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Operating Instructions
iTHERM CompactLine TM311

Compact thermometer with IO-Link

IO-Link

Endress+Hauser
People for Process Automation

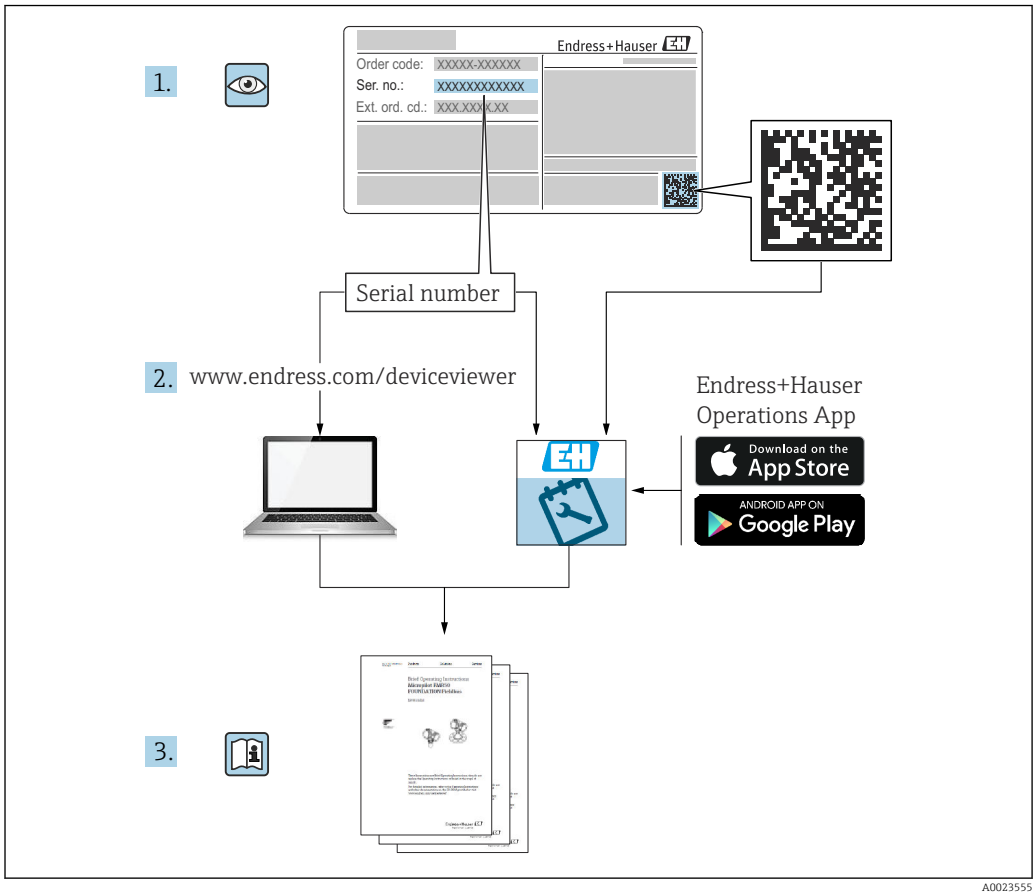

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XXX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

1 Document information

1.1 Document function

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

1.2 Symbols

1.2.1 Safety symbols

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

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

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

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

1.2.2 Electrical symbols

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

1.2.3 Symbols for certain types of information

Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.

Symbol	Meaning
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.4 Symbols in graphics

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

1.2.5 Tool symbols

Symbol	Meaning
 A0011222	Open-ended wrench

1.3 Documentation

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

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

1.3.1 Document function

The following documentation may be available depending on the version ordered:

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

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 Intended 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

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

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!
- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

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

2.4 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.

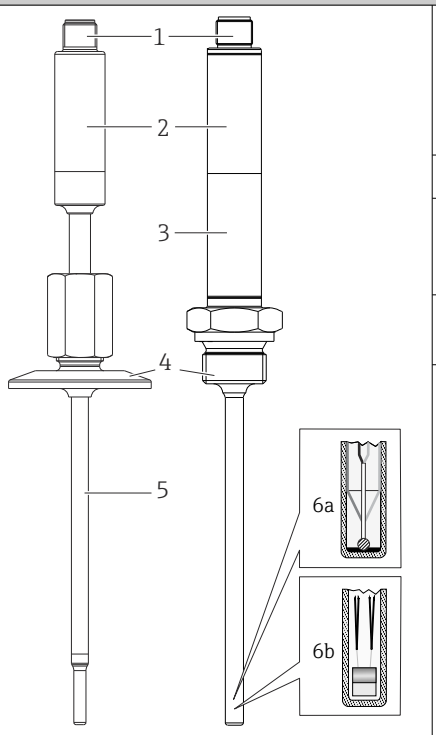
It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device.

2.5 IT security

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

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

3 Product description

Design		Options
	1: Electrical connection, output signal 2: Transmitter housing	**Your benefits:** ▪ M12, 4-pin connector, reduced cost and effort, incorrect wiring is prevented ▪ Optimum protection, IP69 as standard ▪ 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 → 🖹 53	Over 50 different versions for industrial, hygienic and aseptic applications.
	5: Thermowell	▪ Versions with and without thermowell (insert in direct contact with process) ▪ Thermowell diameter 6 mm and optimized T-pieces and elbow pieces

	6: Insert with:
	6a: iTHERM TipSens
	6b: Pt100 (TF), basic
		Your benefits:
		▪ **iTHERM TipSens** - insert with shortest response times:
		  ▪ Insert: Ø3 mm (⅛ in) or Ø6 mm (¼ in)
		  ▪ Fast, highly accurate measurements, delivering maximum process safety and control
		  ▪ Quality and cost optimization
		  ▪ Minimization of necessary immersion length: better product protection thanks to improved process flow
		▪ **Pt100 (TF), basic**
		▪ 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. Do the data on the nameplate match the ordering information on the delivery note?
7. 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.

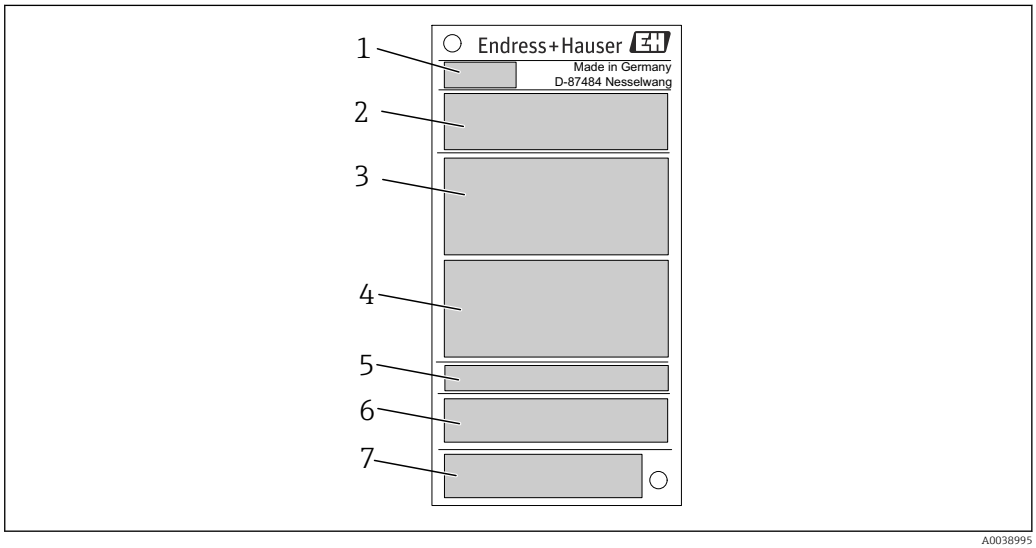
4.2 Product identification

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

4.2.1 Nameplate

The correct device?

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



1 *Sample graphic*

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

4.2.2 Scope of delivery

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

4.3 Name and address of manufacturer

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

4.4 Storage and transport

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

Maximum relative humidity: < 95 % as per IEC 60068-2-30

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

Avoid the following environmental influences during storage:
- direct sunlight
- proximity to hot objects
- mechanical vibration
- aggressive media

5 Mounting

5.1 Mounting requirements

Information on the conditions that must be present at the mounting location to ensure correct use (e.g. ambient temperature, degree of protection, climate class, etc.) and information on the device dimensions → 32

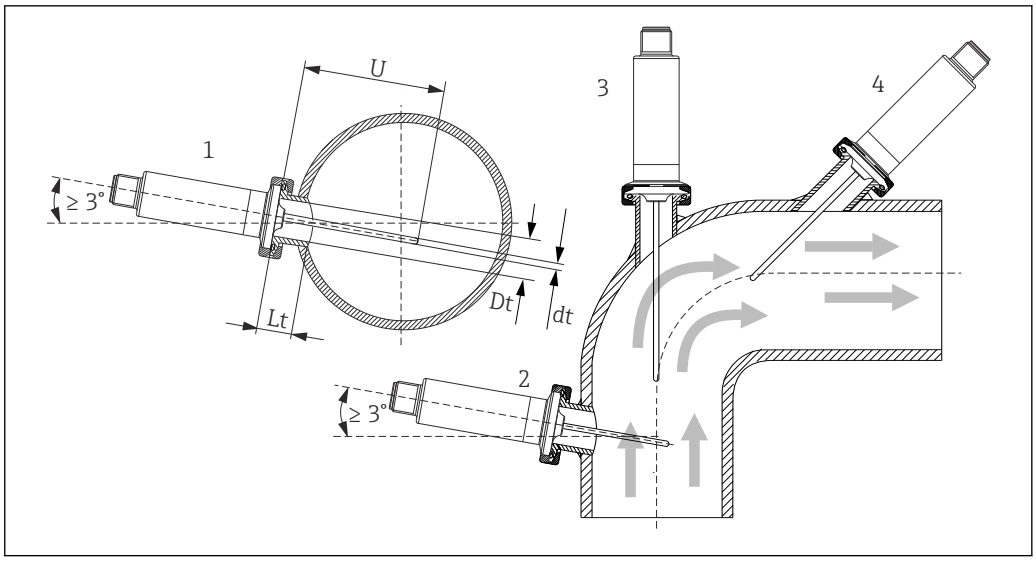
5.1.1 Orientation

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. Therefore, 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*

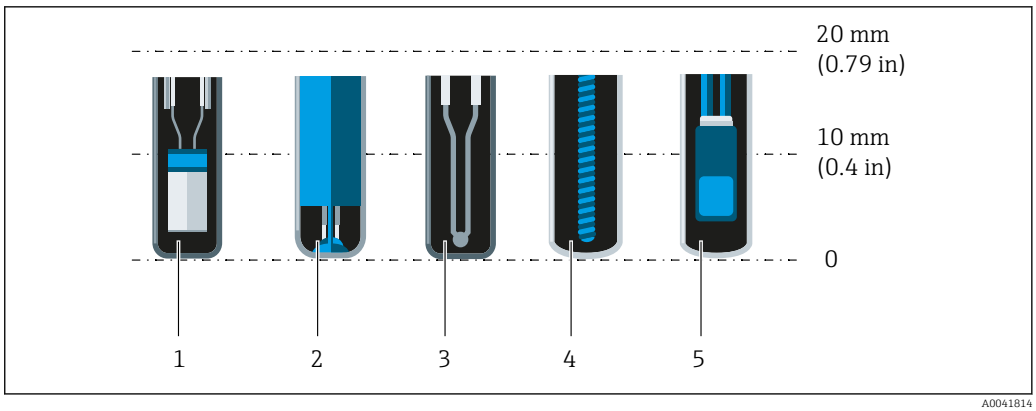
1, 2 Perpendicular to flow direction, installed at a minimum angle of 3 °, to ensure self-draining
3 On elbows
4 Inclined installation in pipes with a small nominal diameter
U Immersion length

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

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

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

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



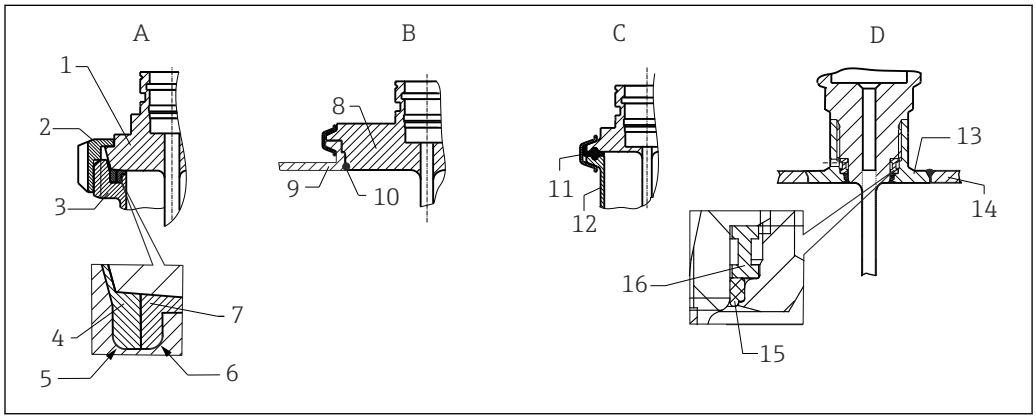
1 StrongSens or TrustSens at 5 to 7 mm (0.2 to 0.28 in)
2 QuickSens at 0.5 to 1.5 mm (0.02 to 0.06 in)
3 Thermocouple (not grounded) at 3 to 5 mm (0.12 to 0.2 in)
4 Wire wound sensor at 5 to 20 mm (0.2 to 0.79 in)
5 Standard thin-film sensor at 5 to 10 mm (0.2 to 0.39 in)

To keep the influence of heat dissipation to a minimum and to achieve the best possible measurement results, 20 to 25 mm (0.79 to 0.98 in) should be in contact with the medium in addition to the actual sensor element.

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

It is particularly important to take this into consideration for T-pieces, as the immersion length is very short on account of their design, and the measured error is higher as a result. It is therefore recommended to use elbow pieces with QuickSens sensors.

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 or insertion length, all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. Flow velocity, process pressure).



3 Detailed installation instructions for hygiene-compliant installation

A Milk pipe connection according to DIN 11851, only in conjunction with EHEDG-certified, self-centering sealing ring
1 Sensor with milk pipe connection
2 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 counterparts for the process connections and the seals or sealing rings are not supplied with the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories. → 26

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 mechanically 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 sprays this area directly so that it is cleaned properly.
2. The Varivent® connections enable flush-mounted 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 Mounting the thermometer

Proceed as follows to mount 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-mounting check

❑	Is the device undamaged (visual inspection)?
❑	Is the device correctly secured?
❑	Does the device correspond to the specifications at the measuring point, e.g. ambient temperature, measuring range etc.?→ 32

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.

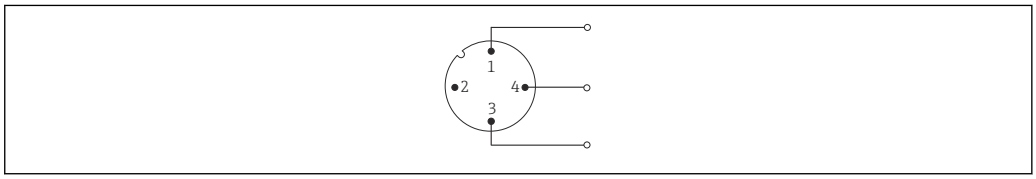
6.2 Connecting the measuring device

NOTICE

Damage to the device!

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

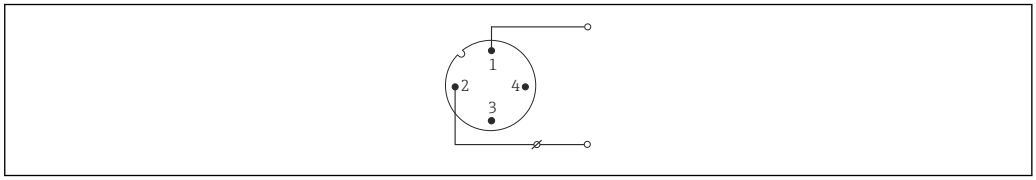
IO-Link operating mode



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)*

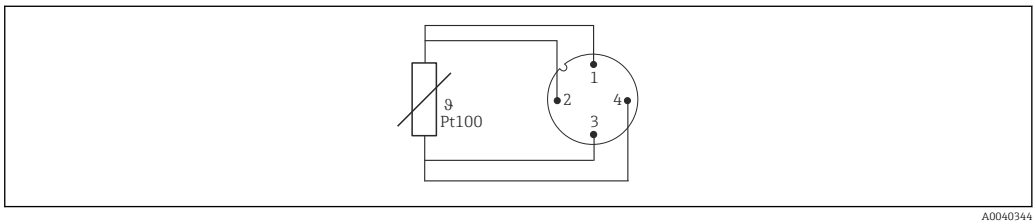
4 to 20 mA operating mode



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 → 30.

6.4 Post-connection check

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

7 Operation options

7.1 Protocol-specific data

7.1.1 IO-Link information

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. The IO-Link communication interface 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: ▪ Identification ▪ Diagnosis ▪ 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 is 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 transfer rate.

This data is 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: http://ioddfinder.io-link.com

8 System integration

8.1 Identification

Device ID	0x030100 (196864)
Vendor ID	0x0011 (17)

8.2 Process data

When the measuring 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 Example: a transmitted value of 123 corresponds to a measured temperature value of 12.3 °C
	32764 = No measurement data	Process value if no valid measured value is available
	- 32760 = Out of range (-)	Process value if the measured value is below the lower limit value
	32760 = Out of range (+)	Process value if the measured value is above the upper limit value

1) IO Device Description

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

8.3 Reading and writing device data

Device data are always exchanged acyclically and at the request of the IO-Link master via the ISDU communication channel. The IO-Link master can read 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 33 = °F 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) Window normally closed (0x0C96) Hysteresis normally open (0x0C9C) Hysteresis normally closed (0x0C99) 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

Identifier	Index (dec)	Index (hex)	Size (byte)	Data type	Access	Default value	Value range	Data storage
Switchback delay	2054	0x0806	1	UInteger8	r/w	0 s	0 to 99 s	Yes
4 mA value	8218	0x201A	4	Float	r/w	0 °C (32 °F)	−50 000 to 50 000 °C	Yes
20 mA value	8219	0x201B	4	Float	r/w	150 °C	−50 000 to 50 000 °C	Yes
Current trimming 4mA	8213	0x2015	4	Float	r/w	4.00 mA	3.85 to 4.15 mA	Yes
Current trimming 20mA	8212	0x2014	4	Float	r/w	20.00 mA	19.85 to 20.15 mA	Yes
Failure mode	8234	0x202A	1	UInteger8	r/w	0 = Low alarm	0 = Low alarm 2 = High alarm	Yes
Failure current	8232	0x2028	4	Float	r/w	22.5 mA	21.5 to 23 mA	Yes
Operating time	6148	0x1804	4	UInteger32	r/-	–	–	Yes
Alarm delay	6147	0x1803	1	UInteger8	r/w	2 s	1 to 5 s	Yes
Device status	36	0x0024	1	UInteger8	r/-	–	0 = Device is OK 1 = Maintenance required 2 = Out of specification 3 = Functional check 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 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 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 33004 = Off 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/-	–	–	–

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

8.3.2 IO-Link-specific device data

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

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

9 Commissioning

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

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. → 26

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 → 15.
	Incorrect device orientation.	▶ Install the device correctly → 10.
	Heat dissipation over the measuring point.	▶ Observe the installed length of the sensor.
No communication	Communication cable is not connected.	▶ Check wiring and cables.

Error	Possible cause	Solution
	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. 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. 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 The difference between the 4mA value and 20mA value must be greater than or equal to 10°C.	1. Check device configuration. 2. Upload and download new configuration.
					Switch points are invalid 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. 2. Check the output. 3. Replace device.
S825	Warning	IO-Link Warning	0x1812	Operating temperature	Operating temperature of the electronics out of specification	1. Check ambient temperature. 2. Check process temperature.
S844 [2]	Warning	-	-	Process value out of specification	Process value is outside the specification	1. Check process value. 2. Check application. 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 Services

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

12 Repair

The design of the device is such that 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 pieces	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 pieces	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 pieces	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 web page for information:
   http://www.endress.com/support/return-material
   ↳ Select the region.
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

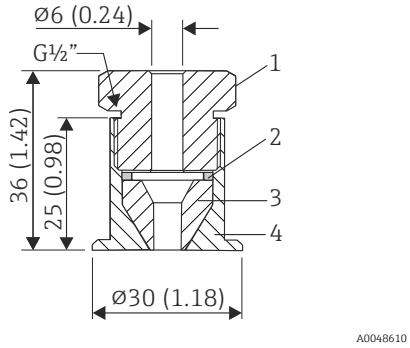
12.3 Disposal

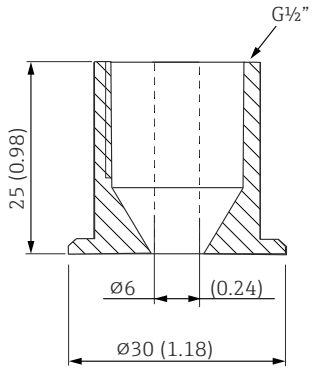
The device contains electronic components and must therefore be disposed of as electronic waste. Please pay particular attention to the local regulations governing waste disposal in your country. Ensure proper separation and reuse of the device components where possible.

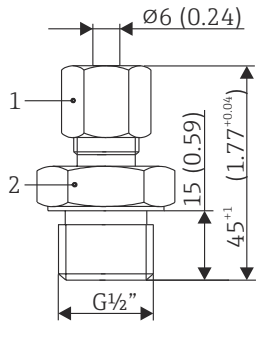
13 Accessories

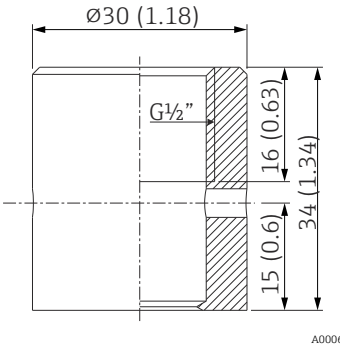
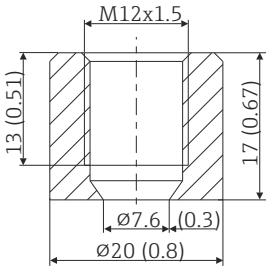
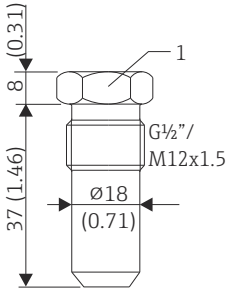
All dimensions in mm (in).

13.1 Device-specific accessories

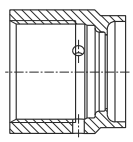
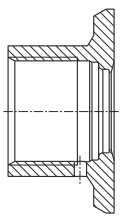
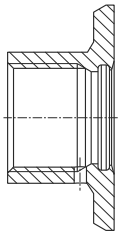
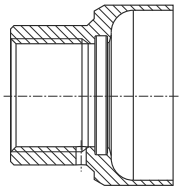
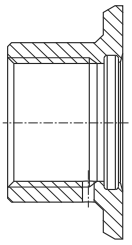
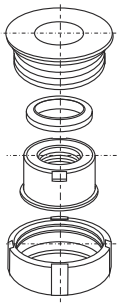
Accessories	Description
Welding boss with sealing taper  *1 Pressure screw, 303/304, width across flats 24 mm* *2 Washer, 303/304* *3 Sealing taper, PEEK* *4 Collar welding boss, 316L*	▪ Collar welding boss movable with sealing taper, washer and pressure screw G½" ▪ Material of parts in contact with the process 316L, PEEK ▪ Max. process pressure 10 bar (145 psi) ▪ Order number with pressure screw 51004751 ▪ Order number without pressure screw 51004752

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

Accessories	Description
Compression fitting  *1 AF14* *2 AF27*	▪ Movable clamping ring, process connection G½" ▪ Material of compression fitting and parts in contact with the process, 316L ▪ Order number TK40-BADA3C (other versions can be configured in the TK40 structure)

Accessories	Description
Welding boss with sealing taper (metal-metal)  A0006621  A0018236	▪ Welding boss for G½" or M12x1.5 thread ▪ Metal-sealing; conical ▪ Material of parts in contact with the process 316L/1.4435 ▪ Max. process pressure 16 bar (232 PSI) ▪ Order number 71424800 (G½") ▪ Order number 71405560 (M12x1.5)
Dummy plug  A0045726 *1 AF22*	▪ Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss ▪ Material: SS 316L/1.4435 ▪ Order number 60022519 (G½") ▪ Order number 60021194 (M12x1.5)

13.1.1 Weld-in adapter

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

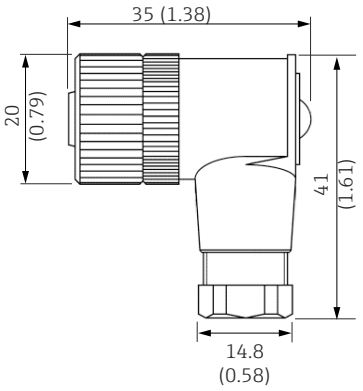
Material	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)
Roughness µm (µin) process side	≤1.5 (59.1)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)

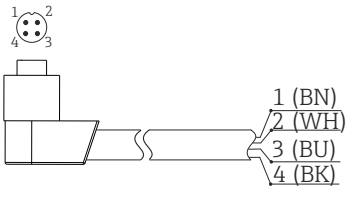
Maximum process pressure for the weld-in adapters:
- 25 bar (362 PSI) at maximum 150 °C (302 °F)
- 40 bar (580 PSI) at maximum 100 °C (212 °F)

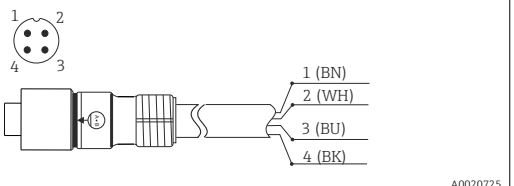
13.2 Communication-specific accessories

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

13.2.1 Coupling

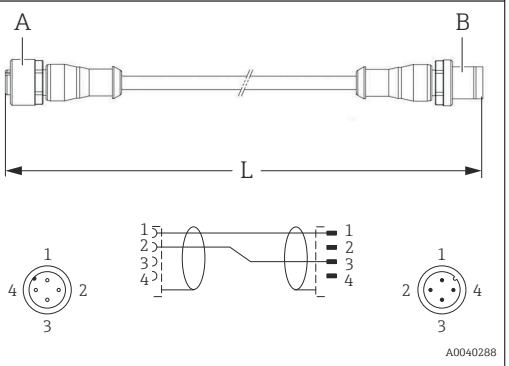
Accessories	Description
▪ M12x1 coupling; elbowed, for termination of connecting cable by user ▪ Connection to M12x1 housing connector ▪ Body materials PBT/PA ▪ Cap-nut GD-Zn, nickel-plated ▪ IP67 degree of protection (fully locked) ▪ Order number 51006327 ▪ Voltage: max. 250 V ▪ Current carrying capacity: max. 4 A ▪ 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) ▪ IP69K protection (optional) ▪ Order number 71387767 ▪ Voltage: max. 250 V ▪ Current carrying capacity: max. 4 A ▪ Temperature: −25 to 70 °C Wire colors: ▪ 1 = BN brown ▪ 2 = WH white ▪ 3 = BU blue ▪ 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) ▪ IP69K protection (optional) ▪ Order number 71217708 ▪ Voltage: max. 250 V ▪ Current carrying capacity: max. 4 A ▪ Temperature: −20 to 105 °C Wire colors: ▪ 1 = BN brown ▪ 2 = WH white ▪ 3 = BU blue ▪ 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 ▪ Cable length ~ 100 mm (3.94 in) without socket and connector ▪ Color: black ▪ Connector 1: M12, 4-pin, A-coded, socket, straight ▪ Connector 2: M12, 4-pin, A-coded, connector, straight ▪ Metal parts: stainless steel ▪ Voltage: max. 60 V_{DC} ▪ Current carrying capacity: max. 4 A ▪ Degree of protection: IP66, IP67 and IP69 in accordance with IEC 60529 (when connected); NEMA 6P ▪ Temperature: −40 to +85 °C (−40 to +185 °F) ▪ Order number 71449142	 *A M12 socket* *B M12 connector* *L 200 mm (7.87 in)*

13.3 Service-specific accessories

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

Accessories	Description
Configurator	Product Configurator - the tool for individual product configuration ▪ Up-to-the-minute configuration data ▪ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language ▪ Automatic verification of exclusion criteria ▪ Automatic creation of the order code and its breakdown in PDF or Excel output format ▪ Ability to order directly in the Endress+Hauser Online Shop The Configurator is available 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 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. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: 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. For details, see Technical Information TI00144R

Accessories	Description
RIA15 field indicator	Field indicator for looping into 4 to 20 mA, panel mounting For details, see Technical Information TI00143K

Accessories	Description
RIA14 field indicator	Field indicator for looping into 4 to 20 mA, optionally available with Ex d approval. For details, see document TI00143R

Accessories	Description
RN22/RN42	RN221: 1- or 2-channel active barrier for separation of 0/4 to 20 mA standard signal circuits, optionally available as a signal duplicator, 24 V DC. HART-transparent RN42: 1-channel active barrier with wide range power supply for safe separation of 0/4 to 20 mA standard signal circuits, HART-transparent For details ▪ Technical Information RN22 -> TI01515K ▪ Technical Information RN42 -> TI01584K

14 Technical data

14.1 Input

Measuring range

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

14.2 Output

Output signal

Order code 020, option A

Sensor output	Pt100, 4-wire connection, class A

Order code 020, option B

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

Order code 020, option C

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

Switching capacity

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

Switch output

Response time ≤ 100 ms

Failure information

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

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

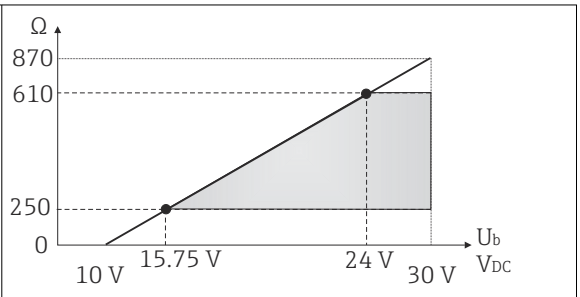
In the 4 to 20 mA mode, the device transmits the failure information according to NAMUR NE43:

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

Underranging	Linear 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 The **high** alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

Load

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



Linearization/transmission behavior

Temperature - linear

Damping

Configurable sensor input damping	0 to 120 s
Factory setting	0 s

Input current required

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

Maximum current consumption

≤ 23 mA for 4 to 20 mA

Switch-on delay

2 s

Protocol-specific data

IO-Link information

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. The IO-Link communication interface 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: ▪ Identification ▪ Diagnosis ▪ 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 is applied (first valid measured value after 2 s)

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 transfer rate.

This data is available in the device description (IODD [2)]), 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: http://ioddfinder.io-link.com

Write protection for device parameters

Software write protection is implemented using system commands.

14.3 Power supply

Supply voltage

Electronic version	Supply voltage
IO-Link/ 4 to 20 mA	U_b = 10 to 30 V_{DC}, protected against reverse polarity IO-Link communication is guaranteed only if the supply voltage is at least 15 V. 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).

Electrical connection

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

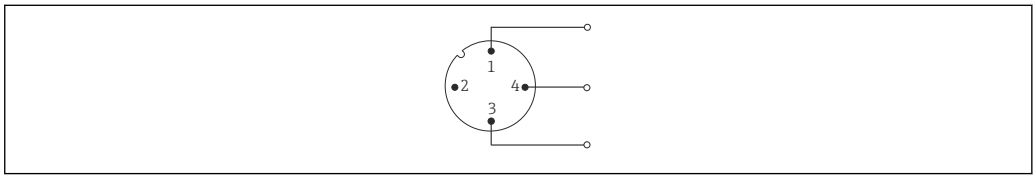
2) IO Device Description

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

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

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

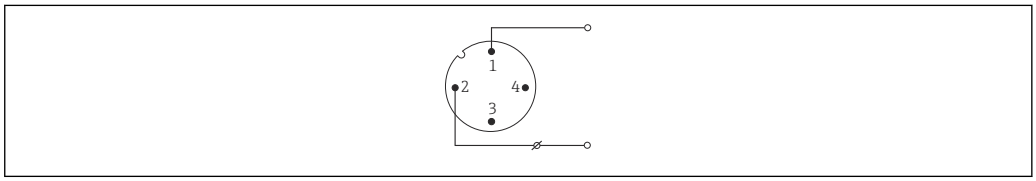
IO-Link operating mode



7 *Pin assignment, device plug*

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

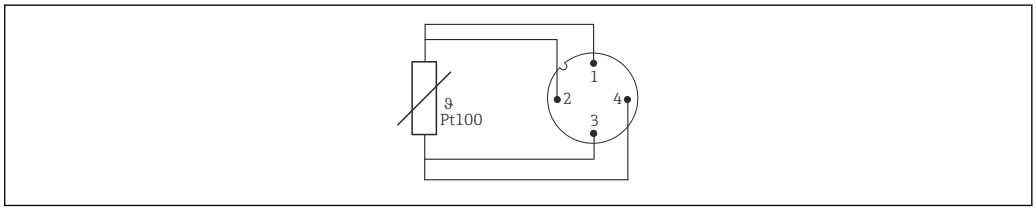
4 to 20 mA operating mode



8 *Pin assignment, device plug*

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

Without electronics



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

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

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

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

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

Thermometer without electronics

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

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

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

Thermometer with electronics

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

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

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

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

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

MV = measured value

LRV = lower range value of the sensor in question

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

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

Measured error digital = 0.127 °C (0.229 °F) + 0.0074 % x [150 °C (302 °F) - (−50 °C (−58 °F))]:	0.14 °C (0.25 °F)
Measured error D/A = 0.05 % x 150 °C (302 °F)	0.08 °C (0.14 °F)
Measured error digital value (IO-Link):	0.14 °C (0.25 °F)
Measured error analog value (current output): √(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)), at least 0.008 °C (0.014 °F)	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) x (0.003 % x 150 °C (302 °F))	0.05 °C (0.09 °F)
Influence of supply voltage (digital) = (30 - 24) x (0.004 % x 200 °C (360 °F)), at least 0.008 °C (0.014 °F)	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) x (0.003 % x 150 °C (302 °F))	0.03 °C (0.05 °F)
Measured error digital value (IO-Link): √(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 Measuring range −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)

Device temperature

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

Response time T_{63} and T_{90}

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

Response time without heat transfer paste

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

Electronics response time

Max. 1 s

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

Sensor current

≤ 1 mA

Calibration

Calibration of thermometers

Calibration involves comparing the measured values of a device under test (DUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:

- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C
- Calibration compared against a precise reference thermometer

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

Sensor-transmitter-matching

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

temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.

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

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

For the device, the manufacturer offers standard calibrations at a reference temperature of −50 to +200 °C (−58 to +392 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from your local sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device.

14.5 Installation

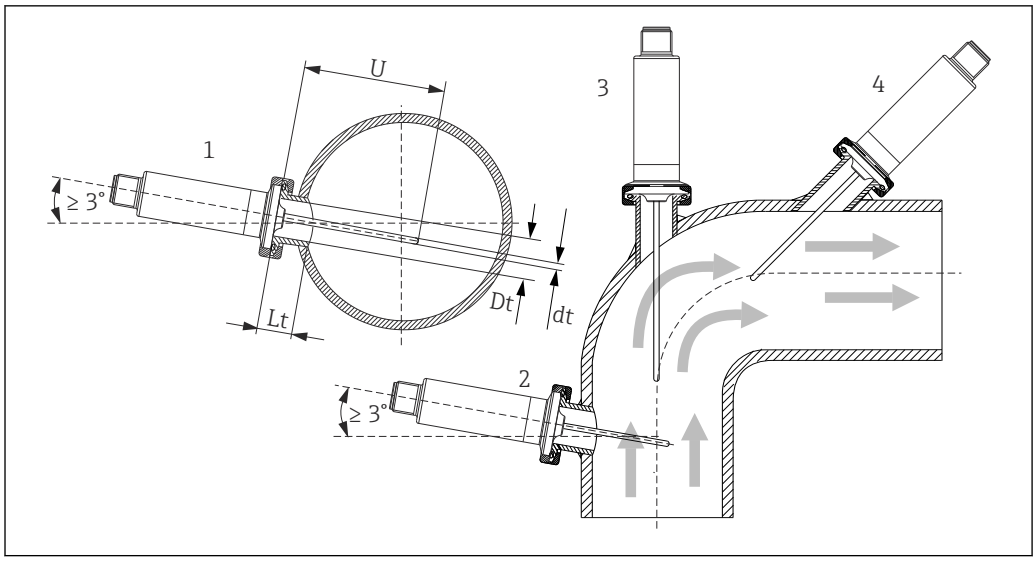
Orientation

No restrictions. 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.

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. Therefore, 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.



10 *Installation examples*

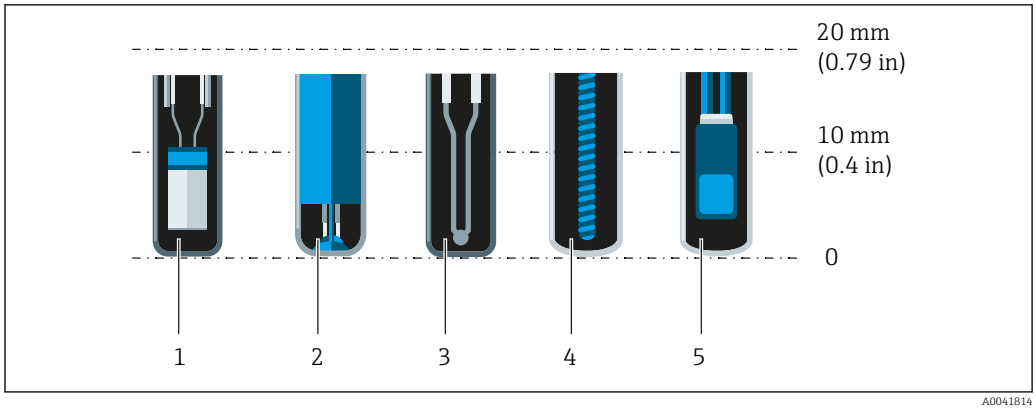
1, 2 Perpendicular to flow direction, installed at a minimum angle of 3 °, to ensure self-draining
3 On elbows
4 Inclined installation in pipes with a small nominal diameter
U Immersion length

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

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

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

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



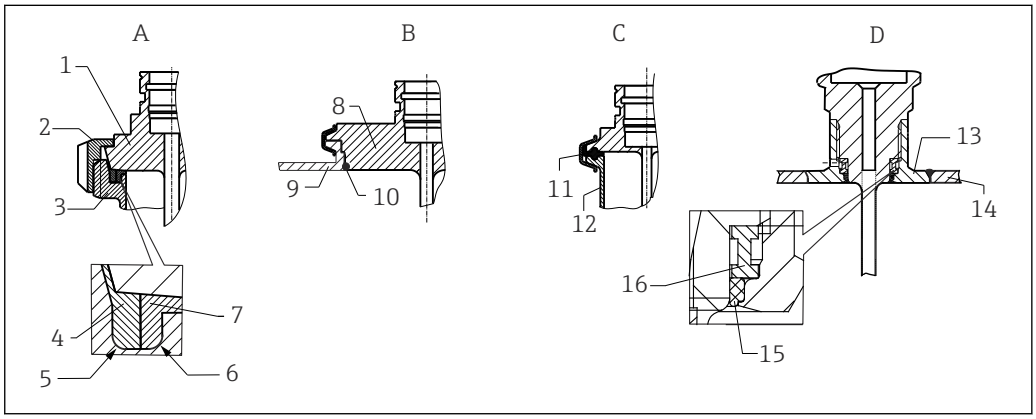
1 StrongSens or TrustSens at 5 to 7 mm (0.2 to 0.28 in)
2 QuickSens at 0.5 to 1.5 mm (0.02 to 0.06 in)
3 Thermocouple (not grounded) at 3 to 5 mm (0.12 to 0.2 in)
4 Wire wound sensor at 5 to 20 mm (0.2 to 0.79 in)
5 Standard thin-film sensor at 5 to 10 mm (0.2 to 0.39 in)

To keep the influence of heat dissipation to a minimum and to achieve the best possible measurement results, 20 to 25 mm (0.79 to 0.98 in) should be in contact with the medium in addition to the actual sensor element.

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

It is particularly important to take this into consideration for T-pieces, as the immersion length is very short on account of their design, and the measured error is higher as a result. It is therefore recommended to use elbow pieces with QuickSens sensors.

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 or insertion length, all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. Flow velocity, process pressure).



11 *Detailed installation instructions for hygiene-compliant installation*

A Milk pipe connection according to DIN 11851, only in conjunction with EHEDG-certified, self-centering sealing ring
1 Sensor with milk pipe connection
2 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 counterparts for the process connections and the seals or sealing rings are not supplied with the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories. → 26

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 mechanically 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 sprays this area directly so that it is cleaned properly.
2. The Varivent® connections enable flush-mounted installation.

14.6 Environment

Ambient temperature range

T_a	−40 to +85 °C (−40 to +185 °F)

Storage temperature

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

T_s	−40 to +85 °C (−40 to +185 °F)

Operating altitude

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

Climate class

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

Degree of protection

As per IEC/EN 60529 IP69

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

Shock and vibration resistance

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

Electromagnetic compatibility (EMC)

EMC 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

14.7 Process

Process temperature range

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

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

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

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

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

Thermal shock

Thermal shock resistance in CIP/SIP process with a temperature increase from +5 to +130 °C (+41 to +266 °F) within 2 seconds.

Process pressure range

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

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

Medium - state of aggregation

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

14.8 Mechanical construction

Design, dimensions

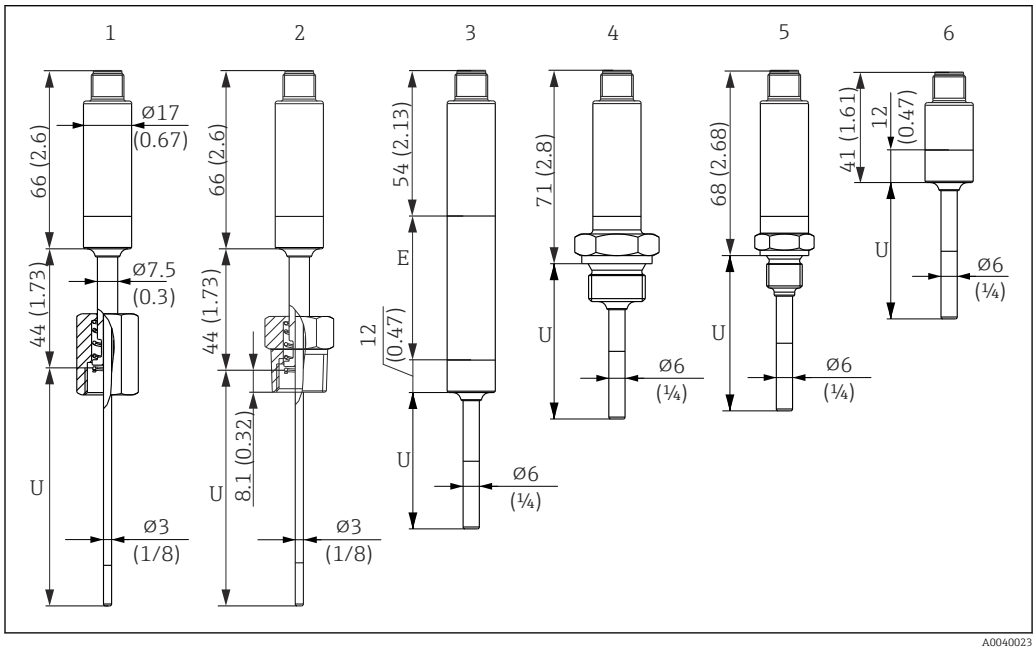
All dimensions in mm (in). The design of the thermometer depends on the thermowell version used:
- Thermometer without thermowell
- Thermowell diameter 6 mm (¼ in)
- T-piece and elbow piece thermowell version as per DIN 11865/ASME BPE 2012 for welding in

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

Variable dimensions:

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



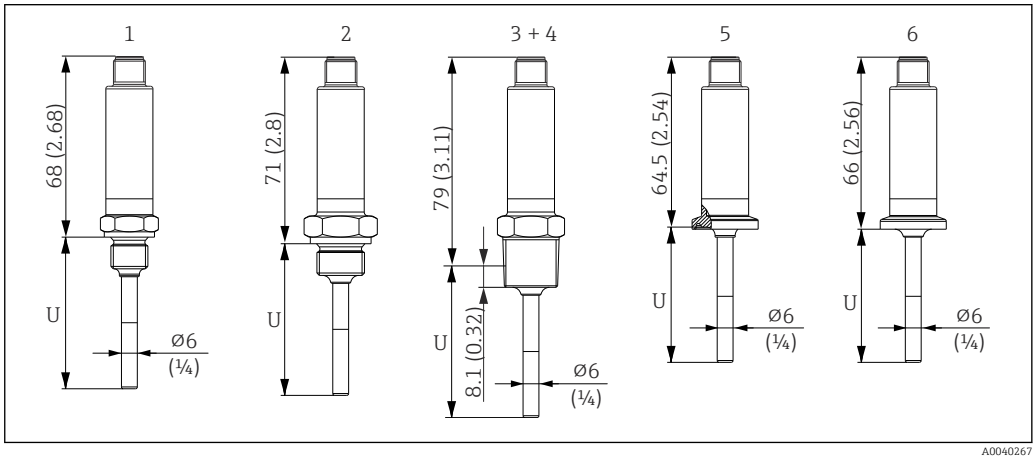
Unit of measurement mm (in)

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
6 Thermometer without electronics

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

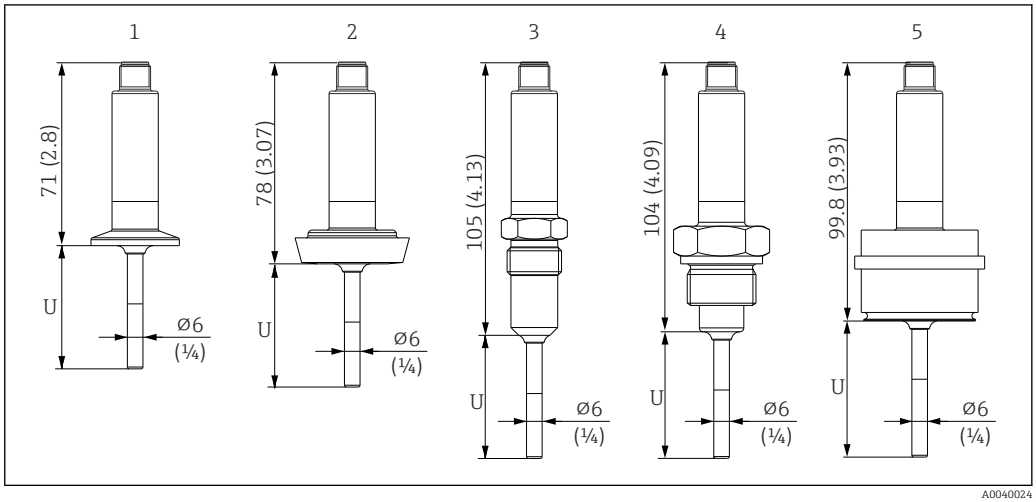
Pay attention to the following equations when calculating the immersion length U for an existing thermowell:

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



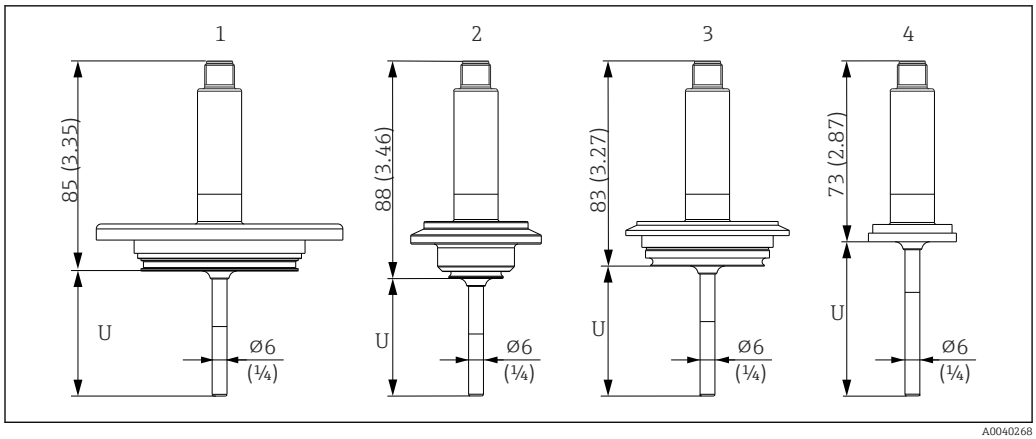
Unit of measurement mm (in)

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



Unit of measurement mm (in)

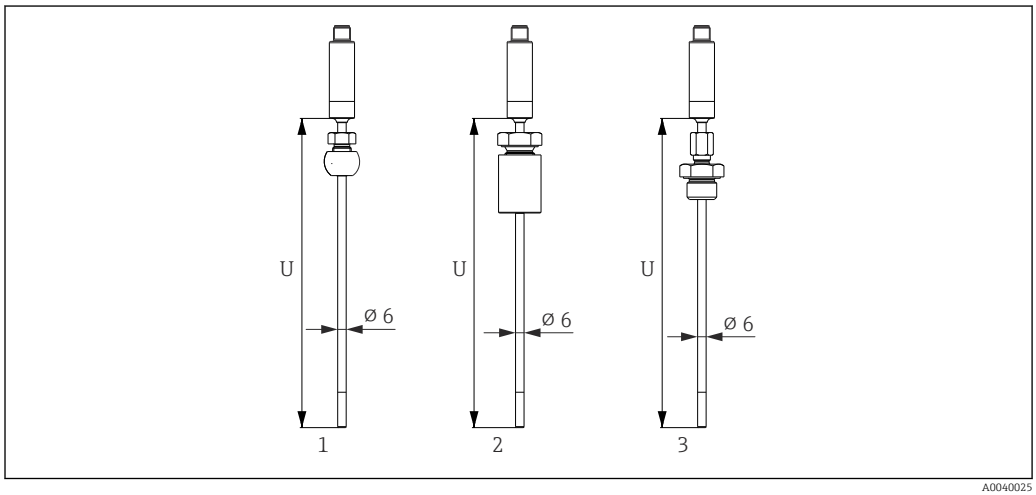
1 *Thermometer with Clamp ISO2852 for DN12 to 21.3, DN25 to 38, DN40 to 51*
2 *Thermometer with milk pipe connection DIN11851 for DN25/DN32/DN40/DN50*
3 *Thermometer with metal sealing system G½"*
4 *Thermometer with G¾" male thread ISO228 for FTL31/33/20/50 Liquiphant adapter*
5 *Thermometer with D45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



Unit of measurement mm (in)

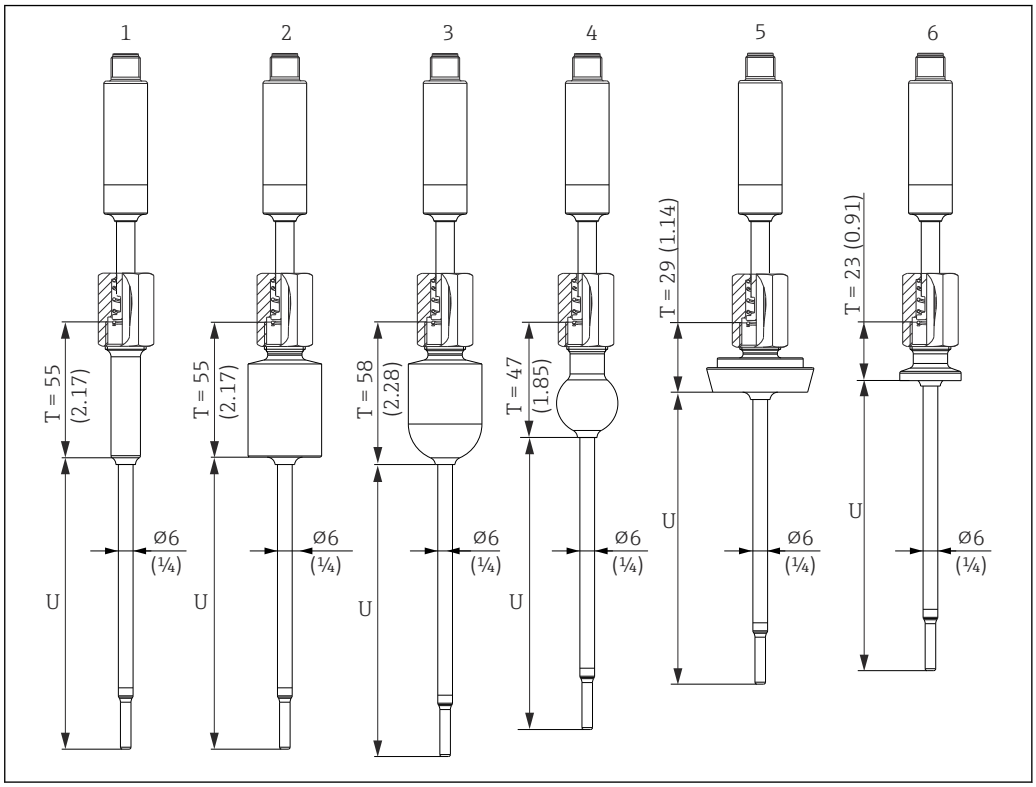
1 Thermometer with APV in-line, DN50
2 Thermometer with Varivent type B, D 31 mm
3 Thermometer with Varivent type F, D 50 mm and Varivent type N, D 68 mm
4 Thermometer with SMS 1147, DN25/DN38/DN51

With compression fitting



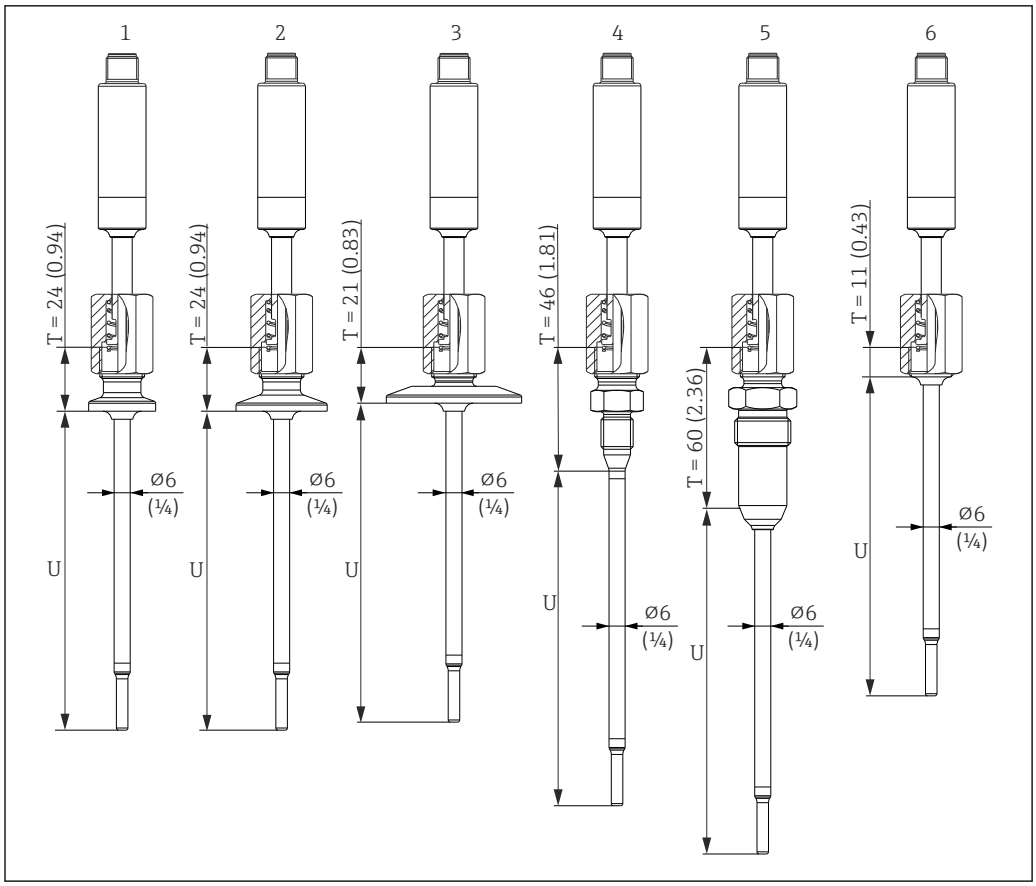
1 Thermometer with compression fitting TK40 spherical, PEEK/316L, sleeve, Ø 25 mm, for welding in
2 Thermometer with compression fitting TK40 cylindrical, Elastosil sleeve, Ø 25 mm, for welding in
3 Thermometer with compression fitting G½" external thread, TK40-BADA3C, 316L

With thermowell diameter 6 mm (¼ in)



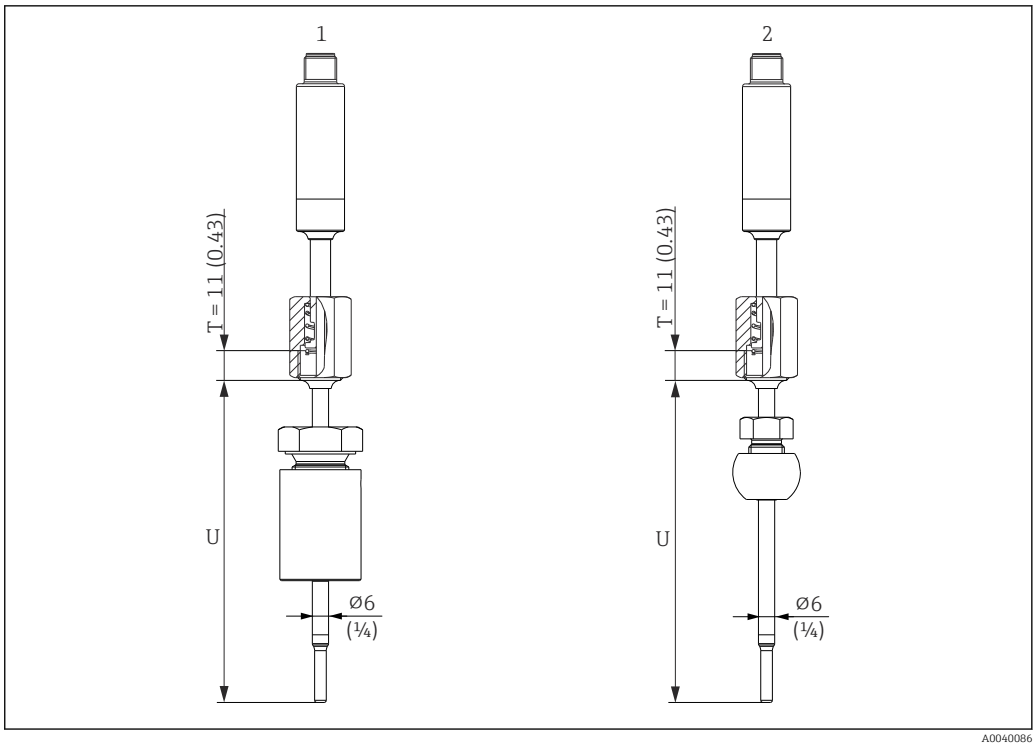
Unit of measurement mm (in)

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



Unit of measurement mm (in)

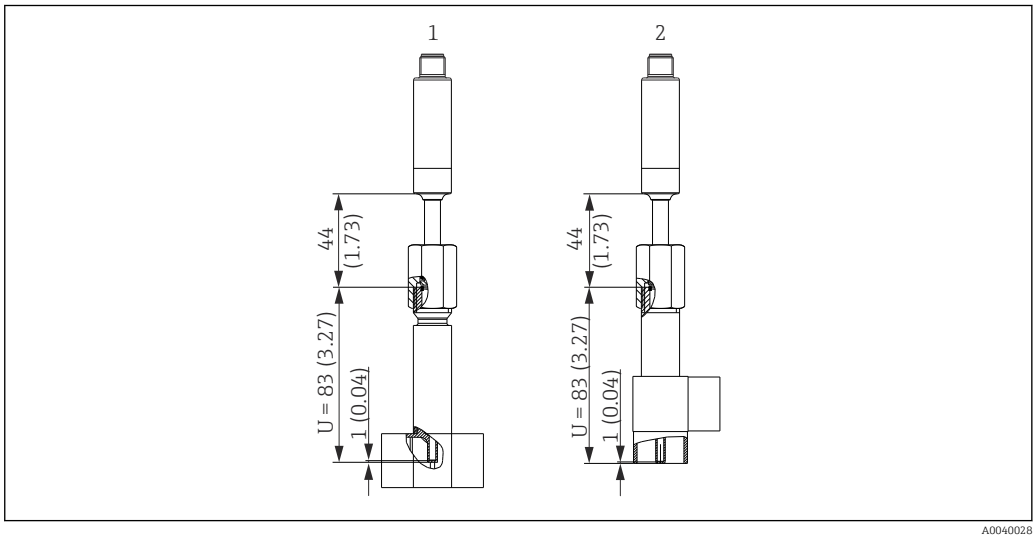
1 *Thermometer with Tri-Clamp version DN18*
2 *Thermometer with Clamp version DN12 to 21.3*
3 *Thermometer with Clamp version DN25 to 38/DN40 to 51*
4 *Thermometer with metal sealing system version, M12 × 1.5*
5 *Thermometer with metal sealing system version, G½"*
6 *Thermometer without process connection*



Unit of measurement mm (in)

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

Thermowell version as T-piece or elbow piece



Unit of measurement mm (in)

1 Thermometer with tee thermowell
2 Thermometer with elbow thermowell

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

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

Possible combinations of the thermowell versions with the available process connections

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

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

Weight

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

Material

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

Description	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L (corresponds to 1.4404 or 1.4435)	X2CrNiMo17-13-2, X2CrNiMo18-14-3	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ 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) ▪ Increased resistance to intergranular corrosion and pitting
1.4435+316L, delta ferrite < 1% or < 0.5%	With regard to analytical limits, the specifications of both materials (1.4435 and 316L) are met simultaneously. In addition, the delta ferrite content of the parts in contact with the process is limited to <1% or <0.5%. ≤3% for weld seams (in accordance with Basel Standard II)		

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

Surface roughness

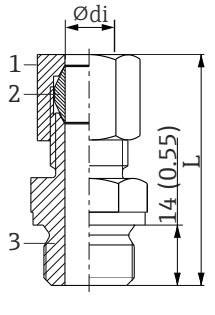
Values for wetted surfaces:

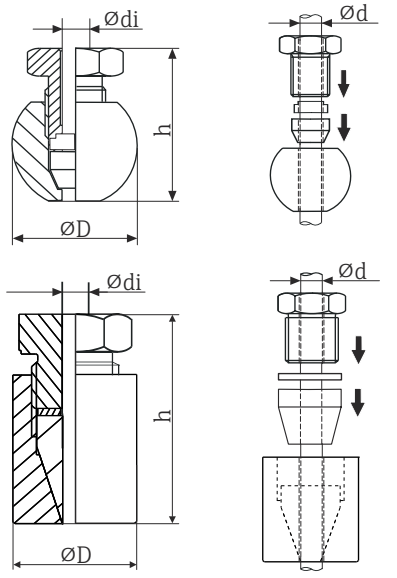
Standard surface, mechanically polished [1]	R_a ≤ 0.76 µm (30 µin)
Mechanically polished [1], buffed [2]	R_a ≤ 0.38 µm (15 µin)
Mechanically polished [1], buffed and electropolished	R_a ≤ 0.38 µm (15 µin)+ electropolished

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

Process connections

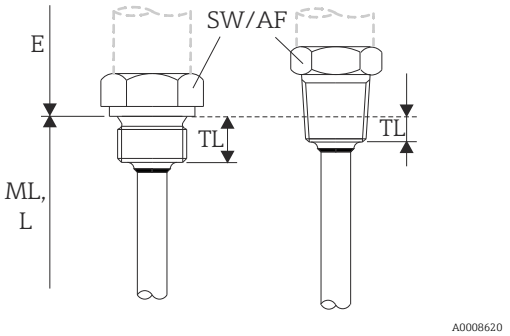
Compression fitting

Type TK40	Version	Dimensions			Technical properties
		Φdi	L	Width across flats	
 *Unit of measurement mm (in)* *1 Nut* *2 Clamping sleeve* *3 Process connection*	G ½" , sleeve 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 ▪ $P_{max.}$ = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L Tightening torque = 40 Nm

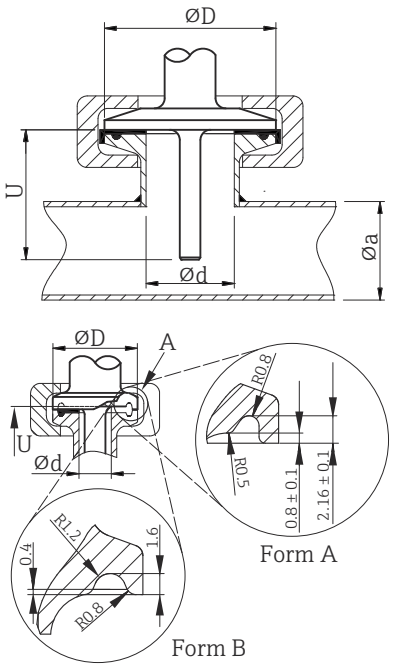
Type TK40 for weld-in	Version	Dimensions			Technical properties [1]
	Spherical or cylindrical	Φdi	ΦD	h	
	Spherical Material of sealing taper PEEK or 316L Thread G¼"	6.3 mm (0.25 in) [2]	25 mm (0.98 in)	33 mm (1.3 in)	▪ $P_{max.}$ = 10 bar (145 psi) ▪ $T_{max.}$ for PEEK sealing taper = +150 °C (+302 °F), tightening torque = 10 Nm ▪ $P_{max.}$ = 50 bar (725 psi) ▪ $T_{max.}$ for 316L sealing taper = +200 °C (+392 °F), tightening torque = 25 Nm ▪ The TK40 PEEK sealing taper is EHEDG tested and 3-A marked
	Cylindrical Sealing taper material Elastosil® 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) ▪ $T_{max.}$ for Elastosil® sealing taper = +150 °C (+302 °F), tightening torque = 5 Nm ▪ The TK40 Elastosil sealing taper is EHEDG tested and 3-A marked

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

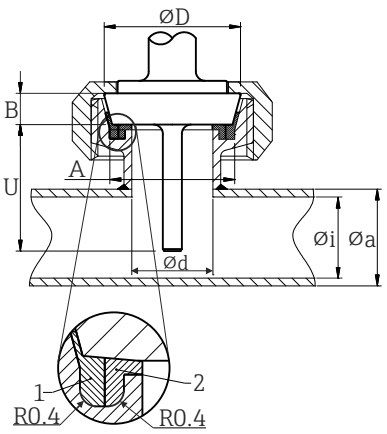
Releasable process connection

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

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

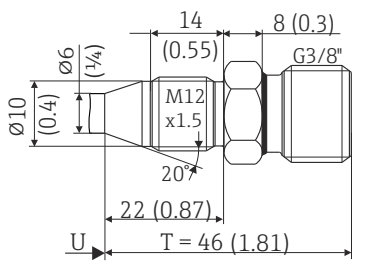
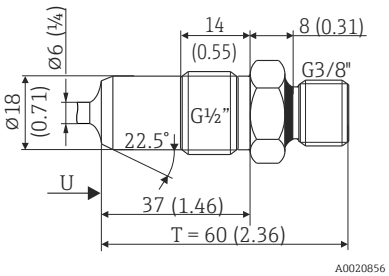
Type	Version	Dimensions		Technical properties	Conformity
	ϕd [1]	ϕD	ϕa		
Clamp according to ISO 2852  Form A: In compliance with ASME BPE Type A Form B: In compliance with ASME BPE Type B and ISO 2852	Microclamp [2] DN8-18 (0.5"-0.75") [3], Form A	25 mm (0.98 in)	-	▪ $P_{max.}$ = 16 bar (232 psi), depends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

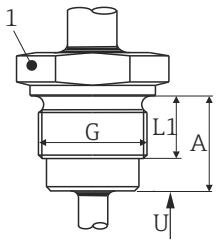
1) Pipes in accordance with ISO 2037 and BS 4825 Part 1
2) Microclamp (not in ISO 2852); no standard pipes
3) DN8 (0.5") only possible with thermowell diameter = 6 mm (¼ in)
4) Groove diameter = 20 mm

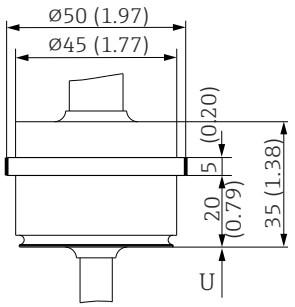
Type	Technical properties
Milk pipe connection according to DIN 11851  A0009561 *1 Centering ring* *2 Sealing ring*	▪ 3-A marked and EHEDG certified (only with EHEDG certified and self-centering sealing ring) ▪ ASME BPE compliance

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)

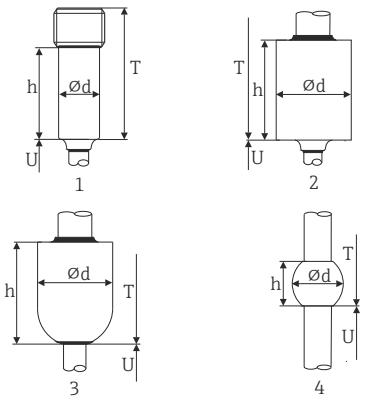
1) Pipes in accordance with DIN 11850

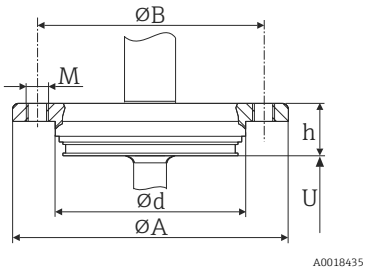
Type		Version	Technical properties
Metal sealing system		Thermowell diameter 6 mm (¼ in)	$P_{max.}$ = 16 bar (232 psi) Maximum torque = 10 Nm (7.38 lbf ft)
M12x1.5	**G½"**		
 A0009574 *Unit of measurement mm (in)*	 A0020856 *Unit of measurement mm (in)*		

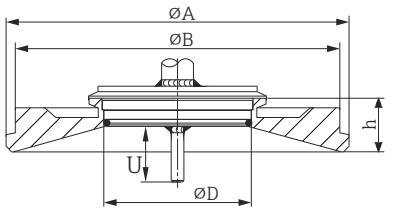
Type	Version G	Dimensions			Technical properties
		L1 thread length	A	1 (SW/AF)	
Thread according to ISO 228 (for Liquiphant weld-in adapter)  A0009572	G¾" for FTL20/31/33 adapter	16 mm (0.63 in)	25.5 mm (1 in)	32	▪ $P_{max.}$ = 25 bar (362 psi) at max. 150 °C (302 °F) ▪ $P_{max.}$ = 40 bar (580 psi)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

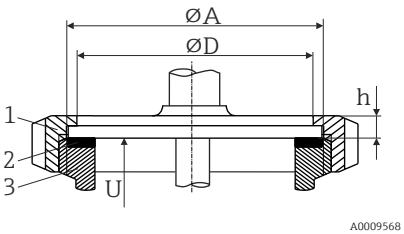
For welding in

Type	Version	Dimensions	Technical properties
Weld-in adapter  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 ▪ With 3-A symbol and EHEDG certification ▪ 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) h = 24 mm (0.94 in)	

Type	Version	Dimensions					Technical properties
		ϕd	ϕA	ϕB	M	h	
APV in-line 	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) ▪ With 3-A symbol and EHEDG certification ▪ ASME BPE compliance

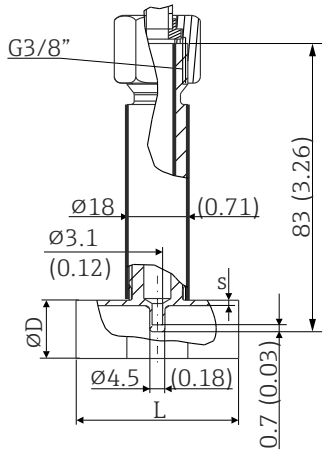
Type	Version	Dimensions				Technical properties	
		ϕD	ϕA	ϕB	h	$P_{max.}$	
Varivent® 	Type B	31 mm (1.22 in)	105 mm (4.13 in)	-	22 mm (0.87 in)	10 bar (145 psi)	▪ With 3-A symbol and EHEDG certification ▪ ASME BPE compliance
	Type F	50 mm (1.97 in)	145 mm (5.71 in)	135 mm (5.31 in)	24 mm (0.95 in)		
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

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

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)	

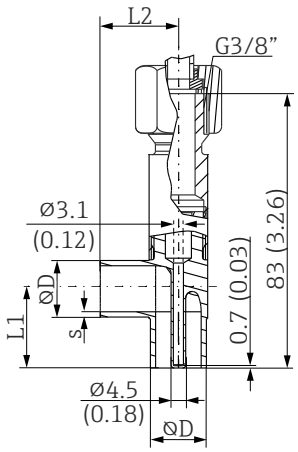
The counterpart connection must fit the sealing ring and fix it in place.

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

Type	Version		Dimensions in mm (in)			Technical properties
			⌀D	L	s [1]	
Tee thermowell for weld-in as per DIN 11865 (series A, B and C)  *Unit of measurement mm (in)*	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) ▪ 3-A marked and EHEDG certified for ≥ DN25 ▪ ASME BPE compliance for ≥ DN25
		DN15 PN25	19 mm (0.75 in)			
		DN20 PN25	23 mm (0.91 in)			
		DN25 PN25	29 mm (1.14 in)			
		DN32 PN25	32 mm (1.26 in)			
	Series B	DN13.5 PN25	13.5 mm (0.53 in)		1.6 mm (0.063 in)	
		DN17.2 PN25	17.2 mm (0.68 in)			
		DN21.3 PN25	21.3 mm (0.84 in)			
		DN26.9 PN25	26.9 mm (1.06 in)			
		DN33.7 PN25	33.7 mm (1.33 in)		2 mm (0.08 in)	
	Series C [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)

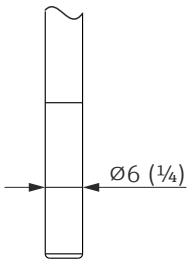
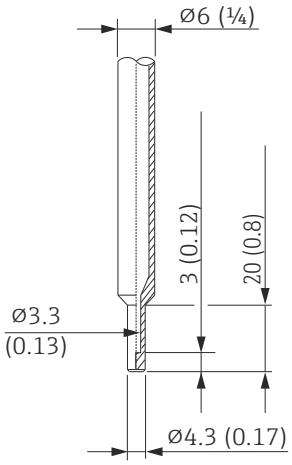
Type	Version		Dimensions			Technical properties
			ΦD	L1	L2	s [1]
Elbow thermowell for weld-in as per DIN 11865 (series A, B and C)  *Unit of measurement mm (in)*	Series A	DN10 PN25	13 mm (0.51 in)	24 mm (0.95 in)		1.5 mm (0.06 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ 3-A marked and EHEDG certified for ≥ DN25 ▪ 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)	
	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

Shape of tip

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

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

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

14.9 Human interface

Operating concept

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

IO-Link operating concept

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

- Operator
- Maintenance
- Specialist

Efficient diagnostic behavior increases measurement availability

- Diagnostics messages
- Remedial measures
- Simulation options

IODD download

http://www.endress.com/download

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

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

Search by
- Manufacturer
- Article number
- Product type

Local operation

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

Local display	There are no display elements directly on the device. The measured value and diagnostic messages, for instance, can be accessed via IO-Link.
Remote operation	IO-Link functions and device-specific parameters are configured via the device's IO-Link communication. 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). Parameters for device replacement can be stored in the IO-Link master.

14.10 Certificates and approvals

Current certificates and approvals that are available for the product can be selected via the Product Configurator at www.endress.com:

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

MTBF	For the transmitter: 327 years, according to Siemens Standard SN29500
Hygiene standard	▪ EHEDG certification type EL - CLASS I. EHEDG-certified/tested process connections. → 📄 53 ▪ 3-A Authorization No. 1144, 3-A Sanitary Standard 74-07. Listed process connections. → 📄 53 ▪ ASME BPE, declaration of conformity can be ordered for options indicated ▪ FDA-compliant ▪ 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: ▪ (EC) No. 1935/2004, Article 3, paragraph 1, Articles 5 and 17 on materials and articles intended to come into contact with food. ▪ (EC) No. 2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food. ▪ (EU) No. 10/2011 on plastic materials and articles intended to come into contact with food.
CRN approval	The CRN approval is only available for certain thermowell versions. These versions are identified and displayed accordingly during the configuration of the device. Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Download Area under www.endress.com : 1. Select the country 2. Select Downloads 3. In the search area: select Approvals/approval type 4. Enter the product code or device 5. Start the search

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

15 Overview of the IO-Link operating menu

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

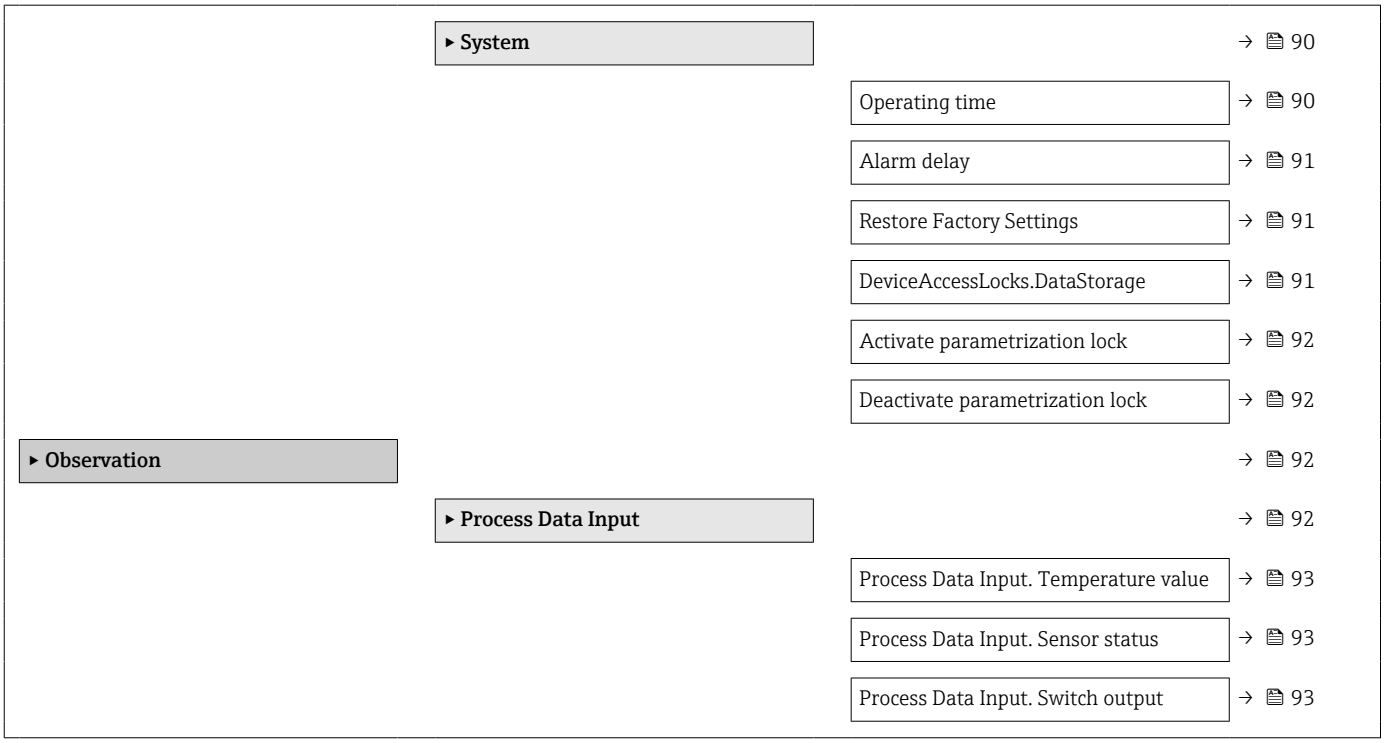
Depending on the parameter configuration, not all submenus and parameters are available in every device.

Operation concept

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

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

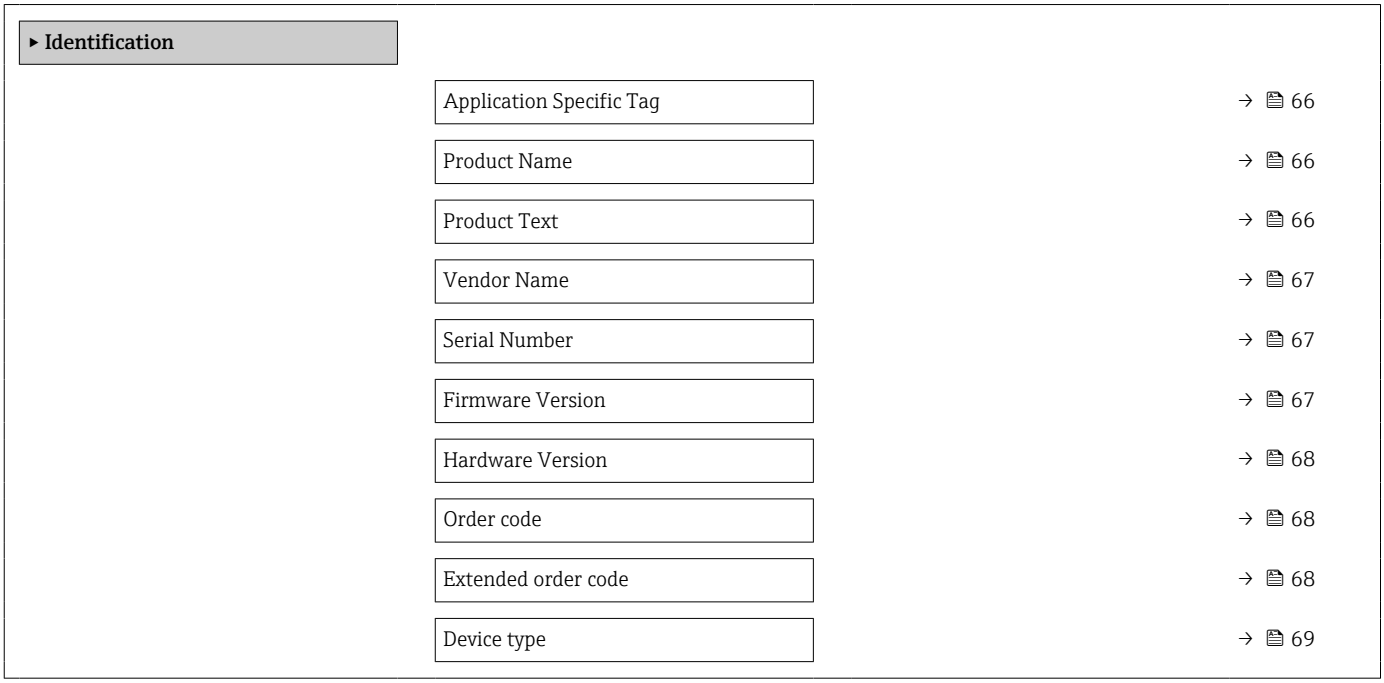
		Sensor simulation	→ 72
		Sensor simulation value	→ 73
		Switch output simulation	→ 73
	▸ **Sensor temperature**		→ 74
		Sensor max value	→ 74
		Sensor min value	→ 75
		Reset sensor min/max values	→ 75
		Lower boundary operating time sensor	→ 75
		Lower extended operating time sensor	→ 76
		Standard operating time sensor	→ 76
		Upper extended operating time sensor	→ 76
		Upper boundary operating time sensor	→ 77
	▸ **Device temperature**		→ 77
		Device temperature	→ 78
		Device temperature max	→ 78
		Device temperature min	→ 78
		Reset device temp. min/max values	→ 79
		Lower boundary operating time device	→ 79
		Lower extended operating time device	→ 79
		Standard operating time device	→ 80
		Upper extended operating time device	→ 80
		Upper boundary operating time device	→ 80
	▸ **Measuring data channel**		→ 81
		MDC Descriptor.Lower limit	→ 81
		MDC Descriptor.Upper limit	→ 81
		MDC Descriptor.Unit code	→ 82
		MDC Descriptor.Scale	→ 82
▸ **Parameter**			→ 82
	▸ **Application**		→ 83
		▸ **Sensor**	→ 83
		▸ **Switch output**	→ 84
		▸ **Current output**	→ 87



15.1 Description of device parameters

15.1.1 Identification

Navigation Identification



Application Specific Tag

Navigation Identification → Application Specific Tag

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

User entry Max. 32 alphanumeric characters

Factory setting As per order specifications

Additional information *User role*

- Operator
- Maintenance
- Specialist

Product Name

Navigation Identification → Product Name

Description Displays the product name

User interface iTHERM CompactLine TM311

Additional information *User role*

- Operator
- Maintenance
- Specialist

Product Text

Navigation Identification → Product Text

Description Displays the product text

User interface Compact thermometer

Additional information *User role*

- Operator
- Maintenance
- Specialist

Vendor Name

Navigation Identification → Vendor Name

Description Displays the manufacturer name

User interface Endress+Hauser

Additional information *User role*

- Operator
- Maintenance
- Specialist

Serial Number

Navigation Identification → Serial Number

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

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

User interface Character string comprising numbers, letters and special characters

Additional information *User role*

- Operator
- Maintenance
- Specialist

Firmware Version

Navigation Identification → Firmware Version

Description Displays the firmware version

User interface Character string comprising numbers, letters and special characters

Additional information *User role*

- Operator
- Maintenance
- Specialist

Hardware Version

Navigation Identification → Hardware Version

Description Displays the hardware version

User interface Character string comprising numbers, letters and special characters

Additional information *User role*

- Operator
- Maintenance
- Specialist

Order code

Navigation Identification → Order code

Description Displays the order code

User interface Character string comprising numbers, letters and special characters

Additional information *User role*

- Operator
- Maintenance
- Specialist

Extended order code

Navigation Identification → Extended order code

Description Displays the extended order code.

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

User interface Character string comprising numbers, letters and special characters

Additional information *User role*

- Operator
- Maintenance
- Specialist

Device type	
Navigation	Identification → Device type
Description	Displays the device type
User interface	37 887 (0x93FF)
Additional information	*User role* ▪ Operator ▪ Maintenance ▪ Specialist

15.1.2 Diagnosis

Navigation Diagnosis

▸ **Diagnosis**		
	▸ **Diagnostic list**	→ 69
	▸ **Event logbook**	→ 70
	▸ **Simulation**	→ 71
	▸ **Sensor temperature**	→ 74
	▸ **Device temperature**	→ 77
	▸ **Measuring data channel**	→ 81

Diagnostic list

Navigation Diagnosis → Diagnostic list

▸ **Diagnostic list**		
	Actual diagnostics 1	→ 70
	Actual diagnostics 2	→ 70
	Actual diagnostics 3	→ 70

Actual diagnostics 1

Navigation Diagnosis → Diagnostic list → Actual diagnostics 1

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

Additional information *User role*

- Operator
- Maintenance
- Specialist

Actual diagnostics 2

Navigation Diagnosis → Diagnostic list → Actual diagnostics 2

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

Additional information *User role*

- Operator
- Maintenance
- Specialist

Actual diagnostics 3

Navigation Diagnosis → Diagnostic list → Actual diagnostics 3

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

Additional information *User role*

- Operator
- Maintenance
- Specialist

Event logbook

Navigation Diagnosis → Event logbook

▸ Event logbook		
	Previous diagnostics 1 … 5	→ 71
	Timestamp 1 … 5	→ 71

Previous diagnostics 1 … 5

Navigation Diagnosis → Event logbook → Previous diagnostics 1 … 5

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

Additional information *User role*

Specialist

Timestamp 1 … 5

Navigation Diagnosis → Event logbook → Timestamp 1 … 5

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

Additional information *User role*

Specialist

Simulation

Navigation Diagnosis → Simulation

▸ Simulation		
	Current output simulation	→ 71
	Value current output	→ 72
	Sensor simulation	→ 72
	Sensor simulation value	→ 73
	Switch output simulation	→ 73

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	→ 74
Sensor min value	→ 75
Reset sensor min/max values	→ 75
Lower boundary operating time sensor	→ 75
Lower extended operating time sensor	→ 76
Standard operating time sensor	→ 76
Upper extended operating time sensor	→ 76
Upper boundary operating time sensor	→ 77

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).

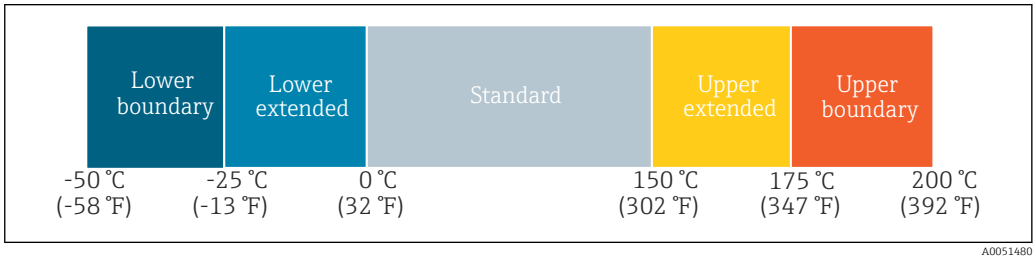
Additional information *User role*

- 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).



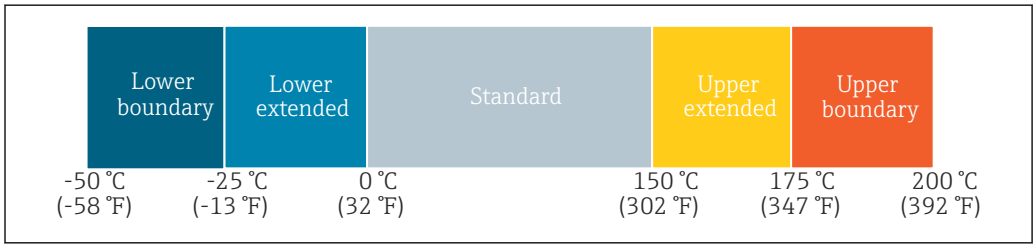
Additional information *User role*

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).



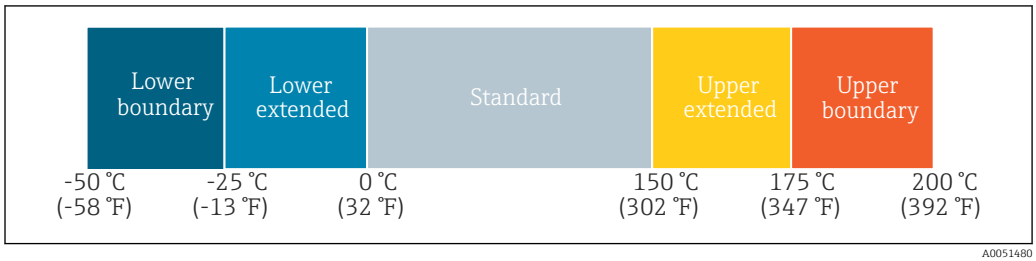
Additional information *User role*

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).



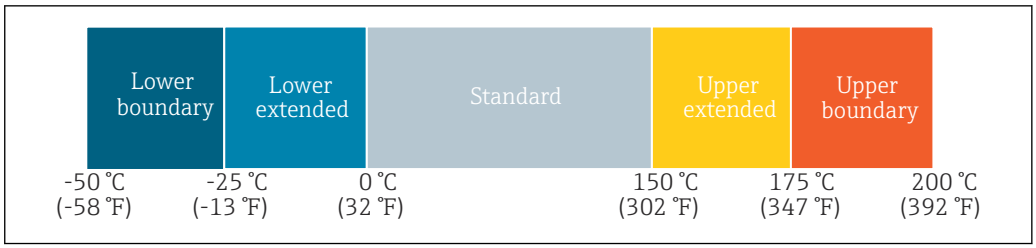
Additional information *User role*

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

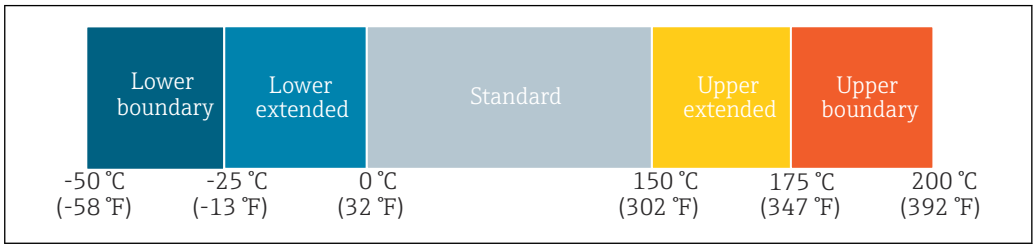
Specialist

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	→ 78
Device temperature max	→ 78
Device temperature min	→ 78
Reset device temp. min/max values	→ 79
Lower boundary operating time device	→ 79
Lower extended operating time device	→ 79
Standard operating time device	→ 80

	Upper extended operating time device	→ 80
	Upper boundary operating time device	→ 80

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).

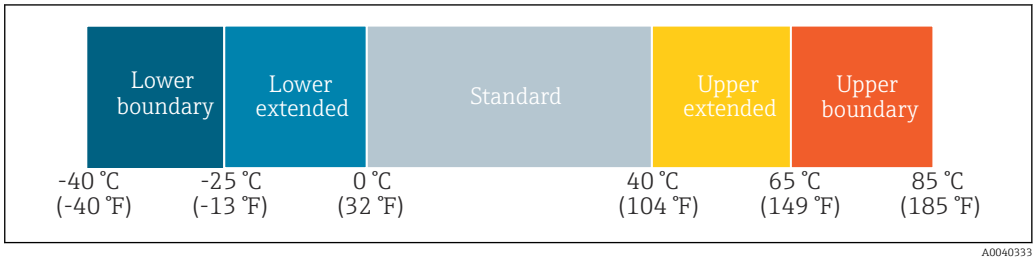
Additional information *User role*

- 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).



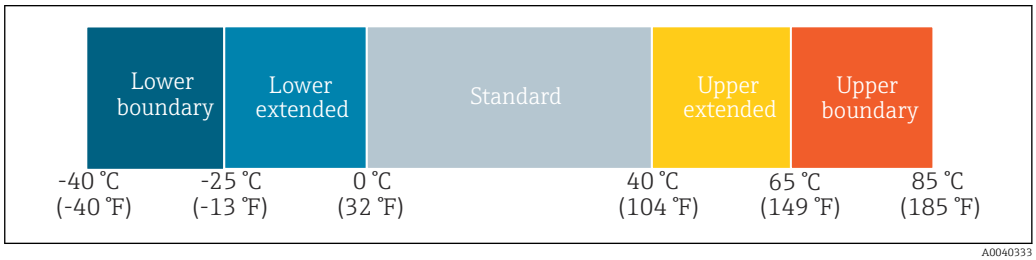
Additional information *User role*

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).



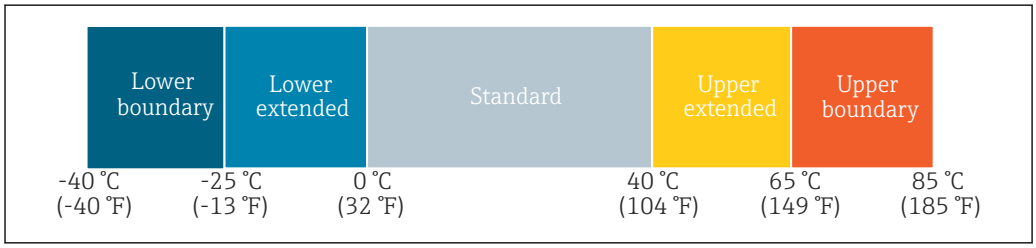
Additional information *User role*

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).



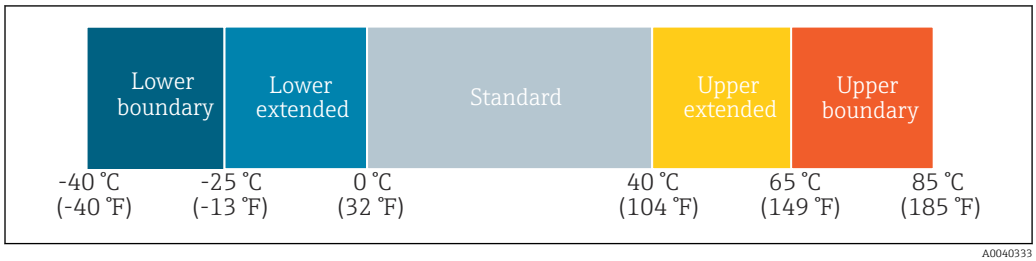
Additional information *User role*

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).



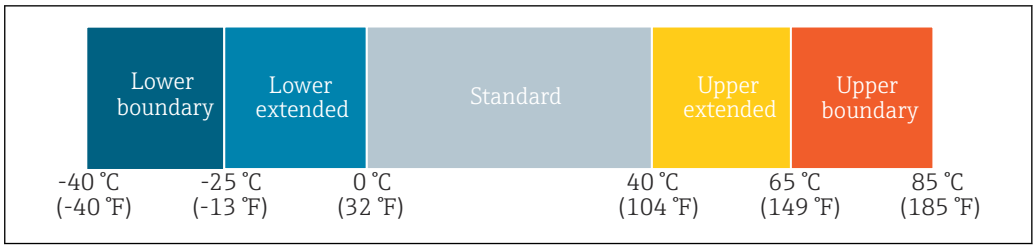
Additional information *User role*

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	→ 81
	MDC Descriptor.Upper limit	→ 81
	MDC Descriptor.Unit code	→ 82
	MDC Descriptor.Scale	→ 82

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}).

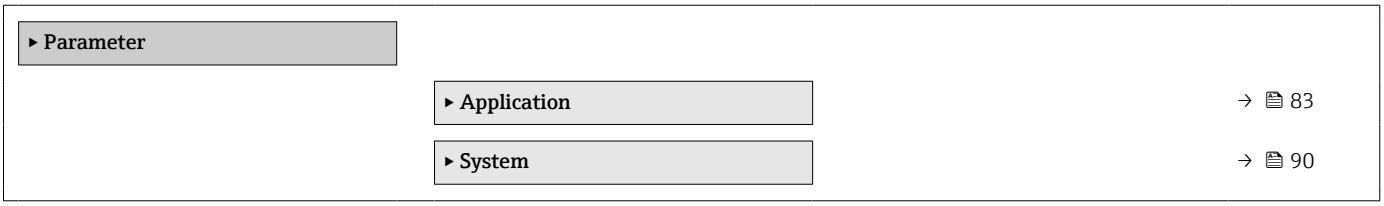
According to Smart Sensor Profile 2nd Edition.

Additional information *User role*

- Operator
- Maintenance
- Specialist

15.1.3 Parameter

Navigation Parameter



Application

Navigation Parameter → Application

▸ Application		
	▸ Sensor	→ 83
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	▸ Current output	→ 90

Sensor

Navigation Parameter → Application → Sensor

▸ Sensor		
	Unit	→ 83
	Damping	→ 83
	Sensor offset	→ 84

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

▸ Switch output		
	Operating mode	→ 85
	Switch point value	→ 86
	Switchback point value	→ 86
	Switch delay	→ 87
	Switchback delay	→ 87

Operating mode

Navigation Parameter → Application → Switch output → Operating mode

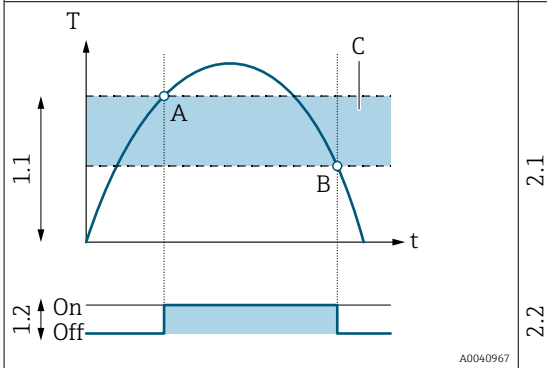
Description Use this function to select the switch output.

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

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

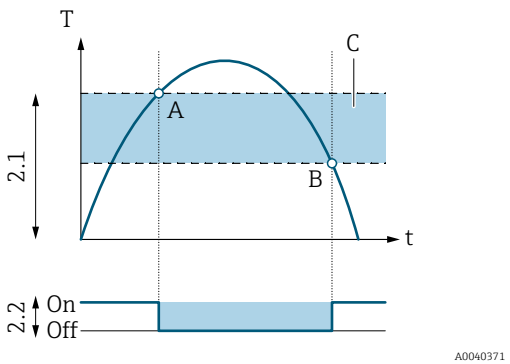
Additional information *Options*
- Hysteresis normally open
  The switch output is specified as a normally open (NO) contact with hysteresis properties (using SP and RSP).
- Hysteresis normally closed
  The switch output is specified as a normally closed (NC) contact with hysteresis properties (using 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

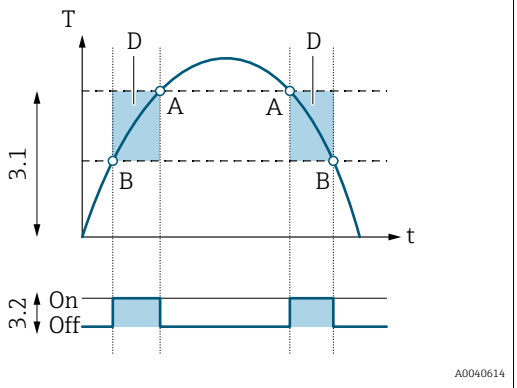
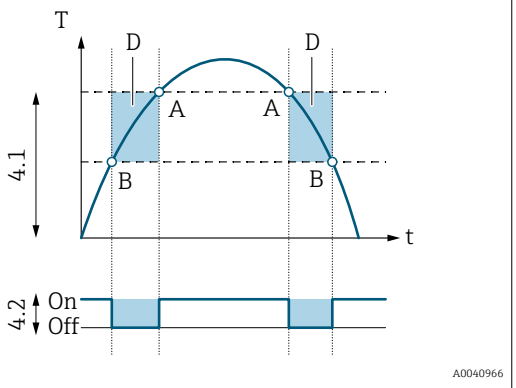


1.1 Input variable
1.2 Switch output
A Switch point (SP)
B Switchback point (RSP)
C Hysteresis

Hysteresis normally closed



2.1 Input variable
2.2 Switch output
A Switch point (SP)
B Switchback point (RSP)
C Hysteresis

Window normally open	Window normally closed
	
3.1 Input variable *3.2 Switch output* *A Switch point (SP) (upper window limit)* *B Switchback point (RSP) (lower window limit)* *D Window*	*4.1 Input variable* *4.2 Switch output* *A Switch point (SP) (upper window limit)* *B Switchback point (RSP) (lower window limit)* *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	→ 88
	20 mA value	→ 88
	Current trimming 4 mA	→ 89
	Current trimming 20 mA	→ 89
	Failure mode	→ 89
	Failure current	→ 90

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

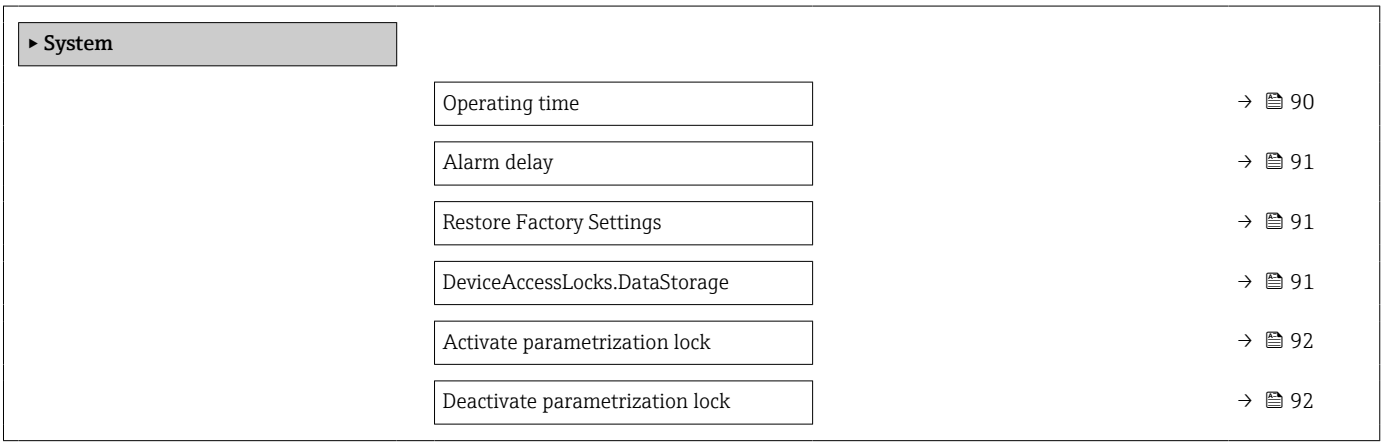
Factory setting 22.5 mA

Additional information *User role*

- Operator
- Maintenance
- Specialist

System

Navigation Parameter → System



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

▸ **Observation**		
	▸ **Process Data Input**	→ 92

Process Data Input

Navigation Observation → Process Data Input

▸ **Process Data Input**		
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	Process Data Input. Switch output	→ 93

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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