Operating Instructions
iTTEMP TMT162

Temperature field transmitter
HART® communication
# Table of contents

1. **About this document** .......................... 4  
   1.1 Function of document and how to use .......... 4  
   1.2 Symbols ...................................... 4  
   1.3 Documentation ................................. 6  
   1.4 Registered trademarks ........................ 6  

2. **Safety instructions** ............................ 7  
   2.1 Requirements for the personnel ............... 7  
   2.2 Intended use .................................. 7  
   2.3 Workplace safety .............................. 7  
   2.4 Operational safety ............................ 7  
   2.5 Product safety ................................ 8  
   2.6 IT security .................................... 8  

3. **Incoming acceptance and product identification** .......................... 8  
   3.1 Incoming acceptance .......................... 8  
   3.2 Product identification ........................ 9  
   3.3 Certificates and approvals .................... 9  
   3.4 Storage and transport ........................ 10  

4. **Mounting** ................................. 11  
   4.1 Mounting requirements ...................... 11  
   4.2 Mounting the transmitter ..................... 11  
   4.3 Display mounting ............................ 13  
   4.4 Post-mounting check .......................... 13  

5. **Electrical connection** .................. 14  
   5.1 Connecting requirements ..................... 14  
   5.2 Connecting the sensor ....................... 14  
   5.3 Connecting the measuring device .......... 16  
   5.4 Special connection instructions ............ 18  
   5.5 Ensuring the degree of protection .......... 20  
   5.6 Post-connection check ........................ 20  

6. **Operation options** .......................... 21  
   6.1 Overview of operation options .............. 21  
   6.2 Structure and function of the operating menu .......... 24  
   6.3 Access to the operating menu via the operating tool ........ 26  

7. **System integration** .................. 28  
   7.1 HART device variables and measured values .... 28  
   7.2 Device variables and measured values ....... 29  
   7.3 Supported HART® commands ................. 29  

8. **Commissioning** ............................. 31  
   8.1 Post-installation check ...................... 31  
   8.2 Switching on the device .................... 31  

8.3 Protecting settings from unauthorized access .......................... 31  

9. **Diagnostics and troubleshooting** ........ 33  
   9.1 General trouble shooting .................... 33  
   9.2 Overview of diagnostic information .......... 35  
   9.3 Diagnostic list .............................. 36  
   9.4 Firmware history ............................. 39  

10. **Maintenance** ............................... 39  
    10.1 Cleaning .................................... 39  

11. **Repair** ................................. 40  
    11.1 General notes ............................... 40  
    11.2 Spare parts ................................. 40  
    11.3 Return ..................................... 42  
    11.4 Disposal .................................... 42  

12. **Accessories** ............................... 42  
    12.1 Device-specific accessories ................. 42  
    12.2 Service-specific accessories ............... 43  
    12.3 System products ............................ 43  

13. **Technical data** ............................ 45  
    13.1 Input ........................................ 45  
    13.2 Output ...................................... 46  
    13.3 Power supply ................................ 48  
    13.4 Performance characteristics ............... 49  
    13.5 Environment ................................ 57  
    13.6 Mechanical construction .................... 58  
    13.7 Certificates and approvals .................. 59  

14. **Operating menu and parameter description** .................. 60  
    14.1 'Setup' menu ................................ 67  
    14.2 'Diagnostics' menu ......................... 82  
    14.3 'Expert' menu ............................... 90  

Index ........................................ 116
1 About this document

1.1 Function of document and how to use

1.1.1 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.

1.1.2 Safety Instructions (XA)
When using in hazardous areas, the relevant national standards must be observed. Separate Ex-specific documentation is provided for measuring systems that are used in hazardous areas. This documentation is an integral part of these Operating Instructions. The installation specifications, connection data and safety instructions contained therein must be strictly observed! Make sure that you use the right Ex-specific documentation for the right device with approval for use in hazardous areas! The number of the specific Ex documentation (XA...) is provided on the nameplate. If the two numbers (on the Ex documentation and the nameplate) are identical, then you may use this Ex-specific documentation.

1.1.3 Functional safety
Please refer to Safety Manual SD01632T for the use of approved devices in protective systems according to IEC 61508.

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>Symbol</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| ![Ground connection] | Ground connection  
A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system. |
| ![Potential equalization connection (PE: protective earth)] | Potential equalization connection (PE: protective earth)  
Ground terminals that must be connected to ground prior to establishing any other connections.  
The ground terminals are located on the interior and exterior of the device:  
- Interior ground terminal: potential equalization is connected to the supply network.  
- Exterior ground terminal: device is connected to the plant grounding system. |

### 1.2.3 Symbols for certain types of information

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Permitted] | Permitted  
Procedures, processes or actions that are permitted. |
| ![Preferred] | Preferred  
Procedures, processes or actions that are preferred. |
| ![Forbidden] | Forbidden  
Procedures, processes or actions that are forbidden. |
| ![Tip] | Tip  
Indicates additional information. |
| ![Reference to documentation] | Reference to documentation |
| ![Reference to page] | Reference to page |
| ![Reference to graphic] | Reference to graphic |
| ![Series of steps] | Series of steps |
| ![Result of a step] | Result of a step |
| ![Help in the event of a problem] | Help in the event of a problem |
| ![Visual inspection] | Visual inspection |

### 1.2.4 Tool symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Flat-blade screwdriver] A0011220</td>
<td>Flat-blade screwdriver</td>
</tr>
<tr>
<td>![Phillips screwdriver] A0011219</td>
<td>Phillips screwdriver</td>
</tr>
<tr>
<td>![Allen key] A0011221</td>
<td>Allen key</td>
</tr>
<tr>
<td>![Open-ended wrench] A0011222</td>
<td>Open-ended wrench</td>
</tr>
<tr>
<td>![Torx screwdriver] A0011340</td>
<td>Torx screwdriver</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): 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>
</table>
| Technical Information (TI)                    | Planning aid for your device

The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

| Brief Operating Instructions (KA)             | Guide that takes you quickly to the 1st measured value

The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

| Operating Instructions (BA)                   | Your reference document

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

| Description of Device Parameters (GP)         | Reference for your parameters

The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

| Safety Instructions (XA)                      | Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. The Safety Instructions are an integral part of the Operating Instructions.

Information on the Safety Instructions (XA) relevant to the device is provided on the nameplate.

| Supplementary device-dependent documentation (SD/FY) | Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation. |

1.4 Registered trademarks

HART®
Registered trademark of the HART® FieldComm Group
2 Safety instructions

2.1 Requirements for the personnel

NOTICE
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 beginning work, the specialist staff must have read and understood the instructions in the manuals and supplementary documentation as well as in the certificates (depending on the application)
‣ Follow instructions and comply with basic conditions

The operating personnel must meet the following requirements:

‣ Be instructed and authorized according to the requirements of the task by the facility's owner-operator
‣ Follow the instructions in these Operating Instructions

2.2 Intended use

The device is a universal and configurable temperature field transmitter with either one or two temperature sensor inputs for resistance thermometers (RTD), thermocouples (TC) and resistance and voltage transmitters. The device is designed for mounting in the field. The manufacturer is not liable for damage caused by improper or non-intended use.

2.3 Workplace safety

When working on and with the device:

‣ Wear the required personal protective equipment as per national regulations.

2.4 Operational safety

‣ Operate the device only if it is in proper technical condition, free from errors and faults.
‣ The operator is responsible for the interference-free operation of the device.

Power supply

‣ The device must only be powered by a 11.5 to 42 V\text{DC} voltage supply according to NEC class 02 (low voltage/current) with short circuit power limitation to 8 A/150 VA.

Modifications to the device

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

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

Repair

To ensure continued operational safety and reliability:

‣ Carry out repairs on the device only if they are expressly permitted.
‣ Observe national regulations pertaining to the repair of an electrical device.
‣ Use original spare parts and accessories from Endress+Hauser only.
Hazardous area
To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection or safety equipment):

‣ Based on the technical data on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area. The nameplate can be found on the side of the transmitter housing.
‣ Observe the specifications in the separate supplementary documentation included as an integral part of these instructions.

Electromagnetic compatibility
The measuring system complies with the general safety requirements as per EN 61010-1, the EMC requirements as per the IEC/EN 61326 series and the NAMUR recommendations NE 21 and NE 89.

2.5 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.

2.6 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 device can be identified in the following ways:

- 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.
- Enter the serial number on the nameplate into the Endress+Hauser Operations App or scan the 2-D matrix code (QR code) on the nameplate with the Endress+Hauser Operations App: all the information about the device and the technical documentation pertaining to the device is displayed.

3.2.1  Nameplate

The right device?

The nameplate provides you with the following information on the device:

- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG)
- Technical values: supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols

▸ Compare the information on the nameplate with the order.

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>

3.3  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)

3.3.1  HART® protocol certification

The temperature transmitter is registered by the HART® FieldComm Group. The device meets the requirements of the HART Communication Protocol Specifications, Revision 7 (HCF 7.6).
3.4 Storage and transport

<table>
<thead>
<tr>
<th>Storage temperature</th>
<th>Without display</th>
<th>With display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>–40 to +100 °C</td>
<td>–40 to +80 °C</td>
</tr>
<tr>
<td></td>
<td>(–40 to +212 °F)</td>
<td>(–40 to +176 °F)</td>
</tr>
</tbody>
</table>

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

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

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

If stable sensors are used, the device can be fitted directly to the sensor. For remote mounting to a wall or stand pipe, two mounting brackets are available. The illuminated display can be mounted in four different positions.

4.1 Mounting requirements

4.1.1 Dimensions

The dimensions of the device are provided in the "Technical data" section.

4.1.2 Installation point

Information about the conditions (such as the ambient temperature, degree of protection, climate class etc.) that must be present at the installation point so that the device can be mounted correctly is provided in the "Technical data" section.

For use in hazardous areas, the limit values specified on the certificates and approvals must be observed (see Ex Safety Instructions).

4.2 Mounting the transmitter

**NOTICE**

Do not over-tighten the mounting screws, as this could damage the field transmitter.

- Maximum torque = 6 Nm (4.43 lbf ft)

4.2.1 Direct sensor mounting

1. Mount the thermowell and screw down (1).
2. Screw the insert with the neck tube nipple and adapter into the transmitter (2). Seal the nipple and adapter thread with silicone tape.
3. Connect the sensor cables (4) to the terminals for the sensors, see the terminal assignment.
4. Fit the field transmitter with the insert on the thermowell (1).
5. Mount the fieldbus shielded cable or fieldbus connector (6) on the other cable gland.
6. Guide the fieldbus cables (5) through the cable gland of the fieldbus transmitter housing into the connection compartment.

7. Screw the cable gland tight as described in the Ensuring the degree of protection section → 20. The cable gland must meet explosion protection requirements.

4.2.2 Remote mounting

![Diagram showing remote mounting details]

2 Installation of the field transmitter using the mounting bracket, see 'Accessories' section. Dimensions in mm (in)

2 Combined wall/pipe mounting bracket 2", L-shaped, material 304

3 Pipe mounting bracket 2", U-shaped, material 316L
4.3  Display mounting

1. Remove the cover clamp (1).
2. Unscrew the housing cover together with the O-ring (2).
3. Remove the display with twist protection (3) from the electronics module (4). Fit the display with retainer in the desired position in 90° stages and plug it into the correct slot on the electronics module.
4. Clean the thread in the housing cover and housing base and lubricate if necessary. (Recommended lubricant: Klüber Syntheso Glep 1)
5. Then screw the housing cover together with the O-ring.
6. Fit the cover clamp (1) back on.

4.4  Post-mounting check

After installing the device, always perform the following checks:

<table>
<thead>
<tr>
<th>Device condition and specifications</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the device undamaged (visual inspection)?</td>
<td>-</td>
</tr>
<tr>
<td>Do the ambient conditions match the device specification (e.g. ambient temperature, measuring range, etc.)?</td>
<td></td>
</tr>
</tbody>
</table>
5  Electrical connection

5.1  Connecting requirements

⚠️ CAUTION
The electronics could be destroyed
्र Switch off power supply before installing or connecting the device. Failure to observe this may result in the destruction of parts of the electronics.
ría When connecting Ex-certified devices, please take special note of the instructions and connection schematics in the Ex-specific supplement to these Operating Instructions. Contact the supplier if you have any questions.

A Phillips head screwdriver is required to wire the field transmitter at the terminals.

⚠️ NOTICE
Do not over-tighten the screw terminals, as this could damage the transmitter.
ria Maximum torque = 1 Nm (¾ lbf ft).

Proceed as follows to wire the device:

1. Remove the cover clamp. → 3, 13
2. Unscrew the housing cover on the connection compartment together with the O-ring → 3, 13. The connection compartment is opposite the electronics module.
3. Open the cable glands of the device.
4. Route the appropriate connecting cables through the openings of the cable glands.
5. Wire the cables in accordance with → 4, 15 and as described in the sections: 'Connecting the sensor' → 14 and 'Connecting the measuring device' → 16.
6. On completion of the wiring, screw the screw terminals tight. Tighten the cable glands again. Refer to the information provided in the ‘Ensuring the degree of protection’ section.
7. Clean the thread in the housing cover and housing base and lubricate if necessary. (Recommended lubricant: Klüber Syntheso Glep 1)
8. Screw the housing cover tight again and fit the cover clamp back on. → 13

In order to avoid connection errors always follow the instructions in the post-connection check section before commissioning!

5.2  Connecting the sensor

⚠️ NOTICE
ra ESD - Electrostatic discharge. Protect the terminals from electrostatic discharge. Failure to observe this may result in the destruction or malfunction of parts of the electronics.

Terminal assignment
4  Wiring of the field transmitter, RTD, dual sensor input
1  Sensor input 1, RTD: 2-, 3- and 4-wire
2  Sensor input 2, RTD: 2-, 3-wire
3  Field transmitter power supply and analog output 4 to 20 mA or fieldbus connection

5  Wiring of the field transmitter, TC, dual sensor input
1  Sensor input 1, TC
2  Sensor input 2, TC
3  Field transmitter power supply and analog output 4 to 20 mA or fieldbus connection

**NOTICE**
When connecting 2 sensors ensure that there is no galvanic connection between the sensors (e.g. caused by sensor elements that are not isolated from the thermowell). The resulting equalizing currents distort the measurements considerably.
- The sensors must remain galvanically isolated from one another by connecting each sensor separately to a transmitter. The transmitter provides sufficient galvanic isolation (> 2 kV AC) between the input and output.
The following connection combinations are possible when both sensor inputs are assigned:

<table>
<thead>
<tr>
<th>Sensor input 2</th>
<th>RTD or resistance transmitter, 2-wire</th>
<th>RTD or resistance transmitter, 3-wire</th>
<th>RTD or resistance transmitter, 4-wire</th>
<th>Thermocouple (TC), voltage transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD or resistance transmitter, 2-wire</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>RTD or resistance transmitter, 3-wire</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>RTD or resistance transmitter, 4-wire</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Thermocouple (TC), voltage transmitter</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

5.3 Connecting the measuring device

5.3.1 Cable gland or cable entry

⚠️ CAUTION

Risk of damage

▶ Switch off power supply before installing or connecting the device. Failure to observe this may result in the destruction of parts of the electronics.

▶ If the device has not been grounded as a result of the housing being installed, we recommend grounding it via one of the ground screws. Observe the grounding concept of the plant! Keep the cable shield between the stripped fieldbus cable and the ground terminal as short as possible! Connection of the functional grounding may be needed for functional purposes. Compliance with the electrical codes of individual countries is mandatory.

▶ If the shielding of the fieldbus cable is grounded at more than one point in systems without additional potential matching, mains frequency equalizing currents can occur that damage the cable or the shielding. In such cases, the shielding of the fieldbus cable is to be grounded on one side only, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!

- The terminals for the fieldbus connection have integrated reverse polarity protection.
- Cable cross-section: max. 2.5 mm²
- A shielded cable must be used for the connection.

Follow the general procedure. ➔ 14.
5.3.2 Connecting the HART® communication resistor

If the HART® communication resistor is not integrated into the power supply unit, it is necessary to incorporate a communication resistor of 250 Ω into the 2-wire cable. For the connection, also refer to the documentation published by the HART® FieldComm Group, particularly HCF LIT 20: “HART, a technical summary”.

---

**Diagram 6** Connecting the device to the fieldbus cable

1. Fieldbus terminals - fieldbus communication and power supply
2. Shielded fieldbus cable
3. Ground terminals, internal
4. Ground terminal (external, relevant for remote version)

---

**Diagram 7** HART® connection with Endress+Hauser power supply unit, including integrated communication resistor

1. Temperature field transmitter
2. HART® handheld communicator
3. PLC/DCS
4. Configuration software, e.g. FieldCare, DeviceCare
5. HART® modem
6. Configuration via Field Xpert SMT70
7. Power supply unit, e.g. RN22 from Endress+Hauser
5.3.3  **Shielding and grounding**

The specifications of the HART FieldComm Group must be observed during installation.

5.4  **Special connection instructions**

If the device is fitted with a surge arrester module, the bus is connected and the power is supplied via the screw terminals on the surge arrester module.
5.4.1 Surge arrester function test

**NOTICE**

To perform the function test on the surge arrester module correctly:

► Remove the surge arrester module before performing the test.
► To do so, release screws (1) and (2) with a screwdriver and release securing screw (3) with an Allen key.
► The surge arrester module can be lifted off easily.
► Perform the function test as shown in the following graphic.

---

Ohmmeter in high-impedance range = overvoltage protection working.

Ohmmeter in low-impedance range = overvoltage protection defective. Notify Endress+Hauser Service. Dispose of the defective surge arrester module as electronic waste. For information on device disposal, see the Disposal section.
5.5 Ensuring the degree of protection

The device meets all the requirements of IP66/IP67 protection. Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP66/IP67 protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All housing screws and screw caps must be firmly tightened.
- The connecting cables used must have the specified external diameter (e.g. M20x1.5, cable diameter 8 to 12 mm).
- Firmly tighten the cable gland. → 12, 20
- The cables must loop down before they enter the cable glands ("water trap"). This means that any moisture that may form cannot enter the gland. Install the device so that the cable glands are not facing upwards. → 12, 20
- Replace unused cable glands with dummy plugs.
- Do not remove the grommet from the cable gland.

5.6 Post-connection check

<table>
<thead>
<tr>
<th>Device condition and specifications</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the device and cables undamaged (visual check)?</td>
<td>--</td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td><strong>Notes</strong></td>
</tr>
<tr>
<td>Does the supply voltage match the information on the nameplate?</td>
<td>Standard mode and SIL mode: $U = 11.5$ to $42 , V_{DC}$</td>
</tr>
<tr>
<td>Are the mounted cables relieved of tension?</td>
<td>Visual inspection</td>
</tr>
<tr>
<td>Are the power supply and signal cables connected correctly?</td>
<td>→ 16</td>
</tr>
<tr>
<td>Are all the screw terminals sufficiently tightened?</td>
<td>→ 14</td>
</tr>
<tr>
<td>Are all the cable entries installed, tightened and leak-tight?</td>
<td>→ 20</td>
</tr>
<tr>
<td>Are all housing covers installed and securely tightened?</td>
<td>→ 21</td>
</tr>
</tbody>
</table>
6 Operation options

6.1 Overview of operation options

There are different ways in which the operator can configure and commission the device:

- **Configuration programs** → 26
  HART® functions and device-specific parameters are primarily configured via the Fieldbus interface. Special configuration and operating programs are available from various manufacturers for this purpose.

- **Miniature switch (DIP switch) and proof-test button for various hardware settings**
  - Hardware write protection is activated and deactivated via a miniature switch (DIP switch) on the electronics module.
  - Proof-test button for testing in SIL mode without HART operation. Pressing the button triggers a device restart. The proof test checks the functional integrity of the transmitter in the SIL mode during commissioning, in the event of changes to safety-related parameters or generally at appropriate intervals.

![Diagram of operation options](image)

- 13 Operation options of the device
  1. Hardware settings via DIP switch and proof-test button
  2. HART® handheld communicator
  3. PLC/DCS
  4. Configuration software, e.g. FieldCare, DeviceCare
  5. HART® modem
  6. Configuration via Field Xpert SMT70
  7. Power supply unit and active barrier, e.g. RN22 from Endress+Hauser
6.1.1 Measured value display and operating elements

Display elements

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bar graph display</td>
<td>In increments of 10% with indicators for underranging and overranging.</td>
</tr>
<tr>
<td>2</td>
<td>'Caution' symbol</td>
<td>This is displayed when an error or warning occurs.</td>
</tr>
<tr>
<td>3</td>
<td>Unit display K, °F, °C or %</td>
<td>Unit display for the internal measured value displayed.</td>
</tr>
<tr>
<td>4</td>
<td>Measured value display, digit height 20.5 mm</td>
<td>Displays the current measured value. In the event of an error or warning, the corresponding diagnostics information is displayed. →  35</td>
</tr>
<tr>
<td>5</td>
<td>Status and information display</td>
<td>Indicates which value is currently shown on the display. Text can be entered for every value. In the event of an error or a warning, the sensor input that triggered the error/warning is also displayed where applicable, e.g. SENS1</td>
</tr>
<tr>
<td>6</td>
<td>'Configuration locked' symbol</td>
<td>The 'configuration locked' symbol appears when configuration is locked via the hardware or software</td>
</tr>
<tr>
<td>7</td>
<td>'Communication' symbol</td>
<td>The communication symbol appears when HART® communication is active.</td>
</tr>
</tbody>
</table>

Local operation

**NOTICE**

- **ESD** - Electrostatic discharge. Protect the terminals from electrostatic discharge. Failure to observe this may result in the destruction or malfunction of parts of the electronics.

Hardware write protection and the proof test can be activated via a DIP switch or button on the electronics module. When write protection is active, parameters cannot be modified. A lock symbol on the display indicates that write protection is on. Write protection prevents any write access to the parameters.
Procedure for setting the DIP switch or activating the proof test:

1. Remove the cover clamp.
2. Unscrew the housing cover together with the O-ring.
3. If necessary, remove the display with retainer from the electronics module.
4. Configure the hardware write protection **WRITE LOCK** accordingly using the DIP switch. In general, the following applies: switch to ON = function enabled, switch to OFF = function disabled. If performing a SIL commissioning test and a proof test, make a device restart using the button.

Once the hardware setting has been made, re-assemble the housing cover in the reverse order.
6.2 Structure and function of the operating menu

6.2.1 Structure of the operating menu
The configuration in the SIL mode is different from the configuration in the standard mode. For more detailed information, please refer to the Functional Safety Manual (SD01632T).

### Submenus and user roles

Certain parts of the menu are assigned to certain user roles. Each user role corresponds to typical tasks within the life cycle 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>&quot;Setup&quot;</td>
<td>Contains all parameters for commissioning:</td>
</tr>
<tr>
<td>Operator</td>
<td>• Configuration of the measurement.</td>
<td></td>
<td>• <strong>Setup parameters</strong></td>
</tr>
<tr>
<td></td>
<td>• Configuration of data processing (scaling, linearization, 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>• Configuration of the analog measured value output.</td>
<td></td>
<td>• <strong>&quot;Advanced setup&quot; submenu</strong></td>
</tr>
<tr>
<td></td>
<td>Tasks during operation:</td>
<td></td>
<td>• Contains additional submenus and parameters:</td>
</tr>
<tr>
<td></td>
<td>• Configuration of the display.</td>
<td></td>
<td>• For more accurate configuration of the measurement (adaptation to special measuring conditions).</td>
</tr>
<tr>
<td></td>
<td>• Reading measured values.</td>
<td></td>
<td>• For converting the measured value (scaling, linearization).</td>
</tr>
<tr>
<td></td>
<td>Troubleshooting:</td>
<td>&quot;Diagnostics&quot;</td>
<td>• For scaling the output signal.</td>
</tr>
<tr>
<td></td>
<td>• Diagnosing and eliminating process errors.</td>
<td></td>
<td>• Required in ongoing operation: configuration of the measured value display (displayed values, display format, etc.).</td>
</tr>
<tr>
<td></td>
<td>• Interpretation of device error messages and correcting associated errors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expert</td>
<td>Tasks that require detailed knowledge of the function of the device:</td>
<td>&quot;Expert&quot;</td>
<td>Contains all the parameters of the device (including those that are already contained 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>• <strong>&quot;Sensor&quot; submenu</strong></td>
</tr>
<tr>
<td></td>
<td>• Optimal adaptation of the measurement to difficult conditions.</td>
<td></td>
<td>• Contains all higher-level device parameters that do not affect measurement or measured value communication.</td>
</tr>
<tr>
<td></td>
<td>• Detailed configuration of the communication interface.</td>
<td></td>
<td>• <strong>&quot;Output&quot; submenu</strong></td>
</tr>
<tr>
<td></td>
<td>• Error diagnostics in difficult cases.</td>
<td></td>
<td>• Contains all parameters for configuring the analog current output.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• <strong>&quot;Communication&quot; submenu</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Contains all parameters for configuring the digital communication interface.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• <strong>&quot;Diagnostics&quot; submenu</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Contains all parameters needed to detect and analyze operational errors.</td>
</tr>
</tbody>
</table>
6.3 Access to the operating menu via the 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 helps 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:
- Transmitter parameter configuration
- Loading and saving of device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook

For details, see Operating Instructions BA00027S/04/xx and BA00059AS/04/xx

Source for device description files
For details, see ➔ 28

User interface

6.3.2 DeviceCare

Function scope
The fastest way to configure Endress+Hauser field devices is with the dedicated DeviceCare tool. DeviceCare's user-friendly design enables transparent and intuitive device connection and configuration. Intuitive menus and step-by-step instructions with status information ensure optimum transparency.

Quick and easy to install, connects devices in a single click (one-click connection). Automatic hardware identification and driver catalog update. The devices are configured using DTMs (Device Type Manager). Multilingual support, the tool is touch-enabled for tablet use. Hardware interfaces for modems: (USB/RS232), TCP/IP, USB and PCMCIA.
Source for device description files
For details, see → 28

6.3.3  Field Xpert

Function scope
Field Xpert is an industrial PDA with integrated touchscreen for commissioning and maintaining field devices in explosion hazardous and safe areas. It enables the efficient configuration of FOUNDATION fieldbus, HART and WirelessHART devices. Communication is wireless via Bluetooth or WiFi interfaces.

Source for device description files
For details, see → 28

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
For details, see → 28

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
For details, see → 28

6.3.6  Field Communicator 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
For details, see → 28
7 System integration

Version data for the device

<table>
<thead>
<tr>
<th>Firmware version</th>
<th>04.01.zz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer ID</td>
<td>0x0011</td>
</tr>
<tr>
<td>Device type ID</td>
<td>0x11CE</td>
</tr>
<tr>
<td>HART protocol revision</td>
<td>7.6</td>
</tr>
<tr>
<td>Device revision</td>
<td>4</td>
</tr>
</tbody>
</table>

The suitable device description file (DD or DTM) for the individual operating tools is listed in the table below, along with information on where the file can be acquired.

Operating tools

<table>
<thead>
<tr>
<th>Operating tool</th>
<th>Sources for obtaining device descriptions (DD) or device type managers (DTM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FieldCare, DeviceCare, FieldXpert SMT70 (Endress+Hauser)</td>
<td><a href="http://www.endress.com%E2%86%92">www.endress.com→</a> Downloads → Device driver: Enter type, product root and process communication.</td>
</tr>
<tr>
<td>SIMATIC PDM (Siemens)</td>
<td></td>
</tr>
<tr>
<td>Yokogawa, Plant Resource Manager</td>
<td></td>
</tr>
<tr>
<td>Control Builder, Field Device Manager (Honeywell)</td>
<td></td>
</tr>
<tr>
<td>Schneider Invensys, Archestra IDE</td>
<td></td>
</tr>
<tr>
<td>PACTware</td>
<td></td>
</tr>
<tr>
<td>Field Communicator 475 (Emerson Process Management)</td>
<td>Use update function of handheld terminal</td>
</tr>
</tbody>
</table>

7.1 HART device variables and measured values

The following measured values are assigned to the device variables at the factory:

Device variables for temperature measurement

<table>
<thead>
<tr>
<th>Device variable</th>
<th>Measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary device variable (PV)</td>
<td>Sensor 1</td>
</tr>
<tr>
<td>Secondary device variable (SV)</td>
<td>Device temperature</td>
</tr>
<tr>
<td>Tertiary device variable (TV)</td>
<td>Sensor 1</td>
</tr>
<tr>
<td>Quaternary device variable (QV)</td>
<td>Sensor 1</td>
</tr>
</tbody>
</table>

It is possible to change the assignment of device variables to process variables in the menu Expert → Communication → HART output.
7.2 Device variables and measured values

The following measured values are assigned to the individual device variables:

<table>
<thead>
<tr>
<th>Device variable code</th>
<th>Measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Sensor 1</td>
</tr>
<tr>
<td>1</td>
<td>Sensor 2</td>
</tr>
<tr>
<td>2</td>
<td>Device temperature</td>
</tr>
<tr>
<td>3</td>
<td>Average of sensor 1 and sensor 2</td>
</tr>
<tr>
<td>4</td>
<td>Difference between sensor 1 and sensor 2</td>
</tr>
<tr>
<td>5</td>
<td>Sensor 1 (backup sensor 2)</td>
</tr>
<tr>
<td>6</td>
<td>Sensor 1 with switchover to sensor 2 if a limit value is exceeded</td>
</tr>
<tr>
<td>7</td>
<td>Average of sensor 1 and sensor 2 with backup</td>
</tr>
</tbody>
</table>

The device variables can be queried by a HART® master using HART® command 9 or 33.

7.3 Supported HART® commands

The HART® protocol enables the transfer of measuring data and device data between the HART® master and the field device for configuration and diagnostics purposes. HART® masters such as the handheld terminal or PC-based operating programs (e.g. FieldCare) need device description files (DD, DTM) which are used to access all the information in a HART® device. This information is transmitted exclusively via “commands”.

There are three different types of command:

- **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, among other things.

<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>Command No.</td>
<td>Designation</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>System integration</td>
</tr>
<tr>
<td></td>
<td>iTEMP TMT162</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>
<tr>
<td></td>
<td><strong>Common practice commands</strong></td>
</tr>
<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>36, Cmd036</td>
<td>Set primary variable upper range value</td>
</tr>
<tr>
<td>37, Cmd037</td>
<td>Set primary variable lower range value</td>
</tr>
<tr>
<td>40, Cmd040</td>
<td>Enter/Exit fixed current mode</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>51, Cmd051</td>
<td>Write 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>72, Cmd072</td>
<td>Squawk</td>
</tr>
<tr>
<td>95, Cmd095</td>
<td>Read device communications statistics</td>
</tr>
<tr>
<td>100, Cmd100</td>
<td>Write primary variable alarm code</td>
</tr>
<tr>
<td>103, Cmd103</td>
<td>Write burst period</td>
</tr>
<tr>
<td>104, Cmd104</td>
<td>Write burst trigger</td>
</tr>
<tr>
<td>105, Cmd105</td>
<td>Read burst mode configuration</td>
</tr>
<tr>
<td>107, Cmd107</td>
<td>Write burst device variables</td>
</tr>
<tr>
<td>108, Cmd108</td>
<td>Write burst mode command number</td>
</tr>
<tr>
<td>109, Cmd109</td>
<td>Burst mode control</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>
</tbody>
</table>
8 Commissioning

8.1 Post-installation check
Before commissioning the measuring point, make sure that all final checks have been carried out:
  • ‘Post-mounting check’ checklist
  • ‘Post-connection check’ checklist

8.2 Switching on the device
Once you have completed the post-connection checks, switch on the supply voltage. The transmitter performs a number of internal test functions after power-up. During this process, the following sequence of messages appears on the display:

<table>
<thead>
<tr>
<th>Step</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Text ‘Display’ and firmware version of the display</td>
</tr>
<tr>
<td>2</td>
<td>Firm logo</td>
</tr>
<tr>
<td>3</td>
<td>Device name (scrolling text)</td>
</tr>
<tr>
<td>4</td>
<td>Firmware, hardware revision, device revision and device address</td>
</tr>
<tr>
<td>5</td>
<td>For devices in SIL mode: SIL-CRC is displayed</td>
</tr>
<tr>
<td>6a</td>
<td>Current measured value or</td>
</tr>
<tr>
<td>6b</td>
<td>Current status message</td>
</tr>
</tbody>
</table>

If the switch-on procedure is not successful, the relevant diagnostic event is displayed, depending on the cause. A detailed list of diagnostic events and the corresponding troubleshooting instructions can be found in the ‘Diagnostics and troubleshooting’ section.

The device works after approx. 30 seconds! Normal measuring mode commences as soon as the switch-on procedure is completed. Measured values and status values appear on the display.

8.3 Protecting settings from unauthorized access
If the device is locked and the parameter settings cannot be changed, it must first be enabled via the hardware or software lock. The device is write-protected if the lock symbol is shown on the display.

<table>
<thead>
<tr>
<th>Command No.</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>523, Cmd523</td>
<td>Read condensed status mapping array</td>
</tr>
<tr>
<td>524, Cmd524</td>
<td>Write condensed status mapping</td>
</tr>
<tr>
<td>525, Cmd525</td>
<td>Reset condensed status map</td>
</tr>
<tr>
<td>526, Cmd526</td>
<td>Write status simulation mode</td>
</tr>
<tr>
<td>527, Cmd527</td>
<td>Simulate status bit</td>
</tr>
</tbody>
</table>
To unlock the device
- either switch the write protection switch on the back of the display to the "OFF" position (hardware write protection), or
- deactivate the software write protection via the operating tool. See the description for the 'Define device write protection' parameter. → 71

When hardware write protection is active (write protection switch set to the "ON" position), write protection cannot be disabled via the operating tool. Hardware write protection must always be disabled before software write protection can be enabled or disabled via the operating tool.
9 Diagnostics and troubleshooting

9.1 General trouble shooting

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

In the event of a serious fault, a device might have to be returned to the manufacturer for repair. Refer to the "Return" section before returning the device to Endress+Hauser.

Check display (local display)

| Display is blank - no connection to the HART host system. | 1. Check the supply voltage → terminals + and -  
| 2. Measuring electronics defective → order spare part, → 40 |
| Display is blank - however, connection has been established to the HART host system. | 1. Check whether the display module retainers are correctly seated on the electronics module → 13  
| 2. Display module defective → order spare part, → 40  
| 3. Measuring electronics defective → order spare part, → 40 |

Local error messages on the display

→ 35

Faulty connection to the fieldbus host system

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device is not responding.</td>
<td>Supply voltage does not match the voltage specified on the nameplate.</td>
<td>Apply correct voltage</td>
</tr>
<tr>
<td></td>
<td>Connecting cables are not in contact with the terminals.</td>
<td>Check the electrical contact between the cable and terminals and correct if necessary.</td>
</tr>
<tr>
<td>Output current &lt; 3.6 mA</td>
<td>Signal cable is not wired correctly.</td>
<td>Check wiring.</td>
</tr>
<tr>
<td></td>
<td>Electronics module 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>
<tr>
<td></td>
<td>Commubox is connected incorrectly.</td>
<td>Connect Commubox correctly.</td>
</tr>
</tbody>
</table>

Error messages in the configuration software

→ 36
### Application errors without status messages for RTD sensor connection

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value is incorrect/inaccurate</td>
<td>Incorrect sensor orientation.</td>
<td>Install the sensor correctly.</td>
</tr>
<tr>
<td></td>
<td>Heat conducted by sensor.</td>
<td>Observe the installed length of the sensor.</td>
</tr>
<tr>
<td></td>
<td>Device programming is incorrect (number of wires).</td>
<td>Change the <strong>Connection type</strong> device function.</td>
</tr>
<tr>
<td></td>
<td>Device programming is incorrect (scaling).</td>
<td>Change scaling.</td>
</tr>
<tr>
<td></td>
<td>Incorrect RTD configured.</td>
<td>Change the <strong>Sensor type</strong> device function.</td>
</tr>
<tr>
<td></td>
<td>Sensor connection.</td>
<td>Check that the sensor is connected correctly.</td>
</tr>
<tr>
<td></td>
<td>The cable resistance of the sensor (2-wire) was not compensated.</td>
<td>Compensate the cable resistance.</td>
</tr>
<tr>
<td></td>
<td>Offset incorrectly set.</td>
<td>Check offset.</td>
</tr>
<tr>
<td>Failure current (≤ 3.6 mA or ≥ 21 mA)</td>
<td>Faulty sensor.</td>
<td>Check the sensor.</td>
</tr>
<tr>
<td></td>
<td>Incorrect sensor connection.</td>
<td>Install the connecting cables correctly (terminal diagram).</td>
</tr>
<tr>
<td></td>
<td>Device programming is incorrect (e.g. number of wires).</td>
<td>Change the <strong>Connection type</strong> device function.</td>
</tr>
<tr>
<td></td>
<td>Incorrect programming.</td>
<td>Incorrect sensor type set in the <strong>Sensor type</strong> device function. Set the correct sensor type.</td>
</tr>
</tbody>
</table>

### Application errors without status messages for TC sensor connection

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value is incorrect/inaccurate</td>
<td>Incorrect sensor orientation.</td>
<td>Install the sensor correctly.</td>
</tr>
<tr>
<td></td>
<td>Heat conducted by sensor.</td>
<td>Observe the installed length of the sensor.</td>
</tr>
<tr>
<td></td>
<td>Device programming is incorrect (scaling).</td>
<td>Change scaling.</td>
</tr>
<tr>
<td></td>
<td>Incorrect thermocouple type (TC) configured.</td>
<td>Change the <strong>Sensor type</strong> device function.</td>
</tr>
<tr>
<td></td>
<td>Incorrect reference junction set.</td>
<td>Set the correct reference junction.</td>
</tr>
<tr>
<td></td>
<td>Interference via the thermocouple wire welded in the thermowell (interference voltage coupling).</td>
<td>Use a sensor where the thermocouple wire is not welded.</td>
</tr>
<tr>
<td></td>
<td>Offset incorrectly set.</td>
<td>Check offset.</td>
</tr>
<tr>
<td>Failure current (≤ 3.6 mA or ≥ 21 mA)</td>
<td>Faulty sensor.</td>
<td>Check the sensor.</td>
</tr>
<tr>
<td></td>
<td>Sensor is connected incorrectly.</td>
<td>Install the connecting cables correctly (terminal diagram).</td>
</tr>
<tr>
<td></td>
<td>Incorrect programming.</td>
<td>Incorrect sensor type set in the <strong>Sensor type</strong> device function. Set the correct sensor type.</td>
</tr>
</tbody>
</table>
9.2 Overview of diagnostic information

9.2.1 Displaying diagnostic events

**NOTICE**
Status signals and diagnostic behavior can be configured manually for certain diagnostic events. If a diagnostic event occurs, however, it is not guaranteed that the measured values are valid for the event and comply with the process for the status signals S and M and the diagnostic behavior: 'Warning' and 'Disabled'.

- Reset the status signal assignment to the factory setting.

### Status signals

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Event category</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Operating error</td>
<td>An operating error has occurred.</td>
</tr>
<tr>
<td>C</td>
<td>Service mode</td>
<td>The device is in the service mode (e.g. during a simulation).</td>
</tr>
<tr>
<td>S</td>
<td>Out of specification</td>
<td>The device is being operated outside its technical specifications (e.g. during startup or cleaning processes).</td>
</tr>
<tr>
<td>M</td>
<td>Maintenance required</td>
<td>Maintenance is required.</td>
</tr>
<tr>
<td>N</td>
<td>Not categorized</td>
<td></td>
</tr>
</tbody>
</table>

- If a valid measured value is not available, the display alternates between "- - - - -" and the error message plus the defined error number and the ‘△’ symbol.
- If a valid measured value is present, the display alternates between the status plus the defined error number (7-segment display) and the primary measured value (PV) with the ‘△’ symbol.

### Diagnostic behavior

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Measurement is interrupted. The signal outputs adopt the defined alarm condition. A diagnostic message is generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning</td>
<td>The device continues to measure. A diagnostic message is generated.</td>
</tr>
<tr>
<td>Disabled</td>
<td>The diagnosis is completely disabled even if the device is not recording a measured value.</td>
</tr>
</tbody>
</table>
**Diagnostic event and event text**

The fault can be identified by means of the diagnostic event. The event text helps you by providing information about the fault.

<table>
<thead>
<tr>
<th>Diagnostic event</th>
<th>Status signal</th>
<th>Event number</th>
<th>Event text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>F</td>
<td>042</td>
<td>Sensor corroded</td>
</tr>
</tbody>
</table>

If several diagnostic events are pending at the same time, only the diagnostic message with the highest priority is displayed. Additional pending diagnostic messages are shown in the Diagnostic list submenu →  83. The status signal dictates the priority in which the diagnostic messages are displayed. The following order of priority applies: F, C, S, M. If two or more diagnostic events with the same status signal are active simultaneously, the numerical order of the event number dictates the order of priority in which the events are displayed, e.g.: F042 appears before F044 and before S044.

Past diagnostic messages that are no longer pending are shown in the Event logbook submenu →  84.

**9.3 Diagnostic list**

Each diagnostic event is assigned a certain event behavior at the factory. The user can change this assignment for certain diagnostic events.

**Example:**

<table>
<thead>
<tr>
<th>Configuration examples</th>
<th>Diagnostic number</th>
<th>Status signal</th>
<th>Diagnostic behavior from the factory</th>
<th>Status signal (output via HART® communication)</th>
<th>Current output</th>
<th>PV, status</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Default setting</td>
<td>047</td>
<td>S</td>
<td>Warning</td>
<td>S</td>
<td>Measured value</td>
<td>Measured value, UNCERTAIN</td>
<td>S047</td>
</tr>
<tr>
<td>2. Manual setting: status signal S changed to F</td>
<td>047</td>
<td>F</td>
<td>Warning</td>
<td>F</td>
<td>Measured value</td>
<td>Measured value, UNCERTAIN</td>
<td>F047</td>
</tr>
<tr>
<td>4. Manual setting: Warning changed to Disabled</td>
<td>047</td>
<td>S 1)</td>
<td>Disabled</td>
<td>S 2)</td>
<td>Last valid measured value 3)</td>
<td>Last valid measured value, GOOD</td>
<td>S047</td>
</tr>
</tbody>
</table>

1) Setting is not relevant.
2) Status signal is not displayed.
3) The failure current is output if no valid measured value is available.

The relevant sensor input for these diagnostic events can be identified with the Actual diag channel parameter or on the display.
## Diagnostics and troubleshooting

### Diagnostics for the sensor

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Short text</th>
<th>Corrective measure</th>
<th>Status signal from the factory</th>
<th>Customizable 1)</th>
<th>Diagnosti c behavior from the factory</th>
<th>Customizable 2)</th>
</tr>
</thead>
</table>
| 001               | Device failure - sensor n (sensor RJ) | 1. Restart device  
2. Replace electronics | F | ☒ | ☒ | ☒ |
| 041               | Sensor interrupted - sensor n | 1. Check electrical wiring.  
2. Replace sensor.  
3. Check connection type. | F | ☒ | ☒ | ☒ |
| 042               | Sensor n corroded | 1. Check sensor.  
2. Replace sensor. | M | ☒ | ☒ | ☒ |
| 043               | Short-circuit sensor n | 1. Check electrical connection.  
2. Check sensor.  
3. Replace sensor or cable. | F | ☒ | ☒ | ☒ |
| 044               | Sensor drift detected | 1. Check sensor or main electronics.  
2. Replace sensor or main electronics. | M | ☒ | ☒ | ☒ |
| 047               | Sensor limit reached sensor n (sensor RJ) | 1. Check sensor.  
2. Check process conditions. | S | ☒ | ☒ | ☒ |
| 048               | Drift detection not possible | 1. Check electrical connection.  
2. Check sensor.  
3. Replace sensor. | M | ☒ | ☒ | ☒ |
| 062               | Sensor connection faulty sensor n (sensor RJ) | Check sensor connection. | F | ☒ | ☒ | ☒ |
| 105               | Calibration interval | 1. Execute calibration and reset calibration interval.  
2. Switch off calibration counter. | M | ☒ | ☒ | ☒ |
| 145               | Compensation reference point sensor n | 1. Check terminal temperature.  
2. Check external reference measuring point. | F | ☒ | ☒ | ☒ |

### Diagnostics for the electronics

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Short text</th>
<th>Corrective measure</th>
<th>Status signal from the factory</th>
<th>Customizable 1)</th>
<th>Diagnosti c behavior from the factory</th>
<th>Customizable 2)</th>
</tr>
</thead>
</table>
| 201               | Electronics faulty | 1. Restart device.  
2. Replace electronics. | F | ☒ | ☒ | ☒ |
| 221               | Reference sensor defective sensor RJ | Replace device. | M | ☒ | ☒ | ☒ |
| 241               | Firmware faulty | 1. Restart device.  
2. Power cycle device.  
3. Replace electronics. | F | ☒ | ☒ | ☒ |
| 242               | Firmware incompatible | 1. Check firmware version.  
2. Flash or replace main electronics. | F | ☒ | ☒ | ☒ |
| 261               | Electronics module is defective | 1. Restart device.  
2. Replace main electronics module. | F | ☒ | ☒ | ☒ |
| 283               | Memory content inconsistent | 1. Restart device.  
2. Replace electronics. | F | ☒ | ☒ | ☒ |
| 286               | Data storage inconsistent | 1. Repeat safe parameter configuration.  
2. Replace electronics. | F | ☒ | ☒ | ☒ |

### Diagnostics for the configuration

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Short text</th>
<th>Status signal from the factory</th>
<th>Customizable 1)</th>
<th>Diagnosti c behavior from the factory</th>
<th>Customizable 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>401</td>
<td>Factory reset active</td>
<td>Factory reset in progress, please wait.</td>
<td>C</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Diagnostic number</td>
<td>Short text</td>
<td>Corrective measure</td>
<td>Status signal from the factory</td>
<td>Customizable 1)</td>
<td>Diagnostics behavior from the factory</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>----------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>402</td>
<td>Initialization active sensor n (sensor RJ)</td>
<td>Initialization in progress, please wait</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>410</td>
<td>Data transfer failed</td>
<td>1. Check connection. 2. Repeat data transfer.</td>
<td>F</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
</tr>
<tr>
<td>411</td>
<td>Upload/download active</td>
<td>Upload/download in progress, please wait.</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>412</td>
<td>Download active</td>
<td>Download active, please wait</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>435</td>
<td>Linearization faulty sensor n (sensor RJ)</td>
<td>Check linearization.</td>
<td>F</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
</tr>
<tr>
<td>438</td>
<td>Dataset different</td>
<td>1. Check data set file. 2. Check device configuration. 3. Download new device configuration.</td>
<td>M</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>439</td>
<td>Dataset</td>
<td>Repeat safe parameter configuration</td>
<td>F</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
</tr>
<tr>
<td>485</td>
<td>Process variable simulation active sensor n (device temperature)</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>491</td>
<td>Current output simulation</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>495</td>
<td>Diagnostic event simulation active</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
<tr>
<td>531</td>
<td>Factory adjustment missing sensor n (current output)</td>
<td>1. Contact service organization. 2. Replace device.</td>
<td>F</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
</tr>
<tr>
<td>537</td>
<td>Configuration sensor n (current output)</td>
<td>1. Check device configuration 2. Upload and download new configuration. (In case of current output: check configuration of analog output.)</td>
<td>F</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
</tr>
<tr>
<td>583</td>
<td>Input simulation sensor n</td>
<td>Deactivate simulation.</td>
<td>C</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
</tr>
</tbody>
</table>

**Diagnostics for the process**

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Short text</th>
<th>Corrective measure</th>
<th>Status signal from the factory</th>
<th>Customizable</th>
<th>Diagnostics behavior from the factory</th>
<th>Corrective measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>801</td>
<td>Supply voltage too low 4)</td>
<td>Increase supply voltage.</td>
<td>S</td>
<td>Cannot be adjusted</td>
<td>Alarm</td>
<td>Cannot be adjusted</td>
</tr>
<tr>
<td>825</td>
<td>Operating temperature</td>
<td>1. Check ambient temperature. 2. Check process temperature.</td>
<td>S</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
<td>Cannot be adjusted</td>
</tr>
<tr>
<td>844</td>
<td>Process value out of specification-current output</td>
<td>1. Check process value. 2. Check application. Check sensor.</td>
<td>S</td>
<td>Cannot be adjusted</td>
<td>Warning</td>
<td>Cannot be adjusted</td>
</tr>
</tbody>
</table>

1) Can be set to F, C, S, M, N  
2) Can be set to 'Alarm', 'Warning' and 'Disabled'  
3) n = number of sensor inputs (1 and 2)  
4) With this diagnostic event, the device always outputs a 'low' alarm status (output current ≤ 3.6 mA).
9.4 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. The device and Operating Instructions change.

YY Change to functions and operation. Compatible. The Operating Instructions change.

ZZ Fixes and internal changes. No changes to the Operating Instructions.

<table>
<thead>
<tr>
<th>Date</th>
<th>Firmware version</th>
<th>Changes</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/2017</td>
<td>04.01.zz</td>
<td>HART protocol version 7.6 and addition of operating parameters for functional safety (SIL3)</td>
<td>BA01801T/09/en/01.17</td>
</tr>
<tr>
<td>09/2023</td>
<td>--</td>
<td>--</td>
<td>BA01801T/09/en/03.23</td>
</tr>
</tbody>
</table>

10 Maintenance

No special maintenance work is required for the temperature transmitter.

10.1 Cleaning

A clean, dry cloth can be used to clean the device.
11  Repair

11.1  General notes

Repairs that are not described in these Operating Instructions must only be carried out directly by the manufacturer or by the service department.

11.2  Spare parts

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

---

### Field transmitter spare parts

<table>
<thead>
<tr>
<th>Item no. 1</th>
<th>Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Certificates:</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Material:</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>G</td>
</tr>
<tr>
<td></td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Cable entry:</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
## Item no. 1

<table>
<thead>
<tr>
<th>Housing</th>
<th>Item no. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2 x thread G 1/2&quot; + terminal block + 1 dummy plug</td>
<td></td>
</tr>
<tr>
<td><strong>Version:</strong></td>
<td></td>
</tr>
<tr>
<td>A Standard</td>
<td></td>
</tr>
<tr>
<td>A order code</td>
<td></td>
</tr>
</tbody>
</table>

**Item no. 4**

<table>
<thead>
<tr>
<th>Electronics module</th>
<th>Certificates:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Non-hazardous area</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>ATEX Ex ia, FM IS, CSA IS</td>
</tr>
<tr>
<td><strong>Sensor input; communication:</strong></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1x; HART 5, FW 01.03.zz, DevRev02</td>
</tr>
<tr>
<td>B</td>
<td>2x; HART 5, FW 01.03.zz, DevRev02, config. output sensor 1</td>
</tr>
<tr>
<td>C</td>
<td>2x; FOUNDATION Fieldbus Device Revision 1</td>
</tr>
<tr>
<td>D</td>
<td>2x; PROFIBUS PA, DevRev02</td>
</tr>
<tr>
<td>E</td>
<td>2x; FOUNDATION Fieldbus FW 01.01.zz, Device Revision 2</td>
</tr>
<tr>
<td>F</td>
<td>2x; FOUNDATION Fieldbus FW 02.00.zz, Device Revision 3</td>
</tr>
<tr>
<td>G</td>
<td>1x; HART7, Fw 04.01.zz, DevRev04</td>
</tr>
<tr>
<td>H</td>
<td>2x; HART7, Fw 04.01.zz, DevRev04, config. output sensor 1</td>
</tr>
<tr>
<td><strong>Configuration:</strong></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>50 Hz mains filter</td>
</tr>
<tr>
<td>B</td>
<td>Produced as per original order (quote serial number) 50 Hz mains filter</td>
</tr>
<tr>
<td>K</td>
<td>60 Hz mains filter</td>
</tr>
<tr>
<td>L</td>
<td>Produced as per original order (quote serial number) 60 Hz mains filter</td>
</tr>
</tbody>
</table>

**Order codes**

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Order code</th>
<th>Spare parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>TMT162X-DA</td>
<td>Display HART 5 + retainer + twist protection</td>
</tr>
<tr>
<td>2.3</td>
<td>TMT162X-DB</td>
<td>Display PA/FF + retainer + twist protection</td>
</tr>
<tr>
<td>2.3</td>
<td>TMT162X-DC</td>
<td>Display retainer + twist protection</td>
</tr>
<tr>
<td>2.3</td>
<td>TMT162X-DD</td>
<td>Display HART 7 + retainer + twist protection</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HH</td>
<td>Housing cover blind, aluminum Ex d, FM XP with seal, CSA approval, only as cover of connection compartment</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HI</td>
<td>Housing cover blind, aluminum + seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HK</td>
<td>Housing cover cpl. display, aluminum Ex d with seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HL</td>
<td>Housing cover cpl. display, aluminum with seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HA</td>
<td>Housing cover blind, stainless steel 316L Ex d, ATEX Ex d, FM XP with seal, CSA approval, only as cover of connection compartment</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HB</td>
<td>Housing cover blind, stainless steel 316L, with seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HC</td>
<td>Housing cover cpl. display, Ex d, stainless steel 316L, ATEX Ex d, FM XP, CSA XP, with seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HD</td>
<td>Housing cover cpl. display, stainless steel 316L, with seal</td>
</tr>
<tr>
<td>5</td>
<td>TMT162X-HF</td>
<td>Housing cover cpl. display, polycarbonate, 316L</td>
</tr>
</tbody>
</table>
### 11.3 Return

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

1. Refer to the website for more information:
   [http://www.endress.com/support/return-material](http://www.endress.com/support/return-material)

2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

### 11.4 Disposal

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

### 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](http://www.endress.com).

Always quote the serial number of the device when ordering accessories!

#### 12.1 Device-specific accessories

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy plugs</td>
<td>• M20x1.5 EEx-d/XP&lt;br&gt;• G ½&quot; EEx-d/XP&lt;br&gt;• NPT ¼&quot; ALU&lt;br&gt;• NPT ¼&quot; V4A</td>
</tr>
<tr>
<td>Cable glands</td>
<td>• M20x1.5&lt;br&gt;• NPT ½&quot; D4-8.5, IP68&lt;br&gt;• NPT ¼&quot; cable gland 2 x D0.5 cable for 2 sensors&lt;br&gt;• M20x1.5 cable gland 2 x D0.5 cable for 2 sensors</td>
</tr>
<tr>
<td>Adapter for cable gland</td>
<td>M20x1.5 outside/M24x1.5 inside</td>
</tr>
<tr>
<td>Wall and pipe mounting</td>
<td>Wall and pipe mounting bracket&lt;br&gt;Stainless steel wall/2&quot; pipe&lt;br&gt;Stainless steel 2&quot; pipe V4A</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>The module protects the electronics from overvoltage.</td>
</tr>
</tbody>
</table>
12.2 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 |
| Configurator | Product Configurator - the tool for individual product configuration  
- Up-to-the-minute configuration data  
- Depending on the device: direct input of information specific to the measuring 
point, such as the measuring range or operating language  
- Automatic verification of exclusion criteria  
- Automatic creation of the order code and its breakdown in PDF or Excel output 
format  
- Ability to order directly in the Endress+Hauser Online Shop  
The Product Configurator is available on the Endress+Hauser website:  
www.endress.com-> 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. |
| 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 |

12.3 System products

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
</table>
| Graphic Data Manager Memograph M | 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 
terminally interconnected.  
For details, see Technical Information TI01180R/09 |
| RN22 | Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard 
signal circuits with bidirectional HART® transmission. In the signal duplicator 
option, the input signal is transmitted to two galvanically isolated outputs. The 
device has one active and one passive current input; the outputs can be operated 
actively or passively. The RN22 requires a supply voltage of 24 VDC.  
For details, see Technical Information TI01515K |
### Accessories

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN42</td>
<td>Single-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART® transmission. The device has one active and one passive current input; the outputs can be operated actively or passively. The RN42 can be powered with a wide range voltage of 24 to 230 V&lt;sub&gt;AC/DC&lt;/sub&gt;. For details, see Technical Information TI01584K.</td>
</tr>
</tbody>
</table>
| RID14/RID16 | Field indicator with 8 input channels and FOUNDATION Fieldbus™ or PROFIBUS® PA protocol for displaying process values and calculated values. Onsite display of process parameters in fieldbus systems. For details:  
  - Technical Information RID16: TI00146R  
  - Technical Information RID14: TI00145R |
# 13 Technical data

## 13.1 Input

Measured variable: Temperature (temperature-linear transmission behavior), resistance and voltage.

### Measuring range

It is possible to connect two sensors that are independent of one another \(^1\). The measuring inputs are not galvanically isolated from each other.

<table>
<thead>
<tr>
<th>Resistance thermometer (RTD) as per standard</th>
<th>Description</th>
<th>α</th>
<th>Measuring range limits</th>
<th>Min. span</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60751:2008</td>
<td>Pt100 (1)</td>
<td>0.003851</td>
<td>-200 to +850 °C (−328 to +1562 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>IEC 60751:2008</td>
<td>Pt200 (2)</td>
<td></td>
<td>-200 to +850 °C (−328 to +1562 °F)</td>
<td></td>
</tr>
<tr>
<td>IEC 60751:2008</td>
<td>Pt500 (3)</td>
<td></td>
<td>-200 to +500 °C (−328 to +932 °F)</td>
<td></td>
</tr>
<tr>
<td>IEC 60751:2008</td>
<td>Pt1000 (4)</td>
<td></td>
<td>-200 to +250 °C (−328 to +482 °F)</td>
<td></td>
</tr>
<tr>
<td>JIS C1606:1984</td>
<td>Pt100 (5)</td>
<td>0.003916</td>
<td>-200 to +510 °C (−328 to +950 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>DIN 43760 IPTS-68</td>
<td>Ni100 (6)</td>
<td>0.006180</td>
<td>-200 to +500 °C (−328 to +932 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>DIN 43760 IPTS-68</td>
<td>Ni120 (7)</td>
<td></td>
<td>-200 to +250 °C (−328 to +482 °F)</td>
<td></td>
</tr>
<tr>
<td>GOST 6651-94</td>
<td>Pt50 (8)</td>
<td>0.003910</td>
<td>-185 to +1100 °C (−301 to +2012 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>GOST 6651-94</td>
<td>Pt100 (9)</td>
<td></td>
<td>-200 to +850 °C (−328 to +1562 °F)</td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-2009</td>
<td>Cu50 (10)</td>
<td>0.004280</td>
<td>-180 to +200 °C (−292 to +392 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-2009</td>
<td>Cu100 (11)</td>
<td></td>
<td>-180 to +200 °C (−292 to +392 °F)</td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-94</td>
<td>Ni100 (11)</td>
<td>0.006170</td>
<td>-60 to +180 °C (−76 to +356 °F)</td>
<td>10 K (18 °F)</td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-94</td>
<td>Ni120 (13)</td>
<td></td>
<td>-60 to +180 °C (−76 to +356 °F)</td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-94</td>
<td>Cu50 (14)</td>
<td>0.004260</td>
<td>-50 to +200 °C (−58 to +392 °F)</td>
<td>10 K (18 °F)</td>
</tr>
</tbody>
</table>

- Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA
- With 2-wire circuit, compensation of the wire resistance is possible (0 to 30 Ω)
- With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire

<table>
<thead>
<tr>
<th>Thermocouples as per standard</th>
<th>Description</th>
<th>Measuring range limits</th>
<th>Min. span</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type A (W5Re-W20Re) (30)</td>
<td>0 to +2500 °C (+32 to +4532 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type B (PtRh30-PtRh6) (31)</td>
<td>+40 to +1820 °C (+104 to +3308 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type E (NiCr-CuNi) (34)</td>
<td>-250 to +1000 °C (−418 to +1832 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type J (Fe-CuNi) (35)</td>
<td>-210 to +1200 °C (−346 to +2192 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type K (NiCr-Ni) (36)</td>
<td>-270 to +1372 °C (−454 to +2501 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type N (NiCrSi-NiSi) (37)</td>
<td>-270 to +1300 °C (−454 to +2372 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type R (PtRh13-Pt) (38)</td>
<td>-50 to +1768 °C (−58 to +3214 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type S (PtRh10-Pt) (39)</td>
<td>-50 to +1768 °C (−58 to +3214 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type T (Cu-CuNi) (40)</td>
<td>-200 to +400 °C (−328 to +752 °F)</td>
<td>50 K (90 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1 ASTM E230-3</td>
<td>Type C (W5Re-W26Re) (32)</td>
<td>0 to +2315 °C (+32 to +4199 °F)</td>
<td>50 K (90 °F)</td>
</tr>
</tbody>
</table>

1) In the case of 2-channel measurement the same measuring unit must be configured for the two channels (e.g. both °C or F or K). Independent 2-channel measurement of a resistance transmitter (Ohm) and voltage transmitter (mV) is not possible.
### Thermocouples as per standard

<table>
<thead>
<tr>
<th>Description</th>
<th>Measuring range limits</th>
<th>Min. span</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM E988-96 Type D (W3Re-W25Re) (33)</td>
<td>0 to +2315 °C (+32 to +4199 °F)</td>
<td>0 to +2000 °C (+32 to +3632 °F)</td>
</tr>
<tr>
<td>DIN 43710 Type L (Fe-CuNi) (41)</td>
<td>-200 to +900 °C (-328 to +1652 °F)</td>
<td>-150 to +900 °C (-238 to +1652 °F)</td>
</tr>
<tr>
<td>DIN 43710 Type U (Cu-CuNi) (42)</td>
<td>-200 to +600 °C (-328 to +1112 °F)</td>
<td>-150 to +600 °C (-238 to +1112 °F)</td>
</tr>
<tr>
<td>GOST R8.585-2001 Type L (NiCr-CuNi) (43)</td>
<td>-200 to +800 °C (-328 to +1472 °F)</td>
<td>-200 to +800 °C (+328 to +1472 °F)</td>
</tr>
</tbody>
</table>

- Internal reference junction (Pt100)
- External reference junction: configurable value -40 to +85 °C (-40 to +185 °F)
- Maximum sensor wire resistance 10 kΩ (If the sensor wire resistance is greater than 10 kΩ, an error message is output in accordance with NAMUR NE89.)

### Voltage transmitter (mV)

| Millivolt transmitter (mV) | -20 to 100 mV | 5 mV |

### Type of input

The following connection combinations are possible when both sensor inputs are assigned:

<table>
<thead>
<tr>
<th>Sensor input 1</th>
<th>RTD or resistance transmitter, 2-wire</th>
<th>RTD or resistance transmitter, 3-wire</th>
<th>RTD or resistance transmitter, 4-wire</th>
<th>Thermocouple (TC), voltage transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor input 2</td>
<td>RTD or resistance transmitter, 2-wire</td>
<td>☑️</td>
<td>☑️</td>
<td>-</td>
</tr>
<tr>
<td>RTD or resistance transmitter, 3-wire</td>
<td>☑️</td>
<td>☑️</td>
<td>-</td>
<td>☑️</td>
</tr>
<tr>
<td>RTD or resistance transmitter, 4-wire</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thermocouple (TC), voltage transmitter</td>
<td>☑️</td>
<td>☑️</td>
<td>☑️</td>
<td>☑️</td>
</tr>
</tbody>
</table>

### 13.2 Output

#### Output signal

- Analog output: 4 to 20 mA, 20 to 4 mA (can be inverted)
- Signal encoding: FSK ±0.5 mA via current signal
- Data transmission rate: 1200 baud
- Galvanic isolation: U = 2 kV AC, 1 min. (input/output)

#### 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 failure; sensor short-circuit: ≤ 3.6 mA (‘low’) or ≥ 21 mA (‘high’), can be selected. The ‘high’ alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.
### Technical data

#### Load

\[ R_{\text{max}} = \left( U_{\text{b max.}} - 11.5 \text{ V} \right) / 0.023 \text{ A (current output)} \]

<table>
<thead>
<tr>
<th>( U_b )</th>
<th>1348</th>
<th>1098</th>
<th>750</th>
<th>11.5 V0</th>
<th>36.25 V</th>
<th>17.25 V</th>
</tr>
</thead>
</table>

1. Supply voltage \( U_b \) (VDC)
2. Load (Ω)

#### Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

#### Mains filter

50/60 Hz

#### Filter

1st order digital filter: 0 to 120 s

#### Protocol-specific data

<table>
<thead>
<tr>
<th>Manufacturer ID</th>
<th>17 (0x11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device type ID</td>
<td>0x11CE</td>
</tr>
<tr>
<td>HART\textsuperscript{a} specification</td>
<td>7.6</td>
</tr>
<tr>
<td>Device address in the multi-drop mode (^1)</td>
<td>Software setting addresses 0 to 63</td>
</tr>
</tbody>
</table>

#### HART load

Min. 250 Ω

#### HART device variables

The measured values can be freely assigned to the device variables.

- Measured values for PV, SV, TV and QV (first, second, third and fourth device variable)
- Sensor 1 (measured value)
- Sensor 2 (measured value)
- Device temperature
- Average of the two measured values: 0.5 x (SV1+SV2)
- Difference between sensor 1 and sensor 2: SV1-SV2
- Sensor 1 (backup sensor 2): If sensor 1 fails, the value of sensor 2 automatically becomes the primary HART\textsuperscript{a} value (PV): sensor 1 (OR sensor 2)
- Sensor switching: If the value exceeds the configured threshold value T for sensor 1, the measured value of sensor 2 becomes the primary HART\textsuperscript{a} value (PV). The system switches back to sensor 1 if the measured value of sensor 1 is at least 2 K below T: sensor 1 (sensor 2, if sensor 1 > T)
- Average: 0.5 x (SV1+SV2) with backup (measured value of sensor 1 or sensor 2 in the event of a sensor error in the other sensor)

#### Supported functions

- Burst mode \(^1\)
- Squawk
- Condensed status

1) Not possible in the SIL mode, see Functional Safety Manual SD01632T

#### Wireless HART data

<table>
<thead>
<tr>
<th>Minimum starting voltage</th>
<th>11.5 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting current</td>
<td>3.58 mA</td>
</tr>
<tr>
<td>Technical data</td>
<td>iTEMP TMT162</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>

### Starting time
- Normal operation: 6 s
- SIL mode: 29 s

### Minimum operating voltage
11.5 V

### Multidrop current
4.0 mA

### Time for connection setup
- Normal operation: 9 s
- SIL mode: 10 s

1) No Multidrop current in SIL mode

### Write protection for device parameters
- Hardware: Write protection using DIP switch on electronics module in the device
- Software: Write protection using password

### Switch-on delay
- Until the start of HART® communication, approx. 10 s, while switch-on delay = \( I_s \) ≤ 3.6 mA
- Until the first valid measured value signal is present at the current output, approx. 28 s, while switch-on delay = \( I_s \) ≤ 3.6 mA

### 13.3 Power supply

#### Supply voltage
Values for non-hazardous areas, protected against polarity reversal:
- 11.5 V ≤ Vcc ≤ 42 V (standard)
- I ≤ 23 mA

Values for hazardous area, see Ex documentation.

The transmitter must be powered by a power supply 11.5 to 42 V in accordance with NEC Class 02 (low voltage/low current) with restricted power limited to 8 A/150 VA in the event of a short circuit (in accordance with IEC 61010-1, CSA 1010.1-92).

The device may only be powered by a power unit with an energy-limited circuit in accordance with UL/EN/IEC 61010-1, Section 9.4 and the requirements of Table 18.

#### Current consumption

<table>
<thead>
<tr>
<th>Current consumption</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum current consumption</td>
<td>≤ 3.5 mA Multidrop mode 4 mA (not possible in SIL mode)</td>
</tr>
<tr>
<td>Current limit</td>
<td>≤ 23 mA</td>
</tr>
</tbody>
</table>

#### Terminals
2.5 mm² (12 AWG) plus ferrule

#### Cable entries

<table>
<thead>
<tr>
<th>Version</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread</td>
<td>2x thread ( \frac{1}{2} ) NPT</td>
</tr>
<tr>
<td></td>
<td>2x thread M20</td>
</tr>
<tr>
<td></td>
<td>2x thread G( \frac{1}{4})&quot;</td>
</tr>
<tr>
<td>Cable gland</td>
<td>2x coupling M20</td>
</tr>
</tbody>
</table>

#### Residual ripple
Permanent residual ripple \( U_{55} \leq 3 \) V at \( U_b \geq 13.5 \) V, \( f_{\text{max}} = 1 \) kHz

#### Overvoltage protection
The surge arrester can be ordered as an optional extra. The module protects the electronics from damage from overvoltage. Overvoltage occurring in signal cables (e.g. 4 to 20 mA,
communication lines (fieldbus systems) and power supply is diverted to ground. The functionality of the transmitter is not affected as no problematic voltage drop occurs.

**Connection data:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum continuous voltage (rated voltage)</td>
<td>$U_C = 42 \text{ V}_{\text{DC}}$</td>
</tr>
<tr>
<td>Nominal current</td>
<td>$I = 0.5 \text{ A at } T_{\text{amb.}} = 80 ^\circ \text{C} (176 ^\circ \text{F})$</td>
</tr>
<tr>
<td>Surge current resistance</td>
<td></td>
</tr>
<tr>
<td>• Lightning surge current D1 (10/350 µs)</td>
<td>$I_{\text{imp}} = 1 \text{ kA (per wire)}$</td>
</tr>
<tr>
<td>• Nominal discharge current C1/C2 (8/20 µs)</td>
<td>$I_n = 5 \text{ kA (per wire)}$</td>
</tr>
<tr>
<td>•</td>
<td>$I_n = 10 \text{ kA (total)}$</td>
</tr>
<tr>
<td>Series resistance per wire</td>
<td>$1.8 \Omega$, tolerance $\pm 5 %$</td>
</tr>
</tbody>
</table>

![Electrical connection of surge arrester](image)

16 Electrical connection of surge arrester

1 Sensor 1
2 Sensor 2
3 Bus connection and power supply

**Grounding**

The device must be connected to the potential equalization. The connection between the housing and the local ground must have a minimum cross-section of 4 mm$^2$ (13 AWG). All ground connections must be secured tightly.

13.4 Performance characteristics

**Response time**

The measured value update depends on the type of sensor and connection method and moves within the following ranges:

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance temperature detector (RTD)</td>
<td>0.9 to 1.3 s (depends on the connection method 2/3/4-wire)</td>
</tr>
<tr>
<td>Thermocouples (TC)</td>
<td>0.8 s</td>
</tr>
<tr>
<td>Reference temperature</td>
<td>0.9 s</td>
</tr>
</tbody>
</table>

When recording step responses, take into account that the times for the measurement of the second channel and the internal reference measuring point are added to the specified times where applicable.

**Reference operating conditions**

- Calibration temperature: $+25 ^\circ \text{C} \pm 3 \text{ K (77 ^\circ \text{F} \pm 5.4 ^\circ \text{F})}$
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment
Maximum measurement error

In accordance with DIN EN 60770 and the reference conditions specified above. The measurement error data correspond to ±2 σ (Gaussian distribution), i.e. 95.45%. The data include non-linearities and repeatability.

### Typical

#### Resistance thermometer (RTD) as per standard

<table>
<thead>
<tr>
<th>Standard</th>
<th>Designation</th>
<th>Measuring range</th>
<th>Typical measurement error (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60751:2008</td>
<td>Pt100 (1)</td>
<td>0 to +200 °C (32 to +392 °F)</td>
<td>Digital value 1)</td>
</tr>
<tr>
<td>IEC 60751:2008</td>
<td>Pt1000 (4)</td>
<td></td>
<td>Value at current output</td>
</tr>
<tr>
<td>GOST 6651-94</td>
<td>Pt100 (9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard</th>
<th>Designation</th>
<th>Measuring range</th>
<th>Typical measurement error (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60751:2008</td>
<td>Pt200 (2)</td>
<td>-200 to +850 °C</td>
<td>Digital value 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +1562 °F)</td>
<td>Value at current output</td>
</tr>
<tr>
<td></td>
<td>Pt500 (3)</td>
<td>-200 to +500 °C</td>
<td>ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +932 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Pt1000 (4)</td>
<td>-200 to +250 °C</td>
<td>ME = ± (0.03 °C (0.05 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +482 °F)</td>
<td>ME = ± (0.02 °C (0.04 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td>JIS C1604:1984</td>
<td>Pt100 (5)</td>
<td>-200 to +510 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +950 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td>GOST 6651-94</td>
<td>Pt50 (8)</td>
<td>-185 to +100 °C</td>
<td>ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-301 to +2012 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Pt100 (9)</td>
<td>-200 to +850 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +1562 °F)</td>
<td>ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td>DIN 43760 IPTS-68</td>
<td>Ni100 (6)</td>
<td>-60 to +250 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni120 (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003 / GOST 6651-2009</td>
<td>Cu50 (10)</td>
<td>-180 to +200 °C</td>
<td>ME = ± (0.10 °C (0.18 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Cu100 (11)</td>
<td>-180 to +200 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-292 to +392 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni100 (12)</td>
<td>-60 to +180 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni120 (13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-94</td>
<td>Cu50 (14)</td>
<td>-50 to +200 °C</td>
<td>ME = ± (0.1 °C (0.18 °F) + 0.004% * (MV - LRV))</td>
</tr>
</tbody>
</table>

1) Measured value transmitted via HART®.

#### Thermocouples (TC) as per standard

<table>
<thead>
<tr>
<th>Standard</th>
<th>Designation</th>
<th>Measuring range</th>
<th>Typical measurement error (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60584, Part 1</td>
<td>Type K (NiCr-Ni) (36)</td>
<td>0 to +800 °C</td>
<td>0.22 °C (0.4 °F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-32 to +1472 °F)</td>
<td>0.24 °C (0.43 °F)</td>
</tr>
<tr>
<td>IEC 60584, Part 1</td>
<td>Type S (PtRh10-Pt) (39)</td>
<td>0.17 °C (0.3 °F)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.33 °C (2.4 °F)</td>
</tr>
<tr>
<td>GOST R8.585-2001</td>
<td>Type L (NiCr-CuNi) (43)</td>
<td>2.0 °C (3.6 °F)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.4 °C (4.32 °F)</td>
</tr>
</tbody>
</table>

#### Measurement error for resistance thermometers (RTD) and resistance transmitters

<table>
<thead>
<tr>
<th>Standard</th>
<th>Designation</th>
<th>Measuring range</th>
<th>Measured error (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60751:2008</td>
<td>Pt100 (1)</td>
<td>-200 to +850 °C</td>
<td>ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +1562 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Pt200 (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pt500 (3)</td>
<td>-200 to +500 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +932 °F)</td>
<td>ME = ± (0.03 °C (0.05 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Pt1000 (4)</td>
<td>-200 to +250 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +482 °F)</td>
<td>ME = ± (0.02 °C (0.04 °F) + 0.012% * (MV - LRV))</td>
</tr>
<tr>
<td>JIS C1604:1984</td>
<td>Pt100 (5)</td>
<td>-200 to +510 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +950 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td>GOST 6651-94</td>
<td>Pt50 (8)</td>
<td>-185 to +100 °C</td>
<td>ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-301 to +2012 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Pt100 (9)</td>
<td>-200 to +850 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-328 to +1562 °F)</td>
<td>ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td>DIN 43760 IPTS-68</td>
<td>Ni100 (6)</td>
<td>-60 to +250 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni120 (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003 / GOST 6651-2009</td>
<td>Cu50 (10)</td>
<td>-180 to +200 °C</td>
<td>ME = ± (0.10 °C (0.18 °F) + 0.006% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Cu100 (11)</td>
<td>-180 to +200 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-292 to +392 °F)</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni100 (12)</td>
<td>-60 to +180 °C</td>
<td>ME = ± (0.05 °C (0.09 °F) + 0.005% * (MV - LRV))</td>
</tr>
<tr>
<td></td>
<td>Ni120 (13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIML R84: 2003, GOST 6651-94</td>
<td>Cu50 (14)</td>
<td>-50 to +200 °C</td>
<td>ME = ± (0.1 °C (0.18 °F) + 0.004% * (MV - LRV))</td>
</tr>
</tbody>
</table>

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal.
3) Deviations from maximum measurement error possible due to rounding.
**Measurement error for thermocouples (TC) and voltage transmitters**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Designation</th>
<th>Measuring range</th>
<th>Measured error (°)</th>
<th>D/A ²¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Digital ¹)</td>
<td>D/A ²¹</td>
</tr>
<tr>
<td>IEC 60584-1</td>
<td>Type A (30)</td>
<td>0 to +2500 °C (+32 to +4532 °F)</td>
<td>ME = ± (0.08 °C (0.14 °F) + 0.018% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td>ASTM E230-3</td>
<td>Type B (31)</td>
<td>+500 to +1820 °C (+932 to +308 °F)</td>
<td>ME = ± (1.23 °C (2.14 °F) - 0.05% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td>IEC 60584-1</td>
<td>Type C (32)</td>
<td>0 to +2000 °C (+32 to +3632 °F)</td>
<td>ME = ± (0.5 °C (0.9 °F) + 0.005% * MV - LRV))</td>
<td></td>
</tr>
<tr>
<td>ASTM E988-96</td>
<td>Type D (33)</td>
<td></td>
<td>ME = ± (0.63 °C (1.13 °F) + 0.007% * MV - LRV))</td>
<td></td>
</tr>
<tr>
<td>DIN 43710</td>
<td>Type E (34)</td>
<td>−150 to +1000 °C (−238 to +1832 °F)</td>
<td>ME = ± (0.19 °C (0.33 °F) - 0.006% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type J (35)</td>
<td>−150 to +1200 °C (−238 to +2192 °F)</td>
<td>ME = ± (0.23 °C (0.42 °F) - 0.005% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type K (36)</td>
<td>−150 to +1300 °C (−238 to +2372 °F)</td>
<td>ME = ± (0.3 °C (0.5 °F) - 0.002% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type N (37)</td>
<td>−150 to +1300 °C (−238 to +2372 °F)</td>
<td>ME = ± (0.4 °C (0.7 °F) - 0.01% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type R (38)</td>
<td>+50 to +1768 °C (+122 to +3214 °F)</td>
<td>ME = ± (0.95 °C (1.7 °F) - 0.025% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type S (39)</td>
<td>+50 to +1768 °C (+122 to +3214 °F)</td>
<td>ME = ± (0.98 °C (1.78 °F) - 0.02% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type T (40)</td>
<td>−150 to +400 °C (−238 to +752 °F)</td>
<td>ME = ± (0.31 °C (0.56 °F) - 0.034% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td>GOST R8.585-2001</td>
<td>Type L (41)</td>
<td>−150 to +900 °C (−238 to +1652 °F)</td>
<td>ME = ± (0.26 °C (0.47 °F) - 0.008% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type U (42)</td>
<td>−150 to +600 °C (−238 to +1112 °F)</td>
<td>ME = ± (0.27 °C (0.49 °F) - 0.022% * (MV - LRV))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type L (43)</td>
<td>−200 to +800 °C (−328 to +1472 °F)</td>
<td>ME = ± (2.13 °C (3.83 °F) - 0.012% * (MV - LRV))</td>
<td></td>
</tr>
</tbody>
</table>

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal.
3) Deviations from maximum measurement error possible due to rounding.

MV = measured value
LRV = lower range value of the sensor in question
Total measurement error of transmitter at current output = √(Measurement error digital² + Measurement error D/A²)

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), measured value +200 °C (+392 °F), ambient temperature +25 °C (+77 °F), supply voltage 24 V:

| Measured error digital = 0.06 °C + 0.006% * (200 °C - (-200 °C)): | 0.08 °C (0.15 °F) |
| Measured error D/A = 0.03 % * 200 °C (360 °F): | 0.06 °C (0.11 °F) |

Measurement error digital value (HART): 0.08 °C (0.15 °F)
Measurement error analog value (current output): √(Measurement error digital² + Measurement error D/A²): 0.10 °C (0.19 °F)
Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), measured value +200 °C (+392 °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 = 0.06 °C + 0.006% * (200 °C - (-200 °C))</td>
<td>0.08 °C (0.15 °F)</td>
</tr>
<tr>
<td>Measurement error D/A = 0.03 % * 200 °C (360 °F)</td>
<td>0.06 °C (0.11 °F)</td>
</tr>
<tr>
<td>Influence of ambient temperature (digital) = (35 - 25) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C</td>
<td>0.08 °C (0.14 °F)</td>
</tr>
<tr>
<td>Influence of ambient temperature (D/A) = (35 - 25) * (0.001% * 200 °C)</td>
<td>0.02 °C (0.04 °F)</td>
</tr>
<tr>
<td>Influence of ambient temperature (digital) = (30 - 24) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C</td>
<td>0.05 °C (0.09 °F)</td>
</tr>
<tr>
<td>Influence of supply voltage (D/A) = (30 - 24) * (0.001% * 200 °C)</td>
<td>0.01 °C (0.02 °F)</td>
</tr>
<tr>
<td>Measurement error digital value (HART): √(Measurement error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²)</td>
<td>0.13 °C (0.23 °F)</td>
</tr>
<tr>
<td>Measurement error analog value (current output): √(Measurement error digital² + Measurement error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + Influence of supply voltage (D/A)²)</td>
<td>0.14 °C (0.25 °F)</td>
</tr>
</tbody>
</table>

The measured error data corresponds to 2 σ (Gaussian distribution)

MV = measured value

LRV = lower range value of the sensor in question

Physical input measuring range of sensors

<table>
<thead>
<tr>
<th>Range</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 400 Ω</td>
<td>Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120</td>
</tr>
<tr>
<td>10 to 2000 Ω</td>
<td>Pt200, Pt500, Pt1000</td>
</tr>
<tr>
<td>-20 to 100 mV</td>
<td>Thermocouples type: A, B, C, D, E, J, K, L, N, R, S, T, U</td>
</tr>
</tbody>
</table>

Other measurement errors apply in SIL mode.

For detailed information, see the Functional Safety Manual SD01632T.

Sensor adjustment

Sensor-transmitter-matching

RTD sensors are one of the most linear temperature measuring elements. Nevertheless, the output must be linearized. To significantly improve temperature measurement accuracy, the device allows the use of two methods:
- Callendar–Van Dusen coefficients (Pt100 resistance thermometer)

The Callendar–Van Dusen equation is described as:

\[ R_T = R_0 [1 + AT + BT^2 + C(T-100)T^3] \]

The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically with the aid of sensor calibration.

- Linearization for copper/nickel resistance thermometers (RTD)

The polynomial equation for copper/nickel is as follows:

\[ R_T = R_0 [1 + AT + BT^2] \]

The coefficients A and B are used for the linearization of nickel or copper resistance thermometers (RTD). The exact values of the coefficients derive from the calibration data and are specific to each sensor. The sensor-specific coefficients are then sent to the transmitter.

Sensor-transmitter matching using one of the methods mentioned above significantly improves the temperature measurement accuracy of the entire system. This is because the transmitter uses the specific data pertaining to the connected sensor to calculate the measured temperature, instead of using the standardized sensor curve data.

1-point adjustment (offset)

Shifts the sensor value

2-point adjustment (sensor trimming)

Correction (slope and offset) of the measured sensor value at transmitter input

Current output adjustment

Correction of 4 or 20 mA current output value (not possible in SIL mode)

Operating influences

The measurement error data correspond to ±2 \( \sigma \) (Gaussian distribution), i.e. 95.45%.

### Influence of ambient temperature and supply voltage on operation for resistance thermometers (RTD) and resistance transmitters

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
<th>Ambient temperature: Influence (±) per 1 °C (1.8 °F) change</th>
<th>Supply voltage: Influence (±) per V change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100 (1)</td>
<td>IEC 60751:2008</td>
<td>≤ 0.02 °C (0.036 °F) D/A ¹²</td>
<td>≤ 0.02 °C (0.036 °F) D/A ¹²</td>
</tr>
<tr>
<td>Pt200 (2)</td>
<td>≤ 0.026 °C (0.047 °F)</td>
<td>0.0002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
<td>0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
</tr>
<tr>
<td>Pt500 (3)</td>
<td>≤ 0.013 °C (0.023 °F)</td>
<td>0.0002% * (MV - LRV), at least 0.009 °C (0.016 °F)</td>
<td>0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)</td>
</tr>
<tr>
<td>Pt1000 (4)</td>
<td>≤ 0.01 °C (0.018 °F)</td>
<td>0.0002% * (MV - LRV), at least 0.004 °C (0.007 °F)</td>
<td>0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)</td>
</tr>
<tr>
<td>Pt100 (5)</td>
<td>JIS C1604:1984</td>
<td>≤ 0.013 °C (0.023 °F)</td>
<td>≤ 0.013 °C (0.023 °F)</td>
</tr>
<tr>
<td>Pt50 (8)</td>
<td>≤ 0.003 °C (0.005 °F)</td>
<td>0.0002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
<td>0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
</tr>
<tr>
<td>Pt100 (9)</td>
<td>≤ 0.02 °C (0.036 °F)</td>
<td>0.0002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
<td>0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)</td>
</tr>
</tbody>
</table>

¹: Based on measured value
²: Maximum

Pt200 (2): 0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)
Pt500 (3): 0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)
Pt1000 (4): 0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)
Pt100 (5): 0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)
Pt50 (8): 0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)
Pt100 (9): 0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)
### Technical data

**iTEMP TMT162**

#### Designation

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
<th>Ambient temperature: Influence (±) per 1 °C (1.8 °F) change</th>
<th>Supply voltage: Influence (±) per V change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ni100 (6)</td>
<td>DIN 43760</td>
<td>≤ 0.004 °C (0.007 °F)</td>
<td>≤ 0.005 °C (0.009 °F)</td>
</tr>
<tr>
<td>Ni120 (7)</td>
<td>IPTS-68</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cu50 (10)</td>
<td>DIN 43760</td>
<td>≤ 0.007 °C (0.013 °F)</td>
<td>-</td>
</tr>
<tr>
<td>Ni100 (11)</td>
<td>OIML R84:</td>
<td>0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)</td>
<td>≤ 0.008 °C (0.014 °F)</td>
</tr>
<tr>
<td>Ni120 (12)</td>
<td>2003 /</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ni100 (13)</td>
<td>GOST 6651-2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu50 (14)</td>
<td>≤ 0.007 °C (0.013 °F)</td>
<td></td>
<td>≤ 0.008 °C (0.014 °F)</td>
</tr>
</tbody>
</table>

#### Resistance transmitter (Ω)

<table>
<thead>
<tr>
<th>Resistance (Ω)</th>
<th>Ambient temperature: Influence (±) per 1 °C (1.8 °F) change</th>
<th>Supply voltage: Influence (±) per V change</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 400 Ω</td>
<td>≤ 6 mΩ</td>
<td>0.001 %</td>
</tr>
<tr>
<td>10 to 2000 Ω</td>
<td>≤ 30 mΩ</td>
<td>0.001 %</td>
</tr>
</tbody>
</table>

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal

### Influence of ambient temperature and supply voltage on operation for thermocouples (TC) and voltage transmitters

#### Designation

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
<th>Ambient temperature: Influence (±) per 1 °C (1.8 °F) change</th>
<th>Supply voltage: Influence (±) per V change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A (30)</td>
<td>IEC 60584-1</td>
<td>≤ 0.13 °C (0.23 °F)</td>
<td>≤ 0.07 °C (0.13 °F)</td>
</tr>
<tr>
<td>Type B (31)</td>
<td>≤ 0.06 °C (0.11 °F)</td>
<td></td>
<td>≤ 0.06 °C (0.11 °F)</td>
</tr>
<tr>
<td>Type C (32)</td>
<td>IEC 60584-1/ASTM E988-96</td>
<td>≤ 0.08 °C (0.14 °F)</td>
<td>≤ 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Type D (33)</td>
<td>≤ 0.08 °C (0.14 °F)</td>
<td></td>
<td>≤ 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Type E (34)</td>
<td>≤ 0.03 °C (0.05 °F)</td>
<td></td>
<td>≤ 0.03 °C (0.05 °F)</td>
</tr>
<tr>
<td>Type J (35)</td>
<td>≤ 0.04 °C (0.07 °F)</td>
<td></td>
<td>≤ 0.02 °C (0.04 °F)</td>
</tr>
<tr>
<td>Type K (36)</td>
<td>≤ 0.04 °C (0.07 °F)</td>
<td></td>
<td>≤ 0.02 °C (0.04 °F)</td>
</tr>
<tr>
<td>Type N (37)</td>
<td>≤ 0.05 °C (0.09 °F)</td>
<td></td>
<td>≤ 0.05 °C (0.09 °F)</td>
</tr>
<tr>
<td>Type R (38)</td>
<td>≤ 0.05 °C (0.09 °F)</td>
<td></td>
<td>≤ 0.05 °C (0.09 °F)</td>
</tr>
<tr>
<td>Type S (39)</td>
<td>≤ 0.01 °C (0.02 °F)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Type T (40)</td>
<td>≤ 0.01 °C (0.02 °F)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Type U (41)</td>
<td>≤ 0.02 °C (0.04 °F)</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Type U (42)</td>
<td>≤ 0.01 °C (0.02 °F)</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
## Technical data

### Designation

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type L (43)</td>
<td>GOST R8.585-2001</td>
</tr>
</tbody>
</table>

### Ambient temperature:

<table>
<thead>
<tr>
<th>Influence (±) per 1 °C (1.8 °F) change</th>
<th>Influence (±) per 1 °C (1.8 °F) change</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.02 °C (0.04 °F)</td>
<td>-</td>
</tr>
</tbody>
</table>

### Supply voltage:

<table>
<thead>
<tr>
<th>Influence (±) per V change</th>
<th>Influence (±) per V change</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Voltage transmitter (mV)

<table>
<thead>
<tr>
<th>Voltage range</th>
<th>Influence (±)</th>
<th>Influence (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 to 100 mV</td>
<td>0.001 %</td>
<td>0.001 %</td>
</tr>
<tr>
<td>-</td>
<td>≤ 3 µV</td>
<td>≤ 3 µV</td>
</tr>
</tbody>
</table>

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal.

\[ MV = \text{measured value} \]
\[ \text{LRV} = \text{lower range value of the sensor in question} \]

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

### Long-term drift, resistance thermometers (RTD) and resistance transmitters

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100 (1)</td>
<td>IEC 60751:2008</td>
</tr>
<tr>
<td>Pt200 (2)</td>
<td>≤ 0.016 % * (MV - LRV) or 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Pt500 (3)</td>
<td>≤ 0.018 % * (MV - LRV) or 0.08 °C (0.14 °F)</td>
</tr>
<tr>
<td>Pt1000 (4)</td>
<td>≤ 0.0185 % * (MV - LRV) or 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Pt100 (5)</td>
<td>JIS C1604:1984</td>
</tr>
<tr>
<td>Pt50 (8)</td>
<td>≤ 0.017 % * (MV - LRV) or 0.07 °C (0.13 °F)</td>
</tr>
<tr>
<td>Pt100 (9)</td>
<td>GOST 6651-94</td>
</tr>
<tr>
<td>Ni100 (6)</td>
<td>DIN 43760 IPTS-68</td>
</tr>
<tr>
<td>Ni120 (7)</td>
<td>≤ 0.015 % * (MV - LRV) or 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Cu50 (10)</td>
<td>≤ 0.06 °C (0.10 °F)</td>
</tr>
<tr>
<td>Cu100 (11)</td>
<td>≤ 0.015 % * (MV - LRV) or 0.04 °C (0.07 °F)</td>
</tr>
<tr>
<td>Ni100 (12)</td>
<td>GOST 6651-2009</td>
</tr>
<tr>
<td>Ni120 (13)</td>
<td>≤ 0.03 °C (0.06 °F)</td>
</tr>
<tr>
<td>Cu50 (14)</td>
<td>≤ 0.06 °C (0.10 °F)</td>
</tr>
</tbody>
</table>

1) The larger value is valid.
**Technical data**

**iTEMP TMT162**

**Long-term drift, thermocouples (TC) and voltage transmitters**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
<th>Long-term drift (±) 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>after 1 year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Based on measured value</td>
</tr>
<tr>
<td>Type A (30)</td>
<td>IEC 60584-1</td>
<td>≤ 0.048% * (MV - LRV) or 0.46 °C (0.83 °F)</td>
</tr>
<tr>
<td>Type B (31)</td>
<td></td>
<td>1.08 °C (1.94 °F)</td>
</tr>
<tr>
<td>Type C (32)</td>
<td>IEC 60584-1/ASTM E988-96</td>
<td>≤ 0.038% * (MV - LRV) or 0.41 °C (0.74 °F)</td>
</tr>
<tr>
<td>Type D (33)</td>
<td>ASTM E988-96</td>
<td>≤ 0.035% * (MV - LRV) or 0.57 °C (1.03 °F)</td>
</tr>
<tr>
<td>Type E (34)</td>
<td></td>
<td>≤ 0.024% * (MV - LRV) or 0.15 °C (0.27 °F)</td>
</tr>
<tr>
<td>Type J (35)</td>
<td></td>
<td>≤ 0.025% * (MV - LRV) or 0.17 °C (0.31 °F)</td>
</tr>
<tr>
<td>Type K (36)</td>
<td>IEC 60584-1</td>
<td>≤ 0.027% * (MV - LRV) or 0.23 °C (0.41 °F)</td>
</tr>
<tr>
<td>Type N (37)</td>
<td></td>
<td>0.36 °C (0.65 °F)</td>
</tr>
<tr>
<td>Type R (38)</td>
<td></td>
<td>0.83 °C (1.49 °F)</td>
</tr>
<tr>
<td>Type S (39)</td>
<td></td>
<td>0.84 °C (1.51 °F)</td>
</tr>
<tr>
<td>Type T (40)</td>
<td>DIN 43710</td>
<td>0.25 °C (0.45 °F)</td>
</tr>
<tr>
<td>Type L (41)</td>
<td></td>
<td>0.20 °C (0.36 °F)</td>
</tr>
<tr>
<td>Type U (42)</td>
<td></td>
<td>0.24 °C (0.43 °F)</td>
</tr>
<tr>
<td>Type L (43)</td>
<td>GOST R8.585-2001</td>
<td>0.22 °C (0.40 °F)</td>
</tr>
</tbody>
</table>

**Voltage transmitter (mV)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Long-term drift (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>−20 to 100 mV</td>
<td>≤ 0.027% * (MV - LRV) or 5.5µV</td>
</tr>
<tr>
<td></td>
<td>≤ 0.041% * (MV - LRV) or 8.2µV</td>
</tr>
<tr>
<td></td>
<td>≤ 0.056% * (MV - LRV) or 11.2µV</td>
</tr>
</tbody>
</table>

1) The larger value is valid

**Long-term drift analog output**

<table>
<thead>
<tr>
<th>Long-term drift D/A (±)</th>
<th>after 1 year</th>
<th>after 3 years</th>
<th>after 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.021%</td>
<td>0.029%</td>
<td>0.031%</td>
<td></td>
</tr>
</tbody>
</table>

1) Percentages based on the configured span of the analog output signal.

**Influence of reference junction**

Pt100 DIN IEC 60751 Cl. B (internal reference junction with thermocouples TC)
13.5 Environment

<table>
<thead>
<tr>
<th>Ambient temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>• –40 to +85 °C (–40 to +185 °F), see Ex documentation for hazardous areas</td>
</tr>
<tr>
<td>• Without display: –40 to +85 °C (–40 to +185 °F)</td>
</tr>
<tr>
<td>• With display: –40 to +80 °C (–40 to +176 °F)</td>
</tr>
<tr>
<td>• With surge arrester module: –40 to +85 °C (–40 to +185 °F)</td>
</tr>
<tr>
<td>• SIL mode: –40 to +75 °C (–40 to +167 °F)</td>
</tr>
<tr>
<td>The display may react slowly at temperatures &lt; –20 °C (–4 °F). The readability of the display cannot be guaranteed at temperatures &lt; –30 °C (–22 °F).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Without display: –40 to +100 °C (–40 to +212 °F) –50 to +100 °C (–58 to +212 °F)</td>
</tr>
<tr>
<td>• With display: –40 to +80 °C (–40 to +176 °F)</td>
</tr>
<tr>
<td>• With surge arrester module: –50 to +100 °C (–58 to +212 °F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permitted: 0 to 95 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2 000 m (6 560 ft) above mean sea level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Climate class</th>
</tr>
</thead>
<tbody>
<tr>
<td>As per IEC 60654-1, Class Dx</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Degree of protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die-cast aluminum or stainless steel housing: IP66/67, Type 4X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shock and vibration resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock resistance as per KTA 3505 (section 5.8.4 Shock test)</td>
</tr>
<tr>
<td>IEC 60068-2-6 test</td>
</tr>
<tr>
<td>Fc: Vibration (sinusoidal)</td>
</tr>
<tr>
<td>Vibration resistance according to DNV GL Guideline, Vibration: B</td>
</tr>
<tr>
<td>The use of L-shaped mounting brackets can cause resonance (see wall/pipe 2” mounting bracket in the 'Accessories' section). Caution: vibrations at the transmitter may not exceed specifications.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electromagnetic compatibility (EMC)</th>
<th>CE conformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity.</td>
<td></td>
</tr>
<tr>
<td>Maximum measured error &lt;1% of measuring range.</td>
<td></td>
</tr>
<tr>
<td>Interference immunity as per IEC/EN 61326 series, industrial requirements</td>
<td></td>
</tr>
<tr>
<td>Interference emission as per IEC/EN 61326 series, Class B equipment</td>
<td></td>
</tr>
<tr>
<td>SIL conformity according to IEC 61326-3-1 or IEC 61326-3-2</td>
<td></td>
</tr>
<tr>
<td>A shielded cable that is grounded on both sides must be used for sensor cable lengths of 30 m (98.4 ft) and more. The use of shielded sensor cables is generally recommended.</td>
<td></td>
</tr>
<tr>
<td>Connection of the functional grounding may be needed for functional purposes.</td>
<td></td>
</tr>
<tr>
<td>Compliance with the electrical codes of individual countries is mandatory.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overvoltage category</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
</tr>
</tbody>
</table>
Pollution degree  2

### 13.6 Mechanical construction

**Design, dimensions**  Dimensions in mm (in)

![Diagram of mechanical construction]

- **17** *Die-cast aluminum housing for general applications, or optional stainless steel housing (316L)*

* Dimensions without display = 112 mm (4.41”)

- Separate electronics module and connection compartment
- Display attachable in 90° stages

**Weight**
- Aluminum housing approx. 1.4 kg (3 lb), with display
- Stainless steel housing approx. 4.2 kg (9.3 lb), with display

**Materials**

<table>
<thead>
<tr>
<th>Housing</th>
<th>Sensor terminals</th>
<th>Nameplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die-cast aluminum housing AlSi10Mg/ AlSi12 with powder coating on polyester base</td>
<td>Nickel-plated brass 0.3 µm gold flashed/cpl., corrosion-free</td>
<td>Aluminum AlMg1, anodized in black</td>
</tr>
<tr>
<td>316L</td>
<td></td>
<td>1.4404 (AISI 316L)</td>
</tr>
<tr>
<td>Display O-ring 88x3: HNBR 70° Shore PTFE coating</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Cable entries

<table>
<thead>
<tr>
<th>Version</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread</td>
<td>2x thread ½&quot; NPT</td>
</tr>
<tr>
<td></td>
<td>2x thread M20</td>
</tr>
<tr>
<td></td>
<td>2x thread G½&quot;</td>
</tr>
<tr>
<td>Cable gland</td>
<td>2x coupling M20</td>
</tr>
</tbody>
</table>

13.7 Certificates and approvals

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

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

MTTF according to Siemens SN-29500 at 40 °C (104 °F)

The mean time to failure (MTTF) denotes the theoretically expected time until the device fails during normal operation. The term MTTF is used for non-repairable systems such as temperature transmitters.

Functional safety

SIL 2/3 (hardware/software) certified to:
- IEC 61508-1:2010 (Management)
- IEC 61508-2:2010 (Hardware)
- IEC 61508-3:2010 (Software)

For more detailed information please refer to the Functional Safety Manual.

HART® certification

The temperature transmitter is registered by the HART® FieldComm Group. The device meets the requirements of the FieldComm Group HART® Specifications, Revision 7.6.
# Operating menu and parameter description

The following tables list all the parameters in the "Setup", "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". The parameter groups for the Expert setup contain all the parameters of the "Setup" and "Diagnostics" operating menus, as well as other parameters that are solely reserved for experts.

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

Configuration in the SIL mode differs from the standard mode and is described in the Functional Safety Manual.

For more information, please refer to the Functional Safety Manual SD1632T.

## Setup →

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device tag</td>
<td>67</td>
</tr>
<tr>
<td>Unit</td>
<td>67</td>
</tr>
<tr>
<td>Sensor type 1</td>
<td>67</td>
</tr>
<tr>
<td>Connection type 1</td>
<td>68</td>
</tr>
<tr>
<td>2-wire compensation 1</td>
<td>68</td>
</tr>
<tr>
<td>Reference junction 1</td>
<td>68</td>
</tr>
<tr>
<td>Rj preset value 1</td>
<td>68</td>
</tr>
<tr>
<td>Sensor type 2</td>
<td>67</td>
</tr>
<tr>
<td>Connection type 2</td>
<td>68</td>
</tr>
<tr>
<td>2-wire compensation 2</td>
<td>68</td>
</tr>
<tr>
<td>Reference junction 2</td>
<td>68</td>
</tr>
<tr>
<td>Rj preset value 2</td>
<td>69</td>
</tr>
<tr>
<td>Assign current output (PV)</td>
<td>70</td>
</tr>
<tr>
<td>Lower range value</td>
<td>70</td>
</tr>
<tr>
<td>Upper range value</td>
<td>70</td>
</tr>
</tbody>
</table>

## Setup → Advanced setup →

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter access code</td>
<td>71</td>
</tr>
<tr>
<td>Access status tooling</td>
<td>72</td>
</tr>
<tr>
<td>Locking status</td>
<td>72</td>
</tr>
</tbody>
</table>

## Setup → Advanced setup → Sensor →

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor offset 1</td>
<td>73</td>
</tr>
<tr>
<td>Sensor offset 2</td>
<td>73</td>
</tr>
<tr>
<td>Drift/difference mode</td>
<td>73</td>
</tr>
<tr>
<td>Drift/difference alarm delay</td>
<td>73</td>
</tr>
<tr>
<td>Drift/difference set point</td>
<td>74</td>
</tr>
<tr>
<td>Sensor switch set point</td>
<td>74</td>
</tr>
</tbody>
</table>

## Setup → Advanced setup → Current output →

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output current</td>
<td>75</td>
</tr>
<tr>
<td>Failure mode</td>
<td>75</td>
</tr>
</tbody>
</table>
### Operating menu and parameter description

#### Failure current
- 4 mA current trimming → 76
- 20 mA current trimming → 76
- Reset trim → 76

**Setup → Advanced setup → Display →**

- Display interval → 77
- Value 1 display → 77
- Display text 1 → 78
- Decimal places 1 → 78
- Value 2 display → 77
- Display text 2 → 78
- Decimal places 2 → 78
- Value 3 display → 77
- Display text 3 → 78
- Decimal places 3 → 78

**Setup → Advanced setup → SIL →**

- SIL option → 78
- Operational state → 79
- SIL checksum → 80
- Enter SIL checksum → 79
- Force safe state → 80
- Deactivate SIL → 80
- Restart device → 80

**Setup → Advanced setup → Administration →**

- Device reset → 80
- Define device write protection code → 81

**Diagnostics → Actual diagnostics**

- Previous diagnostics 1 → 82
- Operating time → 82

**Diagnostics → Diagnostic list →**

- Actual diagnostics count → 83
- Actual diagnostics → 82
- Actual diag channel → 83

**Diagnostics → Event logbook →**

- Previous diagnostics n → 84
- Previous diag channel n → 84

**Diagnostics → Device information →**

- Device tag → 67
- Serial number → 85
- Firmware version → 85
- Device name → 85
<table>
<thead>
<tr>
<th>Operating menu and parameter description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Order code</strong></td>
<td>→  85</td>
</tr>
<tr>
<td><strong>Configuration counter</strong></td>
<td>→  87</td>
</tr>
</tbody>
</table>

| Diagnostics → **Measured values** →     |     |
| Sensor 1 value                          | →  87 |
| Sensor 2 value                          | →  87 |
| Device temperature                      | →  88 |

| Diagnostics → **Measured values** → **Min/max values** → |     |
| Sensor n min value                       | →  88 |
| Sensor n max value                       | →  88 |
| Device temperature min.                 | →  88 |
| Device temperature max.                 | →  89 |

| Diagnostics → **Simulation** → **Current output simulation** |     |
| Value current output                     | →  89 |

| Expert → **Enter access code**          | →  71 |
| Access status tooling                   | →  72 |
| Locking status                          | →  72 |

| Expert → **System** → **Unit**          | →  67 |
| Damping                                 | →  90 |
| Alarm delay                             | →  91 |
| Mains filter                            | →  91 |

| Expert → **System** → **Display** →     |     |
| Display interval                        | →  77 |
| Value 1 display                         | →  77 |
| Display text 1                          | →  78 |
| Decimal places 1                        | →  78 |
| Value 2 display                         | →  77 |
| Display text 2                          | →  78 |
| Decimal places 2                        | →  78 |
| Value 3 display                         | →  77 |
| Display text 3                          | →  78 |
| Decimal places 3                        | →  78 |

| Expert → **System** → **Administration** → |     |
| Define device write protection code     | →  81 |
| Device reset                            | →  80 |

| Expert → **Sensor** → **Number of measuring channels** | →  91 |
### Operating menu and parameter description

**iTEMP TMT162**

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Sensor →</th>
<th>Sensor n →</th>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor type n</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Connection type n</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-wire compensation n</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reference junction n</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RJ preset value</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor offset n</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor n lower limit</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor n upper limit</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor serial number</td>
<td>93</td>
</tr>
</tbody>
</table>

1) \( n \) = number of sensor inputs (1 and 2)

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Sensor →</th>
<th>Sensor n →</th>
<th>Sensor trimming →</th>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor trimming</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor trimming lower value</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor trimming upper value</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor trimming min span</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reset trim</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Sensor →</th>
<th>Sensor n →</th>
<th>Linearization →</th>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Call.-V. Dusen coeff. R0, A, B, C</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Polynomial coeff. R0, A, B</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor n lower limit</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor n upper limit</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

1) \( n \) = number of sensor inputs (1 and 2)

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Sensor →</th>
<th>Diagnostic settings →</th>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sensor switch set point</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift/difference mode</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift/difference alarm delay</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift/difference set point</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start value</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calibration countdown</td>
<td>99</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Output →</th>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower range value</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upper range value</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failure mode</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failure current</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 mA current trimming</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 mA current trimming</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reset trim</td>
<td>76</td>
<td></td>
</tr>
</tbody>
</table>
# Operating menu and parameter description

## HART configuration

<table>
<thead>
<tr>
<th>Expert</th>
<th>Communication</th>
<th>HART configuration</th>
<th>Device tag</th>
<th>→</th>
<th>67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART short tag</td>
<td>→</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART address</td>
<td>→</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. of preambles</td>
<td>→</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Configuration changed</td>
<td>→</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reset configuration changed</td>
<td>→</td>
<td>101</td>
</tr>
</tbody>
</table>

## HART info

<table>
<thead>
<tr>
<th>Expert</th>
<th>Communication</th>
<th>HART info</th>
<th>Device type</th>
<th>→</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device revision</td>
<td>→</td>
<td>102</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Device ID</td>
<td>→</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Manufacturer ID</td>
<td>→</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART revision</td>
<td>→</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART descriptor</td>
<td>→</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART message</td>
<td>→</td>
<td>103</td>
</tr>
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<td></td>
<td></td>
<td>Hardware revision</td>
<td>→</td>
<td>103</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Software revision</td>
<td>→</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HART date code</td>
<td>→</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Process unit tag</td>
<td>→</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Location description</td>
<td>→</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Longitude</td>
<td>→</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Latitude</td>
<td>→</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Altitude</td>
<td>→</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Location method</td>
<td>→</td>
<td>105</td>
</tr>
</tbody>
</table>

## HART output

<table>
<thead>
<tr>
<th>Expert</th>
<th>Communication</th>
<th>HART output</th>
<th>Assign current output (PV)</th>
<th>→</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>PV</td>
<td>→</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assign SV</td>
<td>→</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SV</td>
<td>→</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assign TV</td>
<td>→</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TV</td>
<td>→</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assign QV</td>
<td>→</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>QV</td>
<td>→</td>
<td>107</td>
</tr>
</tbody>
</table>

## Burst configuration

<table>
<thead>
<tr>
<th>Expert</th>
<th>Communication</th>
<th>Burst configuration</th>
<th>Burst mode</th>
<th>→</th>
<th>107</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burst command</td>
<td>→</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burst variables 0-3</td>
<td>→</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burst trigger mode</td>
<td>→</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burst trigger level</td>
<td>→</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min. update period</td>
<td>→</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Max. update period</td>
<td>→</td>
<td>110</td>
</tr>
</tbody>
</table>
### Operating menu and parameter description

| Expert → Diagnostics → | Actual diagnostics | → 82 |
| Expert → Diagnostics → | Previous diagnostics 1 | → 82 |
| Expert → Diagnostics → | Operating time | → 82 |

| Expert → Diagnostics → | Diagnostic list → | Actual diagnostics count | → 83 |
| Expert → Diagnostics → | Actual diagnostics | → 82 |
| Expert → Diagnostics → | Actual diag channel | → 83 |

| Expert → Diagnostics → | Event logbook → | Previous diagnostics n | → 84 |
| Expert → Diagnostics → | Previous diag channel | → 84 |

| Expert → Diagnostics → | Device information → | Device tag | → 67 |
| Expert → Diagnostics → | | Squawk | → 110 |
| Expert → Diagnostics → | | Serial number | → 85 |
| Expert → Diagnostics → | | Firmware version | → 85 |
| Expert → Diagnostics → | | Device name | → 85 |
| Expert → Diagnostics → | | Order code | → 85 |
| Expert → Diagnostics → | | Extended order code | → 111 |
| Expert → Diagnostics → | | Extended order code 2 | → 111 |
| Expert → Diagnostics → | | Extended order code 3 | → 111 |
| Expert → Diagnostics → | | Manufacturer ID | → 102 |
| Expert → Diagnostics → | | Manufacturer | → 112 |
| Expert → Diagnostics → | | Hardware revision | → 103 |
| Expert → Diagnostics → | | Configuration counter | → 87 |

| Expert → Diagnostics → | Measured values → | Sensor n value | → 87 |
| Expert → Diagnostics → | | Sensor n raw value | → 113 |
| Expert → Diagnostics → | | Device temperature | → 88 |

| Expert → Diagnostics → | Measured values → | Min/max values → | Sensor n min value | → 88 |
| Expert → Diagnostics → | | Sensor n max value | → 88 |
| Expert → Diagnostics → | | Reset sensor min/max values | → 113 |
| Expert → Diagnostics → | | Device temperature min. | → 88 |
| Expert → Diagnostics → | | Device temperature max. | → 89 |
| Expert → Diagnostics → | | Reset device temperature min/max | → 113 |

<p>| Expert → Diagnostics → | Simulation → | Diagnostic simulation | → 114 |
| Expert → Diagnostics → | | Current output simulation | → 89 |
| Expert → Diagnostics → | | Value current output | → 89 |</p>
<table>
<thead>
<tr>
<th>Operating menu and parameter description</th>
<th>iTEMP TMT162</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Diagnostics →</th>
<th>Diagnostic settings →</th>
<th>Diagnostic behavior →</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor, electronics, process, configuration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert →</th>
<th>Diagnostics →</th>
<th>Diagnostic settings →</th>
<th>Status signal →</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sensor, electronics, process, configuration</td>
</tr>
</tbody>
</table>

→ 114

→ 115
14.1 "Setup" menu

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

\[ n \] = Stands for the number of sensor inputs (1 and 2)

Device tag

Navigation

- Setup → Device tag
- Diagnostics → Device information → Device tag
- Expert → Diagnostics → Device information → Device tag

Description

Use this function to enter a unique name for the measuring point so it can be identified quickly within the plant. This name is shown on the display.

User entry

Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /)

Factory setting

EH_TMT162_serial number

Unit

Navigation

- Setup → Unit
- Expert → System → Unit

Description

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

Selection

- °C
- °F
- K
- °R
- Ohm
- mV

Factory setting

°C

Sensor type n

Navigation

- Setup → Sensor type n
- Expert → Sensor → Sensor n → Sensor type n

Description

Use this function to select the sensor type for the sensor input in question

- Sensor type 1: settings for sensor input 1
- Sensor type 2: settings for sensor input 2

Please observe the terminal assignment when connecting the individual sensors. In the case of 2-channel operation, the possible connection options must also be observed.
### Selection
A list of all the possible sensor types is provided in the 'Technical data' section → 45.

### Factory setting
- Sensor type 1: Pt100 IEC751
- Sensor type 2: No sensor

---

#### Connection type n

**Navigation**
- Setup → Connection type n
- Expert → Sensor → Sensor n → Connection type n

**Prerequisite**
An RTD sensor must be specified as the sensor type.

**Description**
Use this function to select the connection type for the sensor.

**Selection**
- Sensor 1 (connection type 1): 2-wire, 3-wire, 4-wire
- Sensor 2 (connection type 2): 2-wire, 3-wire

**Factory setting**
- Sensor 1 (connection type 1): 4-wire
- Sensor 2 (connection type 2): none

---

#### 2-wire compensation n

**Navigation**
- Setup → 2-wire compensation n
- Expert → Sensor → Sensor n → 2-wire compensation n

**Prerequisite**
An RTD sensor with a 2-wire connection type must be specified as the sensor type.

**Description**
Use this function to specify the resistance value for two-wire compensation in RTDs.

**User entry**
0 to 30 Ohm

**Factory setting**
0

---

#### Reference junction n

**Navigation**
- Setup → Reference junction n
- Expert → Sensor → Sensor n → Reference junction n

**Prerequisite**
A thermocouple (TC) sensor must be selected as the sensor type.
### Description
Use this function to select reference junction measurement for temperature compensation of thermocouples (TC).

- **If Preset value** is selected, the compensation value is specified via the RJ preset value parameter.
- **Temperature measured** must be configured for channel 2 if **Measured value sensor 2** is selected.

### Selection
- No compensation: no temperature compensation is used.
- Internal measurement: the internal reference junction temperature is used.
- Fixed value: a fixed value is used.
- Measured value sensor 2: the measured value of sensor 2 is used.

It is not possible to select the **Measured value sensor 2** option for the **Reference junction 2** parameter.

### Factory setting
Internal measurement

---

### RJ preset value n

#### Navigation
- Setup → RJ preset value
- Expert → Sensor → Sensor n → RJ preset value

#### Prerequisite
The **Preset value** parameter must be set if the **Reference junction n** option is selected.

#### Description
Use this function to define the fixed preset value for temperature compensation.

#### User entry
-50 to +87 °C

#### Factory setting
0.00

---

### Assign current output (PV)

#### Navigation
- Setup → Assign current output (PV)
- Expert → Communication → HART output → Assign current output (PV)

#### Description
Use this function to assign a measured variable to the primary HART® value (PV).
Selection

- Sensor 1 (measured value)
- Sensor 2 (measured value)
- Device temperature
- Average of the two measured values: 0.5 x (SV1+SV2)
- Difference between sensor 1 and sensor 2: SV1-SV2
- Sensor 1 (backup sensor 2): If sensor 1 fails, the value of sensor 2 automatically becomes the primary HART® value (PV): sensor 1 (OR sensor 2)
- Sensor switching: If the value exceeds the configured threshold value T for sensor 1, the measured value of sensor 2 becomes the primary HART® value (PV). The system switches back to sensor 1 if the measured value of sensor 1 is at least 2 K below T: sensor 1 (sensor 2, if sensor 1 > T)
- Average: 0.5 x (SV1+SV2) with backup (measured value of sensor 1 or sensor 2 in the event of a sensor error in the other sensor)

The threshold value can be configured using the Sensor switch set point \( \rightarrow \) 74 parameter. With temperature-dependent switching, it is possible to combine 2 sensors that offer advantages in different temperature ranges.

Factory setting

Sensor 1

---

Lower range value

Navigation

Setup \( \rightarrow \) Lower range value
Expert \( \rightarrow \) Output \( \rightarrow \) Lower range value

Description

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

The limit value that can be set depends on the sensor type used in the Sensor type \( \rightarrow \) 67 parameter and the measured variable assigned in the Assign current output (PV) parameter.

User entry

Depends on the sensor type and the setting for "Assign current output (PV)".

Factory setting

0

---

Upper range value

Navigation

Setup \( \rightarrow \) Upper range value
Expert \( \rightarrow \) Output \( \rightarrow \) Upper range value

Description

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

The limit value that can be set depends on the sensor type used in the Sensor type \( \rightarrow \) 67 parameter and the measured variable assigned in the Assign current output (PV) parameter.

User entry

Depends on the sensor type and the setting for "Assign current output (PV)".

Factory setting

100
14.1.1 "Advanced setup" submenu

Drift/difference mode

If two sensors are connected and the measured values differ by a specified value, a status signal is generated as a diagnostic event. The drift/difference monitoring function can be used to verify the correctness of the measured values and for mutual monitoring of the connected sensors. Drift/difference monitoring is enabled with the Drift/difference mode parameter. A distinction is made between two specific modes. If the In band option is selected (ISV1-SV2I < drift/difference set point), a status message is issued if the value drops below the set point, or if the value exceeds the set point if the Out band (drift) option is selected (ISV1-SV2I > drift/difference set point).

Procedure for configuring the drift/difference mode

1. Start
2. For drift/difference monitoring, select Out band for drift detection and In band for difference monitoring.
3. Set the set point for drift/difference monitoring to the desired value.
4. End

Enter access code

Navigation

Setup → Advanced setup → Enter access code
Expert → Enter access code

Description

Use this function to enable the service parameters via the operating tool. If an incorrect access code is entered, users retain their current access authorization.

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

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 9999
Factory setting 0

Access status tooling

Navigation
Setup → Advanced setup → Access status tooling
Expert → Access status tooling

Description Displays the access authorization to the parameters.

Additional information If an 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.

Selection
• Operator
• Service

Factory setting Operator

Locking status

Navigation
Setup → Advanced setup → Locking status
Expert → Locking status

Description Displays the device locking status (software, hardware or SIL-locked). The DIP switch for hardware locking is fitted on the electronics module. When write protection is activated, write access to the parameters is disabled.
"Sensor" submenu

Sensor offset n

n = Stands for the number of sensor inputs (1 and 2)

Navigation
- Setup → Advanced setup → Sensor → Sensor offset n
- Expert → Sensor → Sensor n → Sensor offset n

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

User entry
-10.0 to +10.0

Factory setting
0.0

Drift/difference mode

Navigation
- Setup → Advanced setup → Sensor → Drift/difference mode
- Expert → Sensor → Diagnostic settings → Drift/difference mode

Description
Use this function to choose whether the device reacts to the drift/difference set point being exceeded or undershot.

Additional information
- If the Out band (drift) option is selected, a status signal is displayed if the absolute value for the differential value exceeds the drift/difference set point
- If the In band option is selected, a status signal is displayed if the absolute value for the differential value drops below the drift/difference set point.

Selection
- Off
- Out band (drift)
- In band

Factory setting
Off

Drift/difference alarm delay

Navigation
- Setup → Advanced setup → Sensor → Drift/difference alarm delay
- Expert → Sensor → Diagnostic settings → Drift/difference alarm delay

Prerequisite
The Drift/difference mode parameter must be activated with the Out band (drift) or In band option.
### Drift/difference set point

**Description**
Use this function to configure the maximum permissible measured value deviation between sensor 1 and sensor 2 which results in drift/difference detection.

**Selection**
0.1 to 999.0 K (0.18 to 1798.2 °F)

**Factory setting**
999.0

**Navigation**
- Setup → Advanced setup → Sensor → Drift/difference set point
- Expert → Sensor → Diagnostic settings → Drift/difference set point

**Prerequisite**
The Drift/difference mode parameter must be activated with the Out band (drift) or In band option.

**Description**
Use this function to set the threshold value for sensor switching → 70.

**Additional information**
The threshold value is relevant if the sensor switching function is assigned to a HART® variable (PV, SV, TV, QV).

**Selection**
Depends on the sensor types selected.

**Factory setting**
850 °C

---

---

---

---
NOTICE
Current trimming does not affect the digital HART® value. This can cause the measured value shown on the display to differ marginally from the value displayed in the higher-level system.

- The digital measured values can be adapted with the sensor trimming parameter in the menu Expert → Sensor → Sensor trimming.

Procedure

<table>
<thead>
<tr>
<th>Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Start</td>
</tr>
<tr>
<td>2. Install an accurate ammeter (more accurate than the transmitter) in the current loop.</td>
</tr>
<tr>
<td>3. Switch on current output simulation and set the simulation value to 4 mA.</td>
</tr>
<tr>
<td>4. Measure the loop current with the ammeter and make a note of the value.</td>
</tr>
<tr>
<td>5. Set the simulation value to 20 mA.</td>
</tr>
<tr>
<td>6. Measure the loop current with the ammeter and make a note of the value.</td>
</tr>
<tr>
<td>7. Enter the current values determined as adjustment values in the <strong>4 mA/20 mA current trimming</strong> parameters</td>
</tr>
<tr>
<td>8. End</td>
</tr>
</tbody>
</table>

Output current

**Navigation**

Setup → Advanced setup → Current output → Output current

**Description**

Displays the calculated output current in mA.

Failure mode

**Navigation**

Setup → Advanced setup → Current output → Failure mode

**Expert → Output → Failure mode**

**Description**

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

**Additional information**

If **Max.** is selected, the signal on alarm level is specified using the **Failure current** parameter.

**Selection**

- Min.
- Max.
Operating menu and parameter description

iTEMP TMT162

Factory setting

### Failure current

**Navigation**

Setup → Advanced setup → Current output → Failure current  
Expert → Output → Failure current

**Prerequisite**
The Max. option is enabled in the Failure mode parameter.

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

**User entry**
21.5 to 23.0 mA

**Factory setting**
22.5

### 4 mA current trimming

**Navigation**

Setup → Advanced setup → Current output → 4 mA current trimming  
Expert → Output → 4 mA current trimming

**Description**
Use this function to set the correction value for the current output at the start of the measuring range at 4 mA → 74.

**User entry**
3.85 to 4.15 mA

**Factory setting**
4 mA

### 20 mA current trimming

**Navigation**

Setup → Advanced setup → Current output → 20 mA current trimming  
Expert → Output → 20 mA current trimming

**Description**
Use this function to set the correction value for the current output at the end of the measuring range at 20 mA → 74.

**User entry**
19.850 to 20.15 mA

**Factory setting**
20.000 mA

### Reset trim
Navigation
Setup → Advanced setup → Current output → Reset trim
Expert → Output → Reset trim

Description
The Wizard resets the 4 to 20 mA values for trimming to the default value.

User entry
Activate the button

"Display" submenu
The settings for displaying the measured value on the optional display are made in the "Display" menu.
These settings do not affect the output values of the transmitter, and are only used to specify the display format on the screen.

Display interval

Navigation
Setup → Advanced setup → Display → Display interval
Expert → System → Display → Display interval

Description
Use this function to set the length of time the measured values are displayed if the values alternate on the local display. This type of change is only generated automatically if several measured values are specified.
The Value 1 display - Value 3 display parameters are used to specify which measured values are shown on the local display → 77.

User entry
4 to 20 s

Factory setting
4 s

Value 1 display (Value 2 or 3 display)

Navigation
Setup → Advanced setup → Display → Value 1 display (Value 2 or 3 display)
System → System → Display → Value 1 display (Value 2 or 3 display)

Description
Use this function to select one of the measured values shown on the local display.

Selection
- Process value
- Sensor 1
- Sensor 2
- Output current
- Percent of range
- Device temperature

Factory setting
Process value
### Display text n 1)

1) 1, 2 or 3 - depends on the display value set

**Navigation**

Setup → Advanced setup → Display → Display text n  
Expert → System → Display → Display text n

**Description**

Display text for this channel that appears on the screen in the 14-segment display.

**User entry**

Enter the display text: the maximum text length is 8 characters.

**Factory setting**

PV

### Decimal places 1 (decimal places 2 or 3)

**Navigation**

Setup → Advanced setup → Display → Decimal places 1 (decimal places 2 or 3)  
Expert → System → Display → Decimal places 1 (decimal places 2 or 3)

**Prerequisite**

A measured value is defined in the parameter *Value 1 display* (Value 2 or 3 display) → 77.

**Description**

Use this function to select the number of decimal places for the display value. This setting does not affect the accuracy of the device for measuring or calculating the value.

- If Automatic is selected, the maximum possible number of decimal places is always shown on the display.

**Selection**

- x  
- x.x  
- x.xx  
- x.xxx  
- x.xxxx  
- Automatic

**Factory setting**

x.x

"SIL" submenu

This menu only appears if the device was ordered with the 'SIL mode' option. The SIL option parameter indicates whether the device can be operated in the SIL mode. To enable the SIL mode for the device, it is necessary to perform menu-guided operation for Expert mode.

For more detailed information please refer to the Functional Safety Manual SD01632T/09.

### SIL option

**Navigation**

Setup → Advanced setup → SIL → SIL option
### Description
Indicates whether the device has been ordered with SIL certification.

- The SIL option is required to operate the device in the SIL mode.

#### Selection
- No
- Yes

#### Factory setting
No

### Operational state

#### Navigation
Setup → Advanced setup → SIL → Operational state

#### Description
Displays the device operational state in the SIL mode.

#### Display
- Checking SIL option
- Startup normal mode
- Wait for checksum
- Self diagnostic
- Normal mode
- Download active
- SIL mode active
- Safe para start
- Safe param running
- Save parameter values
- Parameter check
- Reboot pending
- Reset checksum
- Safe state - Active
- Download verification
- Upload active
- Safe state - Passive
- Safe state - Panic
- Safe state - Temporary

#### Factory setting
Normal mode

### Enter SIL checksum

#### Navigation
Setup → Advanced setup → SIL → Enter SIL checksum

#### Description
If the value '0' is entered in the SIL checksum, the device switches from the SIL mode to the normal mode. Users can also quit the SIL mode using the Deactivate SIL parameter.

#### User entry
0 ... 65535

#### Factory setting
0
Operating menu and parameter description

SIL checksum

Navigation
Setup → Advanced setup → SIL → SIL checksum

Description
Displays the calculated SIL checksum.

The SIL checksum displayed can be used to check the device configuration. If 2 devices have identical configurations, the SIL checksum is also identical. This can make for easy device replacement because if the checksum is the same, the device configuration is guaranteed to be identical too.

Force safe state

Navigation
Setup → Advanced setup → SIL → Force safe state

Prerequisite
The Operational state parameter displays SIL mode active.

Description
During SIL proof testing this parameter can be used to test error detection of the device current readback.

Selection
• On
• Off

Factory setting
Off

Deactivate SIL

Navigation
Setup → Advanced setup → SIL → Deactivate SIL

Description
Use this button to quit the SIL operating mode.

Restart device

Navigation
Setup → Advanced setup → SIL → Restart device

Description
Use this button to restart the device.

"Administration" submenu

Device reset
Navigation

Setup → Advanced setup → Administration → Device reset
Expert → System → Device reset

Description

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

Selection

- **Not active**
  No action is executed and the user exits the parameter.
- **To factory defaults**
  All the parameters are reset to the factory setting.
- **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.
- **Restart device**
  The device is restarted but the device configuration remains unchanged.

Factory setting

Not active

Define device write protection code

Navigation

Setup → Advanced setup → Administration → Define device write protection code
Expert → System → Define device write protection code

Description

Use this function to set a write protection code for the device.

1. 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 9999

Factory setting

0

1. If the device is delivered with this factory setting the device write protection is not active.

Additional information

- Activating device write protection: To do so, enter a value in the Enter access code parameter that does not correspond to the write protection code defined here.
- 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).
- Hardware write protection (DIP switches) is active:
  - Hardware write protection has priority over the software write protection described here.
  - No value can be entered in the Enter access code parameter. The parameter is a read only parameter.
  - Device write protection via software can only be defined and activated if hardware write protection via the DIP switches is disabled. → 22
- If the write protection code has been forgotten, it can be deleted or overwritten by the service organization.
### 14.2 "Diagnostics" menu

All the information that describes the device, the device status and the process conditions can be found in this group.

#### Actual diagnostics

**Navigation**

- Diagnostics → Actual diagnostics
- Expert → Diagnostics → Actual diagnostics

**Description**

Displays the current diagnostic message. If two or more messages occur simultaneously, the message with the highest priority is shown on the display.

**Display**

Symbol for event behavior and diagnostic event.

**Additional information**

Example for display format:

F261-Electronics modules

#### Previous diagnostics 1

**Navigation**

- Diagnostics → Previous diagnostics 1
- Expert → Diagnostics → Previous diagnostics 1

**Description**

Displays the last diagnostic message with the highest priority.

**Display**

Symbol for event behavior and diagnostic event.

**Additional information**

Example for display format:

F261-Electronics modules

#### Operating time

**Navigation**

- Diagnostics → Operating time
- Expert → Diagnostics → Operating time

**Description**

Displays the length of time the device has been in operation.

**Display**

Hours (h)

#### 14.2.1 "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. Information on diagnostics measures in the device and an overview of all the diagnostics messages → 35.
Actual diagnostics count

Navigation
Diagnostics → Diagnostic list → Actual diagnostics count
Expert → Diagnostics → Diagnostic list → Actual diagnostics count

Description
Displays the number of diagnostic messages currently pending in the device.

Actual diagnostics

Navigation
Diagnostics → Diagnostics list → Actual diagnostics
Expert → Diagnostics → Diagnostic list → Actual diagnostics

Description
Displays the current diagnostics messages with the highest priority to the third-highest priority.

Display
Symbol for event behavior and diagnostic event.

Additional information
Example for display format:
F261-Electronics modules

Actual diag channel

Navigation
Diagnostics → Diagnostic list → Actual diag channel
Expert → Diagnostics → Diagnostic list → Actual diag channel

Description
Displays the sensor input to which the diagnostics message refers.

Display
- - - - -
Sensor 1
Sensor 2
Device temperature
Current output
Terminal temperature
14.2.2  "Event logbook" submenu

Previous diagnostics n

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

Navigation
- Diagnostics → Diagnostic list → Previous diagnostics n
- Expert → Diagnostics → Diagnostic list → Previous diagnostics n

Description
Displays the diagnostic messages that occurred in the past. The last 5 messages are listed in chronological order.

Display
Symbol for event behavior and diagnostic event.

Additional information
Example for display format:
F261-Electronics modules

Previous diag n channel

Navigation
- Diagnostics → Diagnostic list → Previous diag channel
- Expert → Diagnostics → Diagnostic list → Previous diag channel

Description
Displays the possible sensor input to which the diagnostics message refers.

Display
- Sensor 1
- Sensor 2
- Device temperature
- Current output
- Terminal temperature

14.2.3  "Device information" submenu

Device tag

Navigation
- Setup → Device tag
- Diagnostics → Device information → Device tag
- Expert → Diagnostics → Device information → Device tag

Description
Use this function to enter a unique name for the measuring point so it can be identified quickly within the plant. This name is shown on the display. → 22

User entry
Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)

Factory setting
32 x '?'
### Serial number

**Navigation**
- Diagnostics → Device information → Serial number
- Expert → Diagnostics → Device information → Serial number

**Description**
Displays 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](http://www.endress.com/deviceviewer)

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

### Firmware version

**Navigation**
- Diagnostics → Device information → Firmware version
- Expert → Diagnostics → Device information → Firmware version

**Description**
Displays the installed device firmware version.

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

### Device name

**Navigation**
- Diagnostics → Device information → Device name
- Expert → Diagnostics → Device information → Device name

**Description**
Displays the device name. It can also be found on the nameplate.

### Order code

**Navigation**
- Diagnostics → Device information → Order code
- Expert → Diagnostics → Device information → Order code

**Description**
Displays the order code of the device. It can also be found on the nameplate. The order code is generated by a reversible transformation 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 replacement device.
- To identify the device quickly and easily, e.g. when contacting the manufacturer.
## Extended order code 1-3

### Navigation
- Diagnostics → Device information → Extended order code 1 to 3
- Expert → Diagnostics → Device information → Extended order code 1 to 3

### Description
Displays 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 replacement device.
- To check the ordered device features using the delivery note.

### ENP version

### Navigation
- Diagnostics → Device information → ENP version
- Expert → Diagnostics → Device information → ENP version

### Description
Displays the version of the electronic nameplate.

**Display**
6-digit number in the format xx.yy.zz

### Device revision

### Navigation
- Diagnostics → Device information → Device revision
- Expert → Diagnostics → Device information → Device revision
- Expert → Communication → HART info → Device revision

### Description
Displays the device revision with which the device is registered with the HART FieldComm Group. It is needed to assign the appropriate device description file (DD) to the device.

**Display**
2-digit hexadecimal number

### Manufacturer ID → 90

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

### Manufacturer
Navigation

Diagnostics → Device information → Manufacturer
Expert → Diagnostics → Device information → Manufacturer

Description

Displays the manufacturer name.

Hardware revision

Navigation

Diagnostics → Device information → Hardware revision
Expert → Diagnostics → Device information → Hardware revision
Expert → Communication → HART info → Hardware revision

Description

Displays the hardware revision of the device.

Configuration counter

Navigation

Diagnostics → Device information → Configuration counter
Expert → Diagnostics → Device information → Configuration counter

Description

Displays the counter reading for changes to device parameters.

Static parameters, whose values change during optimization or configuration, cause this parameter to increase by 1. This supports parameter version management. If several parameters change, e.g. as a result of loading parameters from FieldCare etc. to 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.

14.2.4 "Measured values" submenu

Sensor n value

n = Stands for the number of sensor inputs (1 and 2)

Navigation

Diagnostics → Measured values → Sensor n value
Expert → Diagnostics → Measured values → Sensor n value

Description

Displays the current measured value at the sensor input.

Sensor n raw value

n = Stands for the number of sensor inputs (1 and 2)
Operating menu and parameter description

iTEMP TMT162

Navigation

Diagnostics → Measured values → Sensor n value
Expert → Diagnostics → Measured values → Sensor n value

Description

Displays the non-linearized mV/Ohm value at the specific sensor input.

Device temperature

Navigation

Diagnostics → Measured values → Device temperature
Expert → Diagnostics → Measured values → Device temperature

Description

Displays the current electronics temperature.

"Min/Max values" submenu

Sensor n min value

n = Stands for the number of sensor inputs (1 and 2)

Navigation

Diagnostics → Measured values → Min/max values → Sensor n min value
Expert → Diagnostics → Measured values → Min/max values → Sensor n min value

Description

Displays the minimum temperature measured in the past at sensor input 1 or 2 (peakhold indicator).

Sensor n max value

n = Stands for the number of sensor inputs (1 and 2)

Navigation

Diagnostics → Measured values → Min/max values → Sensor n max value
Expert → Diagnostics → Measured values → Min/max values → Sensor n max value

Description

Displays the maximum temperature measured in the past at sensor input 1 or 2 (peakhold indicator).

Device temperature min.

Navigation

Diagnostics → Measured values → Min/max values → Device temperature min.
Expert → Diagnostics → Measured values → Min/max values → Device temperature min.

Description

Displays the minimum electronics temperature measured in the past (minimum indicator).
**Device temperature max.**

**Navigation**
- Diagnostics → Measured values → Min/max values → Device temperature max.
- Expert → Diagnostics → Measured values → Min/max values → Device temperature max.

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

**14.2.5 "Simulation" submenu**

**Current output simulation**

**Navigation**
- Diagnostics → Simulation → Current output simulation
- Expert → Diagnostics → Simulation → Current output simulation

**Description**
Use this function to switch simulation of the current output on and off. The display alternates between the measured value and a diagnostics message of the "function check" category (C) while simulation is in progress.

**Display**
Measured value display ↔ C491 (current output simulation)

**Selection**
- Off
- On

**Factory setting**
Off

**Additional information**
The simulation value is defined in the Value current output parameter.

**Value current output**

**Navigation**
- Diagnostics → Simulation → Value current output
- Expert → Diagnostics → Simulation → Value current output

**Additional information**
The Current output simulation parameter must be set to On.

**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**
3.59 to 23.0 mA

**Factory setting**
3.58 mA
14.3  "Expert" menu

The parameter groups for the Expert setup contain all the parameters of the "Setup" and "Diagnostics" operating menus, as well as other parameters that are solely reserved for experts. Descriptions of the additional parameters can be found in this section. All the fundamental parameter settings for transmitter commissioning and diagnostic evaluation are described in the "Setup menu" → 67 and "Diagnostics menu" → 82 sections.

Enter access code → 71

Navigation

Setup → Advanced setup → Enter access code
Expert → Enter access code

Access status tooling → 72

Navigation

Setup → Advanced setup → Access status tooling
Expert → Access status tooling

Locking status → 72

Navigation

Setup → Advanced setup → Locking status
Expert → Locking status

14.3.1  "System" submenu

Unit

Navigation

Setup → Unit
Expert → System → Unit

Damping

Navigation

Expert → System → Damping

Description
Use this function to set the time constant for current output damping.

User entry 0 to 120 s

Factory setting 0.00 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.

Alarm delay

Navigation Expert → System → Alarm delay

Description Use this function to set the delay time during which a diagnostics signal is suppressed before it is output.

User entry 0 to 5 s

Factory setting 2 s

Mains filter

Navigation Expert → System → Mains filter

Description Use this function to select the mains filter for A/D conversion.

Selection
- 50 Hz
- 60 Hz

Factory setting 50 Hz

"Display" submenu
Detailed information →  77

"Administration" submenu
Detailed information →  80

14.3.2 "Sensor" submenu

Number of measurement channels

Navigation Expert → Sensor → Number of measurement channels

Description Displays information on the connected and configured measurement channels

Selection
- Not initiated
- 1-channel device
- 2-channel device
"Sensor 1/2" submenu

n = Stands for the number of sensor inputs (1 and 2)

Sensor type n → 67

Navigation

Setup → Sensor type n
Expert → Sensor → Sensor n → Sensor type n

Connection type n → 68

Navigation

Setup → Connection type n
Expert → Sensor → Sensor n → Connection type n

2-wire compensation n → 68

Navigation

Setup → 2-wire compensation n
Expert → Sensor → Sensor n → 2-wire compensation n

Reference junction n → 68

Navigation

Setup → Reference junction n
Expert → Sensor → Sensor n → Reference junction n

RJ preset value n → 69

Navigation

Setup → RJ preset value
Expert → Sensor → Sensor n → RJ preset value

Sensor offset n → 73

n = Stands for the number of sensor inputs (1 and 2)

Navigation

Setup → Advanced setup → Sensor → Sensor offset n
Expert → Sensor → Sensor n → Sensor offset n
**Sensor n lower limit**

**Navigation**
- Expert → Sensor → Sensor n → Sensor n lower limit

**Description**
Displays the minimum physical full scale value.

**Sensor n upper limit**

**Navigation**
- Expert → Sensor → Sensor n → Sensor n upper limit

**Description**
Displays the maximum physical full scale value.

**Sensor serial number**

**Navigation**
- Expert → Sensor → Sensor n → Serial no. sensor

**Description**
Use this function to enter the serial number of the connected sensor.

**User entry**
String with up to 12 characters consisting of numbers and/or text

**Factory setting**
"" (no text)

**"Sensor trimming" submenu**

**Sensor error adjustment (sensor trimming)**

Sensor trimming is used to adapt the actual sensor signal to the linearization of the selected sensor type stored in the transmitter. Compared to sensor transmitter matching, sensor trimming only takes place at the start and end value and does not achieve the same level of accuracy.

Sensor trimming does not adapt the measuring range. It is used to adapt the sensor signal to the linearization stored in the transmitter.

**Procedure**

1. Start

2. Set the **Sensor trimming** parameter to the **Customer-specific** setting.

3. Using a water/oil bath, bring the sensor connected to the transmitter to a known and stable temperature. A temperature which is close to the set start of the measuring range is recommended.
4. Enter the reference temperature for the value at the start of the measuring range for the **Sensor trimming lower value** parameter. Based on the difference between the specified reference temperature and the temperature actually measured at the input, the transmitter internally calculates a correction factor which is now used to linearize the input signal.

5. Using a water/oil bath, bring the sensor connected to the transmitter to a known and stable temperature close to the set end of the measuring range.

6. Enter the reference temperature for the value at the end of the measuring range for the **Sensor trimming upper value** parameter.

7. End

---

**Sensor trimming**

**Navigation**

Expert → Sensor → Sensor n → Sensor trimming → Sensor trimming

**Description**

Use this function to select the linearization method to be used for the connected sensor.

The original linearization can be restored by resetting this parameter to the **Factory setting** option.

**Selection**

- Factory setting
- Customer-specific

**Factory setting**

Factory setting

---

**Sensor trimming lower value**

**Navigation**

Expert → Sensor → Sensor n → Sensor trimming → Sensor trimming lower value

**Prerequisite**

The **Customer-specific** option is enabled in the **Sensor trimming** parameter → 93.

**Description**

Lower point for linear characteristic calibration (this affects offset and slope).

**User entry**

Depends on the selected sensor type and the assignment of the current output (PV).

**Factory setting**

-200 °C

---

**Sensor trimming upper value**

**Navigation**

Expert → Sensor → Sensor n → Sensor trimming → Sensor trimming upper value

**Prerequisite**

The **Customer-specific** option is enabled in the **Sensor trimming** parameter.

**Description**

Upper point for linear characteristic calibration (this affects offset and slope).
**User entry**

Depends on the selected sensor type and the assignment of the current output (PV).

**Factory setting**

+ 850 °C

---

**Sensor trimming min span**

**Navigation**

Expert → Sensor → Sensor n → Sensor trimming → Sensor trimming min span

**Prerequisite**

The Customer-specific option is enabled in the Sensor trimming parameter.

**Description**

Displays the minimum possible span between the sensor trimming upper and lower value.

---

**Reset trim**

**Navigation**

Expert → Sensor → Sensor n → Sensor trimming → Reset trim

**Description**

The Assistant resets the values for sensor trimming to the default value.

**User entry**

Activate the button

---

**Procedure for configuring a linearization using Callendar-Van Dusen coefficients from a calibration certificate**

1. Start
   \[\text{↓}\]
2. Assign current output (PV) = set sensor 1 (measured value)
   \[\text{↓}\]
3. Select unit (°C).
   \[\text{↓}\]
4. Select the sensor type (linearization type) "RTD platinum (Callendar-Van Dusen)".
   \[\text{↓}\]
5. Select connection mode e.g. 3-wire.
   \[\text{↓}\]
6. Set the lower and upper sensor limits.
   \[\text{↓}\]
7. Enter the four coefficients A, B, C and R0.
   \[\text{↓}\]
8. If special linearization is also used for a second sensor, repeat steps 2 to 6.
   \[\text{↓}\]
9. End
### Call.-V. Dusen coeff. R0

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Expert → Sensor → Sensor n → Linearization → Call./v.- Dusen coeff. R0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>The RTD platinum (Callendar/Van Dusen) option is enabled in the <strong>Sensor type</strong> parameter.</td>
</tr>
<tr>
<td>Description</td>
<td>Use this function to set the R0 Value only for linearization with the Callendar-Van Dusen polynomial.</td>
</tr>
<tr>
<td>User entry</td>
<td>10 to 2,000 Ohm</td>
</tr>
<tr>
<td>Factory setting</td>
<td>100 Ohm</td>
</tr>
</tbody>
</table>

### Call.-V. Dusen coeff. A, B and C

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>The RTD platinum (Callendar/Van Dusen) option is enabled in the <strong>Sensor type</strong> parameter.</td>
</tr>
<tr>
<td>Description</td>
<td>Use this function to set the coefficients for sensor linearization based on the Callendar-Van Dusen method.</td>
</tr>
</tbody>
</table>
| Factory setting                | • A: 3.910000e-003  
• B: -5.780000e-007  
• C: -4.180000e-012 |

### Polynomial coeff. R0

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>The RTD poly nickel or RTD copper polynomial option is enabled in the <strong>Sensor type</strong> parameter.</td>
</tr>
<tr>
<td>Description</td>
<td>Use this function to set the R0 Value only for linearization of nickel/copper sensors.</td>
</tr>
<tr>
<td>User entry</td>
<td>10 to 2,000 Ohm</td>
</tr>
<tr>
<td>Factory setting</td>
<td>100 Ohm</td>
</tr>
</tbody>
</table>

### Polynomial coeff. A, B

|--------------------------------|------------------------------------------------------------------------|
**Prerequisite**
The RTD poly nickel or RTD copper polynomial option is enabled in the **Sensor type** parameter.

**Description**
Use this function to set the coefficients for sensor linearization of copper/nickel resistance thermometers.

**Factory setting**
Polynomial coeff. $A = 5.49630 \times 10^{-3}$
Polynomial coeff. $B = 6.75560 \times 10^{-6}$

---

**Sensor n lower limit**

**Navigation**
- Expert → Sensor → Sensor n → Linearization → Sensor n lower limit

**Prerequisite**
The RTD platinum, RTD poly nickel or RTD copper polynomial option is enabled in the **Sensor type** parameter.

**Description**
Use this function to set the lower calculation limit for special sensor linearization.

**User entry**
Depends on the **sensor type** selected.

**Factory setting**
Depends on the **sensor type** selected.

---

**Sensor n upper limit**

**Navigation**
- Expert → Sensor → Sensor n → Linearization → Sensor n upper limit

**Prerequisite**
The RTD platinum, RTD poly nickel or RTD copper polynomial option is enabled in the **Sensor type** parameter.

**Description**
Use this function to set the upper calculation limit for special sensor linearization.

**User entry**
Depends on the **sensor type** selected.

**Factory setting**
Depends on the **sensor type** selected.

---

"Diagnostic settings" submenu

**Sensor switch set point** → 74

**Navigation**
- Setup → Advanced setup → Sensor → Sensor switch set point
- Expert → Sensor → Diagnostic settings → Sensor switch set point
Drift/difference mode → 73

Navigation
- Setup → Advanced setup → Sensor → Drift/difference mode
- Expert → Sensor → Diagnostic settings → Drift/difference mode

Drift/difference alarm delay → 73

Navigation
- Setup → Advanced setup → Sensor → Drift/difference alarm delay
- Expert → Sensor → Diagnostic settings → Drift/difference alarm delay

Drift/difference set point → 74

Navigation
- Setup → Advanced setup → Sensor → Drift/difference set point
- Expert → Sensor → Diagnostic settings → Drift/difference set point

Control

Navigation
- Expert → Sensor → Diagnostic settings → Control

Description
Option to control the calibration counter. The countdown duration (in days) is specified with the Start value parameter.

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

Factory setting
Off

Start value

Navigation
- Expert → Sensor → Diagnostic settings → Start value

Description
Use this function to set the start value for the calibration counter.

User entry
0 to 1826 d (days)

Factory setting
1826
Calibration countdown

Navigation  
Expert → Sensor → Diagnostic settings → Calibration countdown

Description  
Displays the time remaining until the next calibration.

The calibration counter only runs if the device is switched on. Example: If the calibration counter is set to 365 days on January 1, 2011 and no electricity is supplied to the device for 100 days, the alarm for the calibration appears on April 10, 2012.

14.3.3 "Output" submenu

Lower range value → 70

Navigation  
Setup → Lower range value
Expert → Output → Lower range value

Upper range value → 70

Navigation  
Setup → Upper range value
Expert → Output → Upper range value

Failure mode → 75

Navigation  
Setup → Advanced setup → Current output→ Failure mode
Expert → Output → Failure mode

Failure current → 76

Navigation  
Setup → Advanced setup → Current output→ Failure current
Expert → Output → Failure current

4 mA current trimming → 76

Navigation  
Setup → Advanced setup → Current output → 4 mA current trimming
Expert → Output → 4 mA current trimming
20 mA current trimming → 76

Navigation
- Setup → Advanced setup → Current output → 20 mA current trimming
- Expert → Output → 20 mA current trimming

Reset trim → 76

Navigation
- Setup → Advanced setup → Current output → Reset trim
- Expert → Output → Reset trim

14.3.4 "Communication" submenu

"HART® configuration" submenu

Device tag → 84

Navigation
- Diagnostics → Device information → 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
Definition of the HART® address of the device.

User entry
0 to 63

Factory setting
0
### 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

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Expert → Communication → HART® configuration → No. of preambles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Use this function to define the number of preambles in the HART® telegram</td>
</tr>
<tr>
<td>User entry</td>
<td>2 to 20</td>
</tr>
<tr>
<td>Factory setting</td>
<td>5</td>
</tr>
</tbody>
</table>

---

### Configuration changed

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Expert → Communication → HART® configuration → Configuration changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Displays whether the configuration of the device has been changed by a master (primary or secondary).</td>
</tr>
</tbody>
</table>

---

### Reset configuration changed

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Expert → Communication → HART® configuration → Reset configuration changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The Configuration changed information is reset by a master (primary or secondary).</td>
</tr>
<tr>
<td>User entry</td>
<td>Activate the button</td>
</tr>
</tbody>
</table>

---

### "HART® Info" submenu

### Device type

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Expert → Communication → HART® info → Device type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Displays 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.</td>
</tr>
<tr>
<td>Display</td>
<td>4-digit hexadecimal number</td>
</tr>
<tr>
<td>Factory setting</td>
<td>0x11CE</td>
</tr>
</tbody>
</table>
### Device revision

**Navigation**
- Expert → Communication → HART® info → Device revision

**Description**
Displays the device revision with which the device is registered with the HART® FieldComm Group. It is needed to assign the appropriate device description file (DD) to the device.

**Display**
4

**Factory setting**
4 (0x04)

### Device ID

**Navigation**
- Expert → Communication → HART® info → Device ID
- Expert → Diagnostics → Device information → Device ID

**Description**
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.

**Display**
ID generated for specific serial number

### Manufacturer ID

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

**Description**
Displays the manufacturer ID with which the device is registered with the HART® FieldComm Group.

**Display**
2-digit hexadecimal number

**Factory setting**
0x0011

### HART® revision

**Navigation**
- Expert → Communication → HART® info → HART® revision

**Description**
Displays the HART® revision of the device

### HART® descriptor
### Navigation
- **Expert → Communication → HART® info → HART® descriptor**

### Description
Use this function to define a description for the measuring point.

### User entry
Up to 16 alphanumeric characters (letters, numbers and special characters)

### Factory setting
The device name

#### 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
The device name

#### Hardware revision

### Navigation
- **Expert → Diagnostics → Device information → Hardware revision**
- **Expert → Communication → HART® info → Hardware revision**

### Description
Displays the hardware revision of the device.

#### Software revision

### Navigation
- **Expert → Communication → HART® info → Software revision**

### Description
Displays the software revision of the device.

#### HART® date code

### Navigation
- **Expert → Communication → HART® info → HART® date code**

### Description
Use this function to define 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**

打开了专家模式 → 通信 → HART® 信息 → 过程标示

**Description**

使用此功能输入设备安装的工艺单元。

**User entry**

最多 32 个字母数字字符（字母、数字和特殊字符）

**Factory setting**

32 x ‘?’

### Location description

**Navigation**

打开了专家模式 → 通信 → HART® 信息 → 地点描述

**Description**

使用此功能输入地点描述，以便于在工厂中找到设备。

**User entry**

最多 32 个字母数字字符（字母、数字和特殊字符）

**Factory setting**

32 x ‘?’

### Longitude

**Navigation**

打开了专家模式 → 通信 → HART® 信息 → 经度

**Description**

使用此功能输入经度坐标，以描述设备的位置。

**User entry**

-180.000 到 +180.000 °

**Factory setting**

0

### Latitude

**Navigation**

打开了专家模式 → 通信 → HART® 信息 → 纬度

**Description**

使用此功能输入纬度坐标，以描述设备的位置。

**User entry**

-90.000 到 +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**

\[-1.0 \cdot 10^{20} \text{ to } +1.0 \cdot 10^{20} \text{ m}\]

**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.

**Selection**

- 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)** → 67

**Navigation**

Setup → Assign current output (PV)

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

**PV**

**Navigation**

Expert → Communication → HART® output → PV

**Description**

Displays the primary HART® value
Assign SV

Navigation

Expert → Communication → HART® output → Assign SV

Description

Use this function to assign a measured variable to the secondary HART® value (SV)

Selection

See Assign current output (PV) parameter →  67

Factory setting

Device temperature

SV

Navigation

Expert → Communication → HART® output → SV

Description

Displays the secondary HART® value

Assign TV

Navigation

Expert → Communication → HART® output → Assign TV

Description

Use this function to assign a measured variable to the tertiary HART® value (TV)

Selection

See Assign current output (PV) parameter, →  67

Factory setting

Sensor 1

TV

Navigation

Expert → Communication → HART® output → TV

Description

Displays the tertiary HART® value

Assign QV

Navigation

Expert → Communication → HART® output → Assign QV

Description

Use this function to assign a measured variable to the quaternary HART® value (QV)

Selection

See Assign current output (PV) parameter, →  67
**Factory setting**

Sensor 1

---

**QV**

**Navigation**

Expert → Communication → HART® output → QV

**Description**

Displays the quaternary HART® value

---

"Burst configuration" submenu

Up to 3 burst modes can be configured.

---

**Burst mode**

**Navigation**

Expert → Communication → Burst configuration → Burst mode

**Description**

Activation of the HART burst mode for burst message X. Message 1 has the highest priority, message 2 the second-highest priority, etc. This prioritization is only correct if the Min. update period is the same for all burst configurations. The prioritization of the messages depends on the Min. update period; the shortest time has the highest priority.

**Selection**

- Off
  
The device only sends data to the bus at the request of a HART master
- On
  
The device regularly sends data to the bus without being requested to do so.

**Factory setting**

Off

---

**Burst command**

**Navigation**

Expert → Communication → Burst configuration → Burst command

**Description**

Use this function to select the command whose answer is sent to the HART master in the activated burst mode.
Selection

- Command 1
  Read out the primary variable
- Command 2
  Read out the current and the main measured value as a percentage
- Command 3
  Read out the dynamic HART variables and the current
- Command 9
  Read out the dynamic HART variables including the related status
- Command 33
  Read out the dynamic HART variables including the related unit
- Command 48
  Read out the additional device status

Factory setting

Command 2

Additional information

Commands 1, 2, 3, 9 and 48 are universal HART commands. Command 33 is a "Common-Practice" HART command. More details on this are provided in the HART specifications.

Burst variable n

- \( n = \) Number of burst variables (0 to 3)

Navigation

Expert → Communication → Burst configuration → Burst variable n

Prerequisite

This parameter can only be selected if the Burst mode option is enabled. The selection of burst variables depends on the burst command. If command 9 and command 33 are selected, the burst variables can be selected.

Description

Use this function to assign a measured variable to slots 0 to 3. This assignment is only relevant for the burst mode. The measured variables are assigned to the 4 HART variables (PV, SV, TV, QV) in the HART output menu.

Selection

- Sensor 1 (measured value)
- Sensor 2 (measured value)
- Device temperature
- Average of the two measured values: \( 0.5 \times (SV1 + SV2) \)
- Difference between sensor 1 and sensor 2: \( SV1 - SV2 \)
- Sensor 1 (backup sensor 2): If sensor 1 fails, the value of sensor 2 automatically becomes the primary HART value (PV): sensor 1 (OR sensor 2)
- Sensor switching: If the value exceeds the configured threshold value \( T \) for sensor 1, the measured value of sensor 2 becomes the primary HART value (PV). The system switches back to sensor 1 if the measured value of sensor 1 is at least 2 K below \( T \): sensor 1 (sensor 2, if sensor 1 > T)

The threshold value can be set with the Sensor switch set point parameter. With temperature-dependent switching, it is possible to combine 2 sensors that offer advantages in different temperature ranges.

Average: \( 0.5 \times (SV1 + SV2) \) with backup (measured value of sensor 1 or sensor 2 in the event of a sensor error in the other sensor)
Factory setting

- Burst variable slot 0: sensor 1
- Burst variable slot 1: device temperature
- Burst variable slot 2: sensor 1
- Burst variable slot 3: sensor 1

Burst trigger mode

Navigation

Expert → Communication → Burst configuration → Burst trigger mode

Description

Use this function to select the event that triggers burst message X.

- Continuous:
  The message is triggered in a time-controlled manner, at least observing the time interval defined in the Min. update period parameter.
- Range:
  The message is triggered if the specified measured value has changed by the value defined in the Burst trigger level X parameter.
- Rising:
  The message is triggered if the specified measured value exceeds the value in the Burst trigger level X parameter.
- Falling:
  The message is triggered if the specified measured value falls below the value in the Burst trigger level X parameter.
- On change:
  The message is triggered if a measured value of the message changes.

Selection

- Continuous
- Range
- Rising
- In band
- On change

Factory setting

Continuous

Burst trigger level

Navigation

Expert → Communication → Burst configuration → Burst trigger value

Prerequisite

This parameter can only be selected if the Burst mode option is enabled.

Description

Use this function to enter the value which, together with the trigger mode, determines the time of burst message 1. This value determines the time of the message.

User entry

-1.0e+20 to +1.0e+20

Factory setting

-10.000

Min. update period
Operating menu and parameter description

---

**Navigation**
- Expert → Communication → Burst configuration → Min. update period

**Prerequisite**
This parameter is dependent on the selection in the Burst trigger mode parameter.

**Description**
Use this function to enter the minimum time span between two burst commands of burst message X. The value is entered in the milliseconds unit.

**User entry**
500 to [value entered for the maximum time span in the Max. update period] parameter as integers

**Factory setting**
1000

---

**Max. update period**

**Navigation**
- Expert → Communication → Burst configuration → Min. update period

**Prerequisite**
This parameter is dependent on the selection in the Burst trigger mode parameter.

**Description**
Use this function to enter the maximum time span between two burst commands of burst message X. The value is entered in the milliseconds unit.

**User entry**
[Value entered for the minimum time span in the Min. update period] parameter to 3600000 as integers

**Factory setting**
2000

---

### 14.3.5 "Diagnostics" submenu
For a detailed description, see → 82

"Diagnostic list" submenu
For a detailed description, see → 82

"Event logbook" submenu
For a detailed description, see → 84

"Device information" submenu

---

**Device tag** → 84

**Navigation**
- Setup → Device tag
  - Diagnostics → Device information → Device tag
  - Expert → Diagnostics → Device information → Device tag

---

**Squawk**
Navigation

Expert → Diagnostics → Device information → Squawk

Description
This function can be used locally to facilitate the identification of the device in the field. Once the Squawk function has been activated, all the segments flash on the display.

Selection
- **Squawk once**: Display of device flashes for 60 seconds and then returns to normal operation.
- **Squawk on**: Display of device flashes continuously.
- **Squawk off**: Squawk is switched off and the display returns to normal operation.

User entry
Activate the relevant button

---

**Serial number → 85**

Navigation

Diagnostics → Device information → Serial number
Expert → Diagnostics → Device information → Serial number

---

**Firmware version → 85**

Navigation

Diagnostics → Device information → Firmware version
Expert → Diagnostics → Device information → Firmware version

---

**Device name → 85**

Navigation

Diagnostics → Device information → Device name
Expert → Diagnostics → Device information → Device name

---

**Order code → 85**

Navigation

Diagnostics → Device information → Order code
Expert → Diagnostics → Device information → Order code

---

**Extended order code 1-3**

Navigation

Expert → Diagnostics → Device information → Extended order code 1 to 3
Description
Displays 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 replacement device.
- To check the ordered device features using the delivery note.

### Manufacturer ID →  102

#### Navigation
- Expert → Communication → HART® info → Manufacturer ID
- Expert → Diagnostics → Device information → Manufacturer ID

#### Manufacturer

#### Navigation
- Expert → Diagnostics → Device information → Manufacturer

#### Description
Displays the manufacturer name.

### Hardware revision

#### Navigation
- Expert → Diagnostics → Device information → Hardware revision
- Expert → Communication → HART® info → Hardware revision

#### Description
Displays the hardware revision of the device.

### Configuration counter →  87

#### Navigation
- Diagnostics → Device information → Configuration counter
- Expert → Diagnostics → Device information → Configuration counter

### "Measured values" submenu

**Sensor n value →  87**

- _n_ = Stands for the number of sensor inputs (1 and 2)
Navigation

Diagnostics → Measured values → Sensor n value
Expert → Diagnostics → Measured values → Sensor n value

Sensor n raw value

n = Stands for the number of sensor inputs (1 and 2)

Navigation

Expert → Diagnostics → Measured values → Sensor n raw value

Description

Displays the non-linearized mV/Ohm value at the specific sensor input.

Device temperature → 88

Navigation

Diagnostics → Measured values → Device temperature
Expert → Diagnostics → Measured values → Device temperature

'Min/Max values' submenu

For a detailed description, see → 88

The following section provides a description of the additional parameters in this submenu that only appear in the Expert mode.

Reset sensor min/max values

Navigation

Expert → Diagnostics → Measured values → Min/max values → Reset sensor min/max values

Description

Reset the peakhold indicators for the minimum and maximum temperatures measured at the sensor inputs.

Selection

• No
• Yes

Factory setting

No

Reset device temp. min/max values

Navigation

Expert → Diagnostics → Measured values → Min/max values → Reset device temp. min/max values

Description

Reset the peakhold indicators for the minimum and maximum electronic temperatures measured.
### Operating menu and parameter description

#### Selection
- **No**
- **Yes**

#### Factory setting
No

### "Simulation" submenu

#### Diagnostic simulation

**Navigation**
- Expert → Diagnostics → Simulation → Diagnostic simulation

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

**Display**
If simulation is active, the relevant diagnostic event is displayed with the configured status signal. → 35

**Selection**
Off, or a diagnostic event from the defined list of diagnostic events → 35

**Factory setting**
Off

### Current output simulation

**Navigation**
- Diagnostics → Simulation → Current output simulation
- Expert → Diagnostics → Simulation → Current output simulation

### Value current output

**Navigation**
- Diagnostics → Simulation → Value current output
- Expert → Diagnostics → Simulation → Value current output

### "Diagnostic settings" submenu

#### Diagnostic behavior

**Navigation**
- Expert → Diagnostics → Diagnostic settings → Diagnostic behavior

**Description**
A certain event behavior is assigned at the factory to each diagnostic event in the categories: **sensor, electronics, process and configuration**. The user can change this assignment for certain diagnostic events via the diagnostic settings. → 36
Selection

- Alarm
- Warning
- Disabled

Factory setting

For detailed information see the ‘Overview of diagnostic events’ \(\rightarrow\) 36

Status signal

Navigation

![Expert → Diagnostics → Diagnostic settings → Status signal](image)

Description

A certain status signal is assigned at the factory to each diagnostic event in the categories: sensor, electronics, process and configuration \(^1\). The user can change this assignment for certain diagnostic events via the diagnostic settings. \(\rightarrow\) 36

Selection

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

Factory setting

For detailed information see the ‘Overview of diagnostic events’ \(\rightarrow\) 36

\(^1\) Digital information available via HART® communication
## Index

### 0 ... 9
- 2-wire compensation (parameter) .................. 68, 92
- 4 mA current trimming (parameter) ............. 76, 99
- 20 mA current trimming (parameter) ........... 76, 100

### A
- Access status tooling (parameter) ............... 72, 90

### Accessory
- Device-specific .................................. 42
- System components ............................. 43

### Actual diag channel
- Access status tooling (parameter) ............... 83

### Actual diagnostics
- Access status tooling (parameter) ............... 83
- Access status tooling (parameter) ............... 82

### Actual diagnostics count
- Access status tooling (parameter) ............... 83

### Administration (submenu)
- Access status tooling (parameter) ............... 80, 91

### Advanced setup (submenu)
- Access status tooling (parameter) ............... 71

### Alarm delay (parameter)
- Access status tooling (parameter) ............... 91

### Altitude (parameter)
- Access status tooling (parameter) ............... 105

### Assign current output (PV) (parameter)
- Access status tooling (parameter) ............... 69, 105

### Assign QV (parameter)
- Access status tooling (parameter) ............... 106

### Assign SV (parameter)
- Access status tooling (parameter) ............... 106

### Assign TV (parameter)
- Access status tooling (parameter) ............... 106

### B
- Burst command (parameter) ....................... 107
- Burst configuration (submenu) ................... 107
- Burst mode (parameter) .......................... 107
- Burst trigger level (parameter) ................. 109
- Burst trigger mode (parameter) ................. 109
- Burst variables (parameter) ..................... 108

### Calibration countdown
- Access status tooling (parameter) ............... 99

### Call.-V. Dusen coeff. A, B and C (parameter)
- Access status tooling (parameter) ............... 96

### Call.-V. Dusen coeff. R0 (parameter)
- Access status tooling (parameter) ............... 96

### CE mark
- Access status tooling (parameter) ............... 8

### Communication (submenu)
- Access status tooling (parameter) ............... 100

### Configuration changed (parameter)
- Access status tooling (parameter) ............... 101

### Configuration counter
- Access status tooling (parameter) ............... 87, 112

### Connection combinations
- Access status tooling (parameter) ............... 16

### Connection type (parameter)
- Access status tooling (parameter) ............... 68, 92

### Control (parameter)
- Access status tooling (parameter) ............... 98

### Current output (submenu)
- Access status tooling (parameter) ............... 74

### Current output simulation (parameter)
- Access status tooling (parameter) ............... 89, 114

### D
- Damping (parameter) ............................ 90
- Deactivate SIL (Wizard) ......................... 80
- Decimal places 1 (parameter) ................. 78
- Decimal places 2 (parameter) ................. 78
- Decimal places 3 (parameter) ................. 78

### Declaration of Conformity
- Access status tooling (parameter) ............... 8

### Define device write protection code (parameter)
- Access status tooling (parameter) ............... 81

### Device ID (parameter)
- Access status tooling (parameter) ............... 102

### Device info (submenu)
- Access status tooling (parameter) ............... 84, 110

### Device name
- Access status tooling (parameter) ............... 85, 111

### Device reset (parameter)
- Access status tooling (parameter) ............... 80

### Device revision
- Access status tooling (parameter) ............... 86, 102

### Device tag (parameter)
- Access status tooling (parameter) ............... 67, 84, 100, 110

### Device temperature
- Access status tooling (parameter) ............... 88, 113

### Device temperature max.
- Access status tooling (parameter) ............... 89

### Device temperature min.
- Access status tooling (parameter) ............... 88

### Device type
- Access status tooling (parameter) ............... 101

### Diagnostic behavior (parameter)
- Access status tooling (parameter) ............... 114

### Diagnostic events
- Access status tooling (parameter) ............... 35
- Overview ..................................... 36

### Diagnostic list (submenu)
- Access status tooling (parameter) ............... 82

### Diagnostic simulation (parameter)
- Access status tooling (parameter) ............... 114

### Diagnostic (menu)
- Access status tooling (parameter) ............... 82

### Diagnostic (submenu)
- Access status tooling (parameter) ............... 110

### Diagnostic simulation (parameter)
- Access status tooling (parameter) ............... 114

### Disposal
- Access status tooling (parameter) ............... 42

### Document
- Access status tooling (parameter) ............... 4

### Document function
- Access status tooling (parameter) ............... 4

### Drift/difference alarm delay
- Access status tooling (parameter) ............... 73, 98

### Drift/difference mode (parameter)
- Access status tooling (parameter) ............... 73, 98

### Drift/difference set point (parameter)
- Access status tooling (parameter) ............... 74, 98

### E
- ENP version ..................................... 86
- Enter access code (parameter) .................. 71, 90
- Enter SIL checksum (parameter) ............... 79
- Event logbook (submenu) ....................... 84
- Expert (Menu) .................................. 90

### Extended order code
- Access status tooling (parameter) ............... 86, 111

### F
- Failure current (parameter) ..................... 76, 99
- Failure mode (parameter) ....................... 75, 99

### FieldCare
- Access status tooling (parameter) ............... 26

### Function scope
- Access status tooling (parameter) ............... 26

### User interface
- Access status tooling (parameter) ............... 26

### Firmware version
- Access status tooling (parameter) ............... 85, 111

### Force safe state (parameter)
- Access status tooling (parameter) ............... 80

### H
- Hardware revision ............................... 87, 103, 112
- HART® address (parameter) ..................... 100
- HART® configuration (submenu) ................. 100
- HART® date code (parameter) .................. 103
- HART® descriptor (parameter) ................. 102
- HART® info (submenu) .......................... 101
- HART® message (parameter) ................... 103
- HART® output (submenu) ....................... 105
- HART® protocol
  - Device variables ............................. 28
  - Operating tools .............................. 28
<table>
<thead>
<tr>
<th>Index</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version data for the device</strong></td>
<td>28</td>
</tr>
<tr>
<td><strong>HART® revision</strong></td>
<td>102</td>
</tr>
<tr>
<td><strong>HART® short tag (parameter)</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>I</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Intended use</strong></td>
<td>7</td>
</tr>
<tr>
<td><strong>L</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Latitude (parameter)</strong></td>
<td>104</td>
</tr>
<tr>
<td><strong>Linearization (submenu)</strong></td>
<td>95</td>
</tr>
<tr>
<td><strong>Location description (parameter)</strong></td>
<td>104</td>
</tr>
<tr>
<td><strong>Location method (parameter)</strong></td>
<td>105</td>
</tr>
<tr>
<td><strong>Locking status</strong></td>
<td>72, 90</td>
</tr>
<tr>
<td><strong>Longitude (parameter)</strong></td>
<td>104</td>
</tr>
<tr>
<td><strong>Lower range value (parameter)</strong></td>
<td>70, 99</td>
</tr>
<tr>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mains filter (parameter)</strong></td>
<td>91</td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
<td>86, 112</td>
</tr>
<tr>
<td><strong>Manufacturer ID (parameter)</strong></td>
<td>86, 102, 112</td>
</tr>
<tr>
<td><strong>Max. update period (parameter)</strong></td>
<td>110</td>
</tr>
<tr>
<td><strong>Measured values (submenu)</strong></td>
<td>87, 112</td>
</tr>
<tr>
<td><strong>Measurement channels (display)</strong></td>
<td>91</td>
</tr>
<tr>
<td><strong>Min. update period (parameter)</strong></td>
<td>109</td>
</tr>
<tr>
<td><strong>Min/max values (submenu)</strong></td>
<td>88</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td></td>
</tr>
<tr>
<td><strong>No. of preambles (parameter)</strong></td>
<td>101</td>
</tr>
<tr>
<td><strong>O</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Operating time</strong></td>
<td>82</td>
</tr>
<tr>
<td><strong>Operation options</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Configuration programs</strong></td>
<td>21</td>
</tr>
<tr>
<td><strong>Onsite operation</strong></td>
<td>21</td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td>21</td>
</tr>
<tr>
<td><strong>Operational state (parameter)</strong></td>
<td>79</td>
</tr>
<tr>
<td><strong>Order code</strong></td>
<td>85, 111</td>
</tr>
<tr>
<td><strong>Output (submenu)</strong></td>
<td>99</td>
</tr>
<tr>
<td><strong>Output current</strong></td>
<td>75</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Polynomial coeff. A, B (parameter)</strong></td>
<td>96</td>
</tr>
<tr>
<td><strong>Polynomial coeff. R0 (parameter)</strong></td>
<td>96</td>
</tr>
<tr>
<td><strong>Previous diag n channel</strong></td>
<td>84</td>
</tr>
<tr>
<td><strong>Previous diagnostics</strong></td>
<td>84</td>
</tr>
<tr>
<td><strong>Previous diagnostics 1</strong></td>
<td>82</td>
</tr>
<tr>
<td><strong>Process unit tag (parameter)</strong></td>
<td>104</td>
</tr>
<tr>
<td><strong>Product safety</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>PV</strong></td>
<td>105</td>
</tr>
<tr>
<td><strong>Q</strong></td>
<td></td>
</tr>
<tr>
<td><strong>QV</strong></td>
<td>107</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Reference junction (parameter)</strong></td>
<td>68, 92</td>
</tr>
<tr>
<td><strong>Reset configuration changed (Wizard)</strong></td>
<td>101</td>
</tr>
<tr>
<td><strong>Reset device temp. min/max values (parameter)</strong></td>
<td>113</td>
</tr>
<tr>
<td><strong>Reset sensor min/max values (parameter)</strong></td>
<td>113</td>
</tr>
<tr>
<td><strong>Reset trim (Wizard)</strong></td>
<td>76, 95, 100</td>
</tr>
<tr>
<td><strong>Restart device (Wizard)</strong></td>
<td>80</td>
</tr>
<tr>
<td><strong>Return</strong></td>
<td>42</td>
</tr>
<tr>
<td><strong>RJ preset value (parameter)</strong></td>
<td>69, 92</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sensor (submenu)</strong></td>
<td>73, 91</td>
</tr>
<tr>
<td><strong>Sensor 1/2 (submenu)</strong></td>
<td>92</td>
</tr>
<tr>
<td><strong>Sensor lower limit</strong></td>
<td>93</td>
</tr>
<tr>
<td><strong>Sensor lower limit (parameter)</strong></td>
<td>97</td>
</tr>
<tr>
<td><strong>Sensor max value</strong></td>
<td>88</td>
</tr>
<tr>
<td><strong>Sensor min value</strong></td>
<td>88</td>
</tr>
<tr>
<td><strong>Sensor n raw value</strong></td>
<td>87</td>
</tr>
<tr>
<td><strong>Sensor offset (parameter)</strong></td>
<td>73, 92</td>
</tr>
<tr>
<td><strong>Sensor raw value</strong></td>
<td>113</td>
</tr>
<tr>
<td><strong>Sensor switch set point (parameter)</strong></td>
<td>74, 97</td>
</tr>
<tr>
<td><strong>Sensor trimming (parameter)</strong></td>
<td>94</td>
</tr>
<tr>
<td><strong>Sensor trimming (submenu)</strong></td>
<td>93</td>
</tr>
<tr>
<td><strong>Sensor trimming lower value (parameter)</strong></td>
<td>94</td>
</tr>
<tr>
<td><strong>Sensor trimming min span</strong></td>
<td>95</td>
</tr>
<tr>
<td><strong>Sensor trimming upper value (parameter)</strong></td>
<td>94</td>
</tr>
<tr>
<td><strong>Sensor type (parameter)</strong></td>
<td>67, 92</td>
</tr>
<tr>
<td><strong>Sensor upper limit</strong></td>
<td>93</td>
</tr>
<tr>
<td><strong>Sensor upper limit (parameter)</strong></td>
<td>97</td>
</tr>
<tr>
<td><strong>Sensor value</strong></td>
<td>87, 112</td>
</tr>
<tr>
<td><strong>Serial no. sensor (parameter)</strong></td>
<td>93</td>
</tr>
<tr>
<td><strong>Serial number</strong></td>
<td>85, 111</td>
</tr>
<tr>
<td><strong>Setup (menu)</strong></td>
<td>67</td>
</tr>
<tr>
<td><strong>SIL (submenu)</strong></td>
<td>78</td>
</tr>
<tr>
<td><strong>SIL checksum (parameter)</strong></td>
<td>80</td>
</tr>
<tr>
<td><strong>SIL option (parameter)</strong></td>
<td>78</td>
</tr>
<tr>
<td><strong>Simulation (submenu)</strong></td>
<td>89</td>
</tr>
<tr>
<td><strong>Software revision</strong></td>
<td>103</td>
</tr>
<tr>
<td><strong>Squawk (Assistant)</strong></td>
<td>110</td>
</tr>
<tr>
<td><strong>Start value (parameter)</strong></td>
<td>98</td>
</tr>
<tr>
<td><strong>Status signal (parameter)</strong></td>
<td>115</td>
</tr>
<tr>
<td><strong>Structure of the operating menu</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>SV</strong></td>
<td>106</td>
</tr>
<tr>
<td><strong>System (submenu)</strong></td>
<td>90</td>
</tr>
<tr>
<td><strong>T</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TV</strong></td>
<td>106</td>
</tr>
<tr>
<td><strong>U</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Unit (parameter)</strong></td>
<td>67, 90</td>
</tr>
<tr>
<td><strong>Upper range value (parameter)</strong></td>
<td>70, 99</td>
</tr>
<tr>
<td><strong>V</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Value 1 display (parameter)</strong></td>
<td>77</td>
</tr>
<tr>
<td><strong>Value 2 display (parameter)</strong></td>
<td>77</td>
</tr>
<tr>
<td><strong>Value 3 display (parameter)</strong></td>
<td>77</td>
</tr>
<tr>
<td><strong>Value current output (parameter)</strong></td>
<td>89, 114</td>
</tr>
<tr>
<td><strong>W</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Workplace safety</strong></td>
<td>7</td>
</tr>
</tbody>
</table>