

Operating Instructions

iTEMP TMT182B

Temperature transmitter



1 About this document

1.1 Document function

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

1.2 Safety instructions (XA)

When used in hazardous areas, compliance with national regulations is mandatory. 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 it contains 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.

1.3 Symbols

1.3.1 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 potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.




CAUTION



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

NOTICE













This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.3.2 Electrical symbols

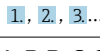


Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current

Symbol	Meaning
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Potential equalization connection (PE: Protective earth) Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: <ul style="list-style-type: none"> ▪ Interior ground terminal: potential equalization connection is connected to the supply network. ▪ Exterior ground terminal: device is connected to the plant grounding system.


1.3.3 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection


1.3.4 Symbols in graphics

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

1.4 Tool symbols


Symbol	Meaning
 A0011219	Phillips head screwdriver

1.5 Documentation

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

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

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

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	Quick guide to obtaining the first measured value The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Reference The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: 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 parameters The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions.  The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
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 product documentation.

1.6 Change 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 Bug fixes and internal changes. No changes to the Operating Instructions.

Documentation version	Firmware version	Changes
BA02260T_0122	01.00.zz	Original firmware
BA02260T_0226	01.00.zz	Updates

1.7 Registered trademarks

HART®

Registered trademark of the FieldComm Group, Austin, Texas, USA

2 Basic safety instructions

2.1 Requirements for the personnel

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

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

The operating personnel must fulfill the following requirements:

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

2.2 Intended use

The device is a universal and user-configurable temperature transmitter with one sensor input for a resistance thermometer (RTD), thermocouples (TC), resistance and voltage transmitters. The head transmitter version of the device is intended for mounting in a terminal head (flat face) as per DIN EN 50446. It is also possible to mount the device on a DIN rail using the optional DIN rail clip.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The manufacturer is not liable for harm caused by improper or unintended use.

2.3 Operational safety

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for ensuring that the device is in good working order.

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 instrumented system):

- ▶ 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.
- ▶ Comply with the instructions in the separate supplementary documentation, which is an integral part of this manual.

Electromagnetic compatibility

The measuring system complies with the EMC requirements stipulated in the IEC/EN 61326 series and NAMUR Recommendation NE 21.

NOTICE

- ▶ Only power the device using a power unit that operates using an energy-limited electric circuit according to UL/EN/IEC 61010-1, Section 9.4 and the requirements in Table 18.

2.4 Product safety

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

2.5 IT security

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

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

2.6 Device-specific IT security

The device offers specific functions to support protective measures by the operator. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. The device provides a password for changing the user role (applies to operation via FieldCare, DeviceCare, PDM).

Function/interface	Factory setting	Recommendation
Password	Not enabled (0000)	Assign a customized access code during commissioning.
Service interface (CDI)	Enabled	On an individual basis following risk assessment.

2.6.1 User-specific password

Write access to the device parameters via the operating tool (e.g. FieldCare, DeviceCare) can be protected by a modifiable, user-specific password.

2.6.2 General information


- During commissioning, any passwords that were used at delivery should be changed.
- Follow the general rules for generating a secure password when defining and managing the password.
- The user is responsible for the management and careful handling of passwords.

3 Incoming acceptance and product identification

3.1 Incoming acceptance

On receipt of the delivery:

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

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

3.2 Product identification

The device can be identified in the following ways:

- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- Enter the serial number from the nameplate in the *W@M Device Viewer* (www.endress.com/deviceviewer): All data relating to the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number from 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

Do you have the correct 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) (optional)
 - Technical values such as supply voltage, current consumption, ambient temperature, communication-specific data (optional)
 - Degree of protection
 - Approvals with symbols
 - Reference to Safety Instructions (XA) (optional)
- ▶ Compare the information on the nameplate with the order.

3.2.2 Name and address of manufacturer

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

3.3 Storage and transport

- Storage temperature: -50 to 100 °C (-58 to 212 °F)
- Humidity: max. rel. humidity: 95 % as per IEC 60068-2-30

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


Avoid the following environmental influences during storage:

- Direct sunlight
- Proximity to hot objects
- Mechanical vibration
- Aggressive media

4 Installation


4.1 Installation requirements

4.1.1 Dimensions


For the device dimensions, see the "Mechanical construction" section in the technical data.
→  46

4.1.2 Installation location

In the terminal head, flat face, as per DIN EN 50446, direct mounting on insert with cable entry (middle hole 7 mm).

 Make sure there is enough space in the terminal head!

It is also possible to mount the head transmitter on a DIN rail as per IEC 60715 using the DIN rail clip accessory.

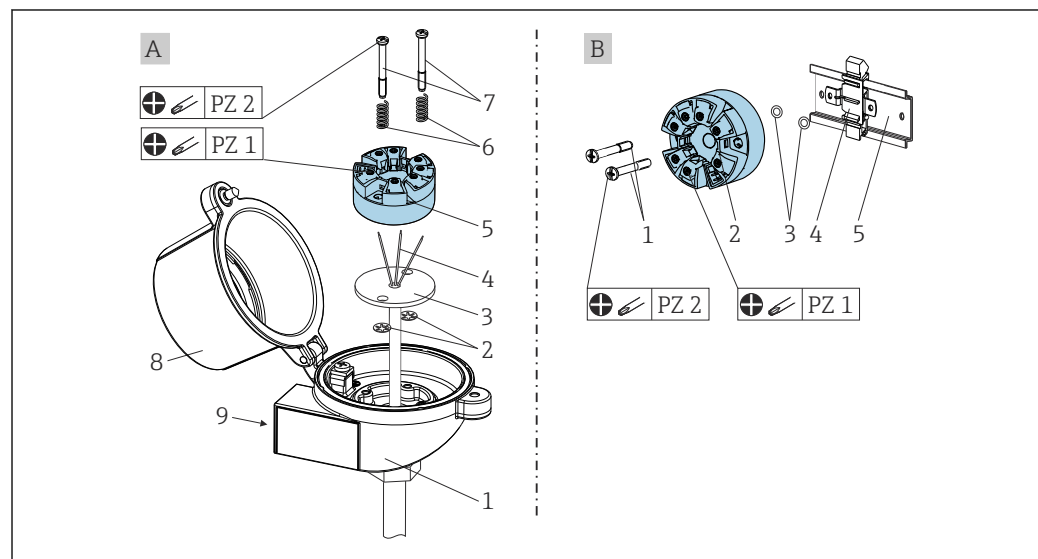
For information about the conditions (such as the ambient temperature, degree of protection, climate class etc.) that must be present at the installation point so that the device can be mounted correctly, see the 'Ambient conditions' section in the technical data.
→  46

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

4.2 Installing the measuring instrument

A Phillips head screwdriver is required to mount the head transmitter:

- Maximum torque for securing screws = 1 Nm ($\frac{3}{4}$ foot-pound), screwdriver: Pozidriv Z2
- Maximum torque for screw terminals = 0.35 Nm ($\frac{1}{4}$ foot-pound), screwdriver: Pozidriv Z1



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A Terminal head, flat face, as per DIN EN 50446, direct mounting on insert with cable entry (center hole 7 mm (0.28 in))

B With DIN rail clip on DIN rail as per IEC 60715 (TH35)

A	Mounting in a terminal head (terminal head flat face as per DIN 43729)
1	Terminal head
2	Retaining rings
3	Insert
4	Connection wires
5	Head transmitter
6	Mounting springs
7	Mounting screws
8	Terminal head cover
9	Cable entry

Procedure for mounting in a terminal head, item A:

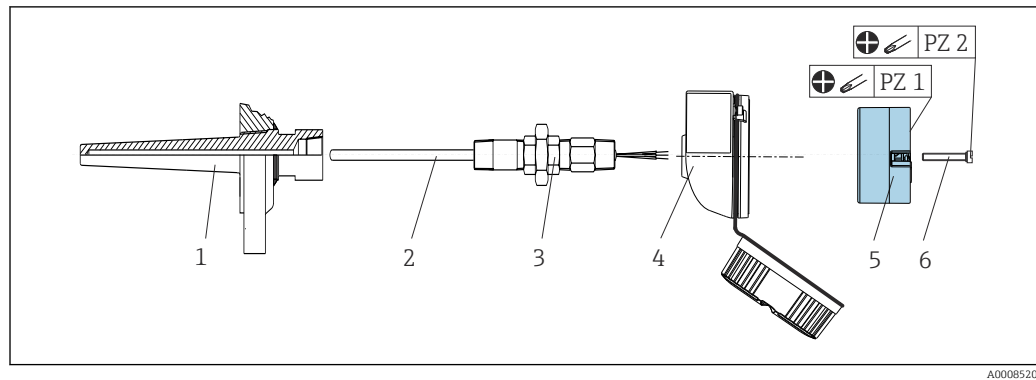
1. Open the terminal head cover (8) on the terminal head.
2. Guide the connection wires (4) of the insert (3) through the center hole in the head transmitter (5).
3. Fit the mounting springs (6) on the mounting screws (7).
4. Guide the mounting screws (7) through the side boreholes of the head transmitter and the insert (3). Fix both mounting screws with the snap rings (2).
5. Tighten the head transmitter (5) along with the insert (3) in the terminal head.
6. After wiring , close the terminal head cover (8) tightly again.

B	Mounting on DIN rail (DIN rail as per IEC 60715)
1	Mounting screws
2	Head transmitter
3	Retaining rings
4	DIN rail clip
5	DIN rail

Procedure for mounting on a DIN rail, item B:

1. Press the DIN rail clip (4) onto the DIN rail (5) until it engages with a click
2. Guide the mounting screws (1) through the lateral bores of the head transmitter (2). Then fix both mounting screws with the snap rings (3).
3. Screw the head transmitter (2) onto the DIN rail clip (4).

4.2.1 Mounting with a central-spring-loaded insert



- 1 Thermowell
- 2 Insert
- 3 Adapter, coupling
- 4 Terminal head
- 5 Head transmitter
- 6 Mounting screws

Structure of thermometer with RTD sensors and head transmitter:

1. Fit the thermowell (1) on the process pipe or the container wall. Secure the thermowell according to the instructions before the process pressure is applied.
2. Fit the necessary neck tube nipples and adapter (3) on the thermowell.
3. Make sure sealing rings are installed if such rings are needed for harsh environmental conditions or special regulations.
4. Guide the mounting screws (6) through the side boreholes of the head transmitter (5).
5. Position the head transmitter (5) in the terminal head (4) in such a way that the power supply lines (terminals 1 and 2) point to the cable entry.
6. Using a screwdriver, screw down the head transmitter (5) in the terminal head (4).
7. Guide the connection wires of the insert (3) through the lower cable entry of the terminal head (4) and through the middle hole in the head transmitter (5). Wire the connection wires up to the transmitter.
8. Screw the terminal head (4), with the integrated and wired head transmitter, onto the ready-mounted nipple and adapter (3).

NOTICE

The terminal head cover must be secured properly to meet the requirements for explosion protection.

- ▶ After wiring, securely screw the terminal head cover back on.

4.3 Post-installation check

After installing the device, carry out the following checks:

Device condition and specifications	Notes
Are the device, the connections and connecting cables free of damage (visual inspection)?	-
Do the ambient conditions match the device specification (e.g., ambient temperature, measuring range)?	See the 'Technical data' section
Have connections been established correctly and with the specified torque?	-

5 Electrical connection

⚠ CAUTION

- ▶ Do not install or wire the device when it is connected to the operating voltage. Non-compliance may result in the destruction of electronics components.
- ▶ Do not occupy the CDI interface. An incorrect connection can destroy the electronics.

NOTICE


Do not overtighten the screw terminals, as this could damage the transmitter.

- ▶ Maximum tightening torque = 1 Nm ($\frac{3}{4}$ lbf ft).

5.1 Connecting requirements

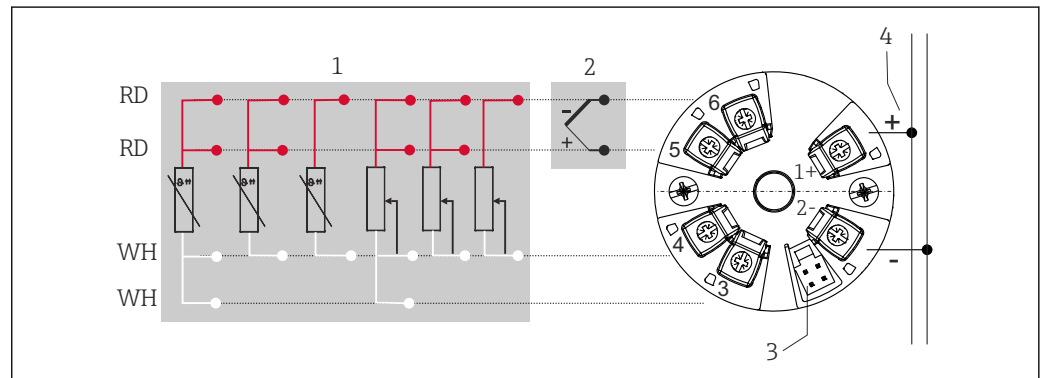
A Phillips head screwdriver is required to wire the head transmitter with screw terminals.


Proceed as follows to wire a mounted head transmitter:

1. Open the cable gland and the housing cover on the terminal head or the field housing.
2. Feed the cables through the opening in the cable gland.
3. Connect the cables as shown in →  13.
4. Tighten the cable gland again and close the housing cover.

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

5.2 Connecting the sensor cables




 1 Assignment of terminal connections for head transmitter

- 1 Sensor input, RTD and Ω , 4-, 3- and 2-wire
- 2 Sensor input, TC and mV
- 3 CDI interface
- 4 Bus connection and power supply

A minimum load of 250 Ω is required in the signal circuit in order to operate the HART[®] transmitter via the HART[®] protocol (terminals 1 and 2).

NOTICE

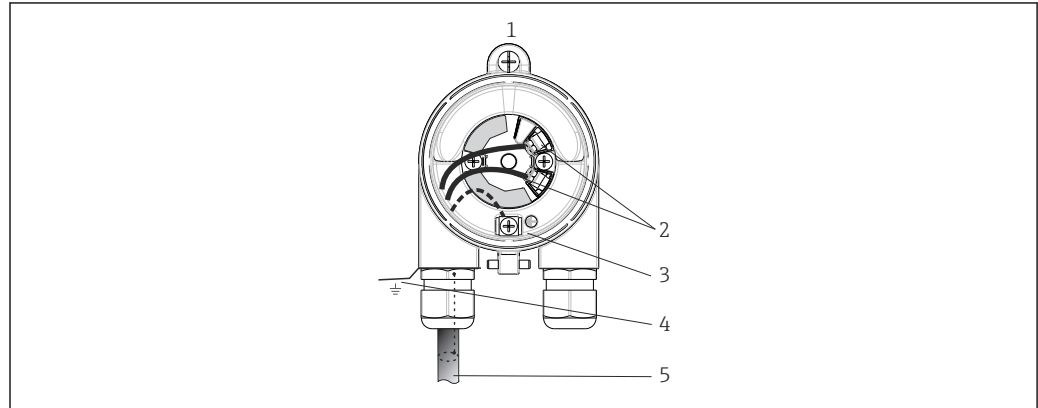
- ▶  ESD – Electrostatic discharge. Protect the terminals from electrostatic discharge. Failure to observe this may result in the destruction or malfunction of parts of the electronics.

5.3 Connecting the transmitter

i Cable specification

- A normal device cable suffices if only the analog signal is used.
- A shielded cable is recommended for HART® communication. Observe grounding concept of the plant.

Also observe the general procedure on → 13.



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i 2 Connecting the signal cables and power supply

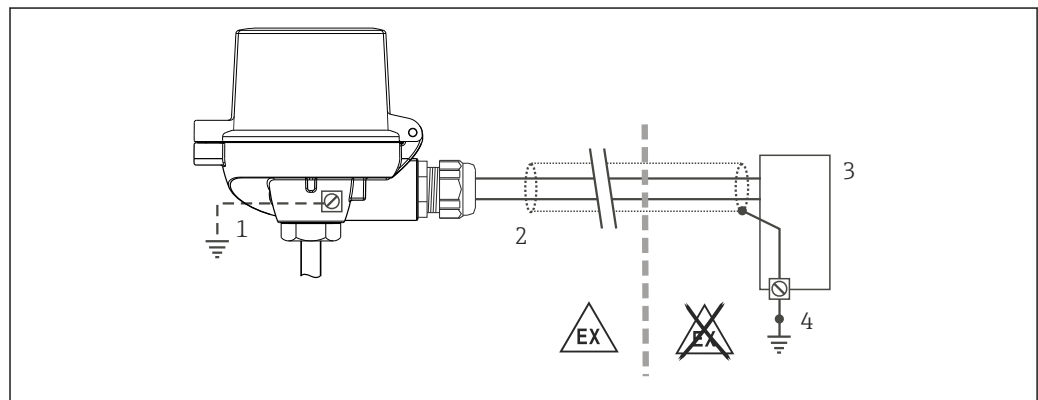
- 1 Head transmitter installed in the terminal head or field housing
- 2 Terminals for HART® protocol and power supply
- 3 Internal ground connection
- 4 External ground connection
- 5 Shielded signal cable (recommended for HART® protocol)

- The terminals for connecting the signal cable (1+ and 2-) are protected against reverse polarity.
- Cable cross-section max. 1.5 mm²

5.4 Special connection instructions

Shielding and grounding

The specifications of the FieldComm Group™ must be observed when installing a HART® transmitter.







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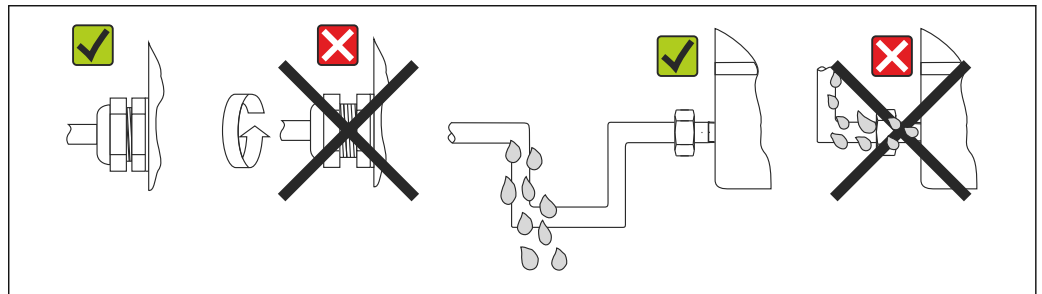
i 3 Shielding and grounding the signal cable at one end with HART® communication

- 1 Optional grounding of the field device, isolated from cable shielding
- 2 Grounding of the cable shield at one end
- 3 Supply unit
- 4 Grounding point for HART® communication cable shield


5.5 Ensuring the degree of protection

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


- The transmitter must be mounted in a terminal head with the appropriate degree of protection.
- The housing seals must be clean and undamaged when inserted into the sealing groove. The seals must be dried, cleaned or replaced if necessary.
- 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. →  4,  15
- 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 in such a way that the cable glands are not facing upwards. →  4,  15
- Replace unused cable glands with dummy plugs.
- Do not remove the grommet from the cable gland.



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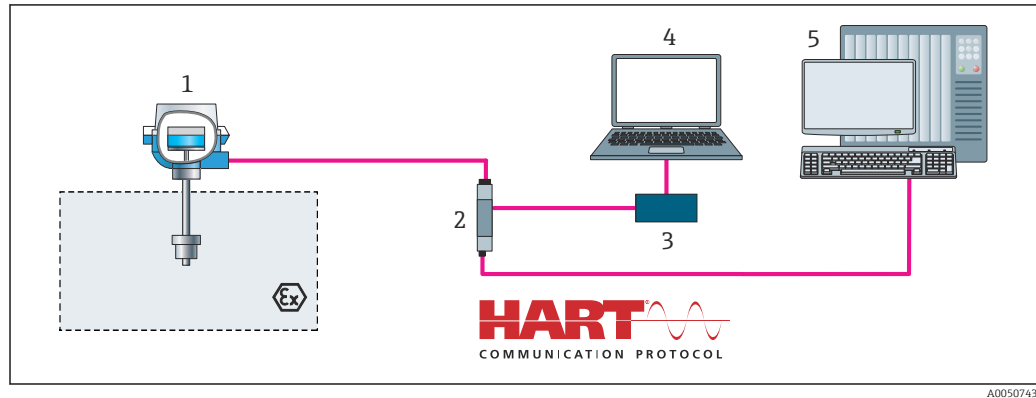
 4 Connection tips to retain IP67 protection

5.6 Post-connection check

Device condition and specifications	Notes
Are the device and cables free from damage (visual check)?	--
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	<ul style="list-style-type: none"> ■ Head transmitter: $U = 10$ to $36 V_{DC}$ ■ Other values apply in the hazardous area, see the corresponding Ex-specific documentation (XA).
Are the mounted cables strain-relieved?	--
Are the power supply and signal cables connected correctly?	→  13
Are all of the screw terminals well-tightened?	--
Are all the cable entries installed, tightened and leak-tight?	--
Are all housing covers installed and securely tightened?	--

6 Operation options

6.1 Overview of operation options

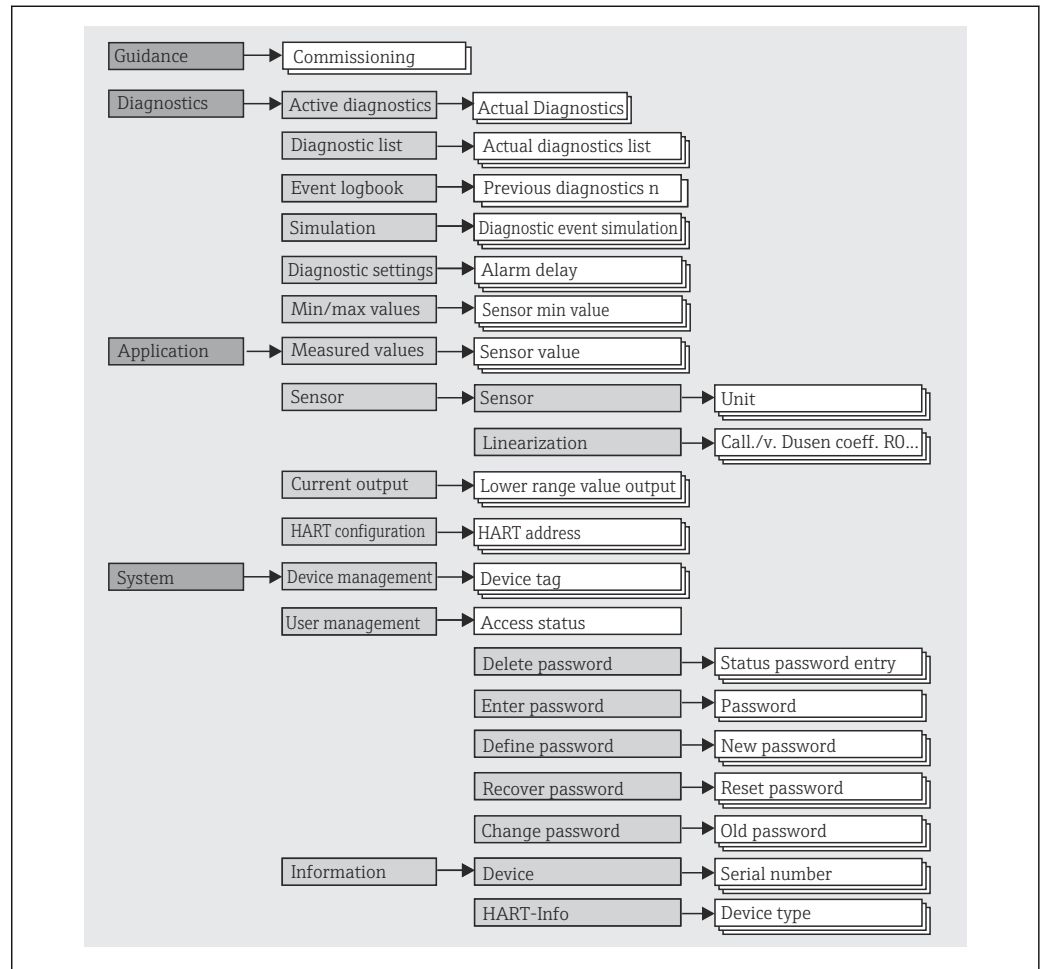


5 Operation options for the transmitter via HART® communication

- 1 Temperature transmitter
- 2 Transmitter active barrier with bidirectional HART® signal transmission
- 3 HART® modem
- 4 PC, laptop or tablet FieldCare/DeviceCare operating tools
- 5 PLC

6.2 Structure and function of the operating menu

6.2.1 Structure of the operating menu



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User roles

The role-based access concept consists of two hierarchical levels for the user and presents the various user roles with defined read/write authorizations derived from the NAMUR shell model.

- **Operator**

The plant operator can only change settings that do not affect the application - and particularly the measuring path - and simple, application-specific functions that are used during operation. The operator is able to read all the parameters, however.

- **Maintenance**

The **Maintenance** user role refers to configuration situations: commissioning and process adaptations as well as troubleshooting. It allows the user to configure and modify all available parameters. In contrast to the **Operator** user role, in the **Maintenance** role the user has read and write access to all the parameters.

- **Changing the user role**

A user role - and therefore existing read and write authorization - is changed by selecting the desired user role (already preselected depending on the operating tool) and entering the correct password when subsequently prompted. When a user logs out, system access always returns to the lowest level in the hierarchy. A user is logged out either by actively selecting the logout function when operating the device or is logged out automatically if the device is not operated for a period of over 600 seconds. Irrespective of this, actions that are already in progress (e.g., active upload/download, data logging, etc.) continue to be executed in the background.

- **As-delivered state**

The **Operator** user role is not enabled when the device is delivered from the factory, i.e. the **Maintenance** role is the lowest level in the hierarchy ex-works. This state makes it possible to commission the device and make other process adaptations without having to enter a password. Afterwards, a password can be assigned for the **Maintenance** user role to protect this configuration. The **Operator** user role is not visible when the device is delivered from the factory.

- **Password**

The **Maintenance** user role can assign a password in order to restrict access to device functions. This activates the **Operator** user role, which is now the lowest hierarchy level where the user is not asked to enter a password. The password can only be changed or disabled in the **Maintenance** user role. A password can be defined at different points in the operation of the device:

In the menu: Guidance → Commissioning wizard: as part of guided device operation

In the menu: System → User management

Submenus

Menu	Typical tasks	Content/meaning
"Diagnostics"	Troubleshooting: <ul style="list-style-type: none"> ▪ Diagnosing and eliminating process errors. ▪ Error diagnostics in difficult cases. ▪ Interpretation of device error messages and correcting associated errors. 	Contains all parameters for detecting and analyzing errors: <ul style="list-style-type: none"> ▪ Diagnostic list Contains up to 3 error messages currently pending ▪ Event logbook Contains the last 10 error messages ▪ "Simulation" submenu Used to simulate measured values, output values or diagnostic messages ▪ "Diagnostic settings" submenu Contains all parameters for configuring error events ▪ "Min/max values" submenu Contains the minimum/maximum indicators and the reset option
"Application"	Commissioning: <ul style="list-style-type: none"> ▪ Configuration of the measurement. ▪ Configuration of data processing (scaling, linearization, etc.). ▪ Configuration of the analog measured value output. Tasks during operation: Reading measured values.	Contains all parameters for commissioning: <ul style="list-style-type: none"> ▪ "Measured values" submenu Contains all the current measured values ▪ "Sensor" submenu Contains all the parameters for configuring the measurement ▪ "Output" submenu Contains all the parameters for configuring the analog current output ▪ "HART configuration" submenu Contains the settings and the most important parameters for HART communication
"System"	Tasks that require detailed knowledge of the system administration of the device: <ul style="list-style-type: none"> ▪ Optimum adaptation of the measurement for system integration. ▪ Detailed configuration of the communication interface. ▪ User and access administration, password control ▪ Information for device identification and HART information 	Contains all the higher-level device parameters that are assigned for system, device and user management, including Bluetooth configuration. <ul style="list-style-type: none"> ▪ "Device management" submenu Contains parameters for general device management ▪ "Device and user management" submenus Parameters for access authorization, password assignment, etc. ▪ "Information" submenu Contains all the parameters for the unique identification of the device ▪ "Display" submenu Configuration of the display

6.3 Access to the operating menu via the operating tool

The FieldCare and DeviceCare operating tools are available for download (<https://www.software-products.endress.com>).

6.3.1 DeviceCare

Function scope

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

Source for device description files

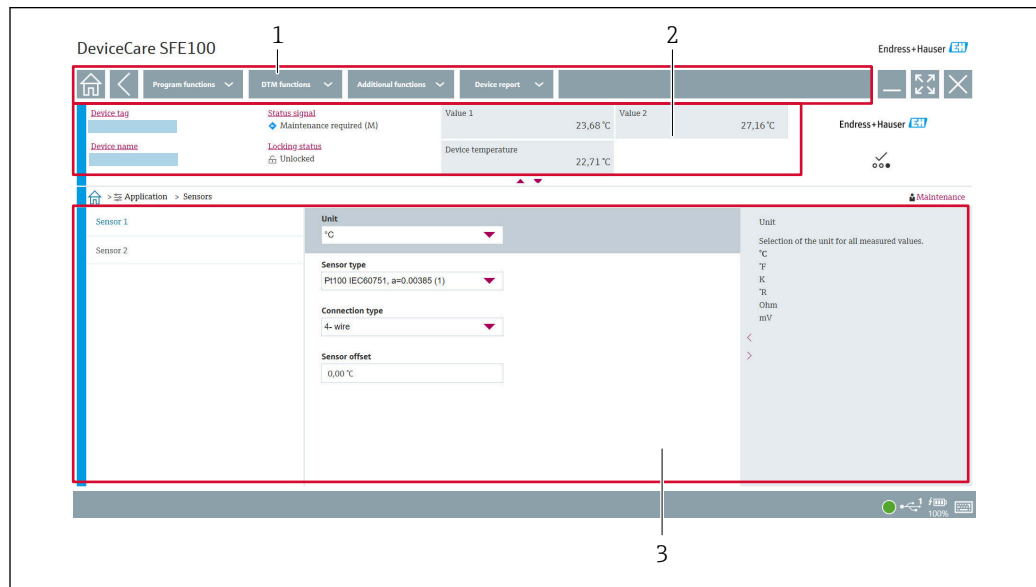
See information in the "System integration" section →  23

Establishing connection

Example: CDI communication kit FXA291 (USB)

1. Make sure that the DTM library is updated for all the connected devices.
 2. Start DeviceCare and connect the device via the **Automatic** button.
 - ↳ The device is detected automatically.
- i** When transmitting the device parameters following offline parameter configuration, the password for **Maintenance** must first be entered in the **System -> User administration** menu, if specified.

User interface



i 6 DeviceCare user interface with device information

- 1 Navigation area
- 2 Displays device name, current status, current measured values
- 3 Device parameter configuration section

6.3.2 FieldCare

Function scope

FDT/DTM-based plant asset management tool from Endress+Hauser. It can be used to configure all intelligent field units in a plant 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 is via the HART[®] protocol, CDI (= Endress+Hauser Common Data Interface). It supports devices with the following protocols, provided a suitable device driver (DTM) is installed: HART, PROFIBUS, FOUNDATION Fieldbus, EtherNet/IP, Modbus, CDI, ISS, IPC and PCP.

Typical functions:

- Parameter configuration of transmitters
- Loading and saving device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook

i For details, see Operating Instructions BA027S/04/xx and BA059AS/04/xx

Source for device description files

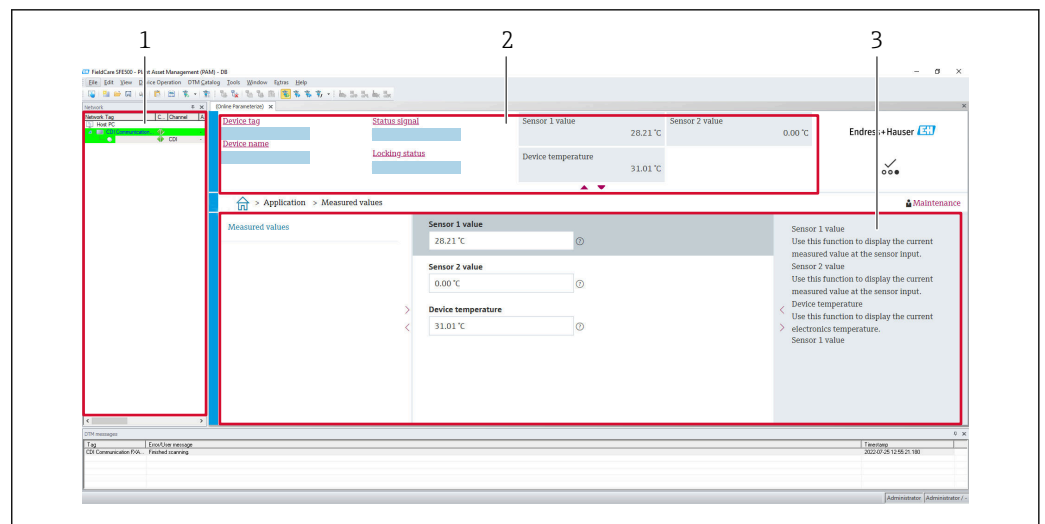
See information → **23**

Establishing connection

Example: CDI communication kit FXA291 (USB)

1. Make sure that the DTM library is updated for all the connected devices.
 2. Start FieldCare and create a project.
 3. Right-click **Host PC** Add device...
 - ↳ The **Add new device** window opens.
 4. Select the **CDI Communication FXA291** option from the list and press **OK** to confirm.
 5. Double-click **CDI Communication FXA291** DTM.
 - ↳ Check whether the correct modem is connected to the serial interface connection.
 6. Right-click **CDI Communication FXA291** and in the context menu select the **Create network** option.
 - ↳ The connection to the device is established.
- i** When transmitting the device parameters following offline parameter configuration, the password for **Maintenance** must first be entered in the **System -> User administration** menu, if specified.

User interface



A0050411

7 FieldCare user interface with device information

- 1 Network view
- 2 Displays device name, current status, current measured values
- 3 Menu navigation, device parameterization, help section

6.3.3 AMS Device Manager

Function scope

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

Source for device description files

See information → 23.

6.3.4 SIMATIC PDM

Function scope

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

Source for device description files

See information →  23.

7 System integration

7.1 Overview of device description files

Version data for the device

Firmware version	01.01.zz	<ul style="list-style-type: none"> ▪ On the title page of the Operating Instructions ▪ On the nameplate ▪ Firmware version parameter System → Information → Device → Firmware version
Manufacturer ID	0x11	<p>Manufacturer ID parameter System → Information → HART info → Manufacturer ID</p>
Device type code	0x11D2	<p>Device type parameter System → Information → HART info → Device type</p>
HART protocol revision	7	---
Device revision	1	<ul style="list-style-type: none"> ▪ On the transmitter nameplate ▪ Device revision parameter System → Information → HART info → Device revision

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

- www.endress.com → Downloads → Search field: Software → Software type: Device driver
- www.endress.com → Products: individual product page, e.g. TMTxy → Documents/Manuals/Software: Electronic Data Description (EDD) or Device Type Manager (DTM).


Endress+Hauser supports all common operating tools from a variety of manufacturers (e.g. Emerson Process Management, ABB, Siemens, Yokogawa, Honeywell and many others). Endress+Hauser's FieldCare and DeviceCare operating tools are also available for download (www.endress.com → Downloads → Search field: Software → Application software) or on the data storage medium which you can obtain from your local Endress+Hauser sales organization.

7.2 Measured variables via HART protocol

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

Device variable	Measured value
Primary device variable (PV)	Sensor 1
Secondary device variable (SV)	Device temperature
Tertiary device variable (TV)	Sensor 1
Quaternary device variable (QV)	Sensor 1

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 need device description files (DD = Device Descriptions, 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.



Command No.	Description
Universal commands	
0, Cmd0	Read unique identifier
1, Cmd001	Read primary variable
2, Cmd002	Read loop current and percent of range
3, Cmd003	Read dynamic variables and loop current
6, Cmd006	Write polling address
7, Cmd007	Read loop configuration
8, Cmd008	Read dynamic variable classifications
9, Cmd009	Read device variables with status
11, Cmd011	Read unique identifier associated with TAG
12, Cmd012	Read message
13, Cmd013	Read TAG, descriptor, date
14, Cmd014	Read primary variable transducer information
15, Cmd015	Read device information
16, Cmd016	Read final assembly number
17, Cmd017	Write message
18, Cmd018	Write TAG, descriptor, date
19, Cmd019	Write final assembly number
20, Cmd020	Read long TAG (32-byte TAG)
21, Cmd021	Read unique identifier associated with long TAG
22, Cmd022	Write long TAG (32-byte TAG)
38, Cmd038	Reset configuration changed flag
48, Cmd048	Read additional device status
Common practice commands	
33, Cmd033	Read device variables
34, Cmd034	Write primary variable damping value
35, Cmd035	Write primary variable range values
40, Cmd040	Enter/Exit fixed current mode
42, Cmd042	Perform device reset
44, Cmd044	Write primary variable units
45, Cmd045	Trim loop current zero
46, Cmd046	Trim loop current gain
50, Cmd050	Read dynamic variable assignments

Command No.	Description
54, Cmd054	Read device variable information
59, Cmd059	Write number of response preambles
72, Cmd072	Squawk
95, Cmd095	Read Device Communication Statistics
100, Cmd100	Write Primary Variable Alarm Code
516, Cmd516	Read Device Location
517, Cmd517	Write Device Location
518, Cmd518	Read Location Description
519, Cmd519	Write Location Description
520, Cmd520	Read Process Unit Tag
521, Cmd521	Write Process Unit Tag
523, Cmd523	Read Condensed Status Mapping Array
524, Cmd524	Write Condensed Status Mapping Array
525, Cmd525	Reset Condensed Status Mapping Array
526, Cmd526	Write Simulation Mode
527, Cmd527	Simulate Status Bit

8 Commissioning

8.1 Function check

Before commissioning the measuring point make sure that all final checks have been carried out:

- Checklist for "Post-installation" check →  12
- "Post-connection check" checklist →  15

8.2 Switching on the device

Once you have completed the post-connection checks, switch on the supply voltage. The device performs a number of internal test functions after it is powered up.

The device operates after approx. seven seconds. Normal measuring mode commences as soon as the switch-on procedure is completed.

8.3 Configuring the device

Wizards

The starting point for device wizards is in the **Guidance** menu. Wizards are used not only to query individual parameters, but also to guide the operator through the configuration and verification of entire parameter combinations by means of a clearly structured sequence, including prompts. The "Start" button can be disabled for wizards that require specific access authorization (lock symbol appears on the screen).


The following five operating elements are supported for navigation in the wizards:

- **Start**
Only on the initial page: start the wizard and go to the first section
- **Next**
Go to the next page of the wizard. Is not enabled until parameters are entered or confirmed.
- **Back**
Return to the previous page
- **Cancel**
If Cancel is selected, the status before the wizard was started is restored
- **Finish**
Closes the wizard and possibility of making additional parameter settings on the device. Only enabled on the final page.

8.3.1 Commissioning wizard

Commissioning is the first step required in order to use a device for a specific application. The Commissioning wizard contains an introductory page (with the "Start" operating element) and a short description of the content. The wizard consists of several sections in which the user is guided step-by-step through the commissioning of the device.

"Device management" is the first section that appears when the user runs the wizard, and contains the following parameters. Its main purpose is to provide information about the device:

Navigation  **Guidance → Commissioning → Start**




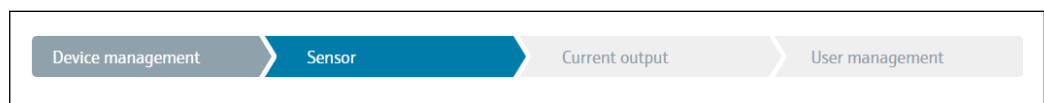
A0037378-EN

Device TAG
 Device name
 Serial number
 Extended order code (n) ¹⁾

1) n = placeholder for 1, 2, 3

The second section, "Sensor", takes the user through all the relevant settings for the sensor. The number of parameters displayed depends on the corresponding settings. The following parameters can be configured:


Navigation  **Guidance → Commissioning → Sensor**

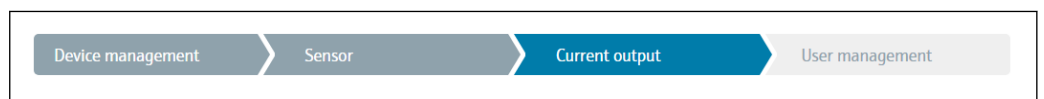


A0037389-EN

Unit
 Sensor type
 Connection type
 2-wire compensation
 Reference junction
 RJ preset value

In the third section, the settings are made for the analog output and the output's alarm response. The following parameters can be configured:


Navigation  **Guidance → Commissioning → Current output**



A0037390-EN

4 mA value
 20 mA value
 Failure mode

In the final section, a password can be defined for the "Maintenance" user role. This is strongly recommended to protect the device against unauthorized access. The following steps describe how to configure a password for the "Maintenance" role for the first time.

Navigation  **Guidance → Commissioning → User management**



A0037391-EN

Access status
 New password
 Confirm new password

1. The **Maintenance** role appears in the "Access status" picklist.
 - ↳ Afterwards, the **New password** and **Confirm new password** input boxes appear.

2. Enter a user-defined password that meets the password rules indicated in the online help.
3. Enter the password again in the **Confirm new password** input box.

Once the password has been entered successfully, parameter changes, particularly those that are needed for commissioning, process adaptation/optimization and troubleshooting, can only be implemented in the **Maintenance** user role and if the password is entered successfully.



8.4 Protecting settings from unauthorized access

By assigning a password for the **Maintenance** user role, it is possible to restrict access authorization in the software and protect the device against unauthorized access.

 See the Commissioning wizard →  26

The parameters are also protected against modification by logging out of the **Maintenance** user role and switching to the **Operator** role.



To disable the write protection, the user must log on with the **Maintenance** user role via the relevant operating tool.

 User role concept →  17

9 Diagnostics and troubleshooting

9.1 General troubleshooting

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

 Due to its design, the device cannot be repaired. However, it is possible to send the device in for examination. See the information in the "Return" section. →  33

General errors

Error	Possible cause	Remedial action
Device is not responding.	Supply voltage does not match the voltage specified on the nameplate.	Check the voltage at the transmitter directly using a voltmeter and correct.
	Connecting cables are not making contact with the terminals.	Check the electrical contact between the cable and terminals and correct if necessary.
	Electronics module is defective.	Replace the device.
Output current <3.6 mA	Signal cable is not wired correctly.	Check wiring.
	Electronics module is defective.	Replace the device.
HART® communication is not working.	Missing or incorrectly installed communication resistor.	Install the communication resistor (250 Ω) correctly.
	Commubox is connected incorrectly.	Connect Commubox correctly.
	Commubox is not set to "HART®".	Set Commubox selector switch to "HART®".



Error messages in the configuration software

→  30



Application errors without status messages for RTD sensor connection

Error	Possible cause	Remedial action
Measured value is incorrect/ inaccurate	Incorrect sensor orientation.	Install the sensor correctly.
	Heat conducted by sensor.	Observe the installed length of the sensor.
	Device programming is incorrect (number of wires).	Change the Connection type device function.
	Device programming is incorrect (scaling).	Change scaling.
	Incorrect RTD configured.	Change the Sensor type device function.
	Sensor connection.	Check that the sensor is connected correctly.
	The cable resistance of the sensor (2-wire) was not compensated.	Compensate the cable resistance.
	Offset incorrectly set.	Check offset.
Failure current (≤ 3.6 mA or ≥ 21 mA)	Sensor defective.	Check the sensor.

Error	Possible cause	Remedial action
	RTD connected incorrectly.	Install the connecting cables correctly (terminal diagram).
	Device programming is incorrect (e.g., number of wires).	Change the Connection type device function.
	Incorrect programming.	Incorrect sensor type set in the Sensor type device function. Set the correct sensor type.



Application errors without status messages for TC sensor connection

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

9.2 Diagnostic information via communication interface

Status signals

Letter/ symbol ¹⁾	Event category	Meaning
F	Operating error	An operating error has occurred.
C	Service mode	The device is in the service mode (e.g., during a simulation).
S	Out of specification	The device is being operated outside its technical specifications (e.g., during startup or cleaning processes).
M	Maintenance required	Maintenance is required.
N -	Not categorized	

1) As per NAMUR NE 107

Diagnostic behavior

Alarm	Measurement is interrupted. The signal outputs take on the defined alarm condition. A diagnostic message is generated.
Warning	The device continues to measure. A diagnostic message is generated.
Disabled	The diagnostic behavior is completely disabled even if the device is not recording a measured value.

9.3 Queued diagnostic messages

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

9.4 Diagnostic list

All of the diagnostic messages currently pending can be displayed in the **Diagnostic list** submenu.


Navigation path

Diagnostics → Diagnostic list

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
041	Sensor interrupted	1. Check electrical connection 2. Replace sensor 1 3. Check connection type	F	Alarm
043	Short circuit	1. Check electrical connection 2. Check sensor 3. Replace sensor or cable	F	Alarm
047	Sensor limit reached	1. Check sensor 2. Check process conditions	S	Warning
Diagnostic of electronic				
145	Compensation reference point	1. Check terminal temperature 2. Check external reference point	F	Alarm
201	Electronics faulty	1. Restart device 2. Replace electronics	F	Alarm
221	Reference sensor defective	Replace device	M	Alarm
Diagnostic of configuration				
401	Factory reset active	Factory reset in progress, please wait	C	Warning
402	Initialization active	Initialization in progress, please wait	C	Warning
402	Initialization active		C	Warning
410	Data transfer failed	1. Check connection 2. Repeat data transfer	F	Alarm
411	Up-/download active	Up-/download in progress, please wait	C	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
435	Linearization faulty	Check linearization	F	Alarm
485	Process variable simulation active	Deactivate simulation	C	Warning
491	Output simulation	Deactivate simulation	C	Warning
495	Diagnostic event simulation active	Deactivate simulation	C	Warning
531	Factory adjustment missing	1. Contact service organization 2. Replace device	F	Alarm
537	Configuration	1. Check device configuration 2. Up- and download new configuration	F	Alarm
537	Configuration	Check current output configuration	F	Alarm
582	Sensor diagnostics TC deactivated	Switch on diagnostics for thermocouple measurement	C	Warning
Diagnostic of process				
801	Supply voltage too low	Increase supply voltage	S	Alarm
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
844	Process value out of specification	1. Check process value 2. Check application 3. Check sensor	S	Warning

9.5 Event logbook


 Previous diagnostic messages are displayed in the **Event logbook** submenu.

10 Maintenance and cleaning

The device does not require specific maintenance work.

10.1 Cleaning of surfaces not in contact with the medium

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

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

11 Repair

11.1 General notes

Due to its design, the device cannot be repaired.

11.2 Spare parts

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


Type	Order code
Standard - DIN mounting set (2 screws and springs, 4 lock washers, 1 CDI connector cover)	71044061
US - M4 mounting set (2 screws and 1 CDI connector cover)	71044062

11.3 Return

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

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

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.

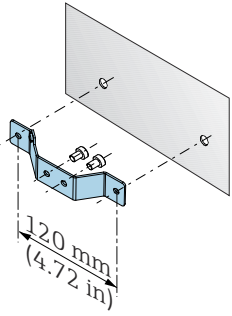
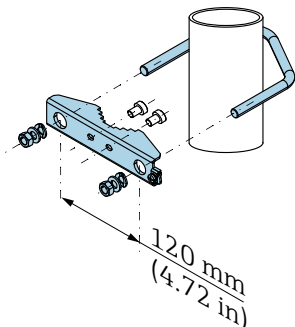
12 Accessories

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

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

12.1 Device-specific accessories

Accessories for the head transmitter
Field housing TA30x for Endress+Hauser head transmitter
Adapter for DIN rail mounting, DIN rail clip as per IEC 60715 (TH35) without securing screws
Standard - DIN mounting set (2 screws + springs, 4 lock washers and 1 CDI interface cover)
US - M4 securing screws (2 M4 screws and 1 CDI interface cover)

Accessories enclosed	
Wall mounting bracket, 316 L	 <p>A technical drawing of a wall mounting bracket. The bracket is L-shaped and is shown being attached to a vertical wall. A dimension line indicates a length of 120 mm (4.72 in) for the horizontal part of the bracket.</p> <p style="text-align: right;">A0061686</p>
Pipe mounting bracket, 316 L	 <p>A technical drawing of a pipe mounting bracket. The bracket is L-shaped and is shown being attached to a horizontal pipe. A dimension line indicates a length of 120 mm (4.72 in) for the horizontal part of the bracket.</p> <p style="text-align: right;">A0061687</p>

12.2 Communication-specific accessories

Commubox FXA195 USB/HART modem

Connects intrinsically safe 'smart transmitters' with a HART protocol to the USB interface of a laptop/PC. This enables the remote operation of the transmitters with FieldCare.



Technical Information TI00404F

www.endress.com/fxa195

12.3 Service-specific accessories

DeviceCare SFE100

DeviceCare is an Endress+Hauser configuration tool for field devices using the following communication protocols: HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, IO/Link, Modbus, CDI and Endress+Hauser Common Data Interfaces.



Technical Information TI01134S

www.endress.com/sfe100

FieldCare SFE500

FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.

The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.



Technical Information TI00028S

www.endress.com/sfe500

Netilion

With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data.

These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.



www.netilion.endress.com

12.4 Online tools

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

12.5 System components

RN series active barrier

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

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

Process indicators from the RIA product family

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

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

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

13 Technical data

13.1 Input

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

Resistance thermometer (RTD) as per standard	Designation	α	Measuring range limits	Min. span
IEC 60751:2022	Pt100 (1) Pt200 (2) Pt500 (3) Pt1000 (4)	0.003851	-200 to 850 °C (-328 to 1 562 °F) -200 to 850 °C (-328 to 1 562 °F) -200 to 500 °C (-328 to 932 °F) -200 to 250 °C (-328 to 482 °F)	10 K (18 °F)
JIS C1604:1984	Pt100 (5)	0.003916	-200 to 510 °C (-328 to 950 °F)	10 K (18 °F)
DIN 43760 IPTS-68	Ni100 (6) Ni120 (7)	0.006180	-60 to 250 °C (-76 to 482 °F) -60 to 250 °C (-76 to 482 °F)	10 K (18 °F)
GOST 6651-94	Pt50 (8) Pt100 (9)	0.003910	-185 to 1 100 °C (-301 to 2 012 °F) -200 to 850 °C (-328 to 1 562 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-2009	Cu50 (10) Cu100 (11)	0.004280	-180 to 200 °C (-292 to 392 °F) -180 to 200 °C (-292 to 392 °F)	10 K (18 °F)
	Ni100 (12) Ni120 (13)	0.006170	-60 to 180 °C (-76 to 356 °F) -60 to 180 °C (-76 to 356 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-94	Cu50 (14)	0.004260	-50 to 200 °C (-58 to 392 °F)	10 K (18 °F)
-	Pt100 (Callendar Van Dusen) Nickel polynomial Copper polynomial	-	The measuring range limits are specified by entering the limit values that depend on the coefficients A to C and R0.	10 K (18 °F)
<ul style="list-style-type: none"> ■ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ■ With 2-wire circuit, compensation of wire resistance possible (0 to 30 Ω) ■ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire 				
Resistance transmitter	Resistance Ω		10 to 400 Ω 10 to 2 000 Ω	10 Ω 10 Ω

Thermocouples as per standard	Designation	Measuring range limits		Min. span
IEC 60584, Part 1 ASTM E230-3	Type A (W5Re-W20Re) (30)	0 to 2 500 °C (32 to 4 532 °F)	Recommended temperature range: 0 to 2 500 °C (32 to 4 532 °F)	50 K (90 °F)
	Type B (PtRh30-PtRh6) (31)	40 to 1 820 °C (104 to 3 308 °F)	500 to 1 820 °C (932 to 3 308 °F)	50 K (90 °F)
	Type E (NiCr-CuNi) (34)	-250 to 1 000 °C (-482 to 1 832 °F)	-150 to 1 000 °C (-238 to 1 832 °F)	50 K (90 °F)
	Type J (Fe-CuNi) (35)	-210 to 1 200 °C (-346 to 2 192 °F)	-150 to 1 200 °C (-238 to 2 192 °F)	50 K (90 °F)
	Type K (NiCr-Ni) (36)	-270 to 1 372 °C (-454 to 2 501 °F)	-150 to 1 200 °C (-238 to 2 192 °F)	50 K (90 °F)
	Type N (NiCrSi-NiSi) (37)	-270 to 1 300 °C (-454 to 2 372 °F)	-150 to 1 300 °C (-238 to 2 372 °F)	50 K (90 °F)
	Type R (PtRh13-Pt) (38)	-50 to 1 768 °C (-58 to 3 214 °F)	200 to 1 768 °C (392 to 3 214 °F)	50 K (90 °F)
	Type S (PtRh10-Pt) (39)	-50 to 1 768 °C (-58 to 3 214 °F)	200 to 1 768 °C (392 to 3 214 °F)	50 K (90 °F)
	Type T (Cu-CuNi) (40)	-200 to 400 °C (-328 to 752 °F)	-150 to 400 °C (-238 to 752 °F)	50 K (90 °F)
IEC 60584, Part 1 ASTM E230-3 ASTM E988-96	Type C (W5Re-W26Re) (32)	0 to 2 315 °C (32 to 4 199 °F)	0 to 2 000 °C (32 to 3 632 °F)	50 K (90 °F)
ASTM E988-96	Type D (W3Re-W25Re) (33)	0 to 2 315 °C (32 to 4 199 °F)	0 to 2 000 °C (32 to 3 632 °F)	50 K (90 °F)
DIN 43710	Type L (Fe-CuNi) (41)	-200 to 900 °C (-328 to 1 652 °F)	-150 to 900 °C (-238 to 1 652 °F)	50 K (90 °F)
	Type U (Cu-CuNi) (42)	-200 to 600 °C (-328 to 1 112 °F)	-150 to 600 °C (-238 to 1 112 °F)	50 K (90 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)	-200 to 800 °C (-328 to 1 472 °F)	-200 to 800 °C (328 to 1 472 °F)	50 K (90 °F)

Thermocouples as per standard	Designation	Measuring range limits	Min. span
	<ul style="list-style-type: none"> Internal reference junction (Pt100) External preset value: configurable value -40 to 85 °C (-40 to 185 °F) Maximum sensor wire resistance 10 kΩ 		
Voltage transmitter (mV)	Millivolt transmitter (mV)	-20 to 100 mV	5 mV

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 for 1 minute (input/output)

Failure information

Failure information as per NAMUR NE 43:

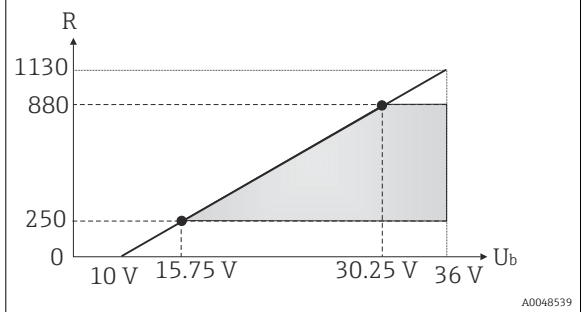
Failure information is created if the measuring information is missing or not valid. A complete list of all the faults occurring in the measuring system is created.

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

Load

$R_{b \max} = (U_b \max. - 10 \text{ V}) / 0.023 \text{ A}$ (current output). Valid for head transmitter

Load in Ohm
 U_b = supply voltage in V DC



Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Filters

1st order digital filter: 0 to 120 s

Protocol-specific data

Manufacturer ID	17 (0x11)
Device type code	0x11D2
HART® specification	7
Device address in multi-drop mode	Software setting addresses 0 to 63
Device description files (DTM, DD)	Information and files available at: www.endress.com www.fieldcommgroup.org
HART load	Min. 250 Ω

HART device variables	<p>Measured value for primary value (PV) Sensor (measured value)</p> <p>Measured values for SV, TV, QV (secondary, tertiary and quaternary variable)</p> <ul style="list-style-type: none"> ▪ SV: device temperature ▪ TV: sensor (measured value) ▪ QV: sensor (measured value)
Supported functions	Condensed status

Wireless HART data

Minimum starting voltage	10 V _{DC}
Starting current	3.58 mA
Starting time	7 s
Minimum operating voltage	10 V _{DC}
Multidrop current	4.0 mA
Time for connection setup	9 s

Write protection for device parameters Software: user role-based concept (password assignment)

Switch-on delay ≤ 7 s until the first valid measured value signal is present at the current output and until the start of HART® communication. While switch-on delay = I_a ≤ 3.8 mA

13.3 Power supply

Supply voltage Values for non-hazardous areas, protected against polarity reversal:
U = 10 to 36 V_{DC}
Values for hazardous area, see Ex documentation.


Current consumption

- 3.6 to 23 mA
- Minimum current consumption 3.5 mA
- Current limit ≤ 23 mA

Terminals	Terminal design	Cable design	Cable cross-section
	Screw terminals	Rigid or flexible	≤ 1.5 mm ² (16 AWG)

13.4 Performance characteristics

Response time	Resistance thermometer (RTD) and resistance transmitter (Ω measurement)	≤ 1 s
	Thermocouples (TC) and voltage transmitters (mV)	≤ 1 s
	Reference temperature	≤ 1 s

 When recording step responses, it must be taken into account that the times of the internal reference measuring point are added to the specified times where applicable.

Update time Approx. 100 ms

Reference operating conditions ■ Calibration temperature: +25 °C ±3 K (77 °F ±5.4 °F)
 ■ Supply voltage: 24 V DC
 ■ 4-wire circuit for resistance adjustment

Maximum measurement error In accordance with EN IEC 62828 and the reference operating conditions specified above. The measurement error data corresponds to ±2 σ (Gaussian distribution). The data includes non-linearities and repeatability.

MV = measured value

LRV = lower range value of the sensor in question

Typically

Standard	Designation	Measuring range	Typical measurement error (±)	
Resistance thermometer (RTD) as per standard			Digital value ¹⁾	Value at current output
IEC 60751:2008	Pt100 (1)	0 to 200 °C (32 to 392 °F)	0.1 °C (0.18 °F)	0.12 °C (0.22 °F)
IEC 60751:2008	Pt1000 (4)		0.09 °C (0.16 °F)	0.11 °C (0.20 °F)
GOST 6651-94	Pt100 (9)		0.10 °C (0.18 °F)	0.12 °C (0.22 °F)
Thermocouples (TC) as per standard			Digital value ¹⁾	Value at current output
IEC 60584, Part 1	Type K (NiCr-Ni) (36)	0 to 800 °C (32 to 1472 °F)	0.65 °C (1.17 °F)	0.69 °C (1.24 °F)
IEC 60584, Part 1	Type S (PtRh10-Pt) (39)		1.50 °C (2.70 °F)	1.52 °C (2.74 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.60 °C (4.68 °F)	2.61 °C (4.70 °F)

1) Measured value transmitted via HART®.

Measurement error for resistance thermometers (RTD) and resistance transmitters

Standard	Designation	Measuring range	Measurement error (±)	
			Digital ¹⁾	D/A ²⁾
			Based on measured value ³⁾	
IEC 60751:2008	Pt100 (1)	-200 to 850 °C (-328 to 1562 °F)	ME = ± (0.08 °C (0.14 °F) + 0.006% * (MV - LRV))	
	Pt200 (2)		ME = ± (0.2 °C (0.36 °F) + 0.011% * (MV - LRV))	
	Pt500 (3)		ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))	
	Pt1000 (4)		ME = ± (0.06 °C (0.11 °F) + 0.007% * (MV - LRV))	
JIS C1604:1984	Pt100 (5)	-200 to 510 °C (-328 to 950 °F)	ME = ± (0.08 °C (0.14 °F) + 0.006% * (MV - LRV))	
GOST 6651-94	Pt50 (8)	-185 to 1100 °C (-301 to 2012 °F)	ME = ± (0.13 °C (0.23 °F) + 0.008% * (MV - LRV))	
	Pt100 (9)	-200 to 850 °C (-328 to 1562 °F)	ME = ± (0.08 °C (0.14 °F) + 0.0055% * (MV - LRV))	
DIN 43760 IPTS-68	Ni100 (6)	-60 to 250 °C (-76 to 482 °F)	ME = ± (0.08 °C (0.14 °F) - 0.004% * (MV - LRV))	
	Ni120 (7)			
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	-180 to 200 °C (-292 to 392 °F)	ME = ± (0.12 °C (0.22 °F) + 0.006% * (MV - LRV))	
	Cu100 (11)	-180 to 200 °C (-292 to 392 °F)	ME = ± (0.08 °C (0.14 °F) + 0.003% * (MV - LRV))	
	Ni100 (12)	-60 to 180 °C (-76 to 356 °F)	ME = ± (0.08 °C (0.14 °F) - 0.004% * (MV - LRV))	
	Ni120 (13)			
OIML R84: 2003, GOST 6651-94	Cu50 (14)	-50 to 200 °C (-58 to 392 °F)	ME = ± (0.12 °C (0.22 °F) + 0.004% * (MV - LRV))	

Standard	Designation	Measuring range	Measurement error (±)	
			Digital ¹⁾	D/A ²⁾
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± 25 mΩ + 0.0032 % * MV	0.03 % (≅ 4.8 μA)
		10 to 2 850 Ω	ME = ± 120 mΩ + 0.006 % * MV	

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

Measurement error for thermocouples (TC) and voltage transmitters

Standard	Designation	Measuring range	Measurement error (±)	
			Digital ¹⁾	D/A ²⁾
			Based on measured value ³⁾	
IEC 60584-1 ASTM E230-3	Type A (30)	0 to 2 500 °C (32 to 4 532 °F)	ME = ± (1.25 °C (2.25 °F) + 0.026% * (MV - LRV))	0.03 % (≅ 4.8 μA)
	Type B (31)	500 to 1 820 °C (932 to 3 308 °F)	ME = ± (2.25 °C (4.05 °F) - 0.09% * (MV - LRV))	
IEC 60584-1 ASTM E230-3 ASTM E988-96	Type C (32)	0 to 2 000 °C (32 to 3 632 °F)	ME = ± (1.15 °C (2.07 °F) + 0.0055% * (MV - LRV))	
	ASTM E988-96		Type D (33)	
IEC 60584-1 ASTM E230-3	Type E (34)	-150 to 1 000 °C (-238 to 1 832 °F)	ME = ± (0.4 °C (0.72 °F) - 0.008% * (MV - LRV))	
	Type J (35)	-150 to 1 200 °C (-238 to 2 192 °F)	ME = ± (0.45 °C (0.81 °F) - 0.007% * (MV - LRV))	
	Type K (36)		ME = ± (0.6 °C (1.08 °F) - 0.01% * (MV - LRV))	
	Type N (37)	-150 to 1 300 °C (-238 to 2 372 °F)	ME = ± (0.8 °C (1.44 °F) - 0.025% * (MV - LRV))	
	Type R (38)	200 to 1 768 °C (392 to 3 214 °F)	ME = ± (1.6 °C (2.88 °F) - 0.025% * (MV - LRV))	
	Type S (39)		ME = ± (1.6 °C (2.88 °F) - 0.025% * (MV - LRV))	
Type T (40)	-150 to 400 °C (-238 to 752 °F)	ME = ± (0.5 °C (0.9 °F) - 0.05% * (MV - LRV))		
DIN 43710	Type L (41)	-150 to 900 °C (-238 to 1 652 °F)	ME = ± (0.5 °C (0.9 °F) - 0.016% * (MV - LRV))	0.03 % (≅ 4.8 μA)
	Type U (42)	-150 to 600 °C (-238 to 1 112 °F)	ME = ± (0.55 °C (0.99 °F) - 0.04% * (MV - LRV))	
GOST R8.585-2001	Type L (43)	-200 to 800 °C (-328 to 1 472 °F)	ME = ± (2.45 °C (4.41 °F) - 0.015% * (MV - LRV))	
Voltage transmitter (mV)		-20 to +100 mV	ME = ± 10.0 μV	4.8 μA

- 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.

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

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

Measurement error digital = 0.08 °C + 0.006% x (200 °C - (-200 °C)):	0.1 °C (0.18 °F)
Measurement error D/A = 0.003 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Measurement error digital value (HART):	0.1 °C (0.18 °F)
Measurement error analog value (current output): $\sqrt{(\text{measurement error digital}^2 + \text{measurement error D/A}^2)}$	0.12 °C (0.22 °F)

Sample calculation with Pt100, measuring range 0 to 200 °C (32 to 392 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:

Measurement error digital = $0.08\text{ °C} + 0.006\% \times (200\text{ °C} - (-200\text{ °C}))$:	0.1 °C (0.18 °F)
Measurement error D/A = $0.03\% \times 200\text{ °C}$ (360 °F)	0.06 °C (0.108 °F)
Influence of ambient temperature (digital) = $(35 - 25) \times (0.0017\% \times 200\text{ °C} - (-200\text{ °C}))$, min. 0.003 °C	0.07 °C (0.13 °F)
Influence of ambient temperature (D/A) = $(35 - 25) \times (0.003\% \times 200\text{ °C})$	0.06 °C (0.108 °F)
Influence of supply voltage (digital) = $(30 - 24) \times (0.01\% \times 200\text{ °C} - (-200\text{ °C}))$, min. 0.005 °C	0.02 °C (0.036 °F)
Influence of supply voltage (D/A) = $(30 - 24) \times (0.003\% \times 200\text{ °C})$	0.04 °C (0.72 °F)
Measurement error digital value (HART): $\sqrt{(\text{Measurement error digital})^2 + (\text{Influence of ambient temperature (digital)})^2 + (\text{Influence of supply voltage (digital)})^2}$	0.12 °C (0.22 °F)
Measurement error analog value (current output): $\sqrt{(\text{Measurement error digital})^2 + (\text{Measurement error D/A})^2 + (\text{Influence of ambient temperature (digital)})^2 + (\text{Influence of ambient temperature (D/A)})^2 + (\text{Influence of supply voltage (digital)})^2 + (\text{Influence of supply voltage (D/A)})^2}$	0.15 °C (0.27 °F)

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 coefficient (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 60751. 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

Current output adjustment

Correction of the 4 or 20 mA current output value.

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

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

Designation	Standard	Ambient temperature: Influence (\pm) per 1 °C (1.8 °F) change		Supply voltage: Influence (\pm) per V change	
		Digital ¹⁾	D/A ²⁾	Digital ¹⁾	D/A ²⁾
		Based on measured value		Based on measured value	
Pt100 (1)	IEC 60751:2008	0.0015% * (MV - LRV), at least 0.003 °C (0.005 °F)	0.003 %	0.001% * (MV - LRV), at least 0.002 °C (0.004 °F)	0.003 %
Pt200 (2)		at least 0.014 °C (0.025 °F)		at least 0.008 °C (0.014 °F)	
Pt500 (3)		0.0015% * (MV - LRV), at least 0.006 °C (0.011 °F)		0.0009% * (MV - LRV), at least 0.003 °C (0.005 °F)	
Pt1000 (4)		at least 0.003 °C (0.005 °F)		at least 0.002 °C (0.004 °F)	
Pt100 (5)	JIS C1604:1984	0.0017% * (MV - LRV), at least 0.003 °C (0.005 °F)	0.003 %	0.0009% * (MV - LRV), at least 0.002 °C (0.004 °F)	0.003 %
Pt50 (8)	GOST 6651-94	0.0017% * (MV - LRV), at least 0.006 °C (0.011 °F)		0.0011% * (MV - LRV), at least 0.003 °C (0.005 °F)	
Pt100 (9)		0.0015% * (MV - LRV), at least 0.003 °C (0.005 °F)		0.0009% * (MV - LRV), at least 0.002 °C (0.004 °F)	
Ni100 (6)	DIN 43760 IPTS-68	at least 0.002 °C (0.004 °F)		0.003 %	
Ni120 (7)			at least 0.003 °C (0.005 °F)		
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	at least 0.005 °C (0.009 °F)	0.003 %	at least 0.003 °C (0.005 °F)	0.003 %
Cu100 (11)		at least 0.003 °C (0.005 °F)		at least 0.002 °C (0.004 °F)	
Ni100 (12)		at least 0.002 °C (0.004 °F)		at least 0.001 °C (0.002 °F)	
Ni120 (13)		at least 0.006 °C (0.011 °F)		at least 0.003 °C (0.005 °F)	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	at least 0.006 °C (0.011 °F)			
Resistance transmitter (Ω)					
10 to 400 Ω		0.0012% * MV, at least 1 m Ω	0.003 %	0.0007% * MV, at least 1 m Ω	0.003 %
10 to 2 000 Ω		0.0013% * MV, at least 12 m Ω		0.0008% * MV, at least 7 m Ω	

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

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

Designation	Standard	Ambient temperature: Influence (\pm) per 1 °C (1.8 °F) change		Supply voltage: Influence (\pm) per V change	
		Digital ¹⁾	D/A ²⁾	Digital	D/A ²⁾
		Based on measured value		Based on measured value	
Type A (30)	IEC 60584-1 ASTM E230-3	0.0032% * (MV - LRV), at least 0.010 °C (0.018 °F)	0.003 %	0.0017% * (MV - LRV), at least 0.010 °C (0.018 °F)	0.003 %
Type B (31)		at least 0.020 °C (0.036 °F)		at least 0.010 °C (0.018 °F)	
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	0.0025% * (MV - LRV), at least 0.010 °C (0.018 °F)		0.0015% * (MV - LRV), at least 0.010 °C (0.018 °F)	
Type D (33)	ASTM E988-96	0.0023% * (MV - LRV), at least 0.010 °C (0.018 °F)		0.0013% * (MV - LRV)	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change	
		Digital ¹⁾	D/A ²⁾	Digital	D/A ²⁾
Type E (34)	IEC 60584-1 ASTM E230-3	0.0016% * (MV - LRV)	0.003 %	0.001% * (MV - LRV)	0.003 %
Type J (35)		0.0018% * (MV - LRV)			
Type K (36)		0.0018% * (MV - LRV), at least 0.010 °C (0.018 °F)			
Type N (37)		at least 0.020 °C (0.036 °F)			
Type R (38)					
Type S (39)		DIN 43710			
Type T (40)					
Type L (41)					
Type U (42)	GOST R8.585-2001	≤ 0.01 °C (0.018 °F)			
Type L (43)					
Voltage transmitter (mV)		0.003 %	0.003 %		
-20 to 100 mV	-			0.002% * MV	0.0008% * MV

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

MV = measured value

LRV = lower range value of the sensor in question

Total 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

Designation	Standard	Long-term drift (±) ¹⁾		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Pt100 (1)	IEC 60751:2008	≤ 0.009% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0103% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0122% * (MV - LRV) or 0.04 °C (0.06 °F)
Pt200 (2)		0.10 °C (0.19 °F)	0.13 °C (0.24 °F)	0.15 °C (0.26 °F)
Pt500 (3)		≤ 0.0095% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.0121% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.0136% * (MV - LRV) or 0.04 °C (0.06 °F)
Pt1000 (4)		≤ 0.0096% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0125% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0143% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.0077% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0102% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0112% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt50 (8)	GOST 6651-94	≤ 0.0076% * (MV - LRV) or 0.05 °C (0.09 °F)	≤ 0.01% * (MV - LRV) or 0.06 °C (0.11 °F)	≤ 0.011% * (MV - LRV) or 0.07 °C (0.12 °F)
Pt100 (9)		≤ 0.008% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0114% * (MV - LRV) or 0.03 °C (0.05 °F)
Ni100 (6)	DIN 43760 IPTS-68	0.02 °C (0.04 °F)	0.02 °C (0.04 °F)	0.03 °C (0.05 °F)
Ni120 (7)				
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.04 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.11 °F)
Cu100 (11)		0.03 °C (0.05 °F)	0.04 °C (0.06 °F)	0.04 °C (0.06 °F)
Ni100 (12)		0.02 °C (0.04 °F)	0.02 °C (0.04 °F)	0.03 °C (0.05 °F)
Ni120 (13)				

Designation	Standard	Long-term drift (\pm) ¹⁾		
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.04 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.11 °F)
Resistance transmitter				
10 to 400 Ω		$\leq 0.0055\% * MV$ or 7 m Ω	$\leq 0.0073\% * MV$ or 10 m Ω	$\leq 0.008\% * (MV - LRV)$ or 11 m Ω
10 to 2000 Ω		$\leq 0.007\% * (MV - LRV)$ or 47 m Ω	$\leq 0.009\% * (MV - LRV)$ or 60 m Ω	$\leq 0.0067\% * (MV - LRV)$ or 67 m Ω

1) Whichever is greater

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

Designation	Standard	Long-term drift (\pm) ¹⁾		
		after 1 year	after 3 years	after 5 years
Based on measured value				
Type A (30)	IEC 60584-1 ASTM E230-3	$\leq 0.049\% * (MV - LRV)$ or 0.75 °C (1.35 °F)	$\leq 0.063\% * (MV - LRV)$ or 0.98 °C (1.76 °F)	$\leq 0.068\% * (MV - LRV)$ or 1.06 °C (1.91 °F)
Type B (31)		1.75 °C (3.15 °F)	2.30 °C (4.14 °F)	2.50 °C (4.50 °F)
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	0.80 °C (1.44 °F)	1.02 °C (1.84 °F)	1.10 °C (1.98 °F)
Type D (33)	ASTM E988-96	0.97 °C (1.75 °F)	1.25 °C (2.25 °F)	1.36 °C (2.45 °F)
Type E (34)	IEC 60584-1 ASTM E230-3	0.28 °C (0.50 °F)	0.36 °C (0.65 °F)	0.39 °C (0.70 °F)
Type J (35)		0.34 °C (0.61 °F)	0.44 °C (0.79 °F)	0.48 °C (0.86 °F)
Type K (36)		0.40 °C (0.72 °F)	0.51 °C (0.92 °F)	0.56 °C (1.01 °F)
Type N (37)		0.57 °C (1.03 °F)	0.676 °C (1.37 °F)	0.82 °C (1.48 °F)
Type R (38)		1.28 °C (2.30 °F)	1.69 °C (3.04 °F)	1.85 °C (3.33 °F)
Type S (39)		1.29 °C (2.32 °F)	1.70 °C (3.06 °F)	
Type T (40)		0.42 °C (0.76 °F)	0.55 °C (0.99 °F)	0.60 °C (1.08 °F)
Type L (41)	DIN 43710	0.28 °C (0.50 °F)	0.36 °C (0.65 °F)	0.40 °C (0.72 °F)
Type U (42)		0.41 °C (0.74 °F)	0.54 °C (0.97 °F)	0.58 °C (1.04 °F)
Type L (43)	GOST R8.585-2001	0.34 °C (0.61 °F)	0.45 °C (0.81 °F)	0.48 °C (0.86 °F)

Voltage transmitter (mV)				
-20 to 100 mV		$\leq 0.027\% * MV$ or 9 μV	$\leq 0.035\% * MV$ or 12 μV	$\leq 0.038\% * MV$ or 13 μV

1) The larger value is valid

Long-term drift analog output

Long-term drift D/A ¹⁾ (\pm)		
after 1 year	after 3 years	after 5 years
0.030%	0.036%	0.038%

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

Influence of the reference junction

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

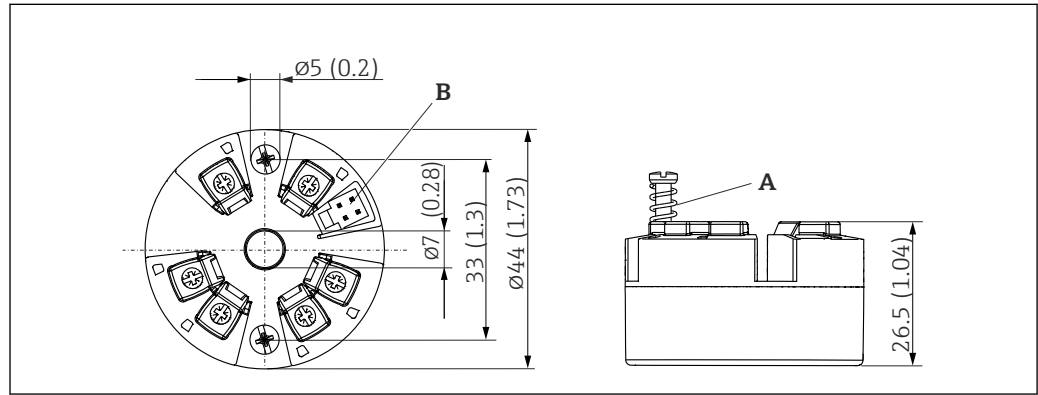
13.5 Environment

Ambient temperature	-40 to 85 °C (-40 to 185 °F), for hazardous areas see Ex documentation.
Storage temperature	-50 to 100 °C (-58 to 212 °F)
Operating height	Up to 4 000 m (13 123 ft) above sea level.
Humidity	Condensation: <ul style="list-style-type: none"> ▪ Permitted ▪ Max. rel. humidity: 95% as per IEC 60068-2-30
Climate class	Climate class C1 as per IEC 60654-1
Degree of protection	With screw terminals: IP 20. In the installed state, it depends on the terminal head or field housing used.
Shock and vibration resistance	Vibration resistance as per DNVGL-CG-0339: 2015 and DIN EN 60068-2-27 2 to 100 Hz at 4g (increased vibration stress) Shock resistance as per KTA 3505 (section 5.8.4 Shock test)
Electromagnetic compatibility (EMC)	<p>CE conformity</p> <p>Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE 21). For details, refer to the Declaration of Conformity. All tests were passed both with and without ongoing digital HART® communication. To ensure interference-free HART® communication with EMC influence, a shielded cable must be used, with the shield connected to ground on both sides.</p> <p>Maximum measurement error <1% of measuring range.</p> <p>Interference immunity as per IEC/EN 61326 series, industrial requirements</p> <p>Interference emission as per IEC/EN 61326 series, Class B equipment</p>
Insulation class	Class III
Overvoltage category	Overvoltage category II
Pollution level	Pollution degree 2

13.6 Mechanical construction

Design and dimensions

Dimensions in mm (in)



8 Version with screw terminals

- A Spring travel $L \geq 5$ mm (not for US - M4 securing screws)
- B CDI interface for connecting a configuration tool

Weight

40 to 50 g (1.4 to 1.8 oz)

Materials

All the materials used are RoHS-compliant.

- Housing: polycarbonate (PC)
- Terminals: screw terminals, nickel-plated brass and gold-plated or tin-plated contacts
- Potting: QSIL 553

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**.

HART® certification

The temperature transmitter is registered by the FieldComm Group™. The device meets the requirements of the HART® Communication Protocol Specifications, Revision 7.

MTTF

168 years

The mean time to failure (MTTF) denotes the theoretically expected time until the device fails during normal operation. The term MTTF is used for systems that cannot be repaired, e.g., temperature transmitters.



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