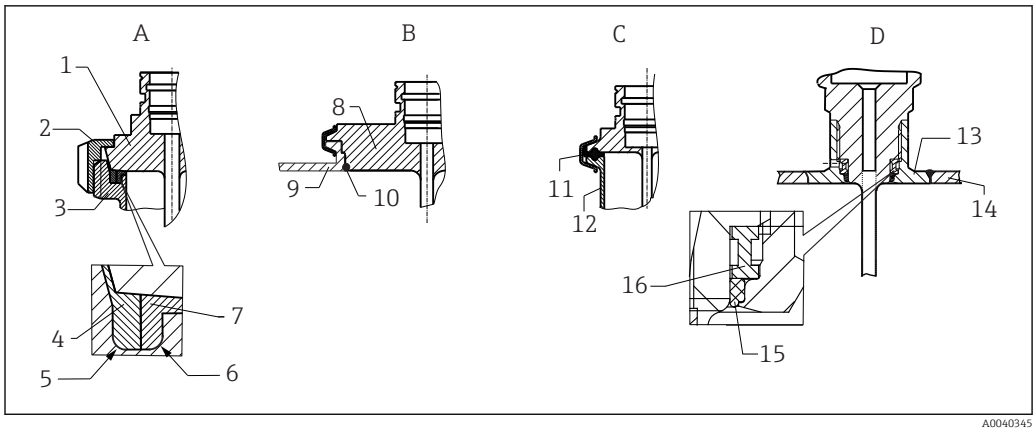
*1, 2 Perpendicular to flow direction, installed at a min. angle of 3 ° to ensure self-draining*
*3 On elbows*
*4 Inclined installation in pipes with a small nominal diameter*
*U Immersion length*

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

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

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

In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to project well into the process so that it extends past the pipe axis. Installation at an angle (4) could be another solution. When determining the immersion length or installation depth 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 connection with EHEDG certified and self-centering sealing ring*
*1 Sensor with milk pipe connection*
*2 Groove slip-on 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 included in the scope of supply for the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories → 30.

**NOTICE**

**The following actions must be taken if a sealing ring (O-ring) or seal fails:**

- The thermometer must be removed.
- The thread and the O-ring joint/sealing surface must be cleaned.
- The sealing ring or seal must be replaced.
- CIP must be performed after installation.

In the case of weld-in connections, exercise the necessary degree of care when performing the welding work on the process side:

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

Pay attention to the following when installing the thermometer to ensure that the cleanability is not affected:

1. The installed sensor is suitable for CIP (cleaning in place). Cleaning is performed together with the pipe or tank. In the case of internal tank fixtures using process connection nozzles, it is important to ensure that the cleaning assembly directly sprays this area so that it is cleaned properly.
2. The Varivent® couplings enable flush-mount installation.

### 5.1.3 General installation instructions

The device generates diagnostic message **S825** if a device temperature of 100 °C is reached due to unfavorable conditions (high process temperature, high ambient temperature, electronics close to the process). 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

Prior to installation:

1. Inspect the device for any damage caused during transportation.
2. Obvious damage must be reported immediately.

3. Pay attention to whether the thermometer may be installed directly in the process or whether a thermowell must be used.

For detailed information, see the Technical Information

Proceed as follows to install 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 loading 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 → 30.

### 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 T-piece or elbow piece thermowell | 5 |
| Process connection, metal sealing system | 10 |
| Compression fitting, spherical, PEEK seal | 10 |
| Compression fitting, spherical, 316L seal | 25 |
| Compression fitting, cylindrical, Elastosil seal | 5 |

1. Replace with a suitable seal if necessary.
2. Replace the seals following disassembly.
3. As all threads must be firmly tightened, using the appropriate torques.

### 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-installation 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.?→ 🖹 38 |

# 6 Electrical connection

## 6.1 Connection conditions

If the 3-A Standard is required, electrical connecting cables must be smooth, corrosion-resistant and easy to clean.

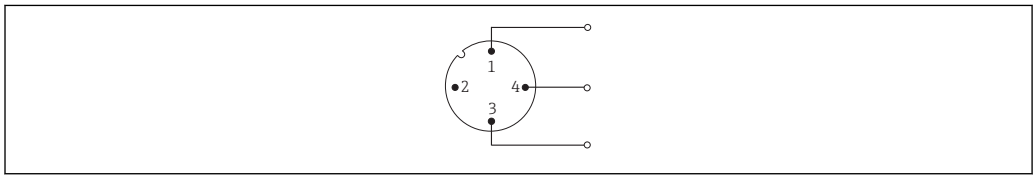
## 6.2 Connecting the measuring device

NOTICE

**Damage to the device!**

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

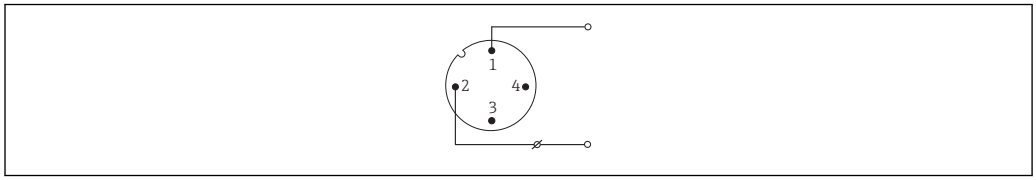
### IO-Link operating mode




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)*

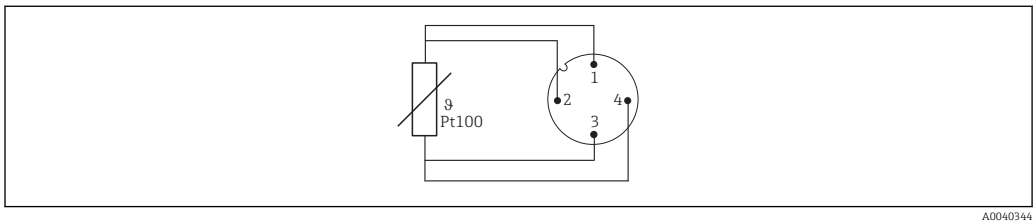
### **4 to 20 mA** operating mode




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 → 36.

## 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 enables direct access to the process and diagnostic data. It also provides the option of configuring the device while in 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 |
| Speed | COM2; 38.4 kBaud |
| Minimum cycle time | 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 has been applied (first valid measured value after 2 s) |

### 7.1.2 Device description

In order to integrate field devices into a digital communication system, the IO-Link system needs a description of the device parameters, such as output data, input data, data format, data volume and supported transmission rate.

These data are available in the device description (IODD [1)]) which is provided to the IO-Link master via generic modules when the communication system is commissioned.

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

1) IO Device Description

# 8 System integration

## 8.1 Identification

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

## 8.2 Process data

When the measuring device 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 device'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 |
| 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 |

| Process value | Values | Meaning |
|---|---|---|
| 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 the following parameter values or device conditions:

### 8.3.1 Specific device data

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

| Identifier | Index (dec) | Index (hex) | Size (byte) | Data type | Access | Default value | Value range | 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 |
| 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 |

| Identifier | Index (dec) | Index (hex) | Size (byte) | Data type | Access | Default value | Value range | Data storage |
|---|---|---|---|---|---|---|---|---|
| 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/- | – | – | – |
| 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/- | – | – | – |

| Identifier | Index (dec) | Index (hex) | Size (byte) | Data type | Access | Default value | Value range | Data storage |
|---|---|---|---|---|---|---|---|---|
| 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

| Identifier | 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

| Identifier | 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 |
| IO-Link 1.1 system test command 242 | 242 | 0xF2 |
| IO-Link 1.1 system test command 243 | 243 | 0xF3 |

# 9 Commissioning

If an existing configuration is changed, measuring operation continues.

## 9.1 Post-installation check

Perform the following checks prior to commissioning the measuring point:

1. Perform the post-installation check using the checklist → 17.
2. Perform the post-connection check using the checklist → 19.

## 9.2 Configuring the measuring device

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 + Port Configuration Tool). The device supports IO-Link Data Storage, which enables easy device replacement.

# 10 Diagnostics and troubleshooting

## 10.1 General troubleshooting

Due to the device's particular design, it cannot be repaired. However, it is possible to send the device in for inspection. → 30

| Error | Possible cause | Solution |
|---|---|---|
| Device is not responding. | Supply voltage does not match the value indicated on the nameplate. | ▶ Apply correct voltage. |
| | The polarity of the supply voltage is wrong. | ▶ Correct the polarity of the supply voltage. |
| Device measures incorrectly. | The device has been incorrectly configured. | ▶ Check and correct the parameter configuration. |
| | The device has been incorrectly connected. | ▶ Check the pin assignment → 18. |
| | Incorrect device orientation. | ▶ Install the device correctly → 13. |
| | Heat dissipation over the measuring point. | ▶ Observe the installed length of the sensor. |
| 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 an error in the device. | ▶ Correct errors 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 service mode (e.g. during a simulation). |
| **S** | ⚠ | Out of specification | The device is being operated outside its technical specifications (e.g. during warm-up 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 | Reason | Corrective measure |
|---|---|---|---|---|---|---|
| F001 | Alarm | IO-Link Error | 0x1817 | Device failure | Device fault | 1. Restart the device.<br>2. Replace device. |
| F004 | Alarm | IO-Link Error | 0x1818 | Sensor defective | The sensor is defective (e.g.: sensor failure or sensor short-circuit) | ▶ Replace device. |
| S047 | Warning | IO-Link Warning | 0x1819 | Sensor limit reached | Sensor limit has been 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 active | ▶ Initialization active, 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) Diagnostic only possible in SIO mode
2) Diagnostic only possible in the 4 to 20mA mode.

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

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 faults via IO-Link. All the device warnings and faults are for information purposes only and do not have a safety function. The errors diagnosed by the device are displayed via IO-Link in accordance with NE107. 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 error occurs. The output signal adopts its fault state (value in the event of an error - see the following section).
  - 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 errors.

## 10.4 Diagnostic list

If two or more diagnostic events are pending simultaneously, only the 3 diagnostic messages with the highest priority are shown in the diagnostic list. The status signal dictates the priority in which the diagnostic messages are displayed. The following order of priority applies: F, C, S, M. If two or more diagnostic events with the same status signal are active simultaneously, the numerical order of the event number dictates the order of priority in which the events are displayed, 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

No special maintenance work is required.

## 11.1 Cleaning

The device must be cleaned whenever necessary. Cleaning can also be done when the device is installed (e.g. CIP Cleaning in Place / SIP Sterilization in Place). When cleaning the device, care must be taken to ensure that it is not damaged.

NOTICE

**Avoid damage to the device and the system**

- Pay attention to the specific IP code when cleaning.

## 11.2 Endress+Hauser 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 E+H or by qualified technical staff using calibration devices onsite. |

# 12 Repair

Due to the device's particular design, it cannot be repaired.

## 12.1 Spare parts

Spare parts currently available for your product can be found online at: http://www.products.endress.com/spareparts_consumables. Always quote the serial number of the device when ordering spare parts!

| Type | Order number |
|---|---|
| Plug screw fitting G1/2 1.4435 | 60022519 |
| Spare part kit, pressure screw TK40 G1/2 d6 | 71217633 |
| Weld-in adapter G3/4, d=50, 316L, 3.1 | 52018765 |
| Weld-in adapter G3/4, d=29, 316L, 3.1 | 52028295 |
| Welding boss for G1/2" sealing system | 60021387 |
| Weld-in adapter M12x1.5 1.4435&316L | 71405560 |
| O-ring 14.9x2.7 VMQ, FDA, 5 pcs | 52021717 |
| Weld-in adapter G3/4, d=55, 316L | 52001052 |
| Weld-in adapter G3/4, 316L, 3.1 | 52011897 |
| O-ring 21.89x2.62 VMQ, FDA, 5 pcs | 52014473 |
| Weld-in adapter G1, d=60, 316L | 52001051 |
| Weld-in adapter G1, d=60, 316L, 3.1 | 52011896 |
| Weld-in adapter G1, d=53, 316L, 3.1 | 71093129 |
| O-ring 28.17x3.53 VMQ, FDA, 5 pcs | 52014472 |
| iTHERM TK40 compression fitting | TK40- |
| Spare part kit, seal TK40 | XPT0001- |
| iTHERM TT411 thermowell | TT411- |

## 12.2 Return

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

1. Refer to the website for more information: http://www.endress.com/support/return-material
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

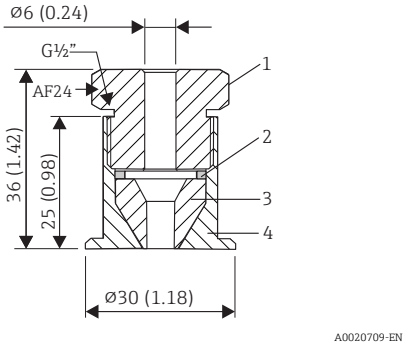
## 12.3 Disposal

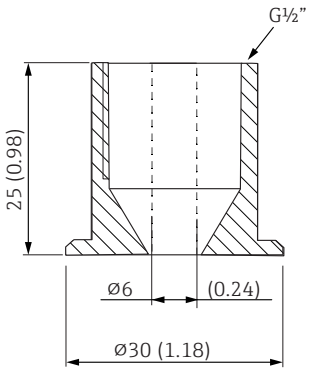
The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please pay particular attention to the local regulations governing waste disposal in your country. Ensure proper separation and reuse of the device components where possible.

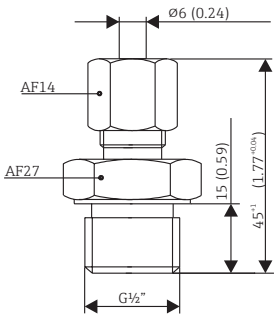
# 13 Accessories

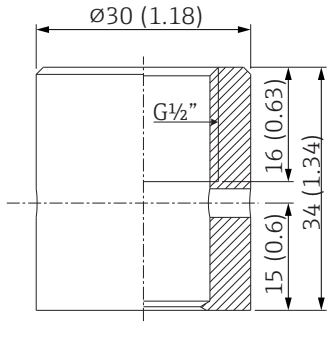
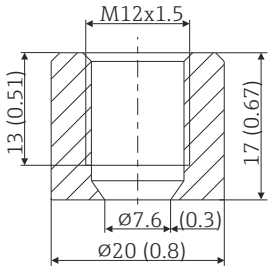
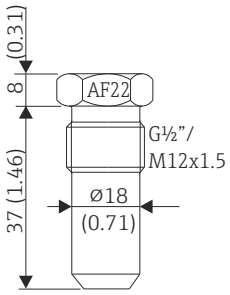
All dimensions in mm (in).

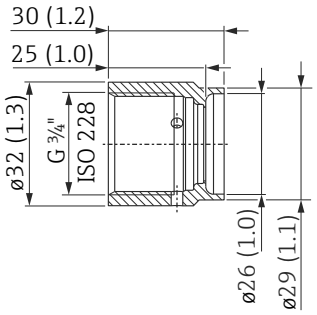
## 13.1 Device-specific accessories

| Accessories | Description |
|---|---|
| Welding boss with sealing taper<br>  <br><br>*1 Pressure screw, 303/304*<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)<br>▪ Order number with pressure screw 51004751<br>▪ Order number without pressure screw 51004752 |

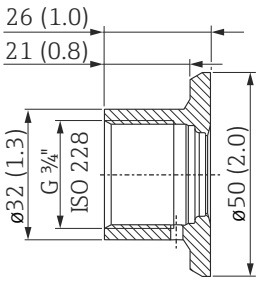
| Accessories | Description |
|---|---|
| Collar welding boss<br>  <br> | ▪ Material of parts in contact with the process 316L<br>▪ Order number without pressure screw 51004752 |

| Accessories | Description |
|---|---|
| Compression fitting<br>  <br> | ▪ Movable clamping ring, process connection G½"<br>▪ Material of compression fitting and parts in contact with the process, 316L<br>▪ Order number TK40-BADA3C (other versions can be configured in the TK40 structure) |

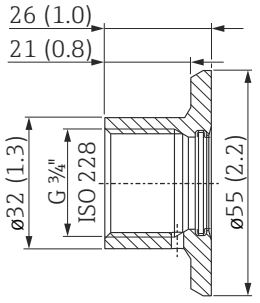
| Accessories | Description |
|---|---|
| Welding boss with sealing taper (metal - metal)<br>  <br>A0006621<br>  <br>A0018236 | ▪ Welding boss for G½" or M12x1.5 thread<br>▪ Metal-sealing; conical<br>▪ Material of parts in contact with the process 316L/1.4435<br>▪ Max. process pressure 16 bar (232 PSI)<br>▪ Order number 71424800 (G½")<br>▪ Order number 71405560 (M12x1.5) |
| Dummy plug<br>  <br>A0009213-EN | ▪ Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss<br>▪ Material: SS 316L/1.4435<br>▪ Order number 60022519 (G½")<br>▪ Order number 60021194 (M12x1.5) |

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL31/33/20, pipe mounting<br>  <br>A0008265 | ▪ G¾", d=29 mm, without flange<br>▪ Material: 316L<br>▪ Roughness in µm (µin), 1.5 (59.1)<br>▪ Order number 52028295 (with inspection certificate EN10204-3.1 material)<br>▪ Order number for seal (5-pc. set), silicone O-ring 52021717 [1], FDA-compliant |

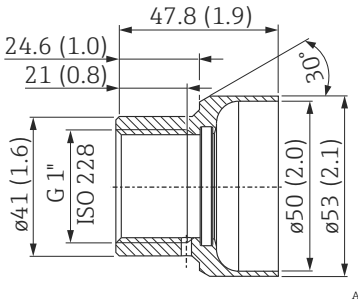
1) A seal is included in the delivery.

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL31/33/20, vessel mounting<br>  | ▪ G¾", d=50 mm, with flange<br>▪ Material 316L<br>▪ Roughness in µm (µin), 0.8 (31.5)<br>▪ Order number 52018765 (with inspection certificate EN10204-3.1 material)<br>▪ Order number for seal (5-pc. set), silicone O-ring 52021717 [1], FDA-compliant<br>▪ EHEDG tested and with 3-A mark |

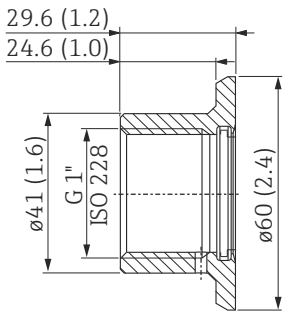
1) A seal is included in the delivery.

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL50<br>  | ▪ G¾", d=55 mm, with flange<br>▪ Material 316L<br>▪ Roughness in µm (µin), 0.8 (31.5)<br>▪ Order number 52001052 (without inspection certificate EN10204-3.1 material)<br>▪ Order number 52011897 (with inspection certificate EN10204-3.1 material)<br>▪ Order number for seal (5-pc. set), silicone O-ring 52014473 [1], FDA-compliant<br>▪ EHEDG tested and with 3-A mark |

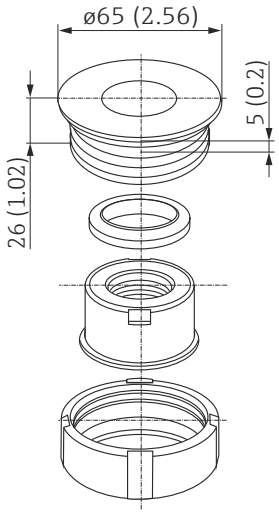
1) A seal is included in the delivery.

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL50<br>  | ▪ G1", d=53 mm, without flange<br>▪ Material 316L<br>▪ Roughness in µm (µin), 0.8 (31.5)<br>▪ Order number 71093129 (with inspection certificate EN10204-3.1 material)<br>▪ Order number for seal (5-pc. set), silicone O-ring 52014472 [1], FDA-compliant |

1) A seal is included in the delivery.

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL50<br>  | ▪ G1", d=60 mm, with flange<br>▪ Material 316L<br>▪ Roughness in µm (µin), 0.8 (31.5)<br>▪ **Order number:** 52001051 (without inspection certificate EN10204-3.1 material)<br>▪ Order number 52011896 (with inspection certificate EN10204-3.1 material)<br>▪ Order number seal (5-pc. set): silicone O-ring 52014472 [1], FDA-compliant<br>▪ EHEDG tested and with 3-A mark |

1) A seal is included in the delivery.

| Accessories | Description |
|---|---|
| Weld-in adapter for FTL50<br>  | ▪ G1", can be aligned<br>▪ Material 316L<br>▪ Roughness in µm (µin), 0.8 (31.5)<br>▪ Order number 52001221 (without inspection certificate EN10204-3.1 material)<br>▪ Order number 52011898 (with inspection certificate EN10204-3.1 material)<br>▪ Order number for seal (5-pc. set), silicone O-ring 52014424 [1], FDA-compliant |

1) A seal is included in the delivery.

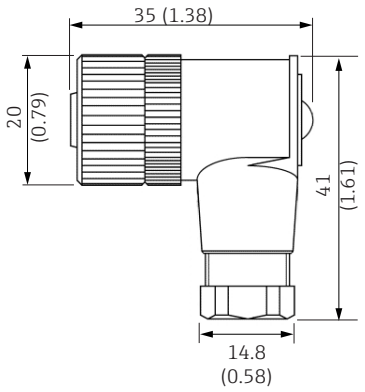
Maximum process pressure for the weld-in adapters:
- 25 bar (362 psi) at max. 150 °C (302 °F)
- 40 bar (580 psi) at max. 100 °C (212 °F)

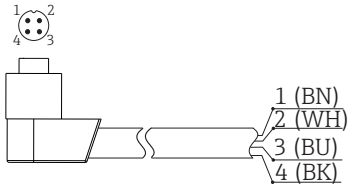
For more information on weld-in adapters FTL20, FTL31, FTL33, FTL50, see the Technical Information TI00426F.

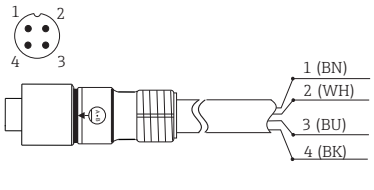
## 13.2 Communication-specific accessories

| Accessories | Description |
|---|---|
| FieldPort SFP20 | **Mobile configuration tool for all IO-Link devices:**<br>▪ Pre-installed device and CommDTMs in FieldCare<br>▪ Pre-installed device and CommDTMs in FieldXpert<br>▪ M12 connection for IO-Link field devices |

### 13.2.1 Coupling

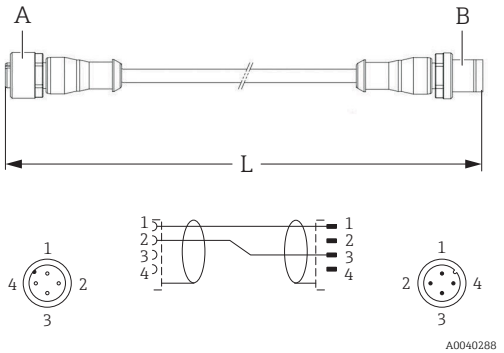
| Accessories | Description |
|---|---|
| ▪ M12x1 coupling; elbowed, for termination of connecting cable by user<br>▪ Connection to M12x1 housing connector<br>▪ Body materials PBT/PA,<br>▪ Cap-nut GD-Zn, nickel-plated<br>▪ IP67 degree of protection (fully locked)<br>▪ Order number 51006327<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −40 to 85 °C |  |

| Accessories | Description |
|---|---|
| ▪ PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling, elbow plug, screw plug, length 5 m (16.4 ft)<br>▪ IP67 degree of protection<br>▪ Order number 52024216<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −25 to 70 °C<br><br>Wire colors:<br>▪ 1 = BN brown<br>▪ 2 = WH white<br>▪ 3 = BU blue<br>▪ 4 = BK black |  |

| Accessories | 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>▪ IP67 degree of protection<br>▪ Order number 71217708<br>▪ Voltage: max. 250 V<br>▪ Current carrying capacity: max. 4 A<br>▪ Temperature: −20 to 105 °C<br><br>Wire colors:<br>▪ 1 = BN brown<br>▪ 2 = WH white<br>▪ 3 = BU blue<br>▪ 4 = BK black |  |

### 13.2.2 Adapter cables

If a TMR3x is replaced by a TM311, the pin assignment must be changed, as the IO-Link standard requires another assignment than that used in TMR3x devices. Either the wiring is changed in the cabinet or the adapter cable is used for the pin assignment between the device and the existing wiring.

| Accessories | 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>▪ Order number 71449142 |  <br>*A M12 socket*<br>*B M12 connector*<br>*L 200 mm (7.87 in)* |

## 13.3 Service-specific accessories

| Accessories | Description |
|---|---|
| Applicator | Software for selecting and sizing Endress+Hauser measuring devices:<br>▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.<br>▪ Graphic illustration of the calculation results<br>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.<br>Applicator is available:<br>Via the Internet: https://portal.endress.com/webapp/applicator |

| Accessories | Description |
|---|---|
| Configurator | Product Configurator - the tool for individual product configuration<br>▪ Up-to-the-minute configuration data<br>▪ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language<br>▪ Automatic verification of exclusion criteria<br>▪ Automatic creation of the order code and its breakdown in PDF or Excel output format<br>▪ Ability to order directly in the Endress+Hauser Online Shop<br>The Configurator is available on the Endress+Hauser website at: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator. |

| Accessories | Description |
|---|---|
| W@M | Life cycle management for your plant<br>W@M offers assistance with a wide range of software applications over the entire process: from planning and procurement to the installation, commissioning and operation of the measuring devices. All the relevant information is available for every measuring device over the entire life cycle, such as the device status, device-specific documentation, spare parts etc.<br>The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.<br>W@M is available:<br>Via the Internet: www.endress.com/lifecyclemanagement |

## 13.4 System components

| Accessories | Description |
|---|---|
| IO-Link master BL20 | IO-Link master from Turck for DIN rails supports PROFINET, EtherNet/IP and Modbus TCP. With web server for easy configuration. |

| Accessories | Description |
|---|---|
| RIA16 field indicator | The field indicator presents the analog measuring signal on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The indicator is looped into the 4 to 20 mA circuit and gets the required energy from there.<br>For details, see Technical Information TI00144R |

| Accessories | Description |
|---|---|
| RIA15 field indicator | Field indicator for integration into 4 to 20 mA, panel mounting<br>For details, see Technical Information TI00143K |

| Accessories | Description |
|---|---|
| RIA14 field indicator | Field indicator for integration into 4 to 20 mA, optionally with Ex d approval.<br>For details, see document TI00143R |

| Accessories | Description |
|---|---|
| RN221N | Active barrier with power supply for safe separation of 4 to 20 mA standard signal circuits.<br>For details, see Technical Information TI00073R and Operating Instructions BA00202R |

| Accessories | Description |
|---|---|
| RNS221 | Supply unit for powering two 2-wire measuring devices solely in the non-Ex area.<br>For details, see Technical Information TI00081R and Brief Operating Instructions KA00110R |

# 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

Version without integrated electronics

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

4 to 20 mA version

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

IO-Link version

| | |
|---|---|
| **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) |

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.

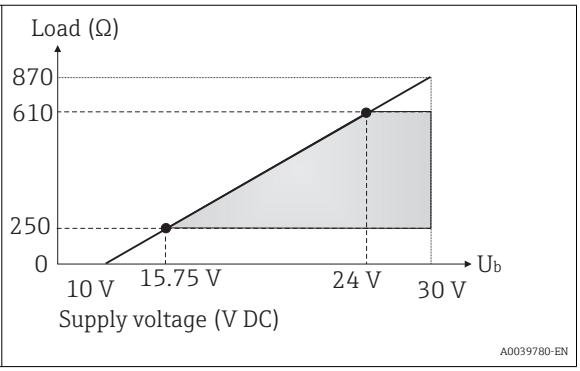
In the 4 to 20 mA mode, the device transmits the failure information according to NAMUR NE43:

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

| | |
|---|---|
| Underranging | Linear drop 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

Protocol-specific data

→ 20

## 14.3 Power supply

Supply voltage

| Electronic version | Supply voltage |
|---|---|
| IO-Link/<br>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 meet electrical safety according to CAN/CSA-C22.2 No. 61010-1 or UL 61010-1, the device may only be powered by a power supply unit with a limited energy electric circuit in accordance with UL/EN/IEC 61010-1 chapter 9.4 or Class 2 according to UL 1310, "SELV or Class 2 circuit".
- Behavior in the event of overvoltage (> 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).

Maximum current consumption

≤ 23 mA for 4 to 20 mA

Switch-on delay

2 s

Overvoltage protection

To protect against overvoltage in the power supply and signal/communication cables for the thermometer electronics, the manufacturer offers the HAW562 surge arrester for DIN rail mounting.

For more detailed information, see Technical Information HAW562 surge arrester (TI01012K) .

## 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

According to DIN EN 60770 and 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 | Designation | 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.

*Thermometer with electronics*

| Standard | Designation | 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 | Designation | 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 relevant sensor

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 voltage 24 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):** √(Measured error digital² + Measured error D/A²) | 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)), min. 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)), min. 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):** √(Measured error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)² | 0.49 °C (0.88 °F) |
| **Measured error analog value (current output):** √(Measured error digital² + Measured error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + 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 measured error data correspond to ±2 σσ (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 measured error for the specified measuring range.
4) Deviations from maximum measured error possible due to rounding.

MV = Measured value

LRV = Lower range value of relevant sensor

Total measured error of transmitter at current output = √(Measured error digital² + Measured error D/A²)

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, straight 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, straight tip (4.3 × 20 mm) | iTHERM TipSens | 1 s | 2.5 s |

1) Between the insert and the thermowell

## 14.5 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

As per IEC/EN 60654-1, Class Dx

Degree of protection

As per IEC/EN 60529 IP69

Depends on the degree of protection of the connection cable → 34

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

- Maximum measured error under EMC tests: < 1 % of the span
- Interference immunity according to IEC/EN 61326 series, requirements for industrial fields
- Interference emission according to IEC/EN 61326 series, Class B equipment

**IO-Link**

Only the requirements of IEC/EN 61131-9 are met in I/O-Link mode.

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 in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21).

For more information, see the Declaration of Conformity.

1. With a connection cable length of 30 m (98.4 ft):
   always use a shielded cable.
2. The use of shielded connection cables is generally recommended.

Electrical safety

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

## 14.6 Mechanical construction

Design, dimensions

All dimensions in mm (in). The design of the thermometer depends on the thermowell version used:

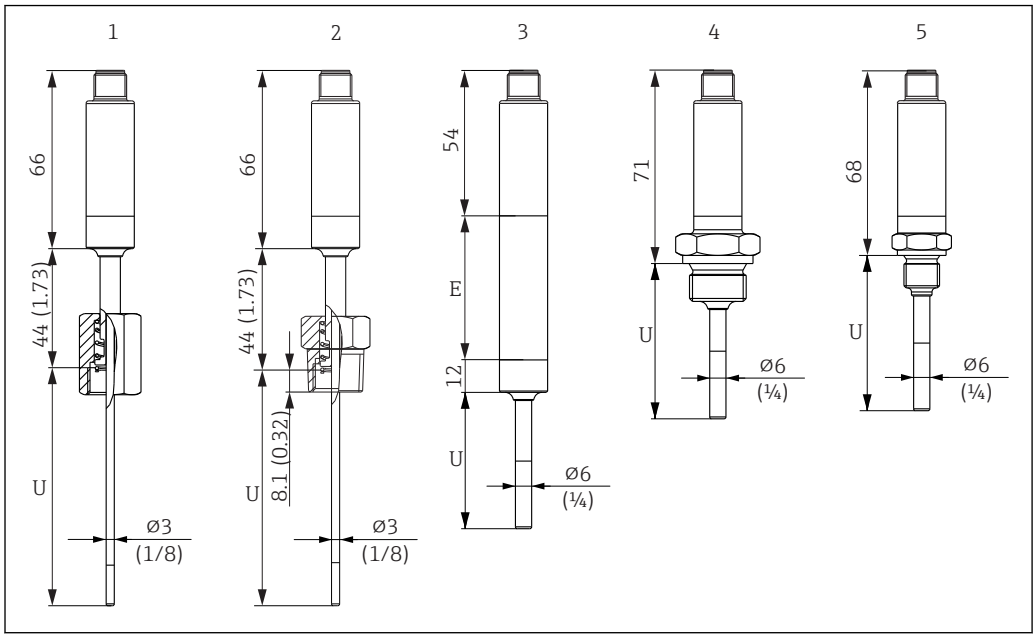
- Thermometer without a thermowell
- Thermowell diameter 6 mm (¼ in)
- T-piece and elbow piece thermowell version as per DIN 11865/ASME BPE 2012 for weld-in

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:*

| Item | 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 |

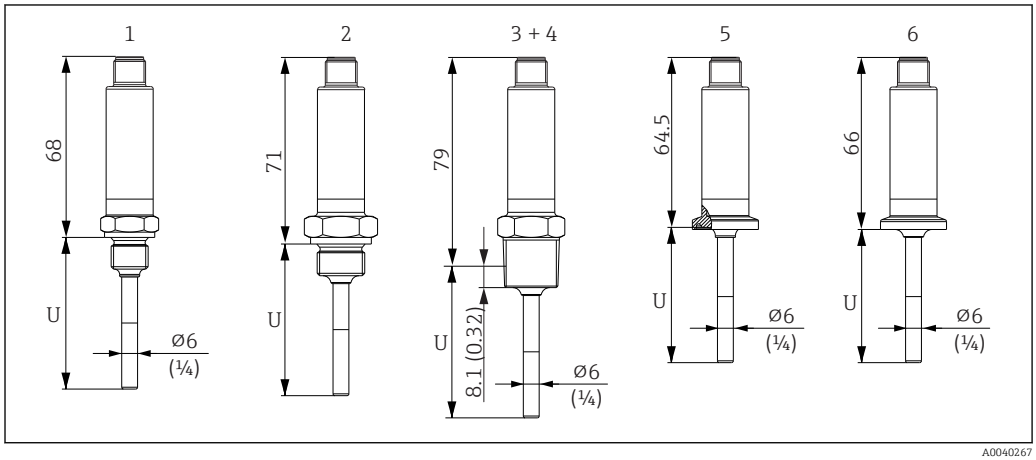
### Without thermowell



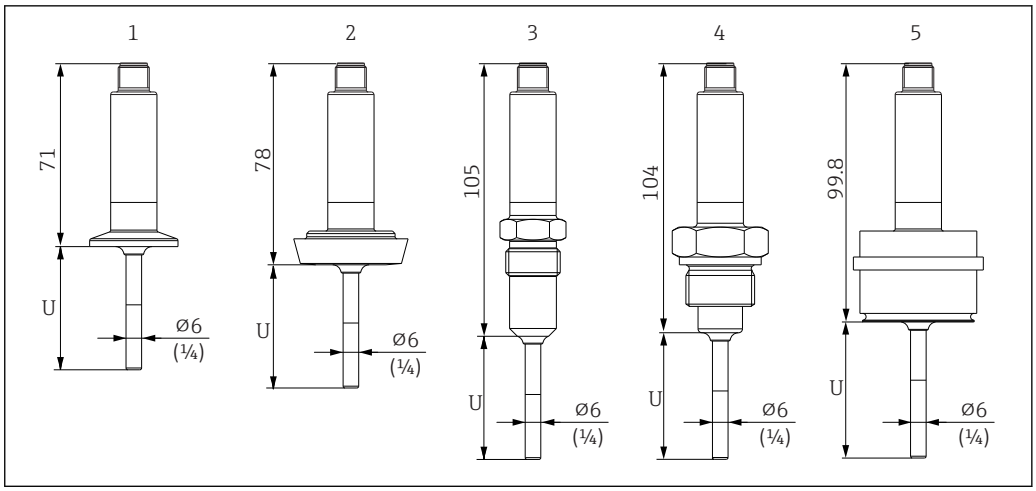

1 *Thermometer with spring-loaded cap-nut, G3/8" thread 3 mm for existing thermowell*
2 *Thermometer with spring-loaded NPT½" male thread 3 mm for existing thermowell*
3 *Thermometer without process connection for compression fitting, with extension neck*
4 *Thermometer with G½" male thread*
5 *Thermometer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

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

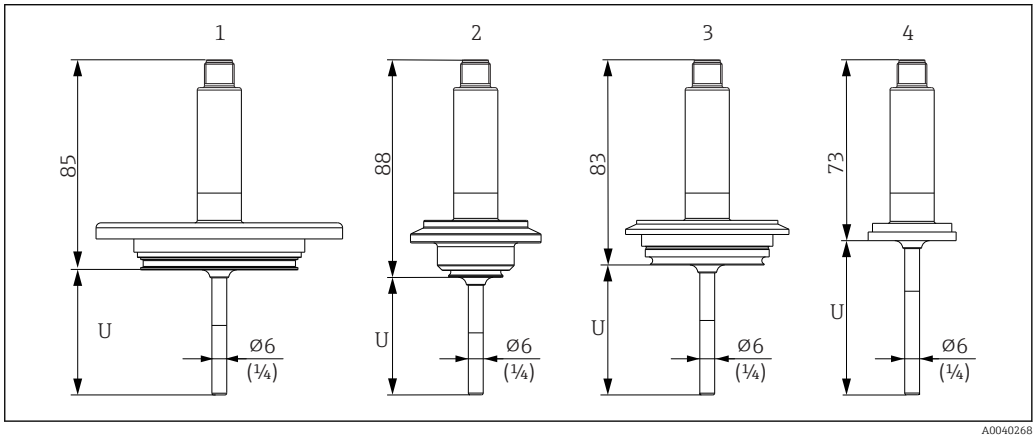
| | |
|---|---|
| Version 1 (G3/8" cap-nut) | $U = U_{(thermowell)} + T_{(thermowell)} + 3\ mm - B_{(thermowell)}$ |
| Version 2 (NPT½" male thread) | $U = U_{(thermowell)} + T_{(thermowell)} - 5\ mm$ (-8 mm screw-in depth + 3mm spring travel) $- B_{(thermowell)}$ |




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")*

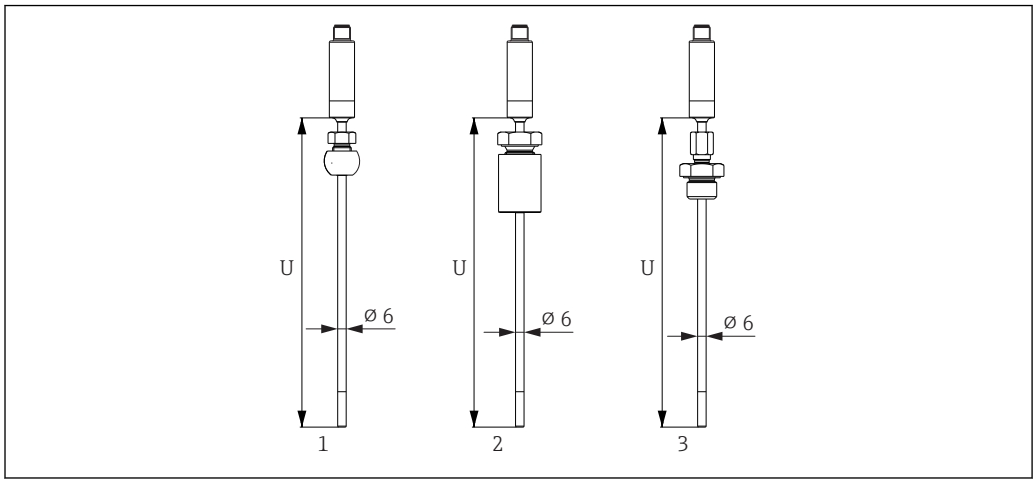



*1 Thermometer with Clamp ISO2852 for DN12 to 21.3, DN25 to 38, DN40 to 51*
*2 Thermometer with milk pipe connection DIN11851 for DN25/DN32/DN40/DN50*
*3 Thermometer with metal sealing system G½"*
*4 Thermometer with G¾" male thread ISO228 for FTL31/33/20/50 Liquiphant adapter*
*5 Thermometer with D45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



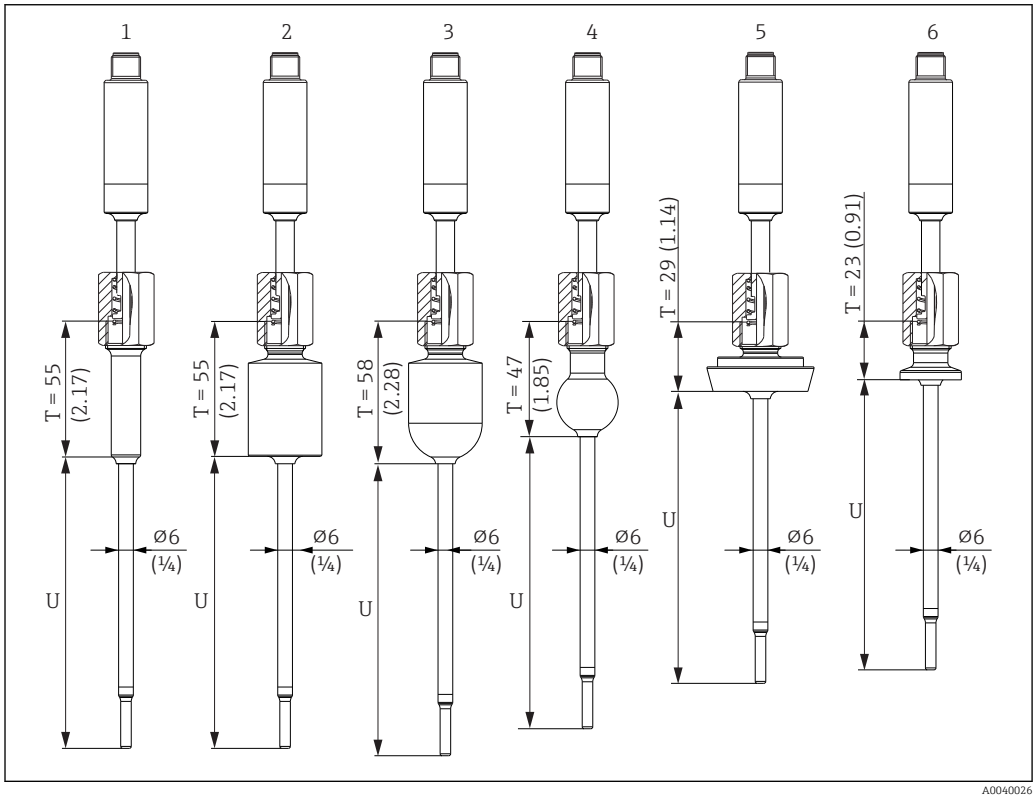

*1 Thermometer with APV in-line, DN50*
*2 Thermometer with Varivent type B, D 31 mm*
*3 Thermometer with Varivent type F, D 50 mm and Varivent type N, D 68 mm*
*4 Thermometer with SMS 1147, DN25/DN38/DN51*

### With compression fitting

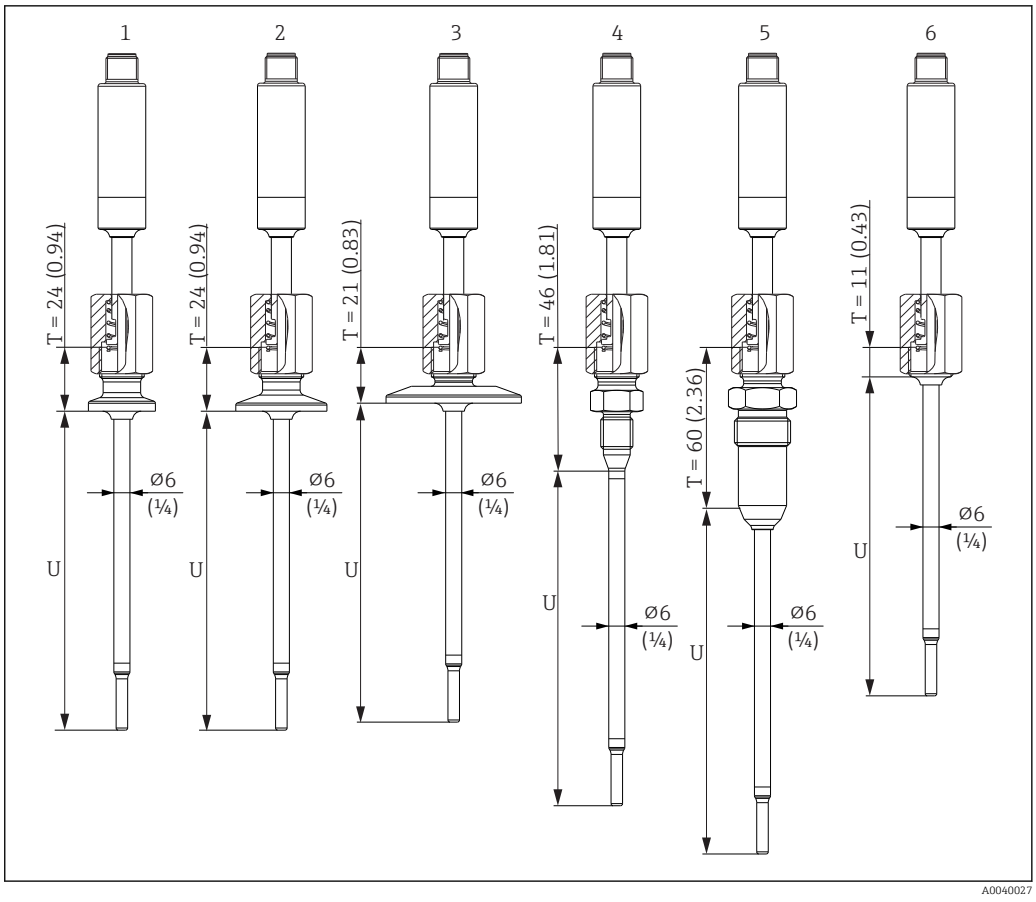



*1 Thermometer with TK40 compression fitting, spherical, PEEK/316L, ferrule, Ø 25 mm, for weld-in*
*2 Thermometer with TK40 compression fitting, cylindrical, Elastosil ferrule, Ø 25 mm, for weld-in*
*3 Thermometer with compression fitting G½" male thread, TK40-BADA3C, 316L*

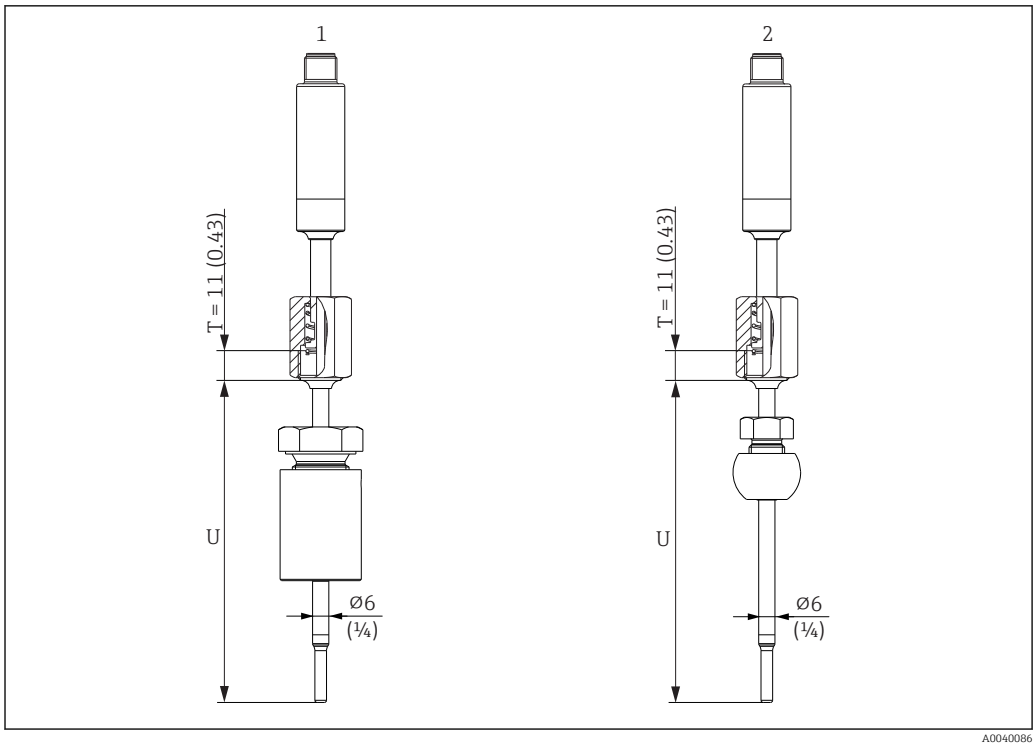
### With thermowell diameter 6 mm (¼ in)




*1 Thermometer with weld-in adapter, cylindrical, D 12 × 40 mm40mm*
*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")*

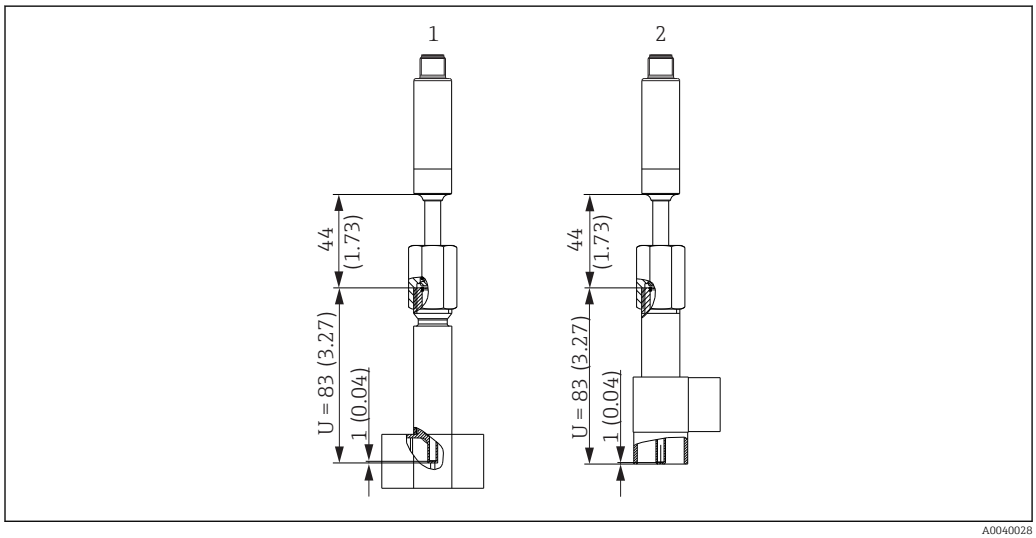



*1 Thermometer with Tri-Clamp version DN18*
*2 Thermometer with Clamp version DN12 to 21.3*
*3 Thermometer with Clamp version DN25 to 38/DN40 to 51*
*4 Thermometer with metal sealing system version, M12 × 1.5*
*5 Thermometer with metal sealing system version, G½"*
*6 Thermometer without process connection*




*1 Thermometer with TK40 compression fitting, cylindrical, Elastosil ferrule, Ø30 mm, for weld-in*
*2 Thermometer with TK40 compression fitting, spherical, PEEK/316L ferrule, Ø25 mm, for weld-in*

### Thermowell version as T-piece or elbow piece




*1 Thermometer with thermowell as T-piece*
*2 Thermometer with thermowell as elbow piece*

- Pipe sizes as per DIN 11865 series A (DIN), B (ISO) and C (ASME BPE)
- 3-A mark for nominal diameters ≥ DN25
- IP69 protection
- 1.4435+316L material, 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 as per 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.

| Identifier | Short form | Recommended max. temperature for continuous use in air | Features |
|---|---|---|---|
| AISI 316L (corresponds to 1.4404 or 1.4435) | X2CrNiMo17-13-2, X2CrNiMo18-14-3 | 650 °C (1 202 °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 % | 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 wetted parts is limited to< 1 % - including the welding seams (following Basel Standard 2). | | |

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

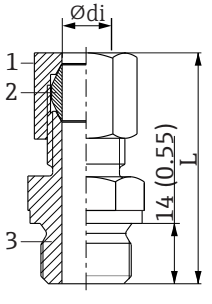
*Values for wetted surfaces:*

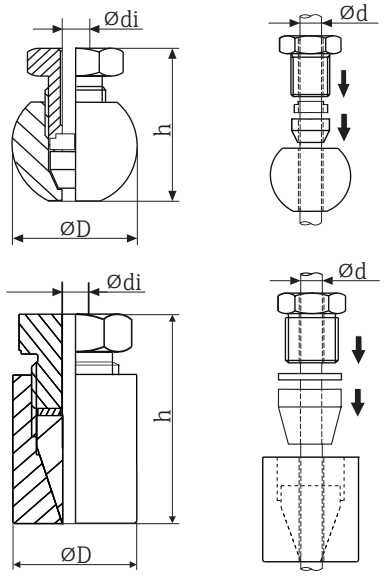
| | |
|---|---|
| Standard surface, mechanically polished [1] | $R_a \leq$ 0.76 µm (30 µin) |
| Mechanically polished [1], buffed [2] | $R_a \leq$ 0.38 µm (15 µin) |
| Mechanically polished [1], buffed and electropolished | $R_a \leq$ 0.38 µm (15 µin)+ electropolished |

1) Or equivalent treatment that guarantees $R_a$ max
2) Not compliant with ASME BPE

## Process connections

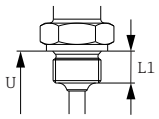
*Compression fitting*

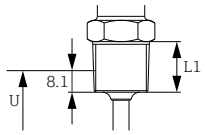
| Type TK40 | Version | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | Ød<sub>i</sub> | L | Across flats | |
|  <br>*1 Nut*<br>*2 Clamping sleeve*<br>*3 Process connection* | G ½" , ferrule material 316L | 6 mm (0.24 in) | Approx. 47 mm (1.85 in) | G½": 27 mm (1.06 in) | ▪ $P_{max.}$ = 40 bar (104 psi) at T = +200 °C (+392 °F) for 316L<br>▪ $P_{max.}$ = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L<br>Tightening torque = 40 Nm |

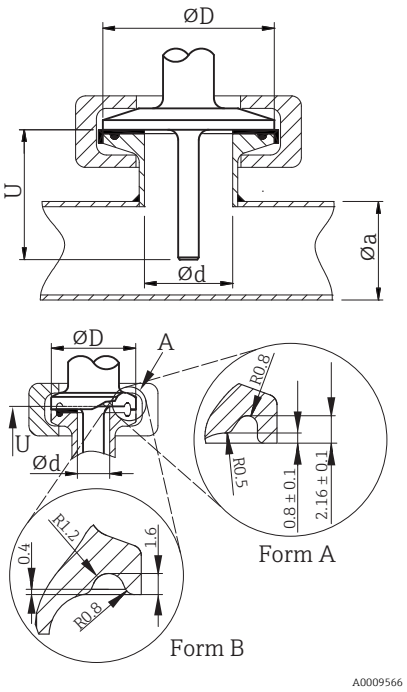
| Type TK40 for weld-in | Version | Dimensions | | | Technical properties [1] |
|---|---|---|---|---|---|
| | Spherical or cylindrical | Ød<sub>i</sub> | ØD | h | |
|  | Spherical<br>Material of sealing taper<br>PEEK or 316L<br>Thread G¼" | 6.3 mm (0.25 in) [2] | 25 mm (0.98 in) | 33 mm (1.3 in) | ▪ $P_{max.}$ = 10 bar (145 psi)<br>▪ $T_{max.}$ for PEEK sealing taper = +150 °C (+302 °F), tightening torque = 10 Nm<br>▪ $P_{max.}$ = 50 bar (725 psi)<br>▪ $T_{max.}$ for 316L sealing taper = +200 °C (+392 °F), tightening torque = 25 Nm<br>▪ The TK40 PEEK sealing taper is EHEDG tested and 3-A marked |
| | Cylindrical<br>Sealing taper material<br>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 = +150 °C (+302 °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).

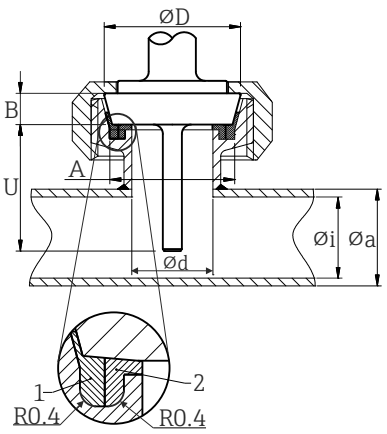
*Releasable process connection*

| Type | Version G | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | L1 thread length | A | Across flats | |
| Thread<br>  | G¼" ISO228 | 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) |
| | G½" ISO228 | | | | |
| | M14x1.5 | 18.6 mm (0.73 in) | 29.5 mm (1.16 in) | 41 | |

| Type | Version G | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | L1 thread length | A | Across flats | |
| | M18x1.5 | | | | |
|  A0040091 | ½" NPT ANSI | | | | |

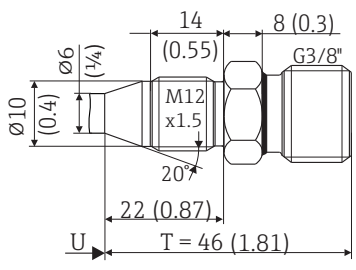
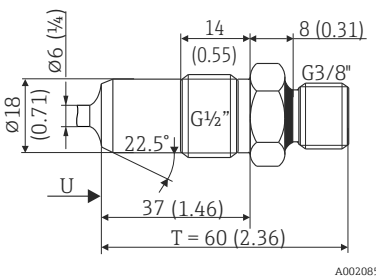
| Type | Version | Dimensions | | Technical properties |
|---|---|---|---|---|
| | Φd [1] | ΦD | Φa | |
| Clamp according to ISO 2852  A0009566 *A Different seal geometries for Microclamp and Tri-clamp* | Microclamp [2] DN8-18 (0.5"-0.75") [3] | 25 mm (0.98 in) | - | ▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal<br>▪ 3-A marked |
| | Tri-clamp DN8-18 (0.5"-0.75") [3] | | - | |
| | DN12-21.3 | 34 mm (1.34 in) | 16 to 25.3 mm (0.63 to 0.99 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>▪ ASME BPE compliance |
| | DN25-38 (1"-1.5") | 50.5 mm (1.99 in) | 29 to 42.4 mm (1.14 to 1.67 in) | |
| | DN40-51 (2") | 64 mm (2.52 in) | 44.8 to 55.8 mm (1.76 to 2.2 in) | |

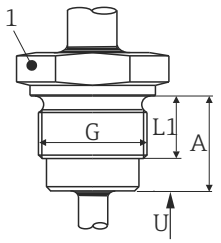
1) Pipes in accordance with ISO 2037 and BS 4825 Part 1
2) Microclamp (not in ISO 2852); no standard pipes
3) DN8 (0.5") only possible with thermowell diameter = 6 mm (¼ in)

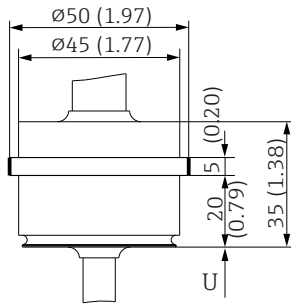
| Type | Technical properties |
|---|---|
| Milk pipe connection according to DIN 11851<br>  <br><br>A0009561<br>*1 Centering ring*<br>*2 Sealing ring* | ▪ 3-A marked and EHEDG certified (only with EHEDG certified and self-centering sealing ring)<br>▪ ASME BPE compliance |

| 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) |

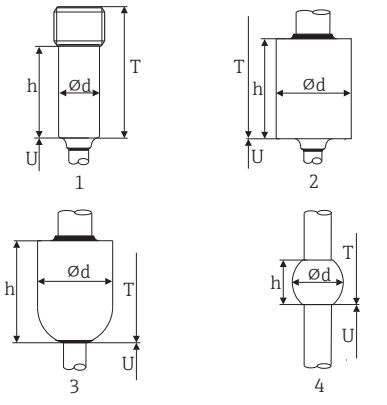
1) Pipes in accordance with DIN 11850

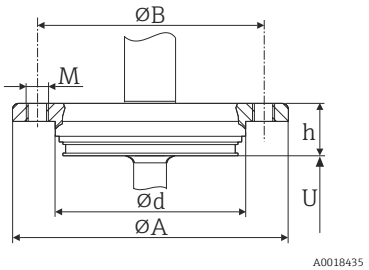
| Type | | Version | Technical properties |
|---|---|---|---|
| Metal sealing system | | Thermowell diameter 6 mm (¼ in) | $P_{max.}$ = 16 bar (232 psi)<br>Maximum torque = 10 Nm (7.38 lbf ft) |
| **M12x1.5** | **G½"** | | |
|  <br><br>A0009574 |  <br><br>A0020856 | | |

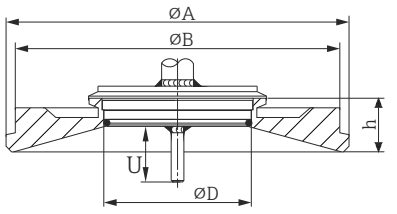
| Type | Version G | Dimensions | | | Technical properties |
|---|---|---|---|---|---|
| | | L1 thread length | A | 1 (SW/AF) | |
| Thread according to ISO 228 (for Liquiphant weld-in adapter)<br>  <br>A0009572 | G¾" for FTL20/31/33 adapter | 16 mm (0.63 in) | 25.5 mm (1 in) | 32 | ▪ $P_{max.}$ = 25 bar (362 psi) at max. 150 °C (302 °F)<br>▪ $P_{max.}$ = 40 bar (580 psi) at max. 100 °C (212 °F)<br>▪ 3-A marked and EHEDG tested<br>▪ ASME BPE compliance |
| | 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>A0034881 | D45 | |

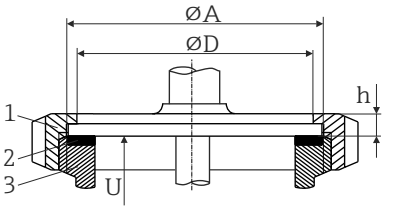
*For welding in*

| Type | Version | Dimensions | Technical properties |
|---|---|---|---|
| Weld-in adapter<br>  <br>A0039503 | 1: Cylindrical | Φd x h = 12 mm (0.47 in) x 40 mm (1.57 in), T = 55 mm (2.17 in) | ▪ $P_{max.}$ depends on the weld-in process<br>▪ 3-A marked and EHEDG certified<br>▪ ASME BPE compliance |
| | 2: Cylindrical | Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in) | |
| | 3: Spherical-cylindrical | Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in) | |
| | 4: Spherical | Φd = 25 mm (0.98 in)<br>h = 24 mm (0.94 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 | Version | 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) | ▪ 3-A marked and EHEDG certified<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) | | |

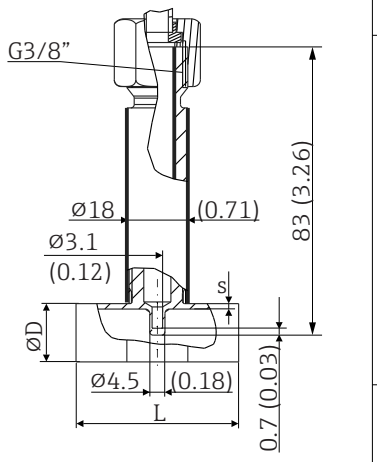
The VARINLINE® housing connection flange is suitable for weld-in into the conical or torispherical head in tanks or vessels with a small diameter (≤ 1.6 m (5.25 ft)) and up to a wall thickness of 8 mm (0.31 in).

| Type | Version | 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.

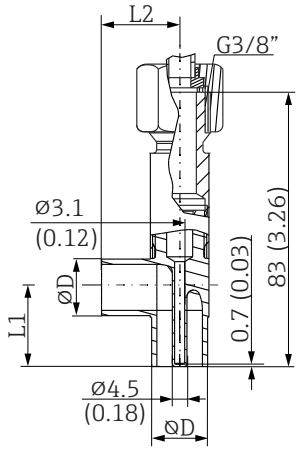
*T-piece, optimized (no welding, no dead legs)*

| Type | Version | | Dimensions in mm (in) | | | Technical properties |
|---|---|---|---|---|---|---|
| | | | ϕD | L | s [1] | |
| T-piece for weld-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 and EHEDG certified for ≥ DN25<br>▪ ASME BPE compliance for ≥ DN25 |
| | | DN15 PN25 | 19 mm (0.75 in) | | | |

| Type | Version | | Dimensions in mm (in) | | | Technical properties |
|---|---|---|---|---|---|---|
| | | | ⌀D | L | s [1] | |
|  | | 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 [2] | 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) Wall thickness
2) Pipe dimensions as per ASME BPE 2012

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

| Type | Version | | Dimensions | | | | Technical properties |
|---|---|---|---|---|---|---|---|
| | | | ⌀D | L1 | L2 | s [1] | |
| Corner piece for weld-in as per DIN 11865 (series A, B and C)<br>  | Series A | DN10 PN25 | 13 mm (0.51 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) | 32 mm (1.26 in) | | 1.6 mm (0.063 in) | |
| | | DN17.2 PN25 | 17.2 mm (0.68 in) | 34 mm (1.34 in) | | | |
| | | DN21.3 PN25 | 21.3 mm (0.84 in) | 36 mm (1.41 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) | |

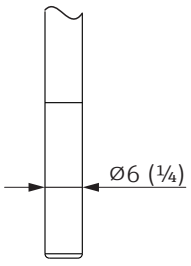
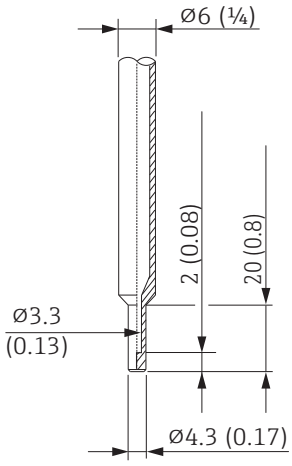
| Type | Version | | Dimensions | | | | Technical properties |
|---|---|---|---|---|---|---|---|
| | | | ⌀D | L1 | L2 | s [1] | |
| | Series C | DN12.7 PN25 (½") [2] | 12.7 mm (0.5 in) | 24 mm (0.95 in) | | 1.65 mm (0.065 in) | |
| | | DN19.05 PN25 (¾") | 19.05 mm (0.75 in) | 25 mm (0.98 in) | | | |
| | | 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 2012

Tip shape

**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
- The flow characteristics are optimized
- Thermowell stability is increased

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

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 → 30.

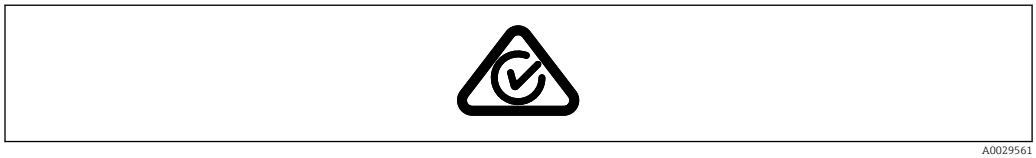
## 14.7 Certificates and approvals

CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.

RoHS

The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).

| | |
|---|---|
| EAC mark | The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark. |
| cCSAus | The product meets the requirements for electrical safety according to CAN/CSA-C22.2 No. 61010-1-12 or UL 61010-1. |
| RCM-Tick marking | The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.<br>  <br>A0029561 |
| MTBF | For the transmitter: 327 years, according to Siemens Standard SN29500 |
| Hygiene standard | ▪ EHEDG certification, type EL CLASS I. EHEDG certified/tested process connections. → 51<br>▪ 3-A Authorization No. 1144, 3-A Sanitary Standard 74-06. Listed process connections. → 51<br>▪ ASME BPE, Declaration of Conformity, can be ordered for options indicated<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 materials of the thermometer in contact with food/product (FCM) comply with the following European regulations:<br>▪ (EC) No. 1935/2004, Article 3, paragraph 1, Articles 5 and 17 on materials and articles intended to come into contact with food.<br>▪ (EC) No. 2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food.<br>▪ (EC) No. 10/2011 on plastic materials and articles intended to come into contact with food. |
| Schiffbauzulassung | Information on the Type Approval Certificates currently available (DNVGL, BV, etc.) can be obtained from the sales organization. |
| 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 |

| | |
|---|---|
| Other standards and guidelines | ▪ Degree of protection provided by enclosures (IP code) according to IEC 60529<br>▪ Safety requirements for electrical equipment for measurement, control and laboratory use according to IEC 61010-1<br>▪ Industrial platinum resistance thermometers in accordance with IEC 60751<br>▪ Electromagnetic compatibility (EMC requirements) IEC/EN 61326 series<br>▪ NAMUR International user association of automation technology in process industries (www.namur.de)<br>  ▪ NE21 - Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment.<br>  ▪ NE43 - Standardization of the Signal Level for the Failure Information of Digital Transmitters.<br>▪ Electromagnetic compatibility (EMC) according to IO-Link Specification IEC 61131-09 |
| 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 |
| Material certification | The material certificate 3.1 (according to EN 10204) can be requested separately. The short form certificate includes a simplified declaration with no enclosures of documents related to the materials used in the design of the individual sensor, but guarantees the traceability of the materials through the identification number of the thermometer. The data regarding the origin of the materials can subsequently be requested by the client if necessary. |
| Calibration | The factory calibration is performed according to an internal procedure in a laboratory of Endress+Hauser that is accredited by the European Accreditation Organization (EA) according to ISO/IEC 17025. A calibration which is performed according to EA guidelines (SIT/Accredia or DKD/DAkkS) can be requested separately.<br>The analog current output of the device is calibrated. |
| Thermowell testing and load capacity calculation | Thermowell pressure testing and thermowell load capacity calculation are performed according to the specifications of DIN 43772. With regard to thermowells with tapered or reduced tips that do not comply with this standard, these are tested using the pressure of corresponding straight thermowells. Tests according to other specifications can be carried out on request. |

# 15 Overview of the IO-Link operating menu

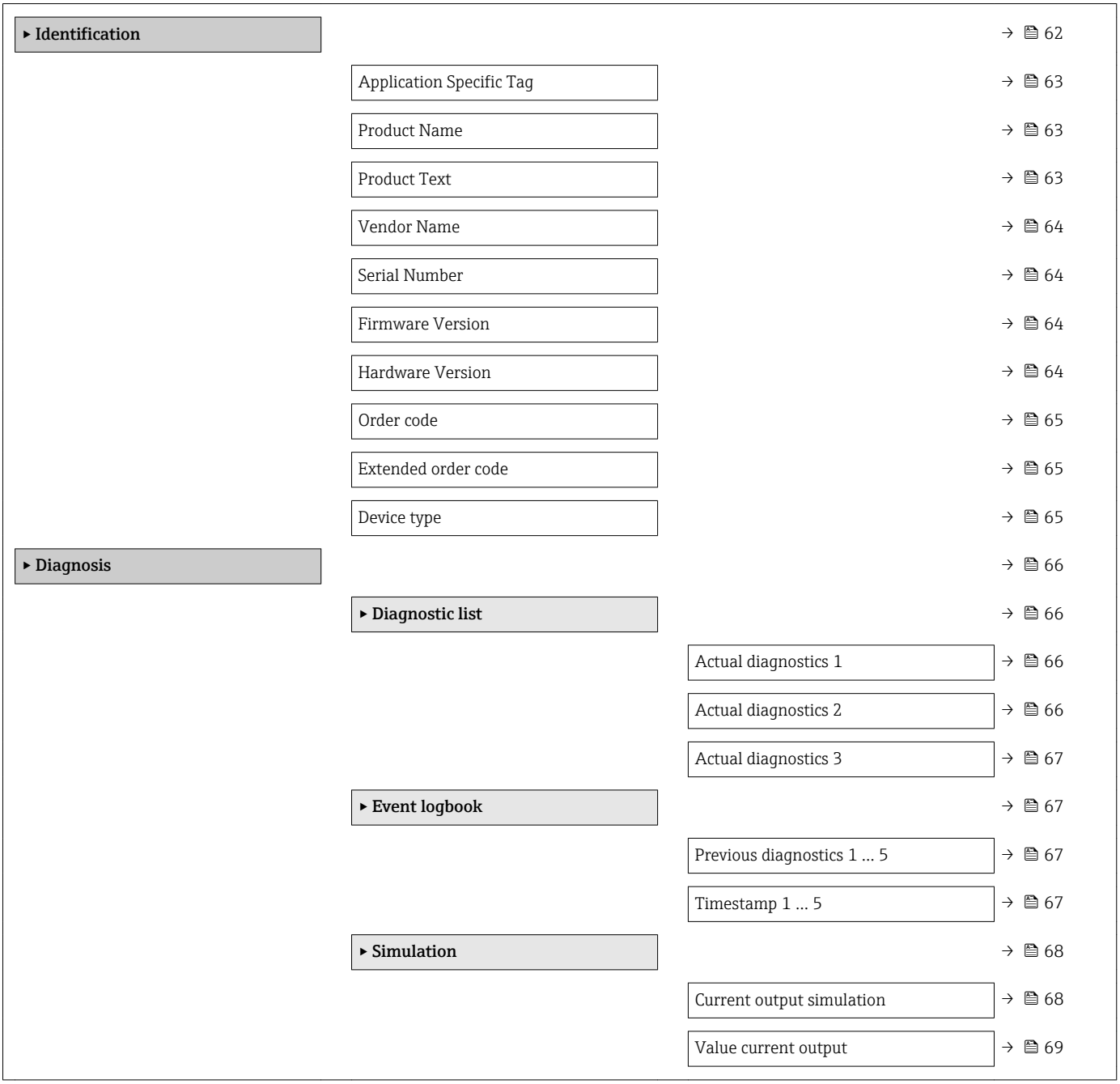
The following tables list all the parameters that are contained in the operating menu.

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

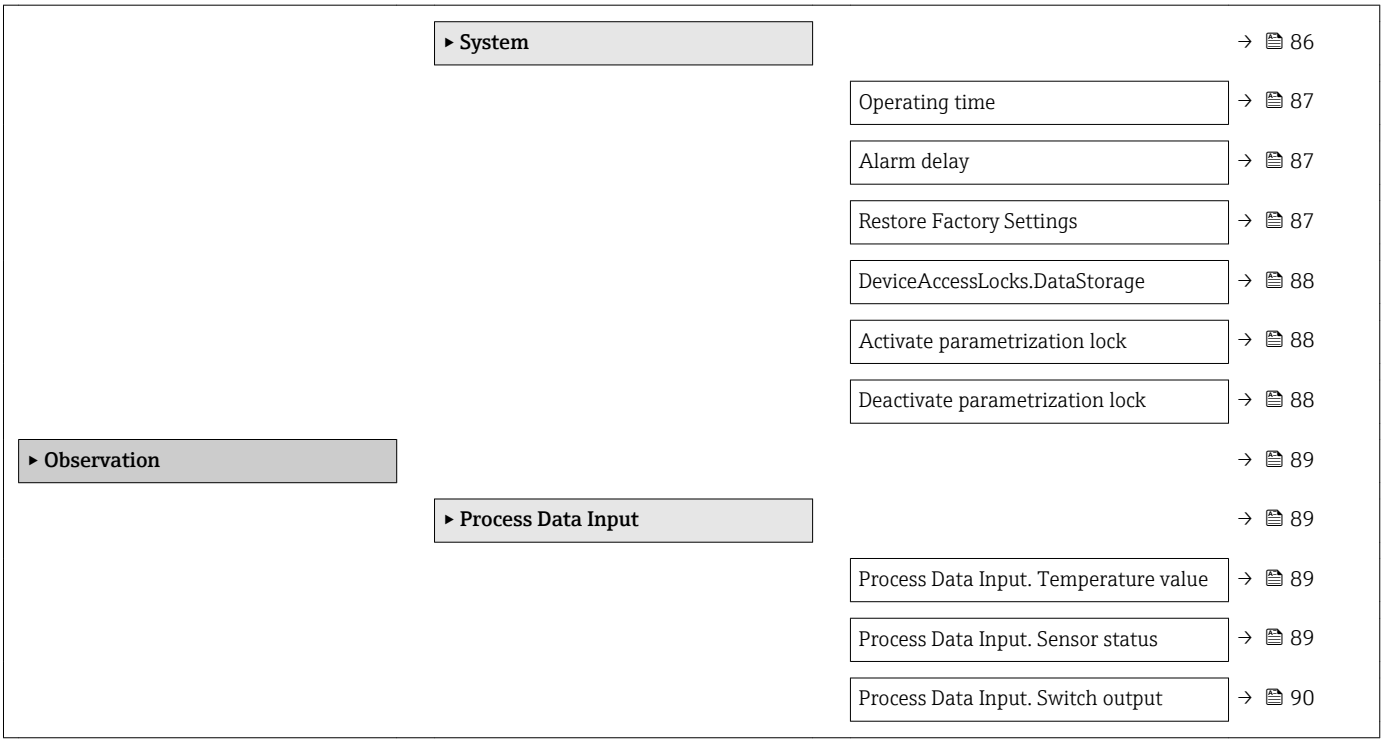
**Operation concept**

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. |



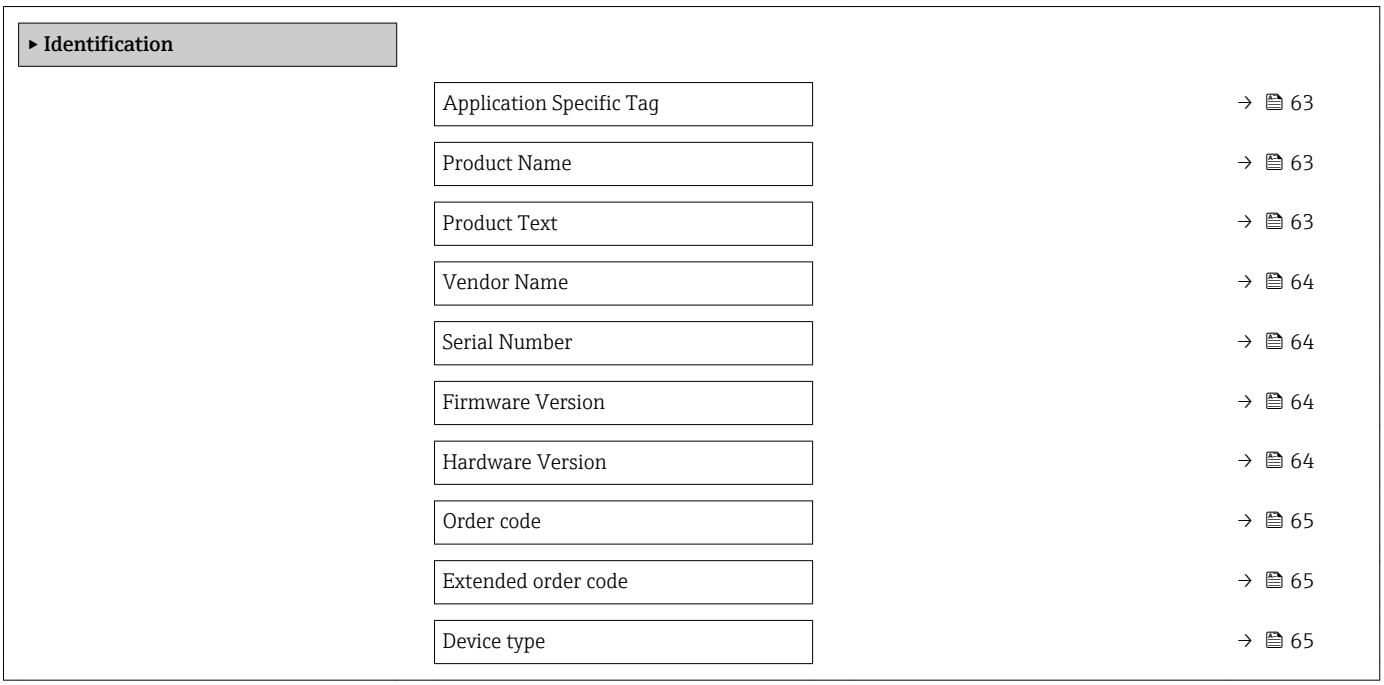
| | | | |
|---|---|---|---|
| | | Sensor simulation | → 69 |
| | | Sensor simulation value | → 69 |
| | | Switch output simulation | → 70 |
| | ▸ **Sensor temperature** | | → 70 |
| | | Sensor max value | → 71 |
| | | Sensor min value | → 71 |
| | | Reset sensor min/max values | → 71 |
| | | Lower boundary operating time sensor | → 72 |
| | | Lower extended operating time sensor | → 72 |
| | | Standard operating time sensor | → 72 |
| | | Upper extended operating time sensor | → 73 |
| | | Upper boundary operating time sensor | → 73 |
| | ▸ **Device temperature** | | → 74 |
| | | Device temperature | → 74 |
| | | Device temperature max | → 74 |
| | | Device temperature min | → 75 |
| | | Reset device temp. min/max values | → 75 |
| | | Lower boundary operating time device | → 75 |
| | | Lower extended operating time device | → 76 |
| | | Standard operating time device | → 76 |
| | | Upper extended operating time device | → 76 |
| | | Upper boundary operating time device | → 77 |
| | ▸ **Measuring data channel** | | → 77 |
| | | MDC Descriptor.Lower limit | → 78 |
| | | MDC Descriptor.Upper limit | → 78 |
| | | MDC Descriptor.Unit code | → 78 |
| | | MDC Descriptor.Scale | → 78 |
| ▸ **Parameter** | | | → 79 |
| | ▸ **Application** | | → 79 |
| | | ▸ **Sensor** | → 79 |
| | | ▸ **Switch output** | → 81 |
| | | ▸ **Current output** | → 84 |




## 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

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Firmware Version

**Navigation** Identification → Firmware Version

**Description** Displays the firmware version

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Hardware Version

**Navigation** Identification → Hardware Version

**Description** Displays the hardware version

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Order code

**Navigation** Identification → Order code

**Description** Displays the order code

**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.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Device type

**Navigation** Identification → Device type

**Description** Displays the device type

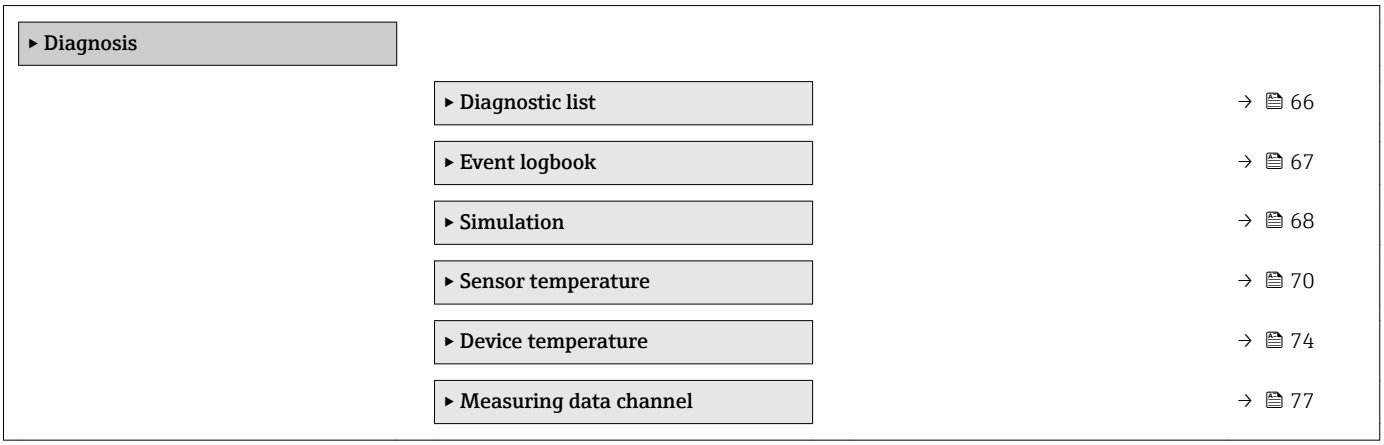
**User interface** 37 887 (0x93FF)

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

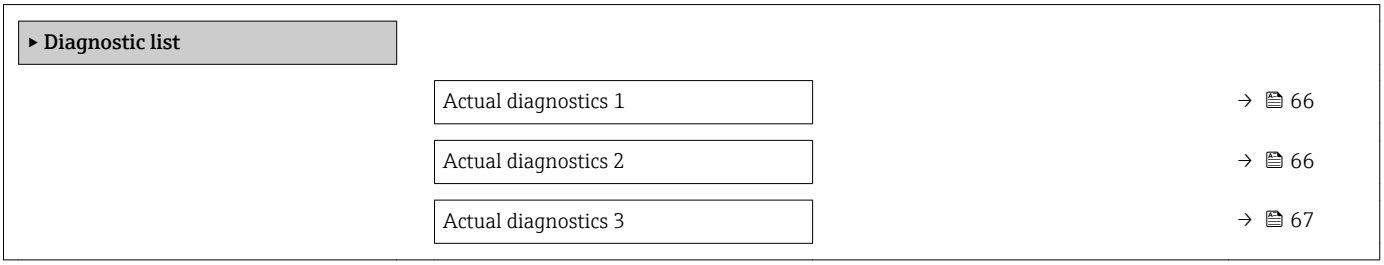
### 15.1.2 Diagnosis

*Navigation* Diagnosis




#### Diagnostic list

*Navigation* Diagnosis → Diagnostic list




#### Actual diagnostics 1

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

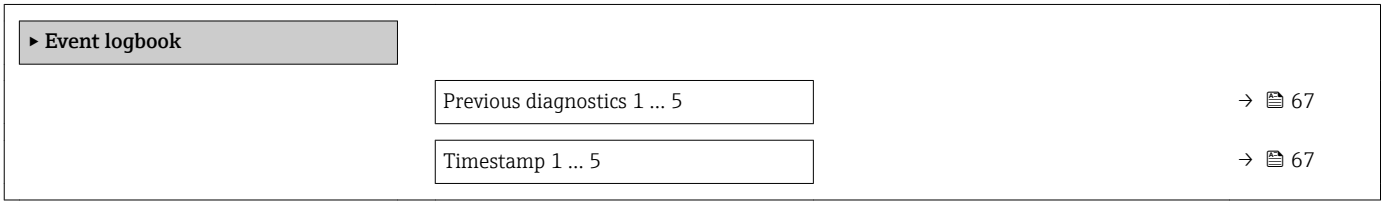
**Description** Displays the diagnostic message with the third-highest priority that is currently active.

**Additional information** *User role*

- Operator
- Maintenance
- Specialist

## Event logbook

*Navigation* Diagnosis → Event logbook




### 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

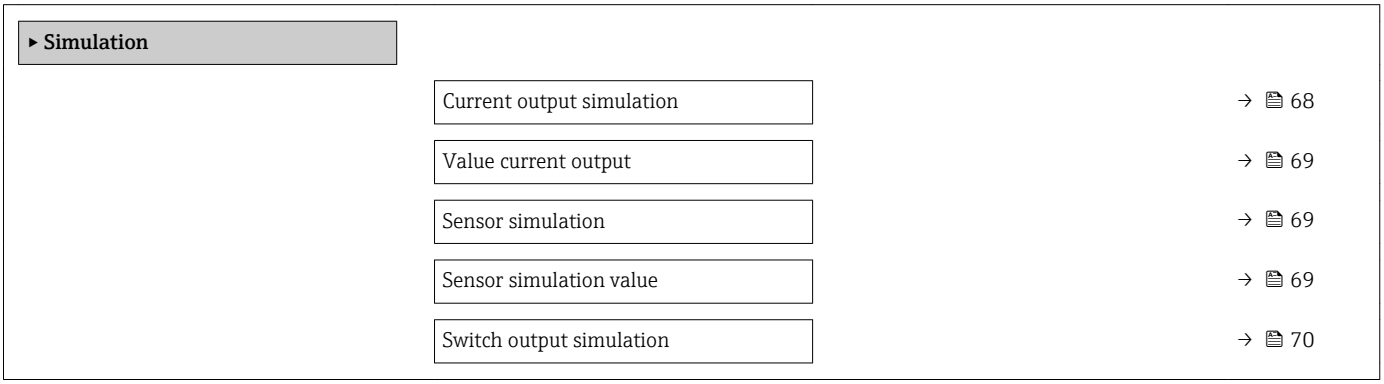
**Description** Displays the time of the last diagnostic message. The time comes from the operating time counter.

**Additional information** *User role*

Specialist

### Simulation

*Navigation* Diagnosis → Simulation




## 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 switching 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 | → 71 |
| | Sensor min value | → 71 |
| | Reset sensor min/max values | → 71 |
| | Lower boundary operating time sensor | → 72 |
| | Lower extended operating time sensor | → 72 |
| | Standard operating time sensor | → 72 |
| | Upper extended operating time sensor | → 73 |

| | | |
|---|---|---|
| | Upper boundary operating time sensor | → 73 |

### 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).

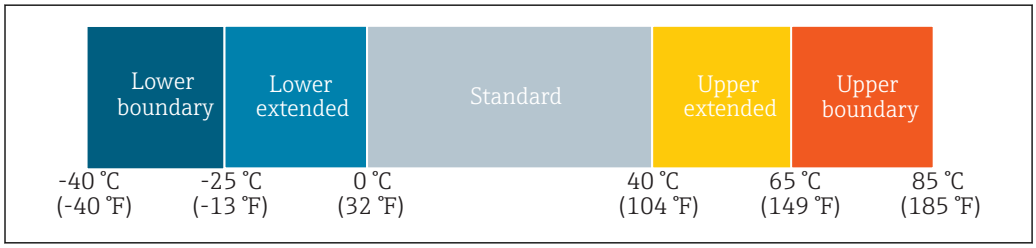
**Additional information** *User role*

- 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).



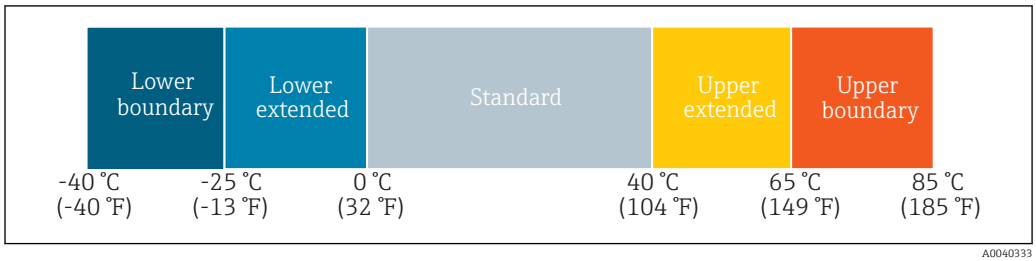

**Additional information** *User role*

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).



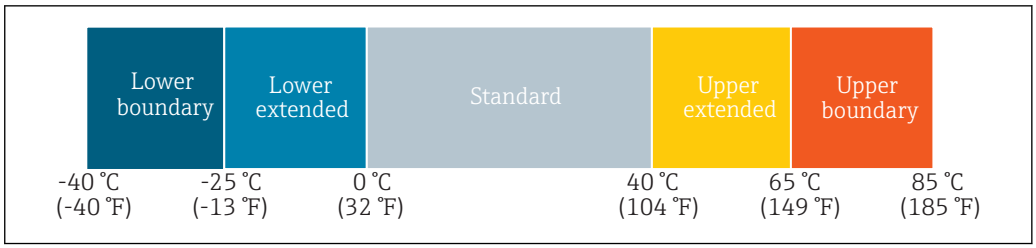

**Additional information** *User role*

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

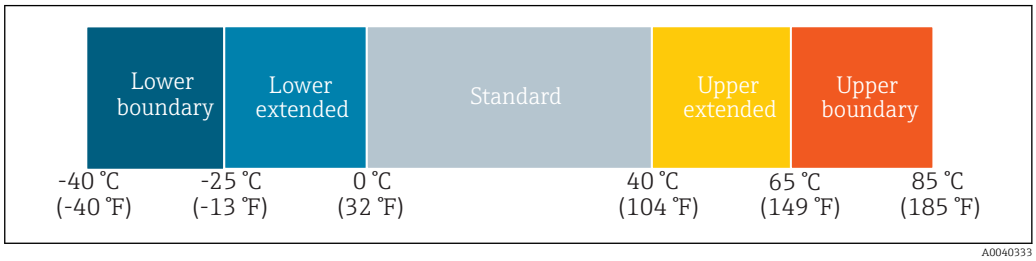
## Upper extended operating time sensor

**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

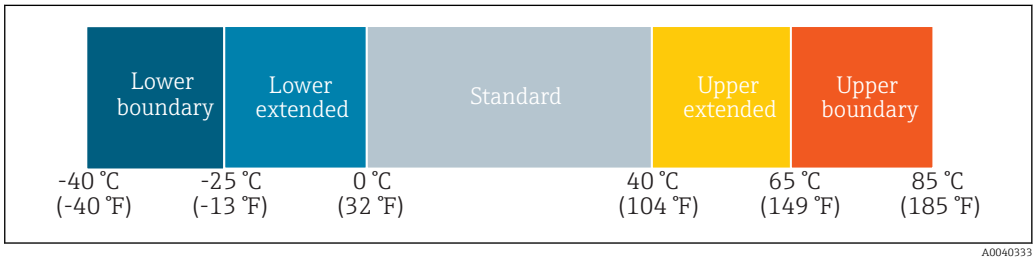
## Upper boundary operating time sensor

**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 | → 74 |
| Device temperature max | → 74 |
| Device temperature min | → 75 |
| Reset device temp. min/max values | → 75 |
| Lower boundary operating time device | → 75 |
| Lower extended operating time device | → 76 |
| Standard operating time device | → 76 |
| Upper extended operating time device | → 76 |
| Upper boundary operating time device | → 77 |

### 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).

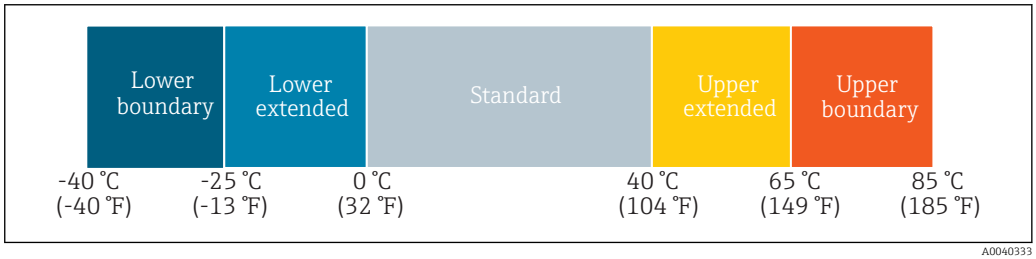
**Additional information** *User role*

- 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).



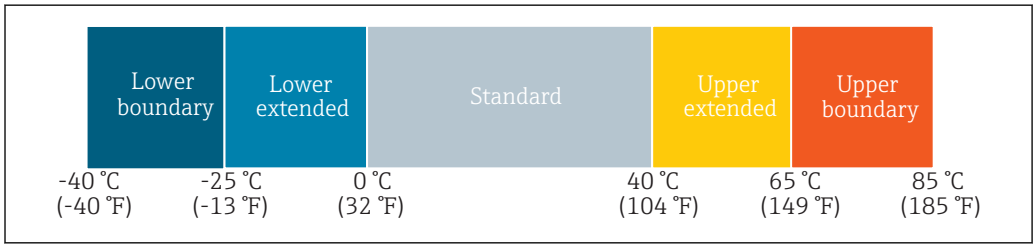

**Additional information** *User role*

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).



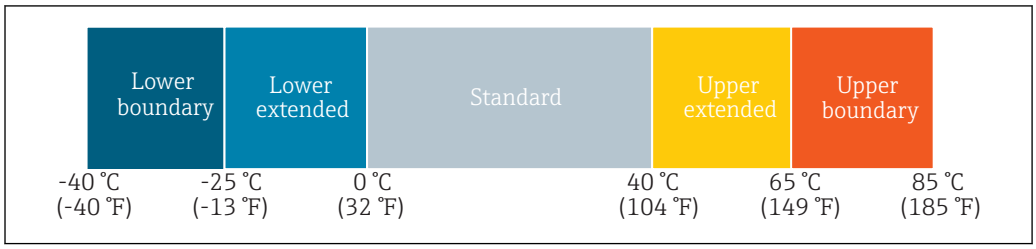

**Additional information** *User role*

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).



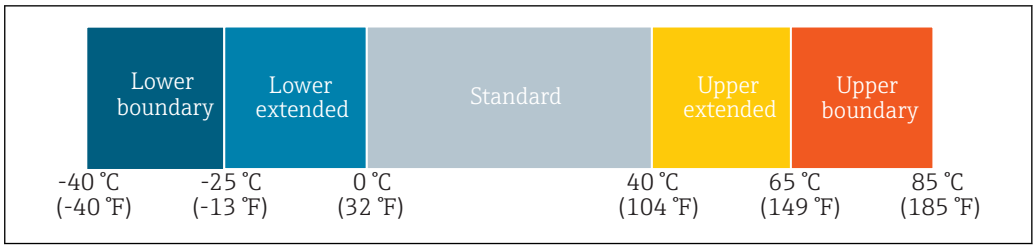

**Additional information** *User role*

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).



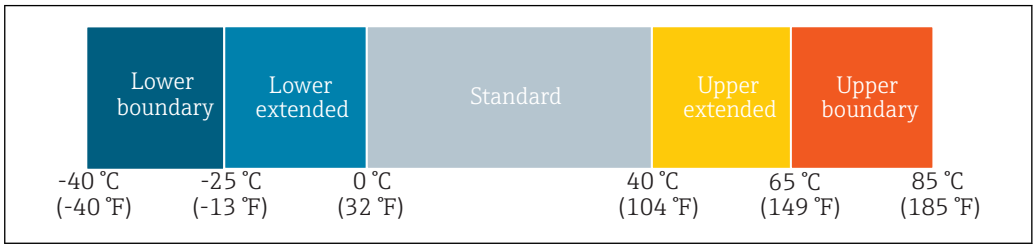

**Additional information** *User role*

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

| ▸ Measuring data channel | | |
|---|---|---|
| | MDC Descriptor.Lower limit | → 78 |
| | MDC Descriptor.Upper limit | → 78 |
| | MDC Descriptor.Unit code | → 78 |
| | MDC Descriptor.Scale | → 78 |

### 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* Parameter

| | | |
|---|---|---|
| ▸ Parameter | | |
| | ▸ Application | → 79 |
| | ▸ System | → 86 |

#### Application

*Navigation* Parameter → Application

| | | |
|---|---|---|
| ▸ Application | | |
| | ▸ Sensor | → 79 |
| | ▸ Switch output | → 86 |
| | ▸ Current output | → 87 |

*Sensor*

*Navigation* Parameter → Application → Sensor

| | | |
|---|---|---|
| ▸ Sensor | | |
| | Unit | → 79 |
| | Damping | → 80 |
| | Sensor offset | → 80 |

**Unit**

**Navigation** Parameter → 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** Parameter → 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** Parameter → Application → Sensor → Sensor offset

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

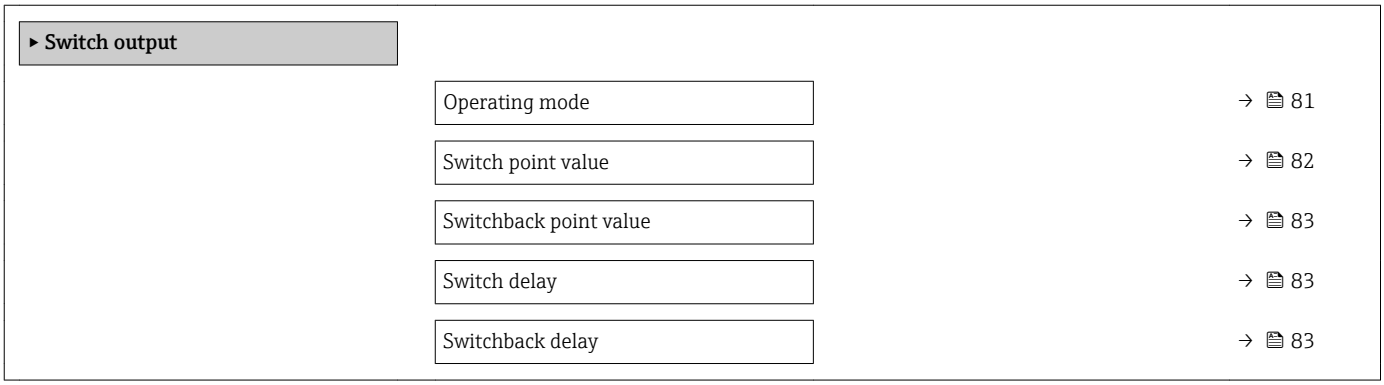
**User entry** −10 to +10 °C (14 to 50 °F)

**Factory setting** 0 °C

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

*Switch output*

*Navigation* Parameter → Application → Switch output




## Operating mode

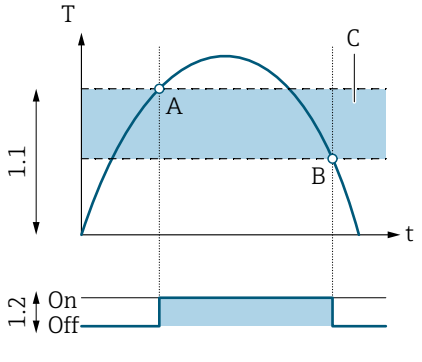
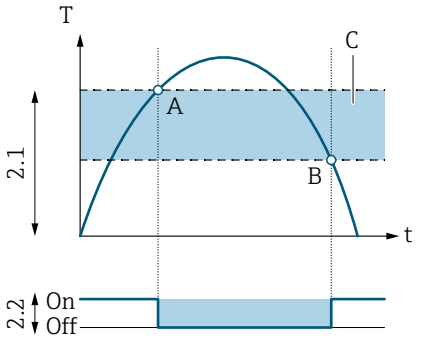
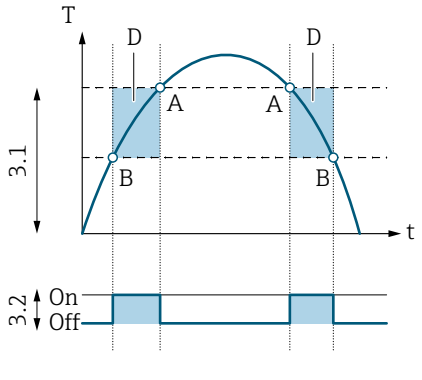
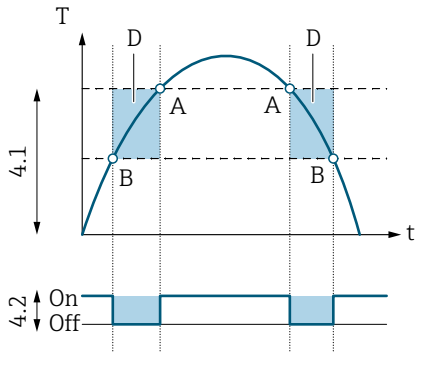
**Navigation** Parameter → Application → Switch output → Operating mode

**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** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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* Parameter → Application → Current output

| ▸ Current output | | |
|---|---|---|
| | 4 mA value | → 84 |
| | 20 mA value | → 85 |
| | Current trimming 4 mA | → 85 |
| | Current trimming 20 mA | → 85 |
| | Failure mode | → 86 |
| | Failure current | → 86 |

## 4 mA value

**Navigation** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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* Parameter → System

| ▸ System | | |
|---|---|---|
| | Operating time | → 87 |

| | | |
|---|---|---|
| | Alarm delay | → 87 |
| | Restore Factory Settings | → 87 |
| | DeviceAccessLocks.DataStorage | → 88 |
| | Activate parametrization lock | → 88 |
| | Deactivate parametrization lock | → 88 |

## Operating time

**Navigation** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → 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** Parameter → System → Deactivate parametrization lock

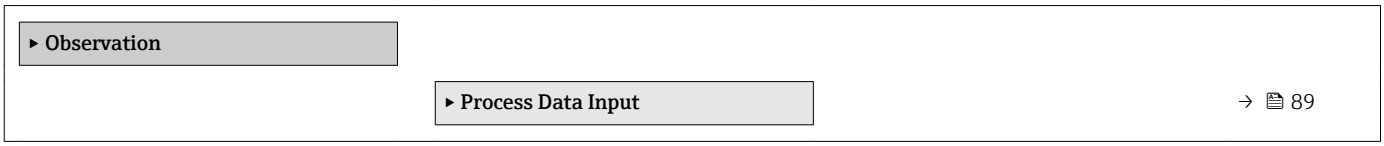
**Description** Use this function to unlock the parameterization of the device.

**Additional information** *User role*

- Maintenance
- Specialist

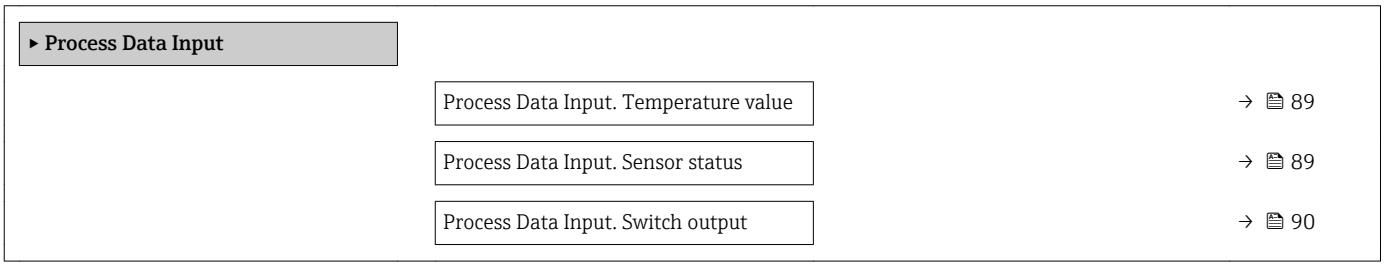
### 15.1.4 Observation

*Navigation* Observation




#### Process Data Input

*Navigation* Observation → Process Data Input




#### 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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