Operating Instructions

iTHERM TrustSens TM371

Compact thermometer in metric style with self-calibration
HART communication
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1 About this document

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

1.2 Symbols

1.2.1 Safety symbols

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

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

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

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

1.2.2 Electrical symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>➝ ➝ ➝</td>
<td>Direct current</td>
</tr>
<tr>
<td>➝</td>
<td>Alternating current</td>
</tr>
<tr>
<td>➝ ➝</td>
<td>Direct current and alternating current</td>
</tr>
<tr>
<td>➝ ➝</td>
<td>Ground connection</td>
</tr>
<tr>
<td>➝ ➝</td>
<td>Potential equalization connection (PE: protective earth)</td>
</tr>
</tbody>
</table>

1.2.3 Symbols for certain types of information

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>Permitted</td>
</tr>
<tr>
<td>✔ ✔</td>
<td>Preferred</td>
</tr>
<tr>
<td>✗</td>
<td>Forbidden</td>
</tr>
</tbody>
</table>
### 1.2.4 Tool symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="A0011222" alt="Symbol" /></td>
<td>Open-ended wrench</td>
</tr>
</tbody>
</table>

### 1.3 Documentation

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

- **Device Viewer** ([www.endress.com/deviceviewer](http://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:

<table>
<thead>
<tr>
<th>Document type</th>
<th>Purpose and content of the document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Information (TI)</td>
<td><strong>Planning aid for your device</strong>&lt;br&gt;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.</td>
</tr>
<tr>
<td>Brief Operating Instructions (KA)</td>
<td><strong>Guide that takes you quickly to the 1st measured value</strong>&lt;br&gt;The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.</td>
</tr>
<tr>
<td>Operating Instructions (BA)</td>
<td><strong>Your reference document</strong>&lt;br&gt;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.</td>
</tr>
<tr>
<td>Description of Device Parameters (GP)</td>
<td><strong>Reference for your parameters</strong>&lt;br&gt;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.</td>
</tr>
<tr>
<td>Document type</td>
<td>Purpose and content of the document</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Safety Instructions (XA)</td>
<td>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.</td>
</tr>
<tr>
<td>Supplementary device-dependent documentation (SD/FY)</td>
<td>Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.</td>
</tr>
</tbody>
</table>
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 hygienic compact thermometer, which features an automatic self-calibration function. It is applied for the acquisition and conversion of temperature input signals for industrial temperature measurement.
▪ The manufacturer is not liable for damage caused by improper or non-intended use.

2.3 Operation safety

**NOTICE**

Operation safety

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

Conversions to the device

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

‣ If, despite this, modifications are required, consult with Endress+Hauser.

Repair

Due to its design, the device cannot be repaired.

‣ However, it is possible to send the device in for examination.
‣ To ensure continued operational safety and reliability, use original spare parts and accessories from Endress+Hauser only.

2.4 Product safety

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

It meets general safety standards and legal requirements. It also complies with the 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  Incoming acceptance and product identification

3.1  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.

3.2  Product identification

The following options are available for 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.

3.2.1  Nameplate

Is this the correct device?

Compare and check the data on the nameplate of the device against the requirements of the
measuring point:

<table>
<thead>
<tr>
<th>1</th>
<th>Order code, serial number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Supply voltage and current consumption</td>
</tr>
<tr>
<td>3</td>
<td>Device revision and firmware version</td>
</tr>
<tr>
<td>4</td>
<td>Ambient temperature</td>
</tr>
<tr>
<td>5</td>
<td>Approvals with symbols</td>
</tr>
<tr>
<td>6</td>
<td>Device TAG name</td>
</tr>
</tbody>
</table>

3.2.2  Name and address of manufacturer

<table>
<thead>
<tr>
<th>Name of manufacturer:</th>
<th>Endress+Hauser Wetzer GmbH + Co. KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of manufacturer:</td>
<td>Obere Wank 1, D-87484 Nesselwang or <a href="http://www.endress.com">www.endress.com</a></td>
</tr>
</tbody>
</table>
3.2.3  Certificates and approvals

For certificates and approvals valid for the device: see the data on the nameplate

Approval-related data and documents: www.endress.com/deviceviewer → (enter the serial number)

Hygiene standard

- EHEDG certification, type EL - CLASS I. EHEDG certified/tested process connections
- 3-A authorization no. 1144, 3-A Sanitary standard 74-07. Listed process connections
- ASME BPE, certificate of conformity can be ordered for indicated options
- FDA-compliant
- All surfaces in contact with the medium are free of animal derived ingredients (ADI/TSE) and do not contain any materials derived from bovine or animal sources.

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.

3.3  Storage and transport

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

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

Avoid the following environmental influences during storage and transport:

- Direct sunlight
- Vibration
- Aggressive media
4  Mounting

4.1  Mounting requirements

Information about the conditions, which have to be existent at the mounting location for a designated use, such as ambient temperature, degree of protection, climate class, etc., as well as device dimensions - see section Technical Data, → 48

The immersion length of the thermometer can influence the accuracy. If the immersion length is too small then errors in the measurement are caused by heat conduction via the process connection. If installing into a pipe then the immersion length should ideally be half of the pipe diameter. → 11

- Installation possibilities: Pipes, tanks or other plant components
- 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.

4.2  Mounting the measuring device

Required tools for mounting in an existing protection tube: Open-end wrench or mounting socket wrench SW/AF 32

![Mounting process of the compact thermometer](image)

1  Mounting of iTHERM QuickNeck connection to the existing protection tube with iTHERM QuickNeck bottom part - no tools required
2  Hexagonal head SW/AF 32 for the mounting in an existing protection tube for M24-, G3/8"-thread
3  Adjustable compression fitting TK40 - mounting of the hexagonal screw with open-end wrench SW/AF 17 only
4  Protection tube
Mounting possibilities in the process

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

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

Installation instructions EHEDG/cleanability: \( L_t \leq (D_t - d_t) \)
Installation instructions 3-A/cleanability: \( L_t \leq 2(D_t - d_t) \)

In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to project well into the process so that it extends past the pipe axis.

Installation at an angle (4) could be another solution. When determining the immersion length or installation depth all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, process pressure).

### Maximum torque

<table>
<thead>
<tr>
<th>Protection tube version</th>
<th>Torque M</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT411, Ø6 mm (0.24 in) (1)</td>
<td>3 to 5 Nm (2.2 to 3.7 lbf ft)</td>
</tr>
<tr>
<td>TT411, Ø6 mm (0.24 in) and Necktube TE411 (2)</td>
<td>10 Nm (7.4 lbf ft)</td>
</tr>
<tr>
<td>TT411, Ø9 mm (0.35 in) (3)</td>
<td>3 to 5 Nm (2.2 to 3.7 lbf ft)</td>
</tr>
<tr>
<td>TT411, Ø12.7 mm (¹⁄₂ in) (4) and Necktube TE411 (5)</td>
<td>3 to 5 Nm (2.2 to 3.7 lbf ft)</td>
</tr>
</tbody>
</table>

When connecting the device with the protection tube: only turn the hexagonal spanner flat on the bottom of the housing.
4  Process connections for thermometer installation in pipes with small nominal diameters
   1  Elbow thermowell for weld-in as per DIN 11865 / ASME BPE 2012

5  Detailed installation instructions for hygiene-compliant installation (depends on the version ordered)
A  Milk pipe connection according to DIN 11851, only in connection with EHEDG certified and self-centering sealing ring
   1  Sensor with milk pipe connection
   2  Groove slip-on nut
   3  Counterpart connection
   4  Centering ring
   5  R0.4
   6  R0.4
   7  Sealing ring
B  'Varivent®' process connection for VARINLINE® housing
   8  Sensor with Varivent connection
   9  Counterpart connection
  10  O-ring
C  Clamp according to ISO 2852
   11  Molded seal
   12  Counterpart connection
D  Process connection Liquiphant-M G1°, horizontal installation
   13  Weld-in adapter
   14  Vessel wall
   15  O-ring
   16  Thrust collar
**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.

The counterpieces for the process connections and the seals or sealing rings are not included in the scope of supply for the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories. → 44

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

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

1. As a general rule, the thermometers should be installed in such a way that does not impact their ability to be cleaned (the requirements of the 3-A Sanitary Standard must be observed).
2. The Varivent® and Liquiphant-M weld-in adapter and Ingold (+ weld-in adapter) connections enable flush-mounted installation.

### 4.3 Post-mounting check

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the device undamaged (visual inspection)?</td>
<td></td>
</tr>
<tr>
<td>Is the device fixed appropriately?</td>
<td></td>
</tr>
<tr>
<td>Does the device comply to the measurement point specifications, such as ambient temperature, etc.?</td>
<td></td>
</tr>
</tbody>
</table>
5 Electrical connection

5.1 Connecting requirements

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

5.2 Connecting the measuring device

NOTICE

To prevent damage to the device

- To prevent any kind of damage from the device electronics, leave the pins 2 and 4 unconnected. They are reserved for the connection of the configuration cable.
- Do not tighten the M12 plug too much, in order to prevent damage to the device.

If voltage supply is connected correctly and the measuring device is operational, the LED is illuminated green.

5.3 Ensuring the degree of protection

The specified degree of protection is ensured when the M12x1 cable plug is tightened. In order to reach IP69 degree of protection, appropriate cord sets with straight or angle plugs are available as accessories.
5.4 Post-connection check

- Is the device or cable undamaged (visual check)?
- Do the cables have adequate strain relief?
- Does the supply voltage match the specifications on the nameplate?

6 Operability

6.1 Overview of operation options

- Installed iTHERM compact thermometer with HART communication protocol
- RIA15 loop powered process display - It is integrated in the current loop and displays the measuring signal or HART process variables in digital form. The process display unit does not require an external power supply. It is powered directly from the current loop.
- Active barrier RN42 – The active barrier is used for transmission and galvanic isolation of 4 to 20 mA/HART signals and supplying loop powered transmitters. The universal power supply works with an input supply voltage of 19.20 to 253 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids.
- Commubox FXA195 for intrinsically safe HART communication with FieldCare via the USB interface.
- FieldCare is a FDT-based plant asset management tool from Endress+Hauser, more details see section ‘accessories’. The acquired self-calibration data is stored in the device (1) and can be read using FieldCare. This also enables an auditable calibration certificate to be created and printed.
6.2 Structure and function of the operating menu

6.2.1 Structure of the operating menu

![Diagram of the operating menu structure]

- **Setup**
  - Device tag
  - Unit
  - 4 mA value
  - 20 mA value
  - Failure mode

- **Calibration**
  - Number of self calibrations
  - Stored self calibration points
  - Deviation
  - Adjustment
  - Limits
  - Interval monitoring
  - Calibration report
  - Lower warning value

- **Diagnostics**
  - Actual diagnostics
  - Previous diagnostics
  - Operating time
  - Diagnostic list
  - Previous diagnostics count
  - Event logbook
  - Diagnostic settings
  - Diagnostic behavior
  - Heartbeat
  - Heartbeat verification
  - Min/max values

- **Device tag**
  - Sensor value
  - Sensor min

- **Expert**
  - Enter access code
  - Access status tooling
  - Locking status
  - System
  - Unit
  - Define software write protection code
  - 4 mA value

- **Output**
  - Loop check configuration
  - Loop check config.
  - Device tag
  - HART configuration
  - Device type
  - HART info
  - HART output
  - Assign current output (PV)

- **Communication**
  - HART output
  - Assign current output (PV)

- **Expert**
  - HART configuration
  - Device tag
  - HART info
  - HART output
  - Assign current output (PV)

- **General**
  - Additional functions
  - Compare Datasets
  - Save/Restore
  - About

---

**Endress+Hauser**
## Submenus and user roles

Certain parts of the menu are assigned to certain user roles. Each user role corresponds to typical tasks within the lifecycle of the device.

<table>
<thead>
<tr>
<th>User role</th>
<th>Typical tasks</th>
<th>Menu</th>
<th>Content/meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>Commissioning:</td>
<td>Setup/Calibration*</td>
<td>Contains all parameters for commissioning and calibration:</td>
</tr>
<tr>
<td>Operator</td>
<td>• Configuration of the measurement.</td>
<td></td>
<td>• Setup parameters</td>
</tr>
<tr>
<td></td>
<td>• Configuration of data processing (Measurement range, etc.).</td>
<td></td>
<td>Once values have been set for these parameters, the measurement should generally be completely configured.</td>
</tr>
<tr>
<td></td>
<td>Reading measured values.</td>
<td></td>
<td>• Calibration parameters</td>
</tr>
<tr>
<td></td>
<td>Calibration:</td>
<td></td>
<td>Contains all information and parameters for the self-calibration, including a wizard for creating a calibration report. This wizard is available in the online parameterization.</td>
</tr>
<tr>
<td></td>
<td>• Configuration of the warning and alarm limit values as well as interval monitoring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Configuration and creation of a calibration report (wizard).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fault elimination:</td>
<td>Diagnostics*</td>
<td>Contains all parameters for detecting and analyzing errors:</td>
</tr>
<tr>
<td></td>
<td>• Diagnosing and eliminating process errors.</td>
<td></td>
<td>• Diagnostic list</td>
</tr>
<tr>
<td></td>
<td>• Interpretation of device error messages and correcting associated errors.</td>
<td></td>
<td>Contains up to 3 currently pending diagnostic messages.</td>
</tr>
<tr>
<td></td>
<td>Heartbeat:</td>
<td>Heartbeat*</td>
<td>• Event logbook</td>
</tr>
<tr>
<td></td>
<td>Creation of a Heartbeat report (wizard)</td>
<td></td>
<td>Contains the last 5 diagnostic messages (no longer pending).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &quot;Device information&quot; submenu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contains information for identifying the device.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &quot;Measured values&quot; submenu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contains all current measured values.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &quot;Simulation&quot; submenu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is used to simulate measured values or output values.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Diagnostic settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Configuration of diagnostic behavior and status signal according to NE107</td>
</tr>
<tr>
<td>Expert</td>
<td>Tasks that require detailed knowledge of the function of the device:</td>
<td>Expert*</td>
<td>Contains all parameters of the device (including those that are already in one of the other menus). The structure of this menu is based on the function blocks of the device:</td>
</tr>
<tr>
<td></td>
<td>• Commissioning measurements under difficult conditions.</td>
<td></td>
<td>• &quot;System&quot; submenu</td>
</tr>
<tr>
<td></td>
<td>• Optimal adaptation of the measurement to difficult conditions.</td>
<td></td>
<td>Contains all higher-order device parameters that do not pertain either to measurement or the measured value communication.</td>
</tr>
<tr>
<td></td>
<td>• Detailed configuration of the communication interface.</td>
<td></td>
<td>• &quot;Output&quot; submenu</td>
</tr>
<tr>
<td></td>
<td>• Error diagnostics in difficult cases.</td>
<td></td>
<td>Contains all parameters for configuring the analog current output and the loop check.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &quot;Communication&quot; submenu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contains all parameters for configuring the digital communication interface.</td>
</tr>
</tbody>
</table>

### 6.3 Access to the operating menu via an operating tool

#### 6.3.1 FieldCare

**Function scope**

FDT/DTM-based plant asset management tool from Endress+Hauser. It can configure all smart field units in a system and help you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. Access takes place via the HART protocol or CDI (= Endress+Hauser Common Data Interface).
Typical functions:
- Configuring parameters of the device
- Loading and saving device data (upload/download)
- Documentation of the measuring point

For iTHERM TrustSens thermometers, FieldCare provides convenient access to automatically created self-calibration reports.

For details, see Operating Instructions BA00027S/04 and BA00065S/04 in the download area on www.endress.com.

Source for device description files
See data → 22

Establishing a connection
As example: via HART modem Commubox FXA191 (RS232) or FXA195 (USB)

1. Make sure to update the DTM library for all connected devices (e.g. FXA19x, iTHERM TrustSens TM371).
2. Start FieldCare and create a project.
3. Go to View --> Network: Right-click on Host PC Add Device...
   ➔ The Add New Device window opens.
4. Select the HART Communication option from the list and press OK to confirm.
5. Double-click on HART Communication DTM instance.
   ➔ Check the Serial Interface port for the correct modem and press OK to confirm.
6. Right-click on HART Communication and select the Add Device... option in the context menu that opens.
7. Select the desired device from the list and press OK to confirm.
   ➔ The device appears in the network list.
8. Right-click on this device and select the Connect option in the context menu that opens.
   ➔ The CommDTM appears in green color.
9. Double-click on the device in the network list to establish the online connection to the device.
   ➔ The online parameterization is available.
User interface

1. Device tag and device name
2. Status area for the status signal
3. Measured values with general device information: PV, output current, percent of range
4. Helping area/additional information
5. Display and input area
6. Navigation area with operating menu structure

6.3.2  DeviceCare

Function scope
DeviceCare is a free configuration tool for Endress+Hauser devices. It supports devices with the following protocols, provided a suitable device driver (DTM) is installed: HART, PROFIBUS, FOUNDATION Fieldbus, Ethernet/IP, Modbus, CDI, ISS, IPC and PCP. The tool is aimed at customers without a digital network in plants and workshops as well as Endress+Hauser service technicians. The devices can be connected directly via a modem (point-to-point) or a bus system. DeviceCare is fast, easy and intuitive to use. It can run on a PC, laptop or tablet with a Windows operating system.

Source for device description files
See data → 22

6.3.3  Field Xpert

Function scope
Field Xpert is an industrial PDA (personal digital assistant) with integrated touchscreen for commissioning and maintaining field devices in explosion hazardous and non-hazardous areas. It allows efficient configuration of FOUNDATION fieldbus, HART and WirelessHART devices.

Source for device description files
See data → 22
6.3.4  AMS Device Manager

Function scope
Program from Emerson Process Management for operating and configuring measuring devices via the HART protocol.

Source for device description files
See data → 22

6.3.5  SIMATIC PDM

Function scope
SIMATIC PDM is a standardized, manufacturer-independent program from Siemens for the operation, configuration, maintenance and diagnosis of intelligent field devices via the HART protocol.

Source for device description files
See data → 22

6.3.6  Field Communicator 375/475

Function scope
Industrial handheld terminal from Emerson Process Management for remote configuration and measured value display via the HART protocol.

Source for device description files
See data → 22
7 System integration

7.1 Overview of device description files

Version data for the device

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **Firmware version**  | 01.00.zz                                                          | The firmware version can be found:
|                       |                                                                  | • on the nameplate → 9  
|                       |                                                                  | • in the operating menu: Diagnostics → Device information → Firmware version |
|                       |                                                                  | ▶ Please make sure to use the operating instructions valid for the device. The corresponding firmware versions for each operating instructions can be found on its title page. |
| **Manufacturer ID**   | (17) 0x11                                                         | Operating menu: Diagnostics → Device information → Manufacturer ID |
| **Device type**       | 0x11CF                                                           | Operating menu: Expert → Communication → HART info → Device type |
| **HART protocol revision** | 7                                                               | Operating menu: Expert → Communication → HART info → HART revision |
| **Device revision**   | 1                                                                | • On the nameplate → 9  
|                       |                                                                  | • Operating menu: Expert → Communication → HART info → Device revision |

The suitable device driver software (DD/DTM) for the individual operating tools can be obtained from different sources:

- www.endress.com --> Downloads --> Media Type: Software --> Software Type: Application Software
- www.endress.com --> Products: individual product page e.g. TM371 --> Documents / Manuals / Software: Electronic Data Description (EDD) or Device Type Manager (DTM).
- via DVD (contact your local Endress+Hauser sales center)

Endress+Hauser supports all common operating tools of different manufacturers (e.g. Emerson Process Management, ABB, Siemens, Yokogawa, Honeywell and many more). The Endress+Hauser operating tools FieldCare and Device care can also be obtained per download (www.endress.com --> Downloads --> Media Type: Software --> Application Software) or via optical data storage medium (DVD) from your local Endress+Hauser sales center.

7.2 Measured variables via HART protocol

The measured values (device variables) are assigned to the device variables as follows:

<table>
<thead>
<tr>
<th>Dynamic variable</th>
<th>Device variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary value (PV)</td>
<td>Temperature</td>
</tr>
<tr>
<td>Secondary value (SV)</td>
<td>Device temperature</td>
</tr>
<tr>
<td>Tertiary value (TV)</td>
<td>Number of self-calibrations</td>
</tr>
<tr>
<td>Quaternary value (QV)</td>
<td>Calibration deviation</td>
</tr>
</tbody>
</table>
7.3 Supported HART® commands

The HART® protocol enables the transfer of measurement data and device data between the HART® master and the field device. HART® masters such as the above listed operating tools require an appropriate device driver software (DD or DTM) to establish the data exchange. The data exchange is initiated via commands.

There are three different types of commands:

- **Universal commands:**
  All HART® devices support and use universal commands. These are associated with the following functionalities for example:
  - Recognition of HART® devices
  - Reading digital measured values

- **Common practice commands:**
  Common practice commands offer functions which are supported and can be executed by many but not all field devices.

- **Device-specific commands:**
  These commands allow access to device-specific functions which are not HART® standard. Such commands access individual field device information.

<table>
<thead>
<tr>
<th>Command No.</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0, Cmd0</td>
<td>Read unique identifier</td>
</tr>
<tr>
<td>1, Cmd001</td>
<td>Read primary variable</td>
</tr>
<tr>
<td>2, Cmd002</td>
<td>Read loop current and percent of range</td>
</tr>
<tr>
<td>3, Cmd003</td>
<td>Read dynamic variables and loop current</td>
</tr>
<tr>
<td>6, Cmd006</td>
<td>Write polling address</td>
</tr>
<tr>
<td>7, Cmd007</td>
<td>Read loop configuration</td>
</tr>
<tr>
<td>8, Cmd008</td>
<td>Read dynamic variable classifications</td>
</tr>
<tr>
<td>9, Cmd009</td>
<td>Read device variables with status</td>
</tr>
<tr>
<td>11, Cmd011</td>
<td>Read unique identifier associated with TAG</td>
</tr>
<tr>
<td>12, Cmd012</td>
<td>Read message</td>
</tr>
<tr>
<td>13, Cmd013</td>
<td>Read TAG, descriptor, date</td>
</tr>
<tr>
<td>14, Cmd014</td>
<td>Read primary variable transducer information</td>
</tr>
<tr>
<td>15, Cmd015</td>
<td>Read device information</td>
</tr>
<tr>
<td>16, Cmd016</td>
<td>Read final assembly number</td>
</tr>
<tr>
<td>17, Cmd017</td>
<td>Write message</td>
</tr>
<tr>
<td>18, Cmd018</td>
<td>Write TAG, descriptor, date</td>
</tr>
<tr>
<td>19, Cmd019</td>
<td>Write final assembly number</td>
</tr>
<tr>
<td>20, Cmd020</td>
<td>Read long TAG (32-byte TAG)</td>
</tr>
<tr>
<td>21, Cmd021</td>
<td>Read unique identifier associated with long TAG</td>
</tr>
<tr>
<td>22, Cmd022</td>
<td>Write long TAG (32-byte TAG)</td>
</tr>
<tr>
<td>38, Cmd038</td>
<td>Reset configuration changed flag</td>
</tr>
<tr>
<td>48, Cmd048</td>
<td>Read additional device status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command No.</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>33, Cmd033</td>
<td>Read device variables</td>
</tr>
<tr>
<td>34, Cmd034</td>
<td>Write primary variable damping value</td>
</tr>
<tr>
<td>35, Cmd035</td>
<td>Write primary variable range values</td>
</tr>
<tr>
<td>40, Cmd040</td>
<td>Enter/Exit fixed current mode</td>
</tr>
<tr>
<td>Command No.</td>
<td>Designation</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>42, Cmd042</td>
<td>Perform device reset</td>
</tr>
<tr>
<td>44, Cmd044</td>
<td>Write primary variable units</td>
</tr>
<tr>
<td>45, Cmd045</td>
<td>Trim loop current zero</td>
</tr>
<tr>
<td>46, Cmd046</td>
<td>Trim loop current gain</td>
</tr>
<tr>
<td>50, Cmd050</td>
<td>Read dynamic variable assignments</td>
</tr>
<tr>
<td>54, Cmd054</td>
<td>Read device variable information</td>
</tr>
<tr>
<td>59, Cmd059</td>
<td>Write number of response preambles</td>
</tr>
<tr>
<td>95, Cmd095</td>
<td>Read Device Communication Statistics</td>
</tr>
<tr>
<td>100, Cmd100</td>
<td>Write Primary Variable Alarm Code</td>
</tr>
<tr>
<td>516, Cmd516</td>
<td>Read Device Location</td>
</tr>
<tr>
<td>517, Cmd517</td>
<td>Write Device Location</td>
</tr>
<tr>
<td>518, Cmd518</td>
<td>Read Location Description</td>
</tr>
<tr>
<td>519, Cmd519</td>
<td>Write Location Description</td>
</tr>
<tr>
<td>520, Cmd520</td>
<td>Read Process Unit Tag</td>
</tr>
<tr>
<td>521, Cmd521</td>
<td>Write Process Unit Tag</td>
</tr>
<tr>
<td>523, Cmd523</td>
<td>Read Condensed Status Mapping Array</td>
</tr>
<tr>
<td>524, Cmd524</td>
<td>Write Condensed Status Mapping Array</td>
</tr>
<tr>
<td>525, Cmd525</td>
<td>Reset Condensed Status Mapping Array</td>
</tr>
<tr>
<td>526, Cmd526</td>
<td>Write Simulation Mode</td>
</tr>
<tr>
<td>527, Cmd527</td>
<td>Simulate Status Bit</td>
</tr>
</tbody>
</table>
8 Commissioning

8.1 Function check

Before commissioning the device make sure that all final checks have been carried out:
- Checklist "Post-mounting check", → 14
- Checklist "Post-connection check", → 16

8.2 Switching on the measuring device

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The device performs a number of internal test functions after power-up. This is indicated by red LED-flashing. The device is operational after approx. 10 seconds in normal operating mode. The LED on the device is illuminated green.

8.2.1 Display elements

1 LED signals for device status indication.

Function description of the different LED signals, see → 37

8.3 Configuring the measuring device

See 'Operating menu and parameter description' → 77

8.3.1 Defining the measurement range

To configure the measurement range, enter the 4 mA value and the 20 mA value.
Navigation

- "Setup" menu → 4 mA value
- "Setup" menu → 20 mA value

1. In the 4 mA value input window, enter the lower range value of your process measurement range and press ENTER to confirm.
2. In the 20 mA value input window, enter the upper range value of your process measurement range and press ENTER to confirm.

8.3.2 Defining the warning limits for the self-calibration

Use this function to define the lower and upper warning limit. As a result of each self-calibration the deviation between the reference sensor and the Pt100 sensor is being determined. If this deviation exceeds the defined warning limit, the device will transmit the defined status signal and show the defined diagnostic behavior via the LED. (Factory setting = Warning - LED red flashes, diagnostic number 144. Measured value status = Uncertain / Not limited).

Navigation

- "Calibration" menu → Limits → Intervention limits

1. In the Lower warning value input window, enter the lower warning limit for the self-calibration deviation and press ENTER to confirm.
2. In the **Upper warning value** input window, enter the upper warning limit for the self-calibration deviation and press ENTER to confirm.

### 8.3.3 Defining the alarm limits for the self-calibration

Use this function to define the lower and upper alarm limit. As a result of each self-calibration, the deviation between the reference sensor and the Pt100 sensor is being determined. If this deviation exceeds the defined alarm limit, the device will transmit the defined status signal and show the defined diagnostic behavior via the LED. (Factory setting = Warning - LED red flashes, diagnostic number 143. Measured value status = Uncertain / Not limited.)

**Navigation**

- "Calibration" menu → Limits → Alarm limits

1. In the **Lower alarm value** input window, enter the lower limit for the self-calibration deviation and press ENTER to confirm.

2. In the **Upper alarm value** input window, enter the upper warning limit for the self-calibration deviation and press ENTER to confirm.

### 8.4 Creating a calibration report

The "calibration report" wizard guides you systematically through the process for creating a calibration report for a pre-selected calibration point.

**Navigation**

- "Calibration" menu → Calibration report

1. At least one stored self-calibration point must be in the device to start the online wizard.

**Configuration and creation of a calibration report**

1. Press CALIBRATION to enter the calibration menu.

2. Press CALIBRATION REPORT to open the calibration wizard.
To read the calibration point data from the device, enter the calibration point index. Index 1 reads the latest calibration point.

4. Press READ DATA to confirm.

An overview of device information and calibration point data appears. See table below for detailed information.

Press SAVE RESULTS AS PDF to confirm.

Your file system explorer window appears. You are asked to save the calibration report as a PDF file.
6. Enter a file name for the calibration report and select a memory location in your file system.

   The calibration report is just being saved on your file system.

7. Either press EXIT to end the calibration report wizard, press SELECT CALIBRATION POINT to select another stored self-calibration point or press READ OLDER CALIBRATION POINT to switch to the previous self-calibration point.

The creation of a self-calibration report is finished. The saved PDF-file can be opened to read or to print the calibration report.

**Relevant self-calibration data for creating a report**

<table>
<thead>
<tr>
<th>Device information</th>
<th>Use this function to display the total count of hours when the device was powered.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time</td>
<td>Display the amount of all stored self-calibration points. This device is able to store 350 self-calibration points. As soon as the memory would reach its limit, the oldest self-calibration point will be overwritten.</td>
</tr>
<tr>
<td>Stored self-calibration points</td>
<td>Enter the number of the requested self-calibration point. The latest self-calibration point always has the number &quot;1&quot;.</td>
</tr>
<tr>
<td>Calibration point data</td>
<td>Use this number to identify a self-calibration point. Each number is unique and is not editable.</td>
</tr>
<tr>
<td>Calibration ID</td>
<td>This function shows the validity of the self-calibration point data.</td>
</tr>
<tr>
<td>Self-calibration status</td>
<td>This function displays the value of the operating hours counter of the shown self-calibration point.</td>
</tr>
<tr>
<td>Operating hours</td>
<td>This function displays the measured Pt100 temperature value at that specific time of the self-calibration.</td>
</tr>
<tr>
<td>Measured temperature value</td>
<td>This function displays the self-calibration deviation from the reference temperature. The deviation is calculated as follows: Self-calibration deviation = reference temperature - measured Pt100 temperature value + adjustment</td>
</tr>
<tr>
<td>Deviation</td>
<td>This function displays the adjustment value added to the measured Pt100 value. This influences the self-calibration deviation. New adjustment = Adjustment - deviation of last self-calibration point</td>
</tr>
<tr>
<td>Adjustment</td>
<td>This function displays the maximum measurement uncertainty at the self-calibration temperature.</td>
</tr>
<tr>
<td>Measurement uncertainty</td>
<td>Displays the device restarts between now and when the displayed self-calibration was executed.</td>
</tr>
</tbody>
</table>

**8.5 Protecting settings from unauthorized access**

Use this function to protect the device from unwanted changes.

**Navigation**

Expert menu → System → Administration → Define device write protection code

If the code is programmed into the device firmware it is saved in the device and the operating tool displays the value **0** so that the defined write protection code is not openly displayed for viewing.

User entry: 0 to 9 999

Factory default: 0 = write protection is not active.
To activate the write protection please go through the following steps:

1. Define a write protection in the **Enter access code** parameter.
2. Enter a code which does not correspond to the one which is defined in step 1.
   ➤ The device is now write protected.

Deactivate the write protection

➤ Enter the defined code in the **Enter access code** parameter.
   ➤ The device is not write protected.

If the write protection code has been forgotten, it can be deleted or overwritten by the service organization.

### 8.6 Advanced settings

The section contains a description of the additional parameters and technical data that are available with the **Heartbeat Verification** and **Heartbeat Monitoring** application packages.

#### 8.6.1 Heartbeat Technology modules

**Overview**

The modules are available in all the device versions. The Heartbeat Technology functionality is available with the revised device driver software (DTM, version 1.11.zz and higher).

**Short description of the modules**

*Heartbeat Diagnostics*

**Function**

- Continuous self-monitoring of the device.
- Diagnostic messages output to
  - a local display, optional
  - an asset management system (e.g. FieldCare/DeviceCare)
  - an automation system (e.g. PLC)
Advantages
- Device condition information is available immediately and processed in time.
- The status signals are classified in accordance with VDI/VDE 2650 and NAMUR recommendation NE 107 and contain information about the cause of the error and remedial action.

Detailed description
→ 31

Heartbeat Verification

Device functionality checked on demand
- Verification of the correct functioning of the measuring device within specifications.
- The verification result provides information about the condition of the device: "Passed" or "Failed".
- The results are documented in a verification report.
- The automatically generated report supports the obligation to demonstrate compliance with internal and external regulations, laws and standards.
- Verification is possible without interrupting the process.

Advantages
- No onsite presence is required to use the function.
- The DTM\(^1\) triggers verification in the device and interprets the results. No specific knowledge is required on the part of the user.
- The verification report can be used to prove quality measures to a third party.
- Heartbeat Verification can replace other maintenance tasks (e.g. periodic check) or extend the test intervals.

Detailed description
→ 32

Heartbeat Monitoring

Function
Calibration information is logged in addition to the verification parameters. 350 calibration points are saved in the device (FIFO memory).

Advantages
- Early detection of changes (trends) to ensure plant availability and product quality.
- Use of information for the proactive planning of measures (e.g. maintenance).

Detailed description
→ 35

8.6.2 Heartbeat Diagnostics

Device diagnostic messages, along with remedial measures, are displayed in the operating tool (FieldCare/DeviceCare).

For information on using the diagnostic messages, see the "Diagnostics and troubleshooting" section. → 37

---

1) DTM: Device Type Manager; controls device operation via DeviceCare, FieldCare, PACTware or a DTM-based control system.
Diagnostic message in the operating tool

1. Navigate to the 'Diagnostics' menu.
   The diagnostic event, along with the event text, is displayed in the Actual diagnostics parameter.

2. In the display area, hover the cursor over the 'Actual diagnostics' parameter.

8.6.3 Heartbeat Verification

Verification report

Creating the verification report using the wizard

The wizard to create a verification report is only available if the device is operated via FieldCare, DeviceCare, PACTware or a DTM-based control system.

Navigation
Menu "Diagnostics → Heartbeat" → Heartbeat Verification

1. Press the **Heartbeat Verification** button.

2. Follow the instructions given by the wizard.
   - The wizard guides you through the entire process for creating the verification report. The verification report can be saved in PDF and XML format.

   The device must be in operation for at least 6 minutes before a verification can be performed.

Content of the verification report

The verification report contains the results of the test objects: **Passed** or **Failed** is indicated as the result.
**Verification report: general information**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description/comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device information</strong></td>
<td></td>
</tr>
<tr>
<td>System operator</td>
<td>Name of the system operator; is defined when the verification report is created.</td>
</tr>
<tr>
<td>Location</td>
<td>Location of the device within the plant; is defined when the verification report is created.</td>
</tr>
<tr>
<td>Device tag</td>
<td>Unique name for the measuring point so it can be identified quickly within the plant. Is defined when commissioning the device.</td>
</tr>
<tr>
<td>Device name</td>
<td>Displays the device name. It can also be found on the nameplate. It cannot be changed.</td>
</tr>
<tr>
<td>Serial number</td>
<td>Displays the serial number of the device. It can also be found on the nameplate. It cannot be changed.</td>
</tr>
<tr>
<td>Order code</td>
<td>Displays the order code of the device. It can also be found on the nameplate. It cannot be changed.</td>
</tr>
<tr>
<td>Firmware version</td>
<td>Displays the device firmware version installed. It cannot be changed.</td>
</tr>
<tr>
<td><strong>Verification information</strong></td>
<td></td>
</tr>
<tr>
<td>Operating time</td>
<td>Indicates how long the device has been in operation up to this point.</td>
</tr>
<tr>
<td>Date/time</td>
<td>Displays the current computer system time.</td>
</tr>
<tr>
<td>Comments</td>
<td>Allows the user to enter optional comments, which appear in the verification report.</td>
</tr>
<tr>
<td><strong>Verification results</strong></td>
<td></td>
</tr>
<tr>
<td>The test result for all the test objects is given on the subsequent pages. The following results are possible:</td>
<td><img src="image" alt="Passed" /> Passed <img src="image" alt="Failed" /> Failed</td>
</tr>
</tbody>
</table>

**Verification criteria for the test objects**

<table>
<thead>
<tr>
<th>Test object</th>
<th>Verification criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mainboard module</strong></td>
<td></td>
</tr>
<tr>
<td>Electronics</td>
<td>Checks the correct functioning of the electronics.</td>
</tr>
<tr>
<td>Memory content</td>
<td>Checks the correct functioning of the data memory.</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>Checks the permitted supply voltage range.</td>
</tr>
<tr>
<td>Electronics temperature</td>
<td>Checks the permitted electronics temperature range or device temperature range.</td>
</tr>
<tr>
<td>Test object</td>
<td>Verification criterion</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sensor module</td>
<td></td>
</tr>
<tr>
<td>Sensor</td>
<td>Checks whether the sensor works as per the specifications.</td>
</tr>
<tr>
<td>Reference temperature</td>
<td>Checks whether the reference sensor works as per the specifications.</td>
</tr>
<tr>
<td>Sensor drift warning limit exceeded</td>
<td>Checks whether the configured warning limits are exceeded.</td>
</tr>
<tr>
<td>Sensor drift alarm limit exceeded</td>
<td>Checks whether the configured alarm limits are exceeded.</td>
</tr>
<tr>
<td>Sensor information</td>
<td></td>
</tr>
<tr>
<td>Number of self-calibrations</td>
<td>Displays all the self-calibrations executed up to now. This value cannot be reset.</td>
</tr>
<tr>
<td>Deviation</td>
<td>Displays the deviation of the measured value from the reference temperature.</td>
</tr>
<tr>
<td>Adjustment of the measurement</td>
<td>Displays the adjustment of the calibration deviation.</td>
</tr>
<tr>
<td>Monitoring parameters</td>
<td></td>
</tr>
<tr>
<td>Device temperature min:</td>
<td>Displays the minimum electronics temperature measured in the past (peakhold indicator).</td>
</tr>
<tr>
<td>Device temperature max:</td>
<td>Displays the maximum electronics temperature measured in the past (peakhold indicator).</td>
</tr>
<tr>
<td>Sensor min value:</td>
<td>Displays the minimum temperature measured in the past at the sensor input (peakhold indicator).</td>
</tr>
<tr>
<td>Sensor max. value:</td>
<td>Displays the maximum temperature measured in the past at the sensor input (peakhold indicator).</td>
</tr>
</tbody>
</table>

**Summary of results**

| Overall results | Displays the overall result of the verification. The verification report can be saved in PDF and XML format. To save the report, click the **Save results as PDF** button or the **Save results as XML** button. |

If the verification fails, try again or contact the Service Organization.

### 8.6.4 Heartbeat Monitoring

Calibration information is logged in addition to the verification parameters.

<table>
<thead>
<tr>
<th>HART variable</th>
<th>Output</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>Temperature</td>
<td>°C/°F</td>
</tr>
<tr>
<td>SV</td>
<td>Device temperature</td>
<td>°C/°F</td>
</tr>
<tr>
<td>TV</td>
<td>Calibration counter</td>
<td>-</td>
</tr>
<tr>
<td>QV</td>
<td>Calibration deviation</td>
<td>°C/°F</td>
</tr>
</tbody>
</table>

**Monitoring information can be read out and analyzed as described below:**

A higher-level controller is configured in such a way that calibration deviations and the calibration counter are saved when the calibration counter changes. This type of function is supported by Endress+Hauser's Advanced Data Manager Memograph M RSG45, for example. The following table provides a sample overview of the monitoring analysis using the Field Data Manager software MS20:
<table>
<thead>
<tr>
<th>Time stamp</th>
<th>Device name</th>
<th>Category</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Serial number: M7041504487</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device name: iTHERM TM371/372</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operating hours: 1626 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reference temperature: 118.67 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Measured temperature value: 118.68 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Deviation: 0.01 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Measuring uncertainty (k=2): 0.35 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Max. permitted deviation: -0.80 / +0.80 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assessment</td>
</tr>
</tbody>
</table>

...
9 Diagnostics and troubleshooting

9.1 Troubleshooting

Always start troubleshooting with the checklists below if faults occur after start up or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

Due to its design, the device cannot be repaired. However, it is possible to send the device back for examination. See the information in the "Return" section. → 43

General errors

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device is not responding.</td>
<td>Supply voltage range does not match that specified on the nameplate.</td>
<td>Apply correct voltage, see nameplate.</td>
</tr>
<tr>
<td></td>
<td>M12 plug is not connected correctly, wrong cable wiring.</td>
<td>Check the wiring.</td>
</tr>
<tr>
<td>Output current &lt; 3.6 mA</td>
<td>Device is defective.</td>
<td>Replace the device.</td>
</tr>
<tr>
<td>HART communication is not working.</td>
<td>Missing or incorrectly installed communication resistor.</td>
<td>Install the communication resistor (250 Ω) correctly.</td>
</tr>
</tbody>
</table>

Commubox is not properly connected. Connect Commubox correctly.

9.2 Diagnostic information via LEDs

<table>
<thead>
<tr>
<th>Position</th>
<th>LEDs</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LED green (gn) is illuminated</td>
<td>Voltage supply is correct. The device is operational and the set limit values are met.</td>
</tr>
<tr>
<td></td>
<td>LED green (gn) is flashing</td>
<td>With a frequency 1 Hz: self-calibration currently being performed. With a frequency 5 Hz for 5 s: self-calibration finished and valid, all process criteria were within specifications. Calibration data stored.</td>
</tr>
<tr>
<td></td>
<td>LED red (rd) and green (gn) are flashing alternating</td>
<td>Self-calibration process finished but not valid, violation of necessary process criteria. Calibration data not stored.</td>
</tr>
<tr>
<td></td>
<td>LED red (rd) is flashing</td>
<td>Presence of a diagnostic event: &quot;Warning&quot;</td>
</tr>
<tr>
<td></td>
<td>LED red (rd) is illuminated</td>
<td>Presence of a diagnostic event: &quot;Alarm&quot;</td>
</tr>
</tbody>
</table>
9.3 Diagnostic information

Status signal and diagnostic behavior can be configured manually.

Status signal - Digital information available via HART® communication

<table>
<thead>
<tr>
<th>Letter/symbol</th>
<th>Status signal</th>
<th>Meaning of the status signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Failure</td>
<td>The device or its periphery behaves in such a way that the measurement value is no longer valid. This includes faults/failures which are caused by the process being measured, but have an impact on the ability to perform a measurement e.g. “no process signal” detected.</td>
</tr>
<tr>
<td>C</td>
<td>Function check</td>
<td>The device is deliberately serviced, configured, parameterized or is in simulation mode. A situation exists where the output signal does not represent the process value and is therefore not valid.</td>
</tr>
<tr>
<td>S</td>
<td>Out of specification</td>
<td>The device is operating outside of its technical specifications or internal diagnostic functions indicate that the current process conditions increase the measurement uncertainty (i.e. during plant start-up or cleaning processes).</td>
</tr>
<tr>
<td>M</td>
<td>Maintenance required</td>
<td>Deviation from normal operation, the device still works, but should be attended to soon to ensure continued operation, e.g. build-up, corrosion, zero point adjustment not possible or memory for data storage almost full.</td>
</tr>
</tbody>
</table>

1) Valid for the default mappings to the diagnostic numbers

Diagnostic behavior - Analog information via current output and LED

<table>
<thead>
<tr>
<th>Diagnostic behavior</th>
<th>Meaning of the behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm</td>
<td>Measurement is interrupted. Mostly the measured data is invalid and the configured failure current is set. A diagnostic message is generated.</td>
</tr>
<tr>
<td>Warning</td>
<td>Usually, the device continues to measure. A diagnostic message is generated.</td>
</tr>
<tr>
<td>Disabled</td>
<td>The diagnostic event is completely surpressed even if the device is not working properly.</td>
</tr>
</tbody>
</table>

Diagnostics event and event text

Example

- **Diagnostics event**
  - **Status signal**: F
  - **Event number**: 001
  - **Event text**: Device failure
  - 3-digit number

The fault can be identified by means of the diagnostics event. The event text helps you by providing information about the fault.
### 9.4 Overview of diagnostics events

Diagnostic events are assigned to a certain diagnostic number and a status signal. The user can change this assignment for certain diagnostic events.

#### Example:

<table>
<thead>
<tr>
<th>Configuration example</th>
<th>Diagnostic number</th>
<th>Status signal</th>
<th>Diagnostic behavior (settings)</th>
<th>Status signal (output via HART® protocol)</th>
<th>Output current</th>
<th>PV, status</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default setting</td>
<td>143</td>
<td>S</td>
<td>Warning</td>
<td>S</td>
<td>Measured value</td>
<td>Measured value, UNCERTAIN</td>
<td>Red is flashing</td>
</tr>
<tr>
<td>Manual configuration: Status signal S is switched to F</td>
<td>143</td>
<td>F</td>
<td>Warning</td>
<td>F</td>
<td>Measured value</td>
<td>Measured value, UNCERTAIN</td>
<td>Red is flashing</td>
</tr>
<tr>
<td>Manual configuration: Diagnostic behavior Warning is switched to Alarm</td>
<td>143</td>
<td>S</td>
<td>Alarm</td>
<td>S</td>
<td>Configured failure current</td>
<td>Measured value, BAD</td>
<td>Red is illuminated</td>
</tr>
<tr>
<td>Manual configuration: Warning is switched to Disabled</td>
<td>143</td>
<td>S</td>
<td>Disabled</td>
<td>-</td>
<td>Last valid measured value</td>
<td>Last valid measured value, GOOD</td>
<td>Green is illuminated</td>
</tr>
</tbody>
</table>

1) Setting is not relevant.
2) Status signal is not indicated.
3) If there is no valid measured value, it is set to the failure current.

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Priority</th>
<th>Short text</th>
<th>Remedy</th>
<th>Status signal (factory default)</th>
<th>Configurable 1)</th>
<th>Diagnostic behavior from the factory</th>
<th>Configurable 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>1</td>
<td>Device failure</td>
<td>1. Restart device. 2. Replace electronics.</td>
<td>F</td>
<td>Not configurable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>004</td>
<td>2</td>
<td>Sensor defective</td>
<td>Replace device.</td>
<td>F</td>
<td></td>
<td>Alarm</td>
<td></td>
</tr>
<tr>
<td>047</td>
<td>22</td>
<td>Sensor limit reached</td>
<td>1. Check sensor. 2. Check process conditions.</td>
<td>S</td>
<td></td>
<td>Warning</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>26</td>
<td>Manual calibration interval expired</td>
<td>1. Execute calibration and reset calibration interval. 2. Switch off calibration counter</td>
<td>M</td>
<td></td>
<td>Warning</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>21</td>
<td>Sensordrift Alarm limit exceeded</td>
<td>1. Check self calibration alarm limits. 2. Check value of adjustment. 3. Replace device</td>
<td>S</td>
<td></td>
<td>Warning</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>27</td>
<td>Sensordrift warning limit exceeded</td>
<td>1. Check self calibration warning limits. 2. Check value of adjustment. 3. Replace device</td>
<td>M</td>
<td></td>
<td>Warning</td>
<td></td>
</tr>
<tr>
<td>221</td>
<td>29</td>
<td>Reference sensor defective</td>
<td>Replace device.</td>
<td>M</td>
<td></td>
<td>Warning</td>
<td></td>
</tr>
</tbody>
</table>

---

*Endress+Hauser*
<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Priority</th>
<th>Short text</th>
<th>Remedy</th>
<th>Status signal (factory default)</th>
<th>Configurable 1)</th>
<th>Diagnostic behavior from the factory</th>
<th>Configurable 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>401</td>
<td>15</td>
<td>Factory reset active</td>
<td>Factory reset in progress, please wait.</td>
<td>C</td>
<td>Not configurable</td>
<td>Warning</td>
<td>Not configurable</td>
</tr>
<tr>
<td>402</td>
<td>16</td>
<td>Initialization active</td>
<td>Initialization in progress, please wait.</td>
<td>C</td>
<td>Not configurable</td>
<td>Warning</td>
<td>Not configurable</td>
</tr>
<tr>
<td>410</td>
<td>3</td>
<td>Data transfer failed</td>
<td>1. Check connection. 2. Repeat data transfer.</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>411</td>
<td>17</td>
<td>Up-/download active</td>
<td>Up-/download in progress.</td>
<td>C</td>
<td>Not configurable</td>
<td>Warning</td>
<td>Not configurable</td>
</tr>
<tr>
<td>435</td>
<td>5</td>
<td>Linearization faulty</td>
<td>Check linearization.</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>437</td>
<td>4</td>
<td>Configuration incompatible</td>
<td>Execute factory reset.</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>438</td>
<td>30</td>
<td>Dataset different</td>
<td>1. Check data set file. 2. Check device parameterization. 3. Download new device parameterization.</td>
<td>M</td>
<td>Not configurable</td>
<td>Warning</td>
<td>Not configurable</td>
</tr>
<tr>
<td>485</td>
<td>18</td>
<td>Process variable simulation active-Sensor</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Configurable</td>
<td>Warning</td>
<td>Configurable</td>
</tr>
<tr>
<td>491</td>
<td>19</td>
<td>Output simulation - current output</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Configurable</td>
<td>Warning</td>
<td>Configurable</td>
</tr>
<tr>
<td>495</td>
<td>20</td>
<td>Diagnostic event simulation active</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Configurable</td>
<td>Warning</td>
<td>Configurable</td>
</tr>
<tr>
<td>501</td>
<td>6</td>
<td>Wiring error ⁴)</td>
<td>Check wiring.</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>531</td>
<td>6</td>
<td>Factory adjustment missing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>537</td>
<td>11</td>
<td>Configuration</td>
<td>1. Check device configuration 2. Up- and download new configuration</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Configuration-Sensor</td>
<td>1. Check sensor configuration. 2. Check device configuration.</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Configuration-Reference sensor</td>
<td>1. Check application 2. Check the current output parameterization</td>
<td>F</td>
<td>Not configurable</td>
<td>Alarm</td>
<td>Not configurable</td>
</tr>
<tr>
<td>801</td>
<td>23</td>
<td>Supply voltage too low</td>
<td>Increase supply voltage.</td>
<td>S</td>
<td>Configurable</td>
<td>Alarm</td>
<td>Configurable</td>
</tr>
<tr>
<td>825</td>
<td>24</td>
<td>Operating temperature</td>
<td>1. Check ambient temperature. 2. Check process temperature.</td>
<td>S</td>
<td>Configurable</td>
<td>Warning</td>
<td>Configurable</td>
</tr>
</tbody>
</table>
### Diagnostics and troubleshooting

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Priority</th>
<th>Short text</th>
<th>Remedy</th>
<th>Status signal (factory default)</th>
<th>Diagnostic behavior from the factory</th>
<th>Conf. 1</th>
<th>Conf. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>844</td>
<td>25</td>
<td>Process value out of spec.</td>
<td>1. Check process value. 2. Check application. 3. Check sensor.</td>
<td>S</td>
<td>Warning</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>905</td>
<td>28</td>
<td>Self calibration interval expired</td>
<td>1. Initiate self-calibration. 2. Deactivate self-calibration interval monitoring. 3. Replace device</td>
<td>M</td>
<td>Warning</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

1) F, C, S, M, N can be configured
2) ‘Alarm’, ‘Warning’ and ‘Disabled’ can be configured
3) Reference sensor defective if temperature range of –45 to +200 °C (–49 to +392 °F) is exceeded. Temperature measurement continues, but self-calibration is permanently disabled.
4) Leading error cause: CDI modem and loop are connected simultaneously, based on wrong connection (CDI modem or loop only) or defective cable plug.

#### 9.5 Diagnostic list

If more than three diagnostic events occur simultaneously, only the messages with the highest priorities are shown in the **Diagnostics list**. Characteristic feature of the displayed priority is the status signal in the following order: F, C, S, M. If there are several diagnostic events with the same status signal, the priority values from the table above are used for ordering the diagnostic events, e.g.: F001 appears first, F501 appears second and S047 appears last.

#### 9.6 Event logbook

Diagnostic events that are no longer pending are shown in the **Event logbook** submenu.

#### 9.7 Firmware history

**Revision history**

The firmware version (FW) on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 01.02.01).

- **XX** Change to main version. No longer compatible. Changes in the device and Operating Instructions.
- **YY** Change to functions and operation. Compatible. Changes in the Operating Instructions.
- **ZZ** Bug fixing. No changes to the Operating Instructions.

<table>
<thead>
<tr>
<th>Date</th>
<th>Firmware Version</th>
<th>Modifications</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/17</td>
<td>01.00.zz</td>
<td>Original firmware</td>
<td>BA01581T/09</td>
</tr>
</tbody>
</table>
10  Maintenance
In general, no specific maintenance is required for this device.

10.1 Cleaning
The sensor has to be cleaned as required. The cleaning can also be proceeded when the device is installed (e.g. CIP Cleaning in Place / SIP Sterilization in Place). Care must be taken to ensure that the sensor is not damaged during the cleaning.

The housing is resistant to typical cleaning agents from the outside. It passed the Ecolab test.
11 Repair

Due to its design, the device cannot be repaired.

11.1 Spare parts

Currently available spare parts for your product can be found online at: http://www.products.endress.com/spareparts_consumables. When ordering spare parts, please quote the serial number of the device!

<table>
<thead>
<tr>
<th>Type</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug screw fitting G1/2 1.4435</td>
<td>60022519</td>
</tr>
<tr>
<td>Spare Part Kit Press-Screw TK40 G1/4 d6</td>
<td>71215757</td>
</tr>
<tr>
<td>Spare Part Kit Press-Screw TK40 G1/2 d6</td>
<td>71217633</td>
</tr>
<tr>
<td>Weld-in adapter G3/4 d=50, 316L, 3.1</td>
<td>52018765</td>
</tr>
<tr>
<td>Weld-in adapter G3/4, d=29, 316L, 3.1</td>
<td>52028295</td>
</tr>
<tr>
<td>G1/2 metal to metal weld in adapter</td>
<td>60021387</td>
</tr>
<tr>
<td>Weld in adapter M12x1.5 316L&amp;1.4435</td>
<td>71405560</td>
</tr>
<tr>
<td>O-ring 14.9x2.7 VMQ, FDA, 5 pieces</td>
<td>52017171</td>
</tr>
<tr>
<td>Weld-in adapter G3/4 d=55, 316L</td>
<td>52001052</td>
</tr>
<tr>
<td>Weld-in adapter G3/4, 316L, 3.1</td>
<td>52011897</td>
</tr>
<tr>
<td>O-ring 21.89x2.62 VMQ, FDA, 5 pcs.</td>
<td>52014473</td>
</tr>
<tr>
<td>Weld-in adapter G1, d=60, 316L</td>
<td>52011896</td>
</tr>
<tr>
<td>Weld-in adapter G1, d=53, 316L, 3.1</td>
<td>71093129</td>
</tr>
<tr>
<td>O-ring 28.17x3.53 VMQ, FDA, 5 pcs.</td>
<td>52014472</td>
</tr>
<tr>
<td>Adapter for Ingold connection</td>
<td>60017887</td>
</tr>
<tr>
<td>O-ring set for Ingold connection</td>
<td>60018911</td>
</tr>
<tr>
<td>Grip cap flexible yellow TPE</td>
<td>71275424</td>
</tr>
<tr>
<td>iTHERM TK40 compression fitting</td>
<td>TK40-</td>
</tr>
<tr>
<td>Spare Part Kit sealing TK40</td>
<td>XPT0001-</td>
</tr>
<tr>
<td>iTHERM TT411 thermowell</td>
<td>TT411-</td>
</tr>
</tbody>
</table>

11.2 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.

11.3 Disposal

The device contains electronic components and must therefore be disposed of as electronic waste. Please pay particular attention to the national disposal regulations in your country. Please separate the different components according to their material consistence.
12  Accessories

Various accessories, which can be ordered with the device or subsequently from Endress + Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

12.1  Device-specific accessories

Device-specific accessories

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
</table>
| Welding boss with sealing taper (metal-metal) | Welding boss for G½" and M12x1.5 thread  
Metal-sealing: conical  
Material of wetted parts: 316L/1.4435  
Max. process pressure 16 bar (232 PSI)  
Order number:  
• 71424800 (G½")  
• 71405560 (M12x1.5) |
| Ø30 (1.18) | G½" |
| 15 (0.6) | 34 (1.34) |
| M12x1.5 | Ø20 (0.8) |
| Ø7.6 (0.3) | 13 (0.51) |
| 37 (1.46) | 37 (1.46) |
| 1 | Size across flats SW22 |

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
</table>
| Dummy plug | Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss  
Material: SS 316L/1.4435  
Order number:  
• 60022519 (G½")  
• 60021194 (M12x1.5) |
| Ø18 (0.71) | 37 (1.46) |
| M12x1.5 | 8 (0.31) |
| Ø½" | 1

A0306421

A0301826

A03063726
### 12.1.1 Weld-in adapter

For more information about order codes and hygienic compliance of the adapters and spare parts, see Technical Information (TI00426F).

<table>
<thead>
<tr>
<th>Weld-in adapter</th>
<th>Material</th>
<th>Roughness μm (μin) process side</th>
<th>Maximum process pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>G ¾&quot;, d=29 for pipe-mounting</td>
<td>316L (1.4435)</td>
<td>≤1.5 (59.1)</td>
<td>25 bar (362 PSI) at maximum 150 °C (302 °F)</td>
</tr>
<tr>
<td>G ¾&quot;, d=50 for vessel-mounting</td>
<td>316L (1.4435)</td>
<td>≤0.8 (31.5)</td>
<td>40 bar (580 PSI) at maximum 100 °C (212 °F)</td>
</tr>
<tr>
<td>G ¾&quot;, d=55 with flange</td>
<td>316L (1.4435)</td>
<td>≤0.8 (31.5)</td>
<td></td>
</tr>
<tr>
<td>G 1&quot;, d=53 without flange</td>
<td>316L (1.4435)</td>
<td>≤0.8 (31.5)</td>
<td></td>
</tr>
<tr>
<td>G 1&quot;, d=60 with flange</td>
<td>316L (1.4435)</td>
<td>≤0.8 (31.5)</td>
<td></td>
</tr>
<tr>
<td>G 1&quot; adjustable</td>
<td>316L (1.4435)</td>
<td>≤0.8 (31.5)</td>
<td></td>
</tr>
</tbody>
</table>
## 12.2 Communication-specific accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
<th>Order Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration kit TXU10</td>
<td>Configuration kit for CDI communication with PC-programmable devices. Includes interface cable for PC with USB port and M12x1 coupling (Non-Ex area). Order code: TXU10-BD</td>
<td></td>
</tr>
<tr>
<td>Commubox FXA291</td>
<td>Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop (Non-Ex area and Ex area). For details, see Technical Information TI00405C</td>
<td></td>
</tr>
<tr>
<td>Cordset M12x1, angle plug</td>
<td>PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling; angle plug; screw plug; length 5 m (16.4 ft); IP69K Order number: 71387767 Core colours: • 1 = BN brown (+) • 2 = WH white (nc) • 3 = BU blue (-) • 4 = BK black (nc)</td>
<td></td>
</tr>
<tr>
<td>Cordset M12x1, straight</td>
<td>PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling nut made of epoxy coated zinc; straight female connector type; screw plug; length 5 m (16.4 ft); IP69K Order number: 71217708 Core colors: • 1 = BN brown (+) • 2 = WH white (nc) • 3 = BU blue (-) • 4 = BK black (nc)</td>
<td></td>
</tr>
<tr>
<td>Commubox FXA195 HART</td>
<td>For intrinsically safe HART communication with FieldCare via the USB interface. For details, see Technical Information TI00404F</td>
<td></td>
</tr>
<tr>
<td>HART Loop Converter HMX50</td>
<td>Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see Technical Information TI00429F and Operating Instructions BA00371F</td>
<td></td>
</tr>
<tr>
<td>Field Xpert SMT70</td>
<td>The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous (Ex Zone 2) and non-hazardous areas. It is suitable for commissioning and maintenance staff For details, see Technical Information TI01342S</td>
<td></td>
</tr>
</tbody>
</table>
## 12.3 Service-specific accessories

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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](https://portal.endress.com/webapp/applicator) |
| Configurator  | Product Configurator - the tool for individual product configuration  
  - Up-to-the-minute configuration data  
  - Depending on the device: Direct input of 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](http://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. |
| 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](http://www.endress.com/lifecyclemanagement) |
| FieldCare SFE500 | FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.  
  For details, see Operating Instructions BA00027S and BA00065S |
| DeviceCare SFE100 | Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices.  
  For details, see Operating Instructions BA00027S |
12.4 System components

<table>
<thead>
<tr>
<th>Advanced Data Manager Memograph M</th>
<th>The Advanced Data Manager Memograph M is a flexible and powerful system for organizing process values. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. Via common communication protocols, the measured and calculated values can be easily communicated to higher-level systems or individual plant modules can be interconnected.</th>
<th>For details, see Technical Information TI01180R/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN42</td>
<td>1-channel active barrier with wide range power supply for the safe separation of 0/4 to 20 mA standard signal circuits, HART-transparent</td>
<td>For details, see Technical Information TI01584K</td>
</tr>
<tr>
<td>RNS221</td>
<td>Supply unit for powering two 2-wire measuring devices in the non-Ex area. Bidirectional communication is possible via the HART communication jacks.</td>
<td>For details, see Technical Information TI00081R</td>
</tr>
</tbody>
</table>

13 Technical Data

13.1 Input

Measuring range

Pt100 thin-film (TF):
- –40 to +160 °C (–40 to +320 °F)
- Optional –40 to +190 °C (–40 to +374 °F)

13.2 Output

Output signal

<table>
<thead>
<tr>
<th>Output signal</th>
<th>4 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog output</td>
<td></td>
</tr>
<tr>
<td>Digital output</td>
<td>HART protocol (revision ?)</td>
</tr>
</tbody>
</table>

Failure information

Failure information as per NAMUR NE43:

Failure information is created if the measuring information is missing or not valid. A complete list of all the errors occurring in the measuring system is created.

- Underranging: Linear decrease from 4.0 to 3.8 mA
- Overranging: Linear increase from 20.0 to 20.5 mA
- Failure, e.g. sensor breakage, sensor short-circuit: ≤ 3.6 mA ('low') or ≥ 21.5 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

Maximum possible HART communication resistance

\[ R_{b\text{ max.}} = \frac{(U_{b\text{ max.}} - 12 \text{ V})}{0.023 \text{ A}} \] (current output)

<table>
<thead>
<tr>
<th>Ω</th>
<th>780</th>
<th>530</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{DC}</td>
<td>0</td>
<td>12</td>
<td>17.75</td>
</tr>
</tbody>
</table>

Linearization/transmission behavior

Temperature-linear

Filter

1st order digital filter: 0 to 120 s, factory setting: 0 s (PV)

Protocol-specific data

<table>
<thead>
<tr>
<th>HART</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer ID</td>
</tr>
<tr>
<td>Device type ID</td>
</tr>
<tr>
<td>HART revision</td>
</tr>
</tbody>
</table>
| Device description files (DTM, DD) | Information and files at:  
- [www.endress.com/downloads](http://www.endress.com/downloads)  
- [www.fieldcommgroup.org](http://www.fieldcommgroup.org) |
| HART load | Min. 250 Ω |
| HART device variables | Measured value for PV (primary value) Temperature  
- Measured values for SV, TV, QV (secondary, tertiary and quaternary variable)  
  - SV: Device temperature  
  - TV: Calibration counter  
  - QV: Calibration deviation |
| Supported functions | Additional transmitter status  
- NE107 diagnostics |

Startup behavior / wireless HART data

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum start-up voltage</td>
</tr>
<tr>
<td>Start-up current</td>
</tr>
<tr>
<td>Start-up time</td>
</tr>
<tr>
<td>Minimum operating voltage</td>
</tr>
<tr>
<td>Multidrop current</td>
</tr>
<tr>
<td>Lead time</td>
</tr>
</tbody>
</table>
### 13.3 Wiring

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

**Supply voltage**

\[ U_b = 12 \text{ to } 30 \, V_{DC} \]

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".

**Current consumption**

- \( I = 3.58 \text{ to } 23 \, mA \)
- Minimum current consumption: \( I = 3.58 \, mA \), multi-drop mode \( I = 4 \, mA \)
- Maximum current consumption: \( I \leq 23 \, mA \)

**Overvoltage protection**

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

For more information see the Technical Information ‘HAW562 Surge arrester’ TI01012K

### 13.4 Performance characteristics

**Reference operating conditions**

- Ambient temperature: \( 25 \, ^\circ C \pm 5 \, ^\circ C \) (\( 77 \, ^\circ F \pm 9 \, ^\circ F \))
- Supply voltage: \( 24 \, V_{DC} \)

**Internal calibration points**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 118 , ^\circ C ) (( 244.4 , ^\circ F )) \pm 1.2 , K / \pm 1.7 , K</td>
<td></td>
</tr>
<tr>
<td>Lowest possible calibration point = ( 116.3 , ^\circ C ) (( 241.3 , ^\circ F ))</td>
<td></td>
</tr>
<tr>
<td>Highest possible calibration point = ( 119.2 , ^\circ C ) (( 246.6 , ^\circ F ))</td>
<td></td>
</tr>
</tbody>
</table>

The individual calibration point of each iTHERM TrustSens device is indicated in the ex-works calibration certificate enclosed with the shipment.

**Measurement uncertainty**

The given uncertainty values include non-linearity and non-repeatability and correspond to 2Sigma (95% confidence level according to the Gaussian distribution curve).

Each iTHERM TrustSens is calibrated and matched by default before shipment to guarantee the given accuracy.

#### Uncertainty of self-calibration at the calibration point: 13

<table>
<thead>
<tr>
<th>Option</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 118 , ^\circ C ) (( 244 , ^\circ F )); self-calibration with excellent uncertainty</td>
<td>( &lt; 0.35 , K ) (( 0.63 , ^\circ F ))</td>
</tr>
<tr>
<td>( 118 , ^\circ C ) (( 244 , ^\circ F )); self-calibration with standard uncertainty</td>
<td>( &lt; 0.55 , K ) (( 0.99 , ^\circ F ))</td>
</tr>
</tbody>
</table>

Uncertainty of the temperature sensor inclusive digital output (HART value) at reference conditions in delivery state:
### Process temperature:

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>+20 to +135 °C (+68 to +275 °F)</td>
<td>&lt; 0.22 K (0.4 °F)</td>
</tr>
<tr>
<td>+135 to +160 °C (+275 to +320 °F)</td>
<td>&lt; 0.38 K (0.68 °F)</td>
</tr>
<tr>
<td>+160 to +170 °C (+320 to +338 °F)</td>
<td>&lt; 0.5 K (0.9 °F)</td>
</tr>
<tr>
<td>+170 to +180 °C (+338 to +356 °F)</td>
<td>&lt; 0.6 K (1.08 °F)</td>
</tr>
<tr>
<td>+180 to +190 °C (+356 to +374 °F)</td>
<td>&lt; 0.8 K (1.44 °F)</td>
</tr>
<tr>
<td>0 to +20 °C (+32 to +68 °F)</td>
<td>&lt; 0.27 K (0.49 °F)</td>
</tr>
<tr>
<td>-20 to 0 °C (-4 to +32 °F)</td>
<td>&lt; 0.46 K (0.83 °F)</td>
</tr>
<tr>
<td>-40 to -20 °C (-40 to -4 °F)</td>
<td>&lt; 0.8 K (1.44 °F)</td>
</tr>
</tbody>
</table>

### Uncertainty of D/A converter (analog output current)

- 0.03 % of the measurement range

1) The uncertainty of the self-calibration can be compared to the uncertainty of a manual on-site calibration with a mobile dry-block-calibrator. Depending on the used equipment and the qualification of the person who is performing the calibration an uncertainty of > 0.3 K (0.54 °F) is standard.

### Long-term drift

<table>
<thead>
<tr>
<th>Component</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100 sensing element</td>
<td>&lt; 1000 ppm/1000 h</td>
</tr>
<tr>
<td>A/D converter (digital output - HART)</td>
<td>&lt; 500 ppm/1000 h</td>
</tr>
<tr>
<td>D/A converter (analog output - current)</td>
<td>&lt; 100 ppm/1000 h</td>
</tr>
</tbody>
</table>

1) This would be detected by the self-calibration.

Long-term drift decreases at an exponential rate over time. So it may not be extrapolated in a linear way for time spans longer than the above given values.

### Influence of ambient temperature

<table>
<thead>
<tr>
<th>Component</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/D converter (digital output - HART) at typical operating conditions</td>
<td>&lt; 0.05 K (0.09 °F)</td>
</tr>
<tr>
<td>A/D converter (digital output - HART) at maximum operating conditions</td>
<td>&lt; 0.15 K (0.27 °F)</td>
</tr>
<tr>
<td>D/A converter (analog output - current)</td>
<td>≤ 30 ppm/°C (2σ), related to the deviation from the reference temperature</td>
</tr>
</tbody>
</table>

### Typical operating conditions

- Ambient temperature: 0 to +40 °C (+32 to +104 °F)
- Process temperature: 0 to +140 °C (+32 to +284 °F)
- Power supply: 18 to 24 V DC

### Influence of supply voltage

According to IEC 61298-2:

<table>
<thead>
<tr>
<th>Component</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/D converter (digital output - HART) at typical operating conditions</td>
<td>&lt; 15 ppm/V</td>
</tr>
<tr>
<td>D/A converter (analog output - current)</td>
<td>&lt; 10 ppm/V</td>
</tr>
</tbody>
</table>

1) Related to the deviation from the reference supply voltage.

Sample calculation with Pt100, measuring range +20 to +135 °C (+68 to +275 °F), ambient temperature +25 °C (+77 °F), supply voltage 24 V:

<table>
<thead>
<tr>
<th>Error Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured error digital</td>
<td>0.220 K (0.396 °F)</td>
</tr>
<tr>
<td>Measured error D/A = 0.03 % x 150 °C (302 °F)</td>
<td>0.045 K (0.081 °F)</td>
</tr>
<tr>
<td>Measured error digital value (HART):</td>
<td>0.220 K (0.396 °F)</td>
</tr>
<tr>
<td>Measured error analog value (current output):</td>
<td>0.225 K (0.405 °F)</td>
</tr>
</tbody>
</table>
Sample calculation with Pt100, measuring range +20 to +135 °C (+68 to +275 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured error digital</td>
<td>0.220 K (0.396 °F)</td>
</tr>
<tr>
<td>Measured error D/A = 0.03 % x 150 °C (302 °F)</td>
<td>0.045 K (0.081 °F)</td>
</tr>
<tr>
<td>Influence of ambient temperature (digital)</td>
<td>0.050 K (0.090 °F)</td>
</tr>
<tr>
<td>Influence of ambient temperature (D/A) = (35 °C - 25 °C) x (30 ppm/°C x 150 °C)</td>
<td>0.045 K (0.081 °F)</td>
</tr>
<tr>
<td>Influence of supply voltage (digital) = (30 V - 24 V) x 15 ppm/V x 150 °C</td>
<td>0.014 K (0.025 °F)</td>
</tr>
<tr>
<td>Influence of supply voltage (D/A) = (30 V - 24 V) x 10 ppm/V x 150 °C</td>
<td>0.009 K (0.016 °F)</td>
</tr>
<tr>
<td>Measured error digital value (HART): (\sqrt{(\text{Measured error digital}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of supply voltage (digital)}^2)})</td>
<td>0.226 K (0.407 °F)</td>
</tr>
<tr>
<td>Measured error analog value (current output): (\sqrt{(\text{Measured error digital}^2 + \text{Measured error D/A}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of ambient temperature (D/A)}^2 + \text{Influence of supply voltage (digital)}^2 + \text{Influence of supply voltage (D/A)}^2)})</td>
<td>0.235 K (0.423 °F)</td>
</tr>
</tbody>
</table>

Response time
Tests in water at 0.4 m/s (1.3 ft/s), according to IEC 60751; 10 K temperature step change. \(t_{63}\) / \(t_{90}\) are defined as the time that passes until the instrument output reaches 63% / 90% of the new value.

**Response time with heat transfer paste**

<table>
<thead>
<tr>
<th>Protection tube</th>
<th>Shape of tip</th>
<th>Insert</th>
<th>(t_{63})</th>
<th>(t_{90})</th>
</tr>
</thead>
<tbody>
<tr>
<td>ø6 mm (0.24 in)</td>
<td>Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>2.9 s</td>
<td>5.4 s</td>
</tr>
<tr>
<td>ø9 mm (0.35 in)</td>
<td>Straight</td>
<td>ø6 mm (0.24 in)</td>
<td>9.1 s</td>
<td>17.9 s</td>
</tr>
<tr>
<td>ø12.7 mm (½ in)</td>
<td>Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>2.9 s</td>
<td>5.4 s</td>
</tr>
<tr>
<td></td>
<td>Straight</td>
<td>ø6 mm (0.24 in)</td>
<td>10.9 s</td>
<td>24.2 s</td>
</tr>
<tr>
<td></td>
<td>Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>2.9 s</td>
<td>5.4 s</td>
</tr>
<tr>
<td></td>
<td>Reduced 8 mm (0.31 in) x 32 mm (1.26 in)</td>
<td>ø6 mm (0.24 in)</td>
<td>10.9 s</td>
<td>24.2 s</td>
</tr>
</tbody>
</table>

1) Between the insert and the protection tube.

**Response time without heat transfer paste**

<table>
<thead>
<tr>
<th>Protection tube</th>
<th>Shape of tip</th>
<th>Insert</th>
<th>(t_{63})</th>
<th>(t_{90})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without protection tube</td>
<td>-</td>
<td>ø6 mm (0.24 in)</td>
<td>5.3 s</td>
<td>10.4 s</td>
</tr>
<tr>
<td>ø6 mm (0.24 in)</td>
<td>Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>7.4 s</td>
<td>17.3 s</td>
</tr>
<tr>
<td>ø9 mm (0.35 in)</td>
<td>Straight</td>
<td>ø6 mm (0.24 in)</td>
<td>24.4 s</td>
<td>54.1 s</td>
</tr>
<tr>
<td>ø12.7 mm (½ in)</td>
<td>Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>7.4 s</td>
<td>17.3 s</td>
</tr>
<tr>
<td></td>
<td>Straight</td>
<td>ø6 mm (0.24 in)</td>
<td>30.7 s</td>
<td>74.5 s</td>
</tr>
<tr>
<td></td>
<td>Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)</td>
<td>ø3 mm (0.12 in)</td>
<td>7.4 s</td>
<td>17.3 s</td>
</tr>
<tr>
<td></td>
<td>Reduced 8 mm (0.31 in) x 32 mm (1.26 in)</td>
<td>ø6 mm (0.24 in)</td>
<td>30.7 s</td>
<td>74.5 s</td>
</tr>
</tbody>
</table>

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,
- Comparison calibration 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 or special calibration furnaces with homogeneous distribution of temperature are typically used for thermometer calibrations. The DUT and the reference thermometer are placed closely together into the bath or furnace at a sufficient depth.

The measurement uncertainty can increase due to heat conduction errors and short immersion lengths. The existing measurement uncertainty is listed on the individual calibration certificate.

For accredited calibrations according to IEC/ISO 17025, the measurement uncertainty must not be twice as high as the accredited measurement uncertainty of the laboratory. If the limit value is exceeded, only a factory calibration can be carried out.

For manual calibration in calibration baths the maximum immersion length of the device ranges from the sensor tip to the lower part of the electronic housing. Do not immerse the housing into the calibration bath!

Self-calibration
The self-calibration procedure uses the Curie temperature (Tc) of a reference material as a built-in temperature reference. A self-calibration is performed automatically, when the process temperature (Tp) falls below the nominal Curie Temperature (Tc) of the device. At the Curie temperature, a phase change of the reference material takes place, which is associated with a change in its electrical properties. The electronics automatically detects this change and simultaneously calculates the deviation of the measured Pt100-temperature to the known, physically fixed Curie temperature. The iTHERM TrustSens thermometer is calibrated. A green flashing LED light indicates the ongoing self-calibration process. Subsequently the thermometer electronics stores the results of this calibration. The calibration data can be read via an asset management software like FieldCare or DeviceCare. A self-calibration certificate can be created automatically. This in-situ self-calibration allows a continuous and repeated monitoring of changes to the Pt100 sensor and to the electronics’ characteristics. As the inline calibration is being performed under real ambient or process conditions (e.g. heating of electronics), the result is closer to reality than a sensor calibration under laboratory conditions.

Process criteria for self-calibration
To ensure a valid self-calibration within the given measurement accuracy, the process temperature characteristics needs to fulfil the criteria, which are checked by the device
automatically. Based on this, the device is ready to perform a self-calibration under the following conditions:

<table>
<thead>
<tr>
<th>Calibration point 118 °C (244.4 °F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process temperature &gt; calibration temperature + 3 °C (5.4 °F) for 25 s before cooling down; t1 - t2.</td>
</tr>
</tbody>
</table>

Cooling rate: 0.5 to 16.5 K/min (0.9 to 29.7 °F/min), while the process temperature crosses the Curie temperature; t2 - t3 + 10 s.

The process temperature ideally declines continuously below 116 °C (240.8 °F). A valid self-calibration process is done when the green LED flashes with a frequency 5 Hz for 5 s.

Insulation resistance

- Insulation resistance ≥ 100 MΩ at ambient temperature, measured between the terminals and the outer jacket with a minimum voltage of 100 V DC.

### 13.5 Environment

<table>
<thead>
<tr>
<th>Ambient temperature range</th>
<th>Ambient temperature ( T_a )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-40 to +60 °C (-40 to +140 °F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum electronics temperature ( T )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40 to +85 °C (-40 to +185 °F)</td>
</tr>
</tbody>
</table>

| Storage temperature range | \( T = -40 \) to +85 °C (-40 to +185 °F) |

| Climate class | As per IEC 60654-1, Class Dx |
Degree of protection
- IP54 for the version without protection tube provided for installation in an existing protection tube
- IP65/67 for housing with LED status indication
- IP69 for housing without LED status indication and only if appropriate cord-set with M12x1 coupling is connected. → 46

The specified rating IP65/67 or IP69 for the compact thermometer is only assured when an approved M12 connector with a suitable IP rating is installed according to its manual.

Shock and vibration resistance
Endress+Hauser temperature sensors meet the requirements of IEC 60751 which specify shock and vibration resistance of 3g in the range from 10 to 500 Hz. This also applies for the quick-fastening iThERM QuickNeck.

Electromagnetic compatibility (EMC)
EMC to all relevant requirements of the IEC/EN 61326 - series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity. All tests were passed both with and without ongoing HART® communication.

All EMC measurements were performed with a turn down (TD) = 5:1. Maximum fluctuations during EMC-tests: < 1% of measuring span.

Interference immunity to IEC/EN 61326 - series, requirements for industrial areas.

13.6 Mechanical construction

Design, dimensions
All dimensions in mm (in). The design of the thermometer depends on the protection tube version used:
- Thermometer without a protection tube
- Diameter 6 mm (0.24 in)
- Diameter 9 mm (0.35 in)
- Diameter 12.7 mm (1/2 in)
- Tee thermowell and elbow thermowell version as per DIN 11865 / ASME BPE 2012 for weld-in

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

Variable dimensions:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Extension neck length, variable depending on the configuration or predefined for the version with iThERM QuickNeck</td>
</tr>
<tr>
<td>L</td>
<td>Protection tube length (U+T)</td>
</tr>
<tr>
<td>B</td>
<td>Protection tube bottom thickness: predefined, depends on protection tube version (see also the individual table data)</td>
</tr>
<tr>
<td>T</td>
<td>Length of protection tube shaft: variable or predefined, depends on protection tube version (see also the individual table data)</td>
</tr>
<tr>
<td>U</td>
<td>Immersion length: variable, depending on the configuration</td>
</tr>
<tr>
<td>ID</td>
<td>Insert diameter 6 mm (0.24 in) or 3 mm (0.12 in)</td>
</tr>
</tbody>
</table>
Without protection tube

For installation with compression fitting TK40 as process connection and the insert in direct contact with the process or in an existing protection tube.

1. Thermometer without extension neck, for mounting with adjustable compression fitting TK40, spherically and cylindrically, only ØID = 6 mm
2. Thermometer with extension neck, for mounting with or in on-site existing compression fitting TK40 in fix position, only ØID = 6 mm
3. Thermometer with compression fitting TK40 fixed by extension neck, thread M24x1.5, ØID = 6 mm
4. Thermometer with neck tube TE411, G3/8” thread adapter nut
Thermometer with M24x1.5 female thread and spring load for protection tube connection, e.g. TT411, ØID = 3 mm or 6 mm

Thermometer with G3/8" female thread and spring load for protection tube connection, e.g. TT411, ØID = 3 mm or 6 mm

Thermometer with iTHERM QuickNeck top part and spring load for protection tube with iTHERM QuickNeck connection, ØID = 3 mm or 6 mm

Thermometer with iTHERM QuickNeck and spring load to mount in existing thermowell with G3/8" female thread

Pay attention to the following equations when calculating the immersion length U for immersion into a protection tube TT411 already available:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_{(protection tube)}</td>
<td>Immersion length of the protection tube available at point of installation</td>
</tr>
<tr>
<td>T_{(protection tube)}</td>
<td>Shaft length of protection tube available at point of installation</td>
</tr>
<tr>
<td>E</td>
<td>Length of the extension neck at point of installation (provided one is available)</td>
</tr>
<tr>
<td>B_{(protection tube)}</td>
<td>Base thickness of protection tube</td>
</tr>
</tbody>
</table>

**Version 5 and 7**

\[ U = U_{(protection tube)} + T_{(protection tube)} + E + 3 \text{ mm} - B_{(protection tube)} \]

**Version 3, 4 and 6**

\[ U = U_{(protection tube)} + T_{(protection tube)} + 3 \text{ mm} - B_{(protection tube)} \]
With protection tube diameter 6 mm (0.24 in)

1. Thermometer with extension neck and process connection as clamp version
2. Thermometer without extension neck and process connection as clamp version
3. Without process connection
4. Process connection version as spherical compression fitting TK40
5. Process connection version as metal sealing system M12x1
6. Process connection version as metal sealing system G½"
7. Process connection version as cylindrical weld-in adapter Ø12 x 40 mm
8. Process connection version as cylindrical weld-in adapter Ø30 x 40 mm
9. Process connection version as spherical-cylindrical weld-in adapter Ø30 x 40 mm
10. Process connection version as spherical weld-in adapter Ø25 x mm
11. Thermometer with quick-fastening iTHERM QuickNeck and process connection as sanitary connection (clamp version)

G3/8" thread for protection tube connection

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension neck E</td>
<td>Without extension neck</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Replaceable extension neck, Ø9 mm (0.35 in)</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td></td>
<td>iTHERM QuickNeck</td>
<td>34 mm (1.34 in)</td>
</tr>
<tr>
<td>Length of protection tube shaft T¹¹</td>
<td>Clamp DN12 according to ISO 2852</td>
<td>24 mm (0.94 in)</td>
</tr>
<tr>
<td></td>
<td>Clamp DN25/DN40 according to ISO 2852</td>
<td>21 mm (0.83 in)</td>
</tr>
<tr>
<td></td>
<td>Without process connection (only G3/8&quot; thread), where necessary with compression fitting TK40</td>
<td>12 mm (0.47 in)</td>
</tr>
<tr>
<td></td>
<td>Metal sealing system M12x1</td>
<td>46 mm (1.81 in)</td>
</tr>
<tr>
<td></td>
<td>Metal sealing system G½&quot;</td>
<td>60 mm (2.36 in)</td>
</tr>
<tr>
<td></td>
<td>Cylindrical weld-in adapter Ø12 mm (0.47 in)</td>
<td>55 mm (2.17 in)</td>
</tr>
<tr>
<td></td>
<td>Cylindrical weld-in adapter Ø30 mm (1.18 in)</td>
<td>55 mm (2.17 in)</td>
</tr>
<tr>
<td></td>
<td>Spherical-cylindrical weld-in adapter</td>
<td>58 mm (2.28 in)</td>
</tr>
<tr>
<td>Item</td>
<td>Version</td>
<td>Length</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Spherical weld-in adapter</td>
<td>47 mm (1.85 in)</td>
<td></td>
</tr>
<tr>
<td>Tri-clamp (0.5&quot;-0.75&quot;)</td>
<td>24 mm (0.94 in)</td>
<td></td>
</tr>
<tr>
<td>Microclamp (DN8-18)</td>
<td>23 mm (0.91 in)</td>
<td></td>
</tr>
<tr>
<td>Sanitary connection DN25/DN32/DN40 according to DIN 11851</td>
<td>29 mm (1.14 in)</td>
<td></td>
</tr>
<tr>
<td>Immersion length U</td>
<td>Independent of the version</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td>Bottom thickness B</td>
<td>Reduced tip Ø4.3 mm (0.17 in)</td>
<td>3 mm (0.12 in)</td>
</tr>
</tbody>
</table>

1) Variable, depending on the configuration
With protection tube diameter 9 mm (0.35 in)

1. Thermometer with extension neck, process connection as clamp version
2. Process connection version as cylindrical weld-in adapter Ø30 x 40 mm
3. Process connection version as spherical-cylindrical weld-in adapter Ø30 x 40 mm
4. Process connection version as spherical weld-in adapter Ø25 x mm
5. Process connection version as sanitary connection according to DIN 11851
6. Process connection version as aseptic pipe union according to DIN 11864-1 Form A
7. Process connection version as metal sealing system G½"
8. Process connection version as thread according to ISO 228 for Liquiphant weld-in adapter
9. Process connection version APV Inline
10. Process connection version Varvent®
11. Process connection version Ingold connection
12. Process connection to SMS 1147
13. Process connection version Neumo Biocontrol
14. Process adapter D45
15. Thermometer with quick-fastening iTHERM QuickNeck and process connection, as clamp version for example
<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension neck E</td>
<td>No separate extension neck available</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Without quick-fastening iTherm QuickNeck independent of the process connection</td>
<td>85 mm (3.35 in)</td>
</tr>
<tr>
<td></td>
<td>Without quick-fastening iTherm QuickNeck in combination with Ingold connection ø25 mm (0.98 in) x 46 mm (1.81 in)</td>
<td>100 mm (3.94 in)</td>
</tr>
<tr>
<td></td>
<td>With quick-fastening iTherm QuickNeck, depending on the process connection:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMS 1147, DN25</td>
<td>40 mm (1.57 in)</td>
</tr>
<tr>
<td></td>
<td>SMS 1147, DN38</td>
<td>41 mm (1.61 in)</td>
</tr>
<tr>
<td></td>
<td>SMS 1147, DN51</td>
<td>42 mm (1.65 in)</td>
</tr>
<tr>
<td></td>
<td>Varivent, type F, D = 50 mm (1.97 in)</td>
<td>52 mm (2.05 in)</td>
</tr>
<tr>
<td></td>
<td>Varivent, type N, D = 68 mm (2.67 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Varivent, type B, D = 31 mm (1.22 in)</td>
<td>56 mm (2.2 in)</td>
</tr>
<tr>
<td></td>
<td>Thread G1&quot; according to ISO 228 for Liquiphant weld-in adapter</td>
<td>77 mm (3.03 in)</td>
</tr>
<tr>
<td></td>
<td>Spherical-cylindrical weld-in adapter</td>
<td>70 mm (2.76 in)</td>
</tr>
<tr>
<td></td>
<td>Cylindrical weld-in adapter</td>
<td>67 mm (2.64 in)</td>
</tr>
<tr>
<td></td>
<td>Aseptic pipe union according to DIN11864-A, DN25</td>
<td>45 mm (1.77 in)</td>
</tr>
<tr>
<td></td>
<td>Aseptic pipe union according to DIN11864-A, DN40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sanitary connection according to DIN 11851, DN32</td>
<td>47 mm (1.85 in)</td>
</tr>
<tr>
<td></td>
<td>Sanitary connection according to DIN 11851, DN40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sanitary connection according to DIN 11851, DN50</td>
<td>48 mm (1.89 in)</td>
</tr>
<tr>
<td></td>
<td>Clamp according to ISO 2852, DN12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clamp according to ISO 2852, DN25</td>
<td>37 mm (1.46 in)</td>
</tr>
<tr>
<td></td>
<td>Clamp according to ISO 2852, DN40</td>
<td>39 mm (1.54 in)</td>
</tr>
<tr>
<td></td>
<td>Clamp according to ISO 2852, DN63.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clamp according to ISO 2852, DN70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microclamp (DN18)</td>
<td>47 mm (1.85 in)</td>
</tr>
<tr>
<td></td>
<td>Tri-clamp (0.75&quot;)</td>
<td>46 mm (1.81 in)</td>
</tr>
<tr>
<td></td>
<td>Ingold connection ø25 mm (0.98 in) x 30 mm (1.18 in)</td>
<td>78 mm (3.07 in)</td>
</tr>
<tr>
<td></td>
<td>Ingold connection ø25 mm (0.98 in) x 46 mm (1.81 in)</td>
<td>94 mm (3.7 in)</td>
</tr>
<tr>
<td></td>
<td>Metal sealing system G½&quot;</td>
<td>77 mm (3.03 in)</td>
</tr>
<tr>
<td></td>
<td>APV-Inline, DN50</td>
<td>51 mm (2.01 in)</td>
</tr>
<tr>
<td>Immersion length U</td>
<td>Independent of the version</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td>Bottom thickness B</td>
<td>Reduced tip ø5.3 mm (0.21 in)x 20 mm (0.79 in)</td>
<td>4 mm (0.16 in)</td>
</tr>
<tr>
<td></td>
<td>Straight tip</td>
<td>2 mm (0.08 in)</td>
</tr>
</tbody>
</table>
With protection tube diameter 12.7 mm (½ in)

- G3/8" thread for protection tube connection
- Protection tube made from solid bar stock drilled for L ≤ 200 mm (7.87 in)
- Welded protection tube for L > 200 mm (7.87 in)

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension neck E</td>
<td>Without extension neck</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Replaceable extension neck, Ø9 mm (0.35 in)</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td></td>
<td>iTHERM QuickNeck</td>
<td>34 mm (1.34 in)</td>
</tr>
<tr>
<td>Length of protection tube shaft T</td>
<td>Weld-in adapter, cylindrical, Ø12.7 mm (½ in)</td>
<td>12 mm (0.47 in)</td>
</tr>
<tr>
<td></td>
<td>All other process connections</td>
<td>65 mm (2.56 in)</td>
</tr>
<tr>
<td>Immersion length U</td>
<td>Independent of the process connection</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td>Bottom thickness B</td>
<td>Reduced tip Ø5.3 mm (0.21 in)x 20 mm (0.79 in)</td>
<td>2 mm (0.08 in)</td>
</tr>
<tr>
<td></td>
<td>Reduced tip Ø8 mm (0.31 in)x 32 mm (1.26 in)</td>
<td>4 mm (0.16 in)</td>
</tr>
<tr>
<td></td>
<td>Straight tip</td>
<td>6 mm (0.24 in)</td>
</tr>
</tbody>
</table>
With tee- or elbow thermowell version

1. Thermometer with extension neck and tee thermowell
2. Version with tee thermowell
3. Version with elbow thermowell
4. Thermometer with quick-fastening iTHERM QuickNeck and elbow thermowell

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension neck E</td>
<td>Without extension neck</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Replaceable extension neck, ø9 mm (0.35 in)</td>
<td>Variable, depending on the configuration</td>
</tr>
<tr>
<td></td>
<td>iTHERM QuickNeck</td>
<td>34 mm (1.34 in) 71.05 mm (2.79 in)</td>
</tr>
<tr>
<td>Bottom thickness B</td>
<td>Independent of the version</td>
<td>0.7 mm (0.03 in)</td>
</tr>
<tr>
<td>Immersion length U</td>
<td>G3/8’ connection</td>
<td>85 mm (3.35 in) 119 mm (4.7 in)</td>
</tr>
</tbody>
</table>

- Pipe sizes according to DIN11865 series A (DIN), B (ISO) and C (ASME BPE)
- Nominal diameters > DN25, with 3-A symbol
- IP69 protection class
Technical Data

• Material 1.4435+316L, Delta ferrite content <0.5%
• Temperature measurement range: –60 to +200 °C (–76 to +392 °F)
• Pressure range: PN25 according to DIN11865

As a general rule, the longer the immersion length U the better the accuracy. For small pipe diameters it is advisable to use elbow thermowells to enable a maximum immersion length U.

Suitable immersion lengths for the following thermometers with G3/8” thermometer connection:
- Easytemp TMR35: 83 mm (3.27 in)
- iTHERM TM411: 85 mm (3.35 in)
- iTHERM TM311: 85 mm (3.35 in)
- iTHERM TrustSens TM371: 85 mm (3.35 in)

Suitable immersion lengths for the following thermometers with iTHERM QuickNeck thermometer connection:
- Easytemp TMR35: 117 mm (4.6 in)
- iTHERM TM411: 119 mm (4.68 in)
- iTHERM TM311: 119 mm (4.68 in)
- iTHERM TrustSens TM371: 119 mm (4.68 in)

Weight 0.2 to 2.5 kg (0.44 to 5.5 lbs) for standard options.

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.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Short form</th>
<th>Recommended max. temperature for continuous use in air</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI 316L (corresponds to 1.4404 or 1.4435)</td>
<td>X2CrNiMo17-13-2, X2CrNiMo18-14-3</td>
<td>650 °C (1202 °F)</td>
<td>• Austenitic, stainless steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High corrosion resistance in general</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>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)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increased resistance to intergranular corrosion and pitting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The wetted part in a protective tube is made of 316L or 1.4435+316L, passivated with 3% sulfuric acid.</td>
</tr>
<tr>
<td>1.4435+316L, delta ferrite &lt; 1% or &lt; 0.5%</td>
<td>With regard to analytical limits, the specifications of both materials (1.4435 and 316L) are met simultaneously. In addition, the delta ferrite content of the wetted parts is limited to &lt;1% or &lt;0.5% ≤3% at weldings (following Basel Standard II)</td>
<td></td>
<td>1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Contact your Endress+Hauser sales team for further information.</td>
</tr>
</tbody>
</table>
## Surface roughness

**Values for process/product contact surfaces:**

<table>
<thead>
<tr>
<th>Surface Description</th>
<th>Ra ≤</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard surface, mechanically polished ¹</td>
<td>0.76 µm (30 µin)</td>
<td></td>
</tr>
<tr>
<td>Mechanically polished ¹, buffed ²</td>
<td>0.38 µm (15 µin)</td>
<td></td>
</tr>
<tr>
<td>Mechanically polished ¹, buffed and electropolished</td>
<td>0.38 µm (15 µin) + electropolished</td>
<td></td>
</tr>
</tbody>
</table>

¹ Or any other finishing method that meets the Ra max
² Non-compliant with ASME BPE
Protection tube

Process connections

All dimensions in mm (in).

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\phi_d$</td>
<td>$\phi_D$</td>
</tr>
<tr>
<td>Aseptic pipe union according to DIN 11864-1, Form A</td>
<td>DN25</td>
<td>26 mm (1.02 in)</td>
<td>42.9 mm (1.7 in)</td>
</tr>
<tr>
<td></td>
<td>DN40</td>
<td>38 mm (1.5 in)</td>
<td>54.9 mm (2.16 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For welding in

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\phi_d$</td>
<td>$h$</td>
</tr>
<tr>
<td>Weld-in adapter</td>
<td>1: Cylindrical</td>
<td>$\phi_d = 12.7$ mm (½ in), $U =$ immersion length from lower edge of thread, $T = 12$ mm (0.47 in)</td>
<td>$P_{\text{max}}$ depends on the weld-in process</td>
</tr>
<tr>
<td></td>
<td>2: Cylindrical</td>
<td>$\phi_d \times h = 12$ mm (0.47 in) x 40 mm (1.57 in), $T = 55$ mm (2.17 in)</td>
<td>$3$-A marked and EHEDG certified</td>
</tr>
<tr>
<td></td>
<td>3: Cylindrical</td>
<td>$\phi_d \times h = 30$ mm (1.18 in) x 40 mm (1.57 in)</td>
<td>ASME BPE compliance</td>
</tr>
<tr>
<td></td>
<td>4: Spherical-cylindrical</td>
<td>$\phi_d \times h = 30$ mm (1.18 in) x 40 mm (1.57 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5: Spherical</td>
<td>$\phi_d = 25$ mm (0.98 in) $h = 24$ mm (0.94 in)</td>
<td></td>
</tr>
</tbody>
</table>

1) For protection pipe $\phi 12.7$ mm (½ in)
2) For protection pipe $\phi 6$ mm (¼ in)
### Releasable process connection

| Sanitary connection according to DIN 11851 |
|---|---|
| ![Diagram of Sanitary Connection](image_url) |

| Version 1) | Dimensions |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| | ØD | A | B | i | a | P_{\text{max}} |
| 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
## Technical Data

iTHERM TrustSens TM371 HART communication

### Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
<th>Conformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamp according to ISO 2852</td>
<td>Microclamp[^1] DN8-18 (0.5”-0.75”)[^1], Form A</td>
<td>ØD 25 mm (0.98 in)</td>
<td>P&lt;sub&gt;max&lt;/sub&gt; = 16 bar (232 psi), depends on clamp ring and suitable seal</td>
<td>Based on ISO 2852[^k]</td>
</tr>
<tr>
<td></td>
<td>Tri-clamp DN8-18 (0.5”-0.75”)[^1], Form B</td>
<td>Øa</td>
<td>3-A marked</td>
<td>ISO 2852</td>
</tr>
<tr>
<td></td>
<td>Clamp DN12-21.3, Form B</td>
<td>ØD 34 mm (1.34 in) Øa 16 to 25.3 mm (0.63 to 0.99 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clamp DN25-38 (1”-1.5”), Form B</td>
<td>ØD 50.5 mm (1.99 in) Øa 29 to 42.4 mm (1.14 to 1.67 in)</td>
<td>P&lt;sub&gt;max&lt;/sub&gt; = 16 bar (232 psi), depends on clamp ring and suitable seal</td>
<td>ASME BPE Type B; ISO 2852</td>
</tr>
<tr>
<td></td>
<td>Clamp DN40-51 (2”), Form B</td>
<td>ØD 64 mm (2.52 in) Øa 44.8 to 55.8 mm (1.76 to 2.2 in)</td>
<td>3-A marked and EHEDG certified (in connection with Combifit seal)</td>
<td>ASME BPE Type B; ISO 2852</td>
</tr>
<tr>
<td></td>
<td>Clamp DN63.5 (2.5”), Form B</td>
<td>ØD 77.5 mm (3.05 in) Øa 68.9 to 75.8 mm (2.71 to 2.98 in)</td>
<td>Can be used with &quot;Novaseptic Connect (NA Connect)&quot; which enables flush-mount installation</td>
<td>ASME BPE Type B; ISO 2852</td>
</tr>
<tr>
<td></td>
<td>Clamp DN70-76.5 (3”), Form B</td>
<td>ØD 91 mm (3.58 in) Øa &gt; 75.8 mm (2.98 in)</td>
<td></td>
<td>ASME BPE Type B; ISO 2852</td>
</tr>
</tbody>
</table>

### Notes

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 protection pipe diameter = 6 mm (¼ in)
4. Groove diameter = 20 mm
## Technical Data

### Metal sealing system

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12x1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>G½&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Protection pipe diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 mm (¼ in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$P_{\text{max.}} = 16$ bar (232 psi)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum torque = 10 Nm (7.38 lbf ft)</td>
</tr>
</tbody>
</table>

### Protection pipe diameter

<table>
<thead>
<tr>
<th>Protection pipe diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mm (¼ in)</td>
</tr>
<tr>
<td>$P_{\text{max.}} = 16$ bar (232 psi)</td>
</tr>
<tr>
<td>Maximum torque = 10 Nm (7.38 lbf ft)</td>
</tr>
</tbody>
</table>

### Process adapter

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>G½&quot;</td>
<td>D45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thread according to ISO 228 (for Liquiphant weld-in adapter)

<table>
<thead>
<tr>
<th>Type</th>
<th>Version G</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GW&quot; for FTL20/31/33 adapter</td>
<td>16 mm (0.63 in)</td>
<td>$P_{\text{max.}} = 25$ bar (362 psi) at max. 150 °C (302 °F)</td>
</tr>
<tr>
<td></td>
<td>GW&quot; for FTL50 adapter</td>
<td>18.6 mm (0.73 in)</td>
<td>$P_{\text{max.}} = 40$ bar (580 psi) at max. 100 °C (212 °F)</td>
</tr>
<tr>
<td></td>
<td>G1&quot; for FTL50 adapter</td>
<td>18.6 mm (0.73 in)</td>
<td>Information about hygienic compliance in connection with FTL31/33/50 adapter see TI00426F</td>
</tr>
</tbody>
</table>
## Technical Data

### iTHERM TrustSens TM371 HART communication

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>d</td>
<td>A</td>
</tr>
<tr>
<td>APV Inline</td>
<td>DN50</td>
<td>69 mm (2.72 in)</td>
<td>99.5 mm (3.92 in)</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>Varivent®</td>
<td>Type B</td>
<td>31 mm (1.22 in)</td>
<td>105 mm (4.13 in)</td>
</tr>
<tr>
<td></td>
<td>Type F</td>
<td>50 mm (1.97 in)</td>
<td>145 mm (5.71 in)</td>
</tr>
<tr>
<td></td>
<td>Type N</td>
<td>68 mm (2.67 in)</td>
<td>165 mm (6.5 in)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varivent® for VARINLINE® housing for installation in pipes</td>
<td>- 3-A marked and EHEDG certified - ASME BPE compliance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Dimensions</th>
<th>Pmax.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>i</td>
</tr>
<tr>
<td>Type N, according to DIN 11866, series A</td>
<td>68 mm (2.67 in)</td>
<td>DN40: 38 mm (1.5 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN50: 50 mm (1.97 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN65: 66 mm (2.6 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN80: 81 mm (3.2 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN100: 100 mm (3.94 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN125: 125 mm (4.92 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DN150: 150 mm (5.9 in)</td>
</tr>
<tr>
<td>Type N, according to EN ISO 1127, series B</td>
<td>68 mm (2.67 in)</td>
<td>38.4 mm (1.51 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44.3 mm (1.75 in)</td>
</tr>
</tbody>
</table>
**T-piece, optimized (no welding, no dead legs)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions in mm (in)</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-piece for weld-in as per DIN 11865 (series A, B and C)</td>
<td>Series A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN10 PN25</td>
<td>13 mm (0.51 in)</td>
<td>1.5 mm (0.06 in)</td>
<td></td>
</tr>
<tr>
<td>DN15 PN25</td>
<td>19 mm (0.75 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN20 PN25</td>
<td>23 mm (0.91 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN25 PN25</td>
<td>29 mm (1.14 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN32 PN25</td>
<td>32 mm (1.26 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Series B</td>
<td>DN13.5 PN25</td>
<td>13.5 mm (0.53 in)</td>
<td>1.6 mm (0.063 in)</td>
</tr>
<tr>
<td>DN17.2 PN25</td>
<td>17.2 mm (0.68 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN21.3 PN25</td>
<td>21.3 mm (0.84 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN26.9 PN25</td>
<td>26.9 mm (1.06 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN33.7 PN25</td>
<td>33.7 mm (1.33 in)</td>
<td>2 mm (0.08 in)</td>
<td></td>
</tr>
<tr>
<td>Series C</td>
<td>DN12.7 PN25 (½&quot;)</td>
<td>12.7 mm (0.5 in)</td>
<td>1.65 mm (0.065 in)</td>
</tr>
<tr>
<td>DN19.05 PN25 (¾&quot;)</td>
<td>19.05 mm (0.75 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN25.4 PN25 (1&quot;)</td>
<td>25.4 mm (1 in)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN38.1 PN25 (1½&quot;)</td>
<td>38.1 mm (1.5 in)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Wall thickness
2) Applies to ≥ DN25. The radius ≥ 3.2 mm (¼ in) cannot be maintained for smaller nominal diameters.
Elbow piece, optimized (no welding, no dead legs)

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\Phi D$</td>
<td>$L_1$</td>
</tr>
<tr>
<td>Elbow piece for weld-in as per DIN 11865 (series A, B and C)</td>
<td>DN10 PN25</td>
<td>13 mm (0.51 in)</td>
<td>24 mm (0.95 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 mm (0.75 in)</td>
<td>25 mm (0.98 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23 mm (0.91 in)</td>
<td>27 mm (1.06 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29 mm (1.14 in)</td>
<td>30 mm (1.18 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 mm (1.38 in)</td>
<td>33 mm (1.3 in)</td>
</tr>
<tr>
<td>Series A</td>
<td>DN13.5 PN25</td>
<td>13.5 mm (0.53 in)</td>
<td>32 mm (1.26 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.2 mm (0.68 in)</td>
<td>34 mm (1.34 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21.3 mm (0.84 in)</td>
<td>36 mm (1.41 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26.9 mm (1.06 in)</td>
<td>29 mm (1.14 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33.7 mm (1.33 in)</td>
<td>32 mm (1.26 in)</td>
</tr>
<tr>
<td>Series B</td>
<td>DN12.7 PN25 (⅜&quot;)</td>
<td>12.7 mm (0.5 in)</td>
<td>24 mm (0.95 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.05 mm (0.75 in)</td>
<td>25 mm (0.98 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.4 mm (1 in)</td>
<td>28 mm (1.1 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38.1 mm (1.5 in)</td>
<td>35 mm (1.38 in)</td>
</tr>
<tr>
<td>Series C</td>
<td>DN19.05 PN25 (½&quot;)</td>
<td>19.05 mm (0.75 in)</td>
<td>25 mm (0.98 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.4 mm (1 in)</td>
<td>28 mm (1.1 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38.1 mm (1.5 in)</td>
<td>35 mm (1.38 in)</td>
</tr>
</tbody>
</table>

1) Wall thickness
2) Applies to ≥ DN25. The radius ≥ 3.2 mm (¹⁄₈ in) cannot be maintained for smaller nominal diameters.

Ingold connection

<table>
<thead>
<tr>
<th>Type</th>
<th>Version, dimensions $\Phi D \times h$</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Phi 25$ mm (0.98 in) x 30 mm (1.18 in)</td>
<td>$x = 1.5$ mm (0.06 in)</td>
</tr>
<tr>
<td></td>
<td>$\Phi 25$ mm (0.98 in) x 46 mm (1.81 in)</td>
<td>$x = 6$ mm (0.24 in)</td>
</tr>
</tbody>
</table>

$P_{max} = 25$ bar (362 psi)
A seal is included in the scope of delivery. V75SR material: Complies with FDA, 3-A Sanitary Standard 18-03 Class 1 and USP Class VI
### SMS 1147

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS 1147</td>
<td>DN25</td>
<td>ΦD 32 mm (1.26 in)</td>
<td>ΦA 35.5 mm (1.4 in)</td>
</tr>
<tr>
<td></td>
<td>DN38</td>
<td>ΦD 48 mm (1.89 in)</td>
<td>ΦA 55 mm (2.17 in)</td>
</tr>
<tr>
<td></td>
<td>DN51</td>
<td>ΦD 60 mm (2.36 in)</td>
<td>ΦA 65 mm (2.56 in)</td>
</tr>
</tbody>
</table>

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

### Neumo Biocontrol

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neumo Biocontrol</td>
<td>D25 PN16</td>
<td>ΦB 64 mm (2.52 in)</td>
<td>ΦA 50 mm (1.97 in)</td>
</tr>
<tr>
<td></td>
<td>D50 PN16</td>
<td>ΦB 90 mm (3.54 in)</td>
<td>ΦA 70 mm (2.76 in)</td>
</tr>
<tr>
<td></td>
<td>D65 PN25</td>
<td>ΦB 120 mm (4.72 in)</td>
<td>ΦA 95 mm (3.74 in)</td>
</tr>
</tbody>
</table>

- \(P_{\text{max}} = 6\) bar (87 psi)
- \(P_{\text{max}} = 16\) bar (232 psi)
- 3-A marked
Compression fitting

<table>
<thead>
<tr>
<th>Type</th>
<th>Version</th>
<th>Dimensions</th>
<th>Technical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spherical or cylindrical</td>
<td>Spherical Material of sealing taper</td>
<td>6.3 mm (0.25 in)</td>
<td>P&lt;sub&gt;max&lt;/sub&gt; = 10 bar (145 psi), T&lt;sub&gt;max&lt;/sub&gt; = +150 °C (+302 °F) for PEEK material, tightening torque = 10 Nm</td>
</tr>
<tr>
<td></td>
<td>316L Thread G¼”</td>
<td>25 mm (0.98 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>33 mm (1.3 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylindrical Material of sealing taper</td>
<td>6.2 mm (0.24 in)</td>
<td>P&lt;sub&gt;max&lt;/sub&gt; = 50 bar (725 psi), T&lt;sub&gt;max&lt;/sub&gt; = +200 °C (+392 °F) for 316L material, tightening torque = 25 Nm</td>
</tr>
<tr>
<td></td>
<td>ELASTOSIL® Thread G½”</td>
<td>9.2 mm (0.36 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 mm (1.18 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>57 mm (2.24 in)</td>
<td></td>
</tr>
</tbody>
</table>

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

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

SWAGELOCK or similar fittings are strongly recommended for higher requirements.

Tip shape

The thermal response time, the reduction of the flow cross-section and the mechanical load that occurs in the process are the criteria that matter when selecting the shape of the tip. Advantages of using reduced or tapered thermometer tips:

- A smaller tip shape has less impact on the flow characteristics of the pipe carrying the medium.
- The flow characteristics are optimized, thereby increasing the stability of the thermowell.
- Endress+Hauser offers users a range of thermowell tips to meet every requirement:
  - Reduced tip with Ø4.3 mm (0.17 in) and Ø5.3 mm (0.21 in): walls of lower thickness significantly reduce the response times of the overall measuring point.
  - Reduced tip with Ø8 mm (0.31 in): walls of greater thickness are particularly well suited to applications with a higher degree of mechanical load or wear (e.g. pitting, abrasion etc.).
11 Thermowell tips available (reduced, straight or tapered)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Thermowell (⌀D1)</th>
<th>Insert (⌀ID)</th>
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<tr>
<td>1</td>
<td>⌀6 mm (¹⁄₄ in)</td>
<td>Reduced tip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⌀3 mm (¹⁄₈ in)</td>
</tr>
<tr>
<td>2</td>
<td>⌀9 mm (0.35 in)</td>
<td>Reduced tip with ⌀5.3 mm (0.21 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight tip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⌀3 mm (¹⁄₈ in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⌀6 mm (¹⁄₄ in)</td>
</tr>
<tr>
<td>3</td>
<td>⌀12.7 mm (¹⁄₂ in)</td>
<td>Reduced tip with ⌀5.3 mm (0.21 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straight tip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced tip with ⌀8 mm (0.31 in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⌀3 mm (¹⁄₈ in)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⌀6 mm (¹⁄₄ in)</td>
</tr>
</tbody>
</table>

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for thermowells in the Endress+Hauser Applicator software. See "Accessories" section.

13.7 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: 180 years - according to Siemens Standard SN29500

Hygiene standard

- EHEDG certification, type EL CLASS I. EHEDG certified/tested process connections. → 66
- 3-A authorization no. 1144, 3-A Sanitary standard 74-07. Listed process connections. → 66
- ASME BPE, certificate of conformity can be ordered for indicated options
- FDA-compliant
- All surfaces in contact with the medium are free of animal derived ingredients (ADI/TSE) and do not contain any materials derived from bovine or animal sources
### 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 options of protection tubes. These will be marked and shown during the configuration of this device.

Detailed ordering information is available from the following sources:

- In the download area on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Select your country → Downloads → Enter product code or device → Media type: Approvals & certificates → Select type of approval → Start search
- From your nearest Endress+Hauser sales organization: [www.addresses.endress.com](http://www.addresses.endress.com)

### Surface purity

Cleaned from oil and grease for O₂ 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

### Material certification

The material certificate 3.1 (according to standard EN 10204) can be requested separately. The 'short form' certificate includes a simplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer. The data related to the origin of the materials can subsequently be requested by the client if necessary.

### Calibration

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress+Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (SIT/Accredia) or (DKD/DAkkS) may be requested separately.

The analog current output of the device is calibrated.

### Protection tube testing and load capacity calculation

- Protection tube pressure tests are carried out in accordance with the specifications in DIN 43772. With regard to protection tubes with tapered or reduced tips that do not comply with this standard, these are tested using the pressure of corresponding straight protection tubes. Tests according to other specifications can be carried out on request.
- Load capacity calculation for the protection tube as per DIN 43772
14 Operating menu and parameter description

The following tables list all the parameters in the 'Setup', 'Calibration', 'Diagnostics' and 'Expert' operating menus. The page reference indicates where a description of the parameter can be found in the manual.

Depending on the parameter configuration, not all submenus and parameters are available in every device. Information on this can be found in the parameter description under "Prerequisite".

This symbol indicates how to navigate to the parameter using operating tools (e.g. FieldCare).

### Setup

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<thead>
<tr>
<th>Setting</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device tag</td>
<td></td>
<td>81</td>
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<tr>
<td>Unit</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>4 mA value</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>20 mA value</td>
<td></td>
<td>82</td>
</tr>
<tr>
<td>Failure mode</td>
<td></td>
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### Calibration

<table>
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</thead>
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<tr>
<td>Number of self-calibrations</td>
<td></td>
<td>82</td>
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<tr>
<td>Stored self calibration points</td>
<td></td>
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<tr>
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<td>Adjustment</td>
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### Calibration → Limits →

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<th>Description</th>
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<tr>
<td>Lower warning value</td>
<td></td>
<td>83</td>
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<tr>
<td>Upper warning value</td>
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### Calibration → Interval monitoring

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1) Same parameter settings both for self calibration monitoring and manual calibration reminder

### Calibration → Calibration report

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### Diagnostics → Diagnostic list

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<th>Description</th>
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<td>Actual diagnostics count</td>
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<td>87</td>
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<tr>
<td>Actual diagnostics</td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>Actual diag (n) channel 1)</td>
<td></td>
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1) n = 2, 3; diagnostics messages with the highest priority to the third-highest priority
### Operating menu and parameter description

**iTHERM TrustSens TM371 HART communication**

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<th>Parameter</th>
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<td>Event logbook</td>
<td>Previous diagnostics n (^1) → 88  &lt;br&gt; Previous diag (n) channel → 88</td>
</tr>
</tbody>
</table>

1) \( n \) = Number of diagnostics messages \((n = 1 \text{ to } 5)\)

<table>
<thead>
<tr>
<th>Menu</th>
<th>Submenu</th>
<th>Parameter</th>
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<td>Diagnostics</td>
<td>Device information</td>
<td>Device tag → 81  &lt;br&gt; Tagging (TAG) → 89  &lt;br&gt; Serial number → 89  &lt;br&gt; Firmware version → 89  &lt;br&gt; Device name → 89  &lt;br&gt; Order code → 89  &lt;br&gt; Extended order code (2, 3) → 90  &lt;br&gt; Manufacturer ID → 90  &lt;br&gt; Manufacturer → 90  &lt;br&gt; Hardware revision → 90  &lt;br&gt; Configuration counter → 91</td>
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<table>
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<tr>
<th>Menu</th>
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<td>Diagnostics</td>
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<td>Sensor value → 91  &lt;br&gt; Sensor raw value → 91  &lt;br&gt; Device temperature → 91</td>
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<table>
<thead>
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<th>Menu</th>
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<tr>
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<td>Measured values</td>
<td>Sensor min value → 92  &lt;br&gt; Sensor max value → 92  &lt;br&gt; Reset sensor min/max values → 92  &lt;br&gt; Device temperature min. → 92  &lt;br&gt; Device temperature max. → 92  &lt;br&gt; Reset device temp. min/max values → 93</td>
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<th>Menu</th>
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<tr>
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<table>
<thead>
<tr>
<th>Menu</th>
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<td>Diagnostic settings</td>
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<th>Submenu</th>
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<td>Heartbeat</td>
<td>Heartbeat verification → 95  &lt;br&gt; Online wizard</td>
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Endress+Hauser
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#### iThERM TrustSens TM371 HART communication

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<td>Altitude</td>
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<td>Assign SV</td>
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<tr>
<td></td>
<td></td>
<td>QV</td>
<td>108</td>
</tr>
</tbody>
</table>
14.1 Setup menu

This menu contains all the parameters that are needed to configure the basic settings of the device. The thermometer can be put into operation with this limited parameter set.

**Device tag**

**Navigation**

Setup → Device tag  
Diagnostics → Device information → Device tag  
Expert → Communication → HART configuration → Device 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 characters, such as letters, numbers or special characters (e.g. @, %, /)

**Factory setting**

Depends on the product root and the serial number

**Unit**

**Navigation**

Setup → Unit  
Expert → System → Unit

**Description**

Use this function to select the engineering unit for all the measured values.

**Options**

- °C
- °F
- K
- °R

**Factory setting**

°C

**Additional information**

Please note that if the factory setting (°C) is switched to another unit, all the temperature value settings will be converted to fit to the setted temperature unit. Example: Upper range value is set to 150 °C. After the unit was switched to °F, the new converted upper range value = 302 °F.

**4 mA value**

**Navigation**

Setup → Lower range value  
Expert → Output → 4 mA value

**Description**

Use this function to assign a measured value to the current value 4 mA.

**Factory setting**

0 °C
20 mA value

Navigation
- Setup → Upper range value
- Expert → Output → 20 mA value

Description
Use this function to assign a measured value to the current value 20 mA.

Factory setting
150 °C

Failure mode

Navigation
- Setup → Failure mode
- Expert → Output → Failure mode

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

Options
- High alarm
- Low alarm

Factory setting
Low alarm

14.2 Calibration menu

All the information that describes the self-calibration procedure as well as the online wizard creating a calibration report.

Number of self-calibrations

Navigation
- Calibration → Number of self-calibrations

Description
This counter displays the amount of all executed self-calibrations. It cannot be reset.

Stored self-calibration points

Navigation
- Calibration → Stored self-calibration points

Description
Displays the amount of all stored self-calibration points. This device is able to store 350 self-calibration points. As soon as the memory would reach its limit, the oldest self-calibration point will be overwritten.

Display
0 to 350
Deviation

Navigation  Calibration → Deviation

Description  This function displays the measured Pt100 self-calibration deviation from the reference temperature. The deviation is calculated as follows: Self-calibration deviation = reference temperature - measured Pt100 temperature value + adjustment

Display  _._._ °C

Factory setting  0

Adjustment

Navigation  Calibration → Adjustment

Description  Use this function to adjust the measured Pt100 value. This value will be added to the measured Pt100 value and therefore influences also the self-calibration deviation.
Self-calibration deviation = reference temperature - measured Pt100 temperature value + adjustment

User entry  –1.0 · 10²⁰ to +1.0 · 10²⁰

Factory setting  0.000

14.2.1  "Limits" submenu

Lower warning value

Navigation  Calibration → Limits → Lower warning value

Description  Enter the lower warning limit for the self-calibration deviation.

User entry  –1.0 · 10²⁰ to –0.5 °C

Factory setting  –0.5 °C

Additional information  Use this function to define the lower warning limit. If the self-calibration deviation exceeds the defined limit, the device will transmit the defined status signal and shows the defined diagnostic behavior via the LED (diagnostic event 144).
(Factory setting = Warning - LED red flashes).

Upper warning value
Navigation  Calibration → Limits → Upper warning value

Description  Enter the upper warning limit for the self calibration deviation.

User entry  +0.5 to +1.0 \cdot 10^{20} ^\circ C

Factory setting  +0.5 ^\circ C

Additional information  Use this function to define the upper warning limit. If the self-calibration deviation exceeds the defined limit, the device will transmit the defined status signal and shows the defined diagnostic behavior via the LED. (Factory setting = Warning - LED red flashes).

Lower alarm value

Navigation  Calibration → Limits → Lower alarm value

Description  Enter the lower alarm limit for the self-calibration deviation.

User entry  –1.0 \cdot 10^{20} to –0.8 ^\circ C

Factory setting  –0.8 ^\circ C

Additional information  Use this function to define the lower alarm limit. If the self-calibration deviation exceeds the defined limit, the device will transmit the defined status signal and show the defined diagnostic behavior via the LED (diagnostic event 143). (Factory setting = Warning - LED red flashes).

Upper alarm value

Navigation  Calibration → Limits → Upper alarm value

Description  Enter the upper alarm limit for the self-calibration deviation.

User entry  +0.8 to +1.0 \cdot 10^{20} ^\circ C

Factory setting  +0.8 ^\circ C

Additional information  Use this function to define the upper alarm limit. If the self-calibration deviation exceeds the defined limit, the device will transmit the defined status signal and shows the defined diagnostic behavior via the LED. (Factory setting = Warning - LED red flashes).
14.2.2 "Interval monitoring" submenu

The parameter configuration in this submenu is allocated into two calibration items:

Self-calibration monitoring: Monitoring function for the start of the next self-calibration.

Manual calibration reminder: This function signalizes when the next manual calibration has to be performed.

Control

Navigation  Calibration → Interval monitoring → Self-calibration monitoring / Manual calibration reminder → Control

Description

Self-calibration monitoring: Use this function to activate the self-calibration countdown. This counter will count down from its start value until the next self-calibration is executed. A successful self-calibration will set the counter to its start value. If the calibration counter value reaches zero, the device will transmit the defined status signal and shows the defined diagnostic behavior via the LED (Factory default = Alarm - red).

Manual calibration reminder: Use this function to set the start value for the calibration counter.

Options

- **Off**: Stops the calibration counter
- **On**: Starts the calibration counter
- **Reset + run**: Resets the calibration counter to the set start value and starts the calibration counter

Factory setting  Off

Start value

Navigation  Calibration → Interval monitoring → Self-calibration monitoring / Manual calibration reminder → Start value

Description

Self-calibration monitoring: Enter the maximum days until a self-calibration must be initiated. This function can be used to monitor the self-calibration interval (e.g. 1 year self-calibration interval corresponds to a start value of 365 days).

Manual calibration reminder: Use this function to set the start value for the calibration counter.

User entry  0 to 1826 d (days)

Factory setting  1826 d

Countdown value

Navigation  Calibration → Interval monitoring → Self-calibration monitoring / Manual calibration reminder → Countdown value
Description

**Self-calibration monitoring:** Displays the remaining time in days until a self-calibration must be initiated. A successful self-calibration will set the counter to its start value. If the countdown value reaches zero, the device will transmit the defined status signal and show the defined diagnostic behavior via the LED. Factory default = Alarm - LED red illuminated

**Manual calibration reminder:** Indication of the remaining time up to the next calibration.

Display

Remaining time in days, from max. 1826 d to 0 d.

Additional information

Use this function to view the time remaining until the next calibration. The countdown of the calibration counter is only running if the device is switched on.

Example: The calibration counter is set to 365 days on January 1st, 2011. If the device will be switched off for 100 days, the calibration counter alarm is displayed on April 10th, 2012.

Online wizard 'Calibration report'

**Calibration report**

Navigation

Calibration → Calibration report

Description

Online wizard for creating a calibration report.

Additional information

For a detailed procedure description see → 27

14.3 Diagnostics menu

Actual diagnostics

Navigation

Diagnostics → Actual diagnostics

Description

Use this function to display the current diagnostic message. If two or more messages occur simultaneously, the message with the highest priority is shown.

Additional information

Example for display format:
F001-Device failure

Previous diagnostics 1

Navigation

Diagnostics → Previous diagnostics 1

Description

Use this function to display the last diagnostic message with the highest priority.

Additional information

Example for display format:
F001-Device failure
Operating time

Navigation  
Diagnostics → Operating time

Description  
Use this function to display the length of time the device has been in operation up to now.

Display  
Hours (h)

14.3.1 "Diagnostic list" submenu
Up to 3 diagnostic messages currently pending are displayed in this submenu. If more than 3 messages are pending, the messages with the highest priority are shown on the display. Overview of all the diagnostic messages and remedies → 39.

Actual diagnostics count

Navigation  
Diagnostics → Diagnostic list → Actual diagnostics count

Description  
Use this function to display the number of diagnostic messages currently pending in the device.

Actual diagnostics

Navigation  
Diagnostics → Diagnostics list → Actual diagnostics

Description  
Use this function to display the current diagnostic messages with the highest priority to the third-highest priority.

Additional information  
Example for display format:
F001-Device failure

Actual diag channel

Navigation  
Diagnostics → Diagnostic list → Actual diag channel

Description  
Indication of the sensor input which this diagnostic message refers.
Use this function to display the current diagnostic message. If two or more messages occur simultaneously, the message with the highest priority is shown.
14.3.2 "Event logbook" submenu

Previous diagnostics n

- n = Number of diagnostic messages (n = 1 to 5)

Navigation

- Diagnostics → Event logbook → Previous diagnostics n

Description

Indication of the diagnostic messages appeared in the past. Use this function to display the diagnostic messages that occurred in the past. The last 5 messages are listed in chronological order.

Additional information

Example for display format:
S844-Process value out of specification

14.3.3 "Device information" submenu

Device tag → 81

Navigation

- Setup → Device tag
  - Diagnostics → Device information → Device tag
  - Expert → Communication → HART configuration → Device tag
Tagging (TAG), metal/RFID

Navigation
Diagnostics → Device information → Tagging (TAG), metal/RFID

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 characters, such as letters, numbers or special characters (e.g. @, %, /)

Factory setting
- none -

Serial number

Navigation
Diagnostics → Device information → Serial number

Description
Use this function to display the serial number of the device. It can also be found on the nameplate.

Uses of the serial number
- To identify the measuring device quickly, e.g. when contacting Endress+Hauser.
- To obtain specific information on the measuring device using the Device Viewer: www.endress.com/deviceviewer

Display
Max. 11-digit character string comprising letters and numbers.

Firmware version

Navigation
Diagnostics → Device information → Firmware version

Description
Use this function to view the device firmware version installed.

Display
Max. 6-digit character string in the format xx.yy.zz

Device name

Navigation
Diagnostics → Device information → Device name

Description
Displays the device name. It can also be found on the nameplate.
Navigation
Diagnostics → Device information → Order code

Description
Use this function to display the order code of the device. It can also be found on the nameplate. The order code is generated from the extended order code, which defines all the device features of the product structure. In contrast, the device features cannot be read directly from the order code.

Uses of the order code
- To order an identical spare device.
- To identify the device quickly and easily, e.g. when contacting the manufacturer.

Extended order code n

n = Number of parts of the extended order code (n = 1 to 3)

Navigation
Diagnostics → Device information → Extended order code n

Description
Use this function to display the first, second and/or third part of the extended order code. On account of length restrictions, the extended order code is split into a maximum of 3 parameters. The extended order code indicates the version of all the features of the product structure for the device and thus uniquely identifies the device. It can also be found on the nameplate.

- Uses of the extended order code
- To order an identical spare device
- To check the ordered device features against the shipping note

Manufacturer ID

Navigation
Diagnostics → Device information → Manufacturer ID
Expert → Communication → HART info → Manufacturer ID

Description
Use this function to view the manufacturer ID with which the device is registered with the HART FieldComm Group.

Display
2-digit hexadecimal number

Factory setting
0x11

Manufacturer

Navigation
Diagnostics → Device information → Manufacturer

Description
Indication of the manufacturer name.
Hardware revision

**Navigation**
Diagnostics → Device information → Hardware revision

**Description**
Indication of the hardware revision of the device.

Configuration counter

**Navigation**
Diagnostics → Device information → Configuration counter

**Description**
Use this function to display the counter reading for changes to device parameters.

Static parameters, whose values change during optimization or configuration, cause this parameter to increment by 1. This supports parameter version management. If several parameters change, e.g. due to loading of parameters from FieldCare, etc. in the device, the counter can show a higher value. The counter cannot be reset and is also not reset to the default value when the device is reset. If the counter overflows, (16 bit), it starts again at 1.

14.3.4 "Measured values" submenu

Sensor value

**Navigation**
Diagnostics → Measured values → Sensor value

**Description**
Use this function to display the current measured value at the sensor input.

Sensor raw value

**Navigation**
Diagnostics → Measured values → Sensor raw value

**Description**
Use this function to display the non-linearized mV/Ohm value at the specific sensor input.

Device temperature

**Navigation**
Diagnostics → Measured values → Device temperature

**Description**
Use this function to display the current electronics temperature.
“Min/max values” submenu

Sensor min value

**Navigation**
Diagnósticos → Medidas → Máximos/mínimos → Valor mínimo del sensor

**Description**
Use this function to display the minimum temperature measured in the past at sensor input (peakhold indicator).

Sensor max value

**Navigation**
Diagnósticos → Medidas → Máximos/mínimos → Valor máximo del sensor

**Description**
Use this function to display the maximum temperature measured in the past at sensor input (peakhold indicator).

Reset sensor min/max values

**Navigation**
Diagnósticos → Medidas → Máximos/mínimos → Restablece valores mínimos/máximos del sensor

**Description**
Use this function to reset min/max values of the sensor to its default values.

**User entry**
By clicking the button **Reset sensor min/max values** the reset function is activated. As a result, the sensor min./max. values are just indicating the reset, temporary values.

Device temperature min.

**Navigation**
Diagnósticos → Medidas → Máximos/mínimos → Temperatura mínima del dispositivo

**Description**
Use this function to display the minimum electronics temperature measured in the past (maximum indicator).

Device temperature max.

**Navigation**
Diagnósticos → Medidas → Máximos/mínimos → Temperatura máxima del dispositivo

**Description**
Use this function to display the maximum electronics temperature measured in the past (peakhold indicator).
### Reset device temp. min/max values

**Navigation**  
Diagnoses → Measured values → Min/max values → Reset device temp. min/max values

**Description**  
Use this function to reset the maximum indicators for the minimum and maximum electronic temperatures measured.

**User entry**  
By clicking the button **Reset device temp. min/max values** the reset function is activated. As a result, the device temperature min/max values are just indicating the reset, temporary values.

### 14.3.5 "Simulation" submenu

#### Diagnostic simulation

**Navigation**  
Diagnoses → Simulation → Diagnostic simulation

**Description**  
Use this function to switch diagnostic simulation on and off.

**Options**  
Use the dropdown menu to enter one of the diagnostic events → 39. In the simulation mode the assigned status signals and diagnostic behaviors are applied. Example: x001-Device failure

**Factory setting**  
Off

#### Current output simulation

**Navigation**  
Diagnoses → Simulation → Current output simulation

**Description**  
Use this function to switch simulation of the current output on and off. The status signal indicates a diagnostic message of the ‘function check’ category (C) while simulation is in progress.

**Options**  
- Off
- On

**Factory setting**  
Off

#### Value current output

**Navigation**  
Diagnoses → Simulation → Value current output
Operating menu and parameter description

**Description**
Use this function to set 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

**Factory setting**
3.58 mA

---

**Sensor simulation**

**Navigation**
Diagnostics → Simulation → Sensor simulation

**Description**
Use this function to switch simulation of the sensor temperature on and off. The status signal indicates a diagnostic message of the "function check" category (C) while simulation is in progress.

**Options**
- Off
- On

**Factory setting**
Off

---

**Sensor simulation value**

**Navigation**
Diagnostics → Simulation → Sensor simulation value

**Description**
Use this function to set a sensor temperature for the simulation. In this way, users can verify the correct adjustment of the sensor temperature limits and the correct function of downstream switching units.

**User entry**
\(-1.0 \cdot 10^{20}\) to \(+1.0 \cdot 10^{20}\) °C

**Factory setting**
0.00 °C

---

**14.3.6 "Diagnostic settings" submenu**

**Diagnostic behavior**

**Navigation**
Diagnostics → Diagnostic settings → Diagnostic behavior

**Description**
Each diagnostic event is assigned to a certain diagnostic behavior. The user can change this assignment for certain diagnostic events. → 39

**Options**
- Alarm
- Warning
- Disabled
**Factory setting**

See overview of diagnostic events → 39

**Status signal**

**Navigation**

Diagnostics → Diagnostic settings → Status signal

**Description**

Each diagnostic event is assigned to a certain status signal  from the factory. The user can change this assignment for certain diagnostic events. → 39

1) Digital information available via HART® communication

**Options**

- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- No effect (N)

**Factory setting**

See overview of diagnostic events → 39

**14.3.7 "Heartbeat" submenu**

Online wizard 'Heartbeat verification'

**Heartbeat verification**

**Navigation**

Diagnostics → Heartbeat → Heartbeat verification

**Description**

Online wizard for creating a Heartbeat verification report.

**Additional information**

For a detailed procedure description → 32

**14.4 Expert menu**

**Enter access code**

**Navigation**

Expert → Enter access code

**Description**

Use this function to enable the service parameters via the operating tool. If an incorrect access code is entered, the user retains his current access authorization.

If a value is entered that is not to equal to the access code, the parameter is automatically set to 0. The service parameters should only be modified by the service organization.
Additional information

Software device write protection is also switched on and off with this parameter.

Software device write protection in conjunction with download from an operating tool with offline capabilities

- Download, the device does not have a defined write protection code:
  The download is performed as normal.
- Download, defined write protection code, device is not locked.
  - The Enter access code parameter (offline) contains the correct write protection code:
    the download is carried out, and the device is not locked following the download. The write protection code in the Enter access code parameter is set to 0.
  - The Enter access code parameter (offline) does not contain the correct write protection code: the download is carried out, and the device is locked following the download. The write protection code in the Enter access code parameter is reset to 0.
- Download, defined write protection code, device is locked.
  - The Enter access code parameter (offline) contains the correct write protection code:
    the download is carried out, and the device is locked following the download. The write protection code in the Enter access code parameter is reset to 0.
  - The Enter access code parameter (offline) does not contain the correct write protection code: the download is not carried out. No values are changed in the device. The value of the Enter access code parameter (offline) is also not changed.

User entry
0 to 999

Factory setting
0

Access status tooling

Navigation
Expert → Access status tooling

Description
Use this function to show access authorization to the parameters.

Additional information
If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the Locking status parameter.

Options
- Operator
- Service

Factory setting
Operator

Locking status

Navigation
Expert → Locking status

Description
Use this function to view the device locking status. When write protection is activated, write access to the parameters is disabled.

Display
Activated or de-activated box: Write protected by software
14.4.1 "System" submenu

Unit → 81

Navigation
- Setup → Unit
- Expert → System → Unit

Damping

Navigation
- Expert → System → Damping

Description
Use this function to set the time constant of the measured value.

User entry
0 to 120 s

Factory setting
0 s

Additional information
The current output reacts with an exponential delay to fluctuations in the measured value. The time constant of this delay is specified by this parameter. If a low time constant is entered, the current output follows the measured value quickly. On the other hand, if a high time constant is entered, the current output reaction is delayed.

"Administration" submenu

Define device write protection code

Navigation
- Expert → System → Administration → Define device write protection code

Description
Sets a write protection code for the device.

User entry
0 to 9999

Factory setting
0

Additional information
If the code is programmed into the device firmware it is saved in the device and the operating tool displays the value 0 so that the defined write protection code is not openly displayed.

If the device is delivered with this factory setting the device write protection is not active.
Operating menu and parameter description

Additional information

- Activating device write protection: A value must be entered in the **Enter access code** parameter, which is not corresponding to this defined device write protection code.
- Deactivating device write protection: if device write protection is activated, enter the defined write protection code in the **Enter access code** parameter.
- Once the device has been reset to the factory setting or the order configuration, the defined write protection code is no longer valid. The code adopts the factory setting (= 0).

⚠️ If the device write protection code was forgotten, it can be deleted or overwritten by the service organization.

Device reset

**Navigation**

Expert → System → Administration → Device reset

**Description**

Use this function to reset the device configuration - either entirely or in part - to a defined state.

**Options**

- **Restart device**
  The device is restarted but the device configuration remains unchanged.
- **To delivery settings**
  All the parameters are reset to the order configuration. The order configuration can differ from the factory setting if customer-specific parameter values were defined when the device was ordered.
- **To factory defaults**
  All the parameters are reset to the factory setting.

14.4.2  "Output" submenu

4 mA value → 81

**Navigation**

Setup → Lower range value

Expert → Output → 4 mA value

20 mA value → 82

**Navigation**

Setup → 20 mA value

Expert → Output → 20 mA value

Failure mode → 82

**Navigation**

Setup → Failure mode

Expert → Output → Failure mode
Failure current

Navigation  
Expert → Output → Failure current

Prerequisite  
The option **High alarm** is enabled in the failure mode.

Description  
Use this function to set the value the current output adopts in an alarm condition.

User entry  
21.5 to 23 mA

Factory setting  
22.5

Adjustment of the analog output (4 and 20 mA current trimming)

Current trimming is used to compensate the analog output (D/A conversion). Here, the output current of the transmitter must be adapted so that it suits the value expected at the higher-order system.

Current trimming does not affect the digital HART® value. This can cause the measured value shown on a locally installed display to differ from the value displayed in the higher-order system.

Procedure

1. Start
   ↓
2. Install an accurate amperemeter (more accurate than the transmitter) in the current loop.
   ↓
3. Switch on current output simulation and set the simulation value to 4 mA.
   ↓
4. Measure the loop current with the amperemeter and make a note of the value.
   ↓
5. Set the simulation value to 20 mA.
   ↓
6. Measure the loop current with the amperemeter and make a note of the value.
   ↓
7. Enter the current values determined as adjustment values in the **Current trimming 4 mA / 20 mA** parameters
   ↓
8. End

Current trimming 4 mA

Navigation  
Expert → Output → Current trimming 4 mA

Description  
Use this function to set the correction value for the current output at the start of the measuring range at 4 mA.
### User entry
3.5 to 4.25 mA

### Factory setting
4 mA

### Additional information
The trimming only affects current loop values from 3.8 to 20.5 mA. Failure mode with Low Alarm and High Alarm current values are not subjected to the trimming.

### Current trimming 20 mA

#### Navigation
Expert → Output → Current trimming 20 mA

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

#### User entry
19.50 to 20.5 mA

#### Factory setting
20.000 mA

#### Additional information
The trimming only affects current loop values from 3.8 to 20.5 mA. Failure mode with Low Alarm and High Alarm current values are not subjected to the trimming.

"Loop check configuration" submenu

### Loop check configuration

#### Navigation
Expert → Output → Loop check configuration → Loop check configuration

#### Description
This function is active when there is at least one value defined. The loop check function will run by each restart (power up) of the device. Measure the loop current with the amperemeter. If the measured values deviates from the simulation values, these current output values have to be adjusted. To activate the loopcheck, define and activate at least one of the following values.
**Additional information**  
After the device has been started up the loop check starts and the activated simulation values will be checked. These loop current values can be measured with an accurate amperemeter. If the measured values deviate from the set simulation values, it is recommended to adjust these current output values. For current trimming 4 mA/20 mA see description above.

![Loop check curve](image)

**Options**  
Activation of the check values:
- Simulation value 1
- Simulation value 2
- Simulation value 3
- Low alarm
- High alarm

**Simulation value n**

![Diagonal line](image)

- n = number of simulation values (1 to 3)

**Navigation**  
Expert → Output → Loop check configuration → Simulation value n

**Description**  
Use this function to adjust the first, second or third value which will be simulated after each restart to check the current loop.

**Options**  
Enter the current values to check the loop
- Simulation value 1  
  User entry: 3.58 to 23 mA
- Simulation value 2  
  User entry: 3.58 to 23 mA
- Simulation value 3  
  User entry: 3.58 to 23 mA
### Factory setting

- **Simulation value 1**: 4.00 mA, not activated
- **Simulation value 2**: 12.00 mA, not activated
- **Simulation value 3**: 20.00 mA, not activated
- **Low alarm** and **High alarm** not activated

### Loop check interval

**Navigation**

- Expert → Output → Loop check configuration → Loop check interval

**Description**

Displays the duration each single value is simulated.

**User entry**

4 to 255 s

**Factory setting**

4 s

### 14.4.3 "Communication" submenu

"HART configuration" submenu

### Device tag → 81

**Navigation**

- Setup → Device tag
  - Expert → Communication → HART configuration → Device tag

### HART short tag

**Navigation**

- Expert → Communication → HART configuration → HART short tag

**Description**

Use this function to define a short tag for the measuring point.

**User entry**

Up to 8 alphanumeric characters (letters, numbers and special characters).

**Factory setting**

8 x ?

### HART address

**Navigation**

- Expert → Communication → HART configuration → HART address

**Description**

Use this function to define the HART address of the device.

**User entry**

0 ... 63
Additional information
The measured value can only be transmitted via the current value if the address is set to '0'. The current is fixed at 4.0 mA for all other addresses (Multidrop mode).

No. of preambles

**Navigation**
Expert → Communication → HART configuration → No. of preambles

**Description**
Use this function to define the number of preambles in the HART telegram.

**User entry**
5 to 20

**Factory setting**
5

Configuration changed

**Navigation**
Expert → Communication → HART configuration → Configuration changed

**Description**
Indicates whether the configuration of the device has been changed by a master (primary or secondary).

"HART info" submenu

Device type

**Navigation**
Expert → Communication → HART info → Device type

**Description**
Use this function to view the device type with which the device is registered with the HART FieldComm Group. The device type is specified by the manufacturer. It is needed to assign the appropriate device description file (DD) to the device.

**Display**
4-digit hexadecimal number

**Factory setting**
0x11CF

Device revision

**Navigation**
Expert → Communication → HART info → Device revision
### Device ID

<table>
<thead>
<tr>
<th><strong>Navigation</strong></th>
<th>Expert → Communication → HART info → Device ID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>A unique HART identifier is saved in the device ID and used by the control systems to identify the device. The device ID is also transmitted in command 0. The device ID is determined unambiguously from the serial number of the device.</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>ID generated for specific serial number</td>
</tr>
</tbody>
</table>

### Manufacturer ID → 88

| **Navigation** | Diagnostics → Device information → Manufacturer ID  
Expert → Communication → HART info → Manufacturer ID |

### HART revision

| **Navigation** | Expert → Communication → HART info → HART revision |
| **Description** | Display of the HART revision of the device. |

### HART descriptor

| **Navigation** | Expert → Communication → HART info → HART descriptor |
| **Description** | Definition of a description for the measuring point. |
| **User entry** | Up to 16 alphanumeric characters (letters, numbers and special characters) |
| **Factory setting** | 16 x '?' |
HART message

Navigation  
Expert → Communication → HART info → HART message

Description  
Use this function to define a HART message which is sent via the HART protocol when requested by the master.

User entry  
Up to 32 alphanumeric characters (letters, numbers and special characters)

Factory setting  
32 x '?'

Hardware revision

Navigation  
Expert → Communication → HART info → Hardware revision

Description  
Display of the hardware revision for the device.

Software revision

Navigation  
Expert → Communication → HART info → Software revision

Description  
Display of the software revision of the device.

HART date code

Navigation  
Expert → Communication → HART info → HART date code

Description  
Definition of a date information for individual use.

User entry  
Date in the format year-month-day (YYYY-MM-DD)

Factory setting  
2010-01-01

Process unit tag

Navigation  
Expert → Communication → HART info → Process unit tag

Description  
Use this function to define a tag description for the process unit.

User entry  
Up to 32 alphanumeric characters (letters, numbers and special characters)
## Location description

**Navigation**  
Expert → Communication → HART info → Location description

**Description**  
Enter the location description to find the device in the plant.

**User entry**  
Up to 32 alphanumeric characters (letters, numbers and special characters)

**Factory setting**  
32 x '?'

## Longitude

**Navigation**  
Expert → Communication → HART info → Longitude

**Description**  
Use this function to enter the longitude coordinates that describe the device location.

**User entry**  
–180.000 to +180.000°

**Factory setting**  
0

## Latitude

**Navigation**  
Expert → Communication → HART info → Latitude

**Description**  
Use this function to enter the latitude coordinates that describe the device location.

**User entry**  
–90.000 to +90.000°

**Factory setting**  
0

## Altitude

**Navigation**  
Expert → Communication → HART info → Altitude

**Description**  
Use this function to enter the altitude data that describe the device location.

**User entry**  
$-1.0 \cdot 10^{20}$ to $+1.0 \cdot 10^{+20}$ m

**Factory setting**  
0 m
Location method

Navigation  
Expert → Communication → HART info → Location method

Description  
Use this function to select the data format for specifying the geographic location. The codes for specifying the location are based on the US National Marine Electronics Association (NMEA) Standard NMEA 0183.

Options  
- No fix
- GPS or Standard Positioning Service (SPS) fix
- Differential PGS fix
- Precise positioning service (PPS)
- Real Time Kinetic (RTK) fixed solution
- Real Time Kinetic (RTK) float solution
- Estimated dead reckoning
- Manual input mode
- Simulation mode

Factory setting  
Manual input mode

"HART output" submenu

Assign current output (PV)

Navigation  
Expert → Communication → HART output → Assign current output (PV)

Description  
Allocation of the measured variable to the primary HART® value (PV).

Display  
Temperature

Factory setting  
Temperature (Fixed assignment)

PV

Navigation  
Expert → Communication → HART output → PV

Description  
Use this function to display the primary HART value

Assign SV

Navigation  
Expert → Communication → HART output → Assign SV

Description  
Allocation of a measured variable to the secondary HART value (SV).
### Display
Device temperature (Fixed assignment)

### SV
**Navigation**
- Expert → Communication → HART output → SV

**Description**
Use this function to display the secondary HART value

### Assign TV
**Navigation**
- Expert → Communication → HART output → Assign TV

**Description**
Allocation of a measured variable to the tertiary HART value (TV).

**Display**
Number of self calibrations (fixed assignment)

### TV
**Navigation**
- Expert → Communication → HART output → TV

**Description**
Use this function to display the tertiary HART value

### Assign QV
**Navigation**
- Expert → Communication → HART output → Assign QV

**Description**
Assignment of a measured variable to the quaternary (fourth) HART value (QV).

**Display**
Deviation (fixed assignment)

### QV
**Navigation**
- Expert → Communication → HART output → QV

**Description**
Use this function to display the quaternary HART value