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Operating Instructions
iTEMP TMT162

Temperature field transmitter
HART® communication

Endress+Hauser
People for Process Automation

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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)

The relevant national standards must be observed when using equipment in hazardous areas. 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 the Functional Safety Manual (FY01106T) for the use of approved devices in safety-related 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 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.

1.2.2 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: ▪ Interior ground terminal: potential equalization is connected to the supply network. ▪ Exterior ground terminal: device is connected to the plant grounding system.

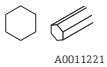
1.2.3 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
1., 2., 3....	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.4 Symbols in graphics

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

1.2.5 Tool symbols

Symbol	Meaning
A0011220	Flat-blade screwdriver
A0011219	Phillips screwdriver
 A0011221	Allen key
A0011222	Open-ended wrench
A0013442	Torx screwdriver

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.

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

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** These Operating Instructions contain all the information that is required in the various life cycle phases 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 a constituent part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for 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 a constituent part of the device documentation.

1.4 Registered trademarks

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

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_{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

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
- 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

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

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)

3.4 Storage and transport

Storage temperature	Without display −40 to +100 °C (−40 to +212 °F)
	With display −40 to +80 °C (−40 to +176 °F)

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

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

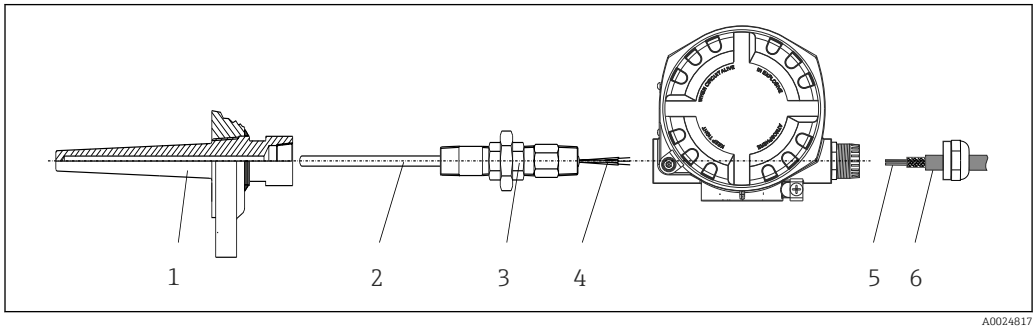
4.2 Mounting the transmitter

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



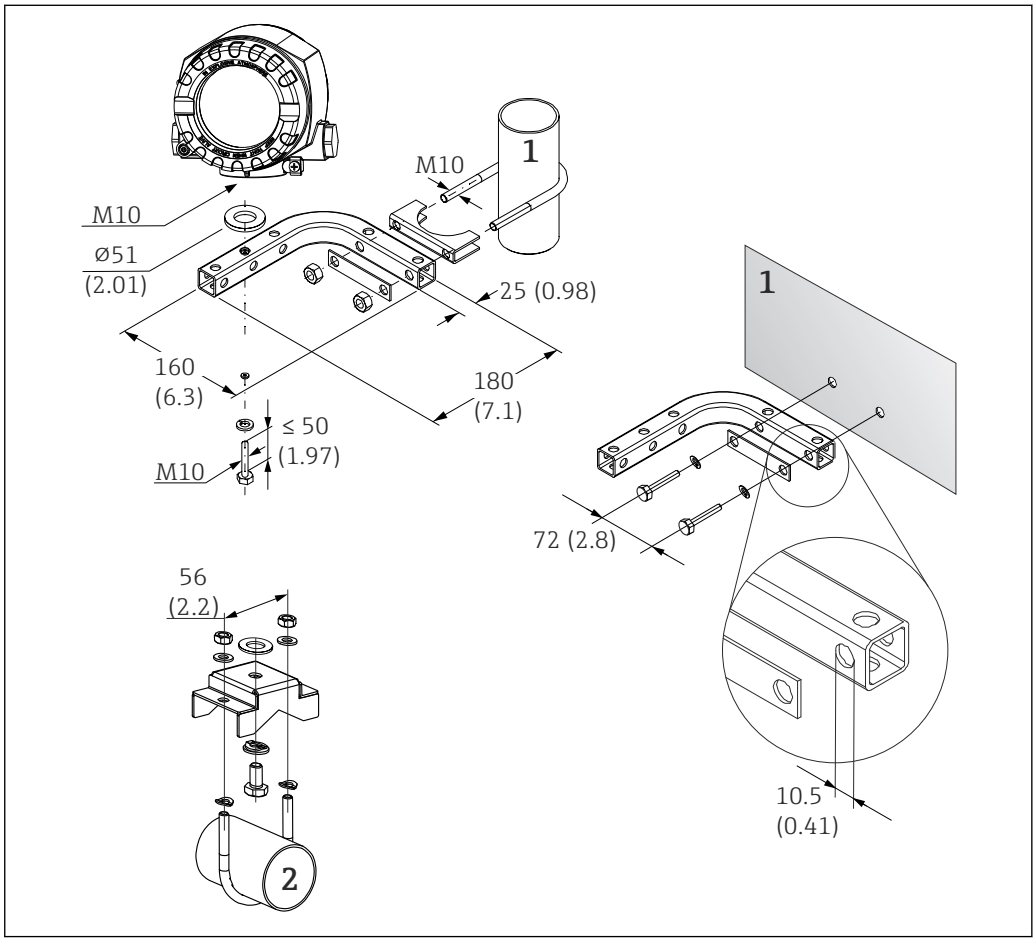
1 *Direct field transmitter mounting on sensor*

1 *Thermowell*
2 *Insert*
3 *Neck tube nipple and adapter*
4 *Sensor cables*
5 *Fieldbus cables*
6 *Fieldbus shielded cable*

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→ 🖹 21. The cable gland must meet explosion protection requirements.

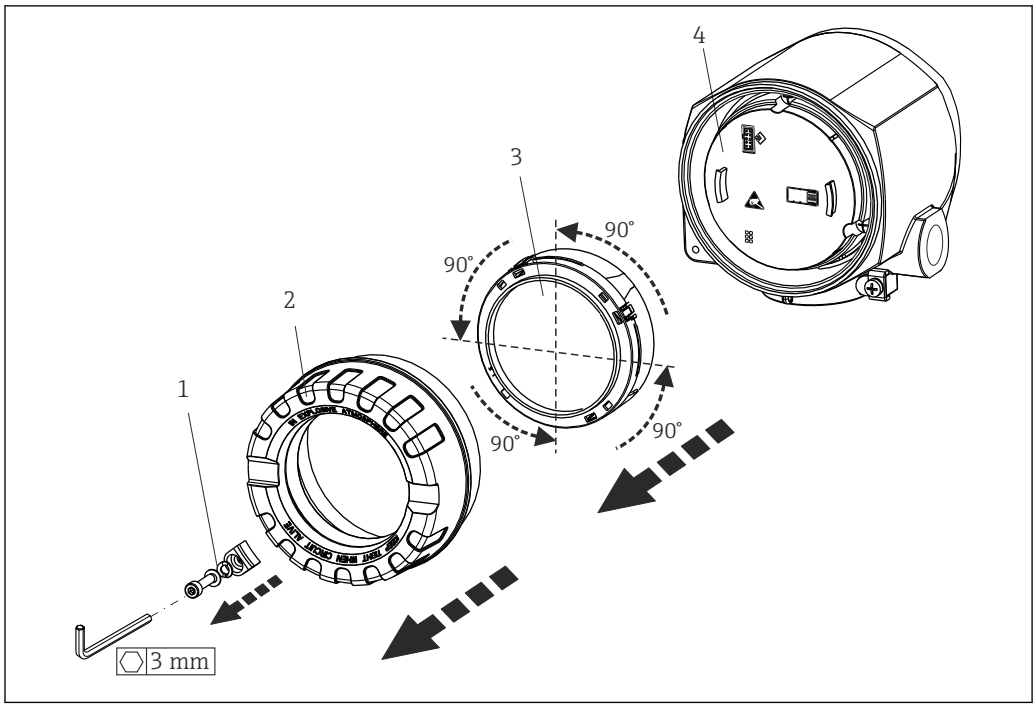
4.2.2 Remote mounting



2 Installation of the field transmitter using the mounting bracket. Dimensions in mm (in)

1 Combined wall/pipe mounting bracket 2", L-shaped, material 304
2 Pipe mounting bracket 2", U-shaped, material 316L

4.3 Display mounting



3 4 display installation positions, attachable in 90° increments

1 Cover clamp
2 Housing cover with O-ring
3 Display with retainer and twist protection
4 Electronics module

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° increments 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, perform the following checks:

Device condition and specifications	Notes
Is the device undamaged (visual inspection)?	-
Do the ambient conditions match the device specification (e.g. ambient temperature, measuring range, etc.)?	

5 Electrical connection

5.1 Connecting requirements

⚠ CAUTION

The electronics could be destroyed

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

- Maximum torque = 1 Nm (¾ lbf ft).

Proceed as follows to wire the device:

1. Remove the cover clamp. → 3, 14
2. Unscrew the housing cover on the connection compartment together with the O-ring → 3, 14. 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, 16 and as described in the sections: "Connecting the sensor" → 15 and "Connecting the measuring instrument" → 17.
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. → 14

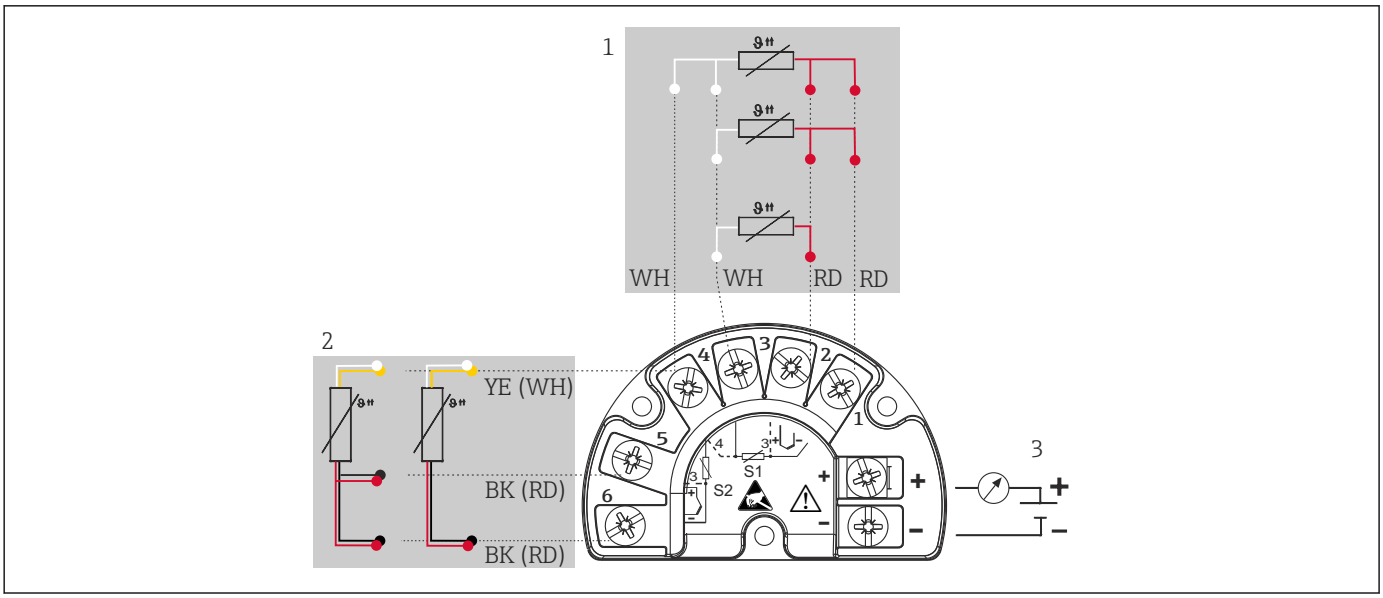
In order to avoid connection errors always follow the instructions in the post-connection check section before commissioning!

5.2 Connecting the sensor

NOTICE

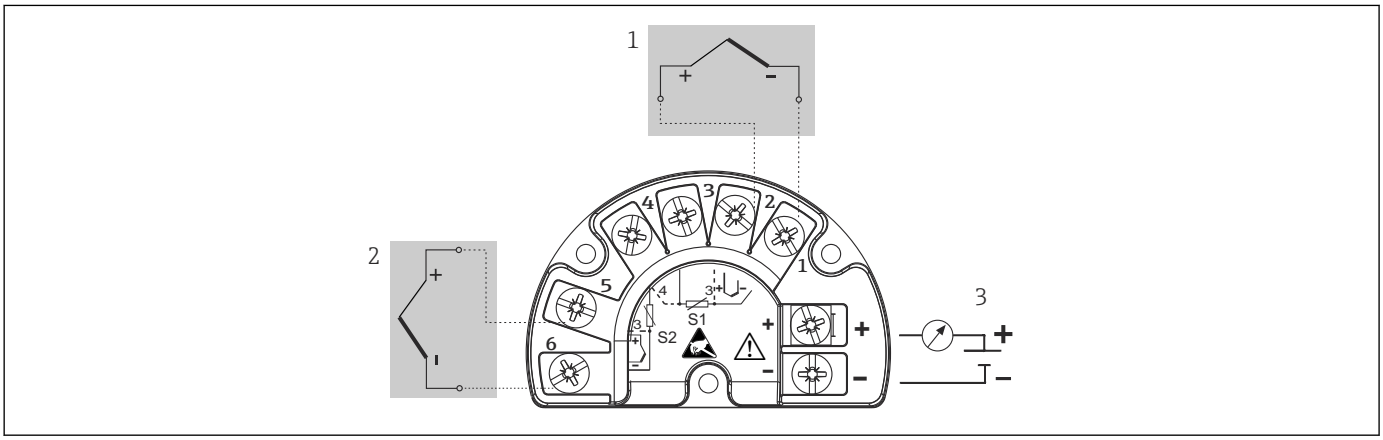
- ESD - Electrostatic discharge Protect the terminals from electrostatic discharge. Failure to observe this may result in the destruction or malfunction of parts of the electronics.

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:

		Sensor input 1			
		RTD or resistance transmitter, 2-wire	RTD or resistance transmitter, 3-wire	RTD or resistance transmitter, 4-wire	Thermocouple (TC), voltage transmitter
Sensor input 2	RTD or resistance transmitter, 2-wire	☑	☑	-	☑
	RTD or resistance transmitter, 3-wire	☑	☑	-	☑
	RTD or resistance transmitter, 4-wire	-	-	-	-
	Thermocouple (TC), voltage transmitter	☑	☑	☑	☑

5.3 Connecting the measuring instrument

5.3.1 Cable gland or cable entry

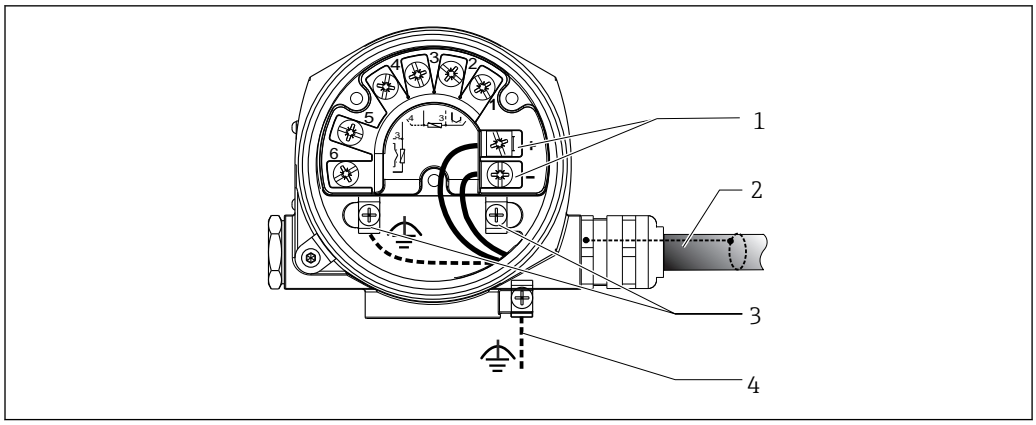
⚠ CAUTION

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 recommended 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.
- In systems without additional potential equalization, grounding the shield of the fieldbus cable at more than one point can lead to the occurrence of mains frequency equalizing currents, potentially causing damage to the cable or its shield. In such cases, the shield of the fieldbus cable should 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 are equipped with integrated reverse polarity protection.
- Cable cross-section: max. 2.5 mm²
- A shielded cable must be used for the connection.

Follow the general procedure. → 15.

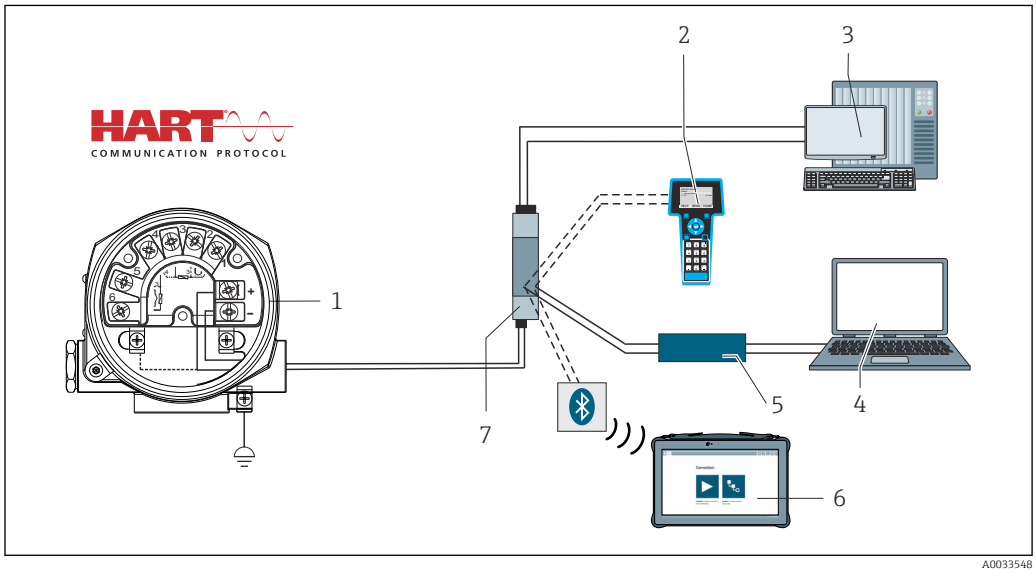


6 *Connecting the device to the fieldbus cable*

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

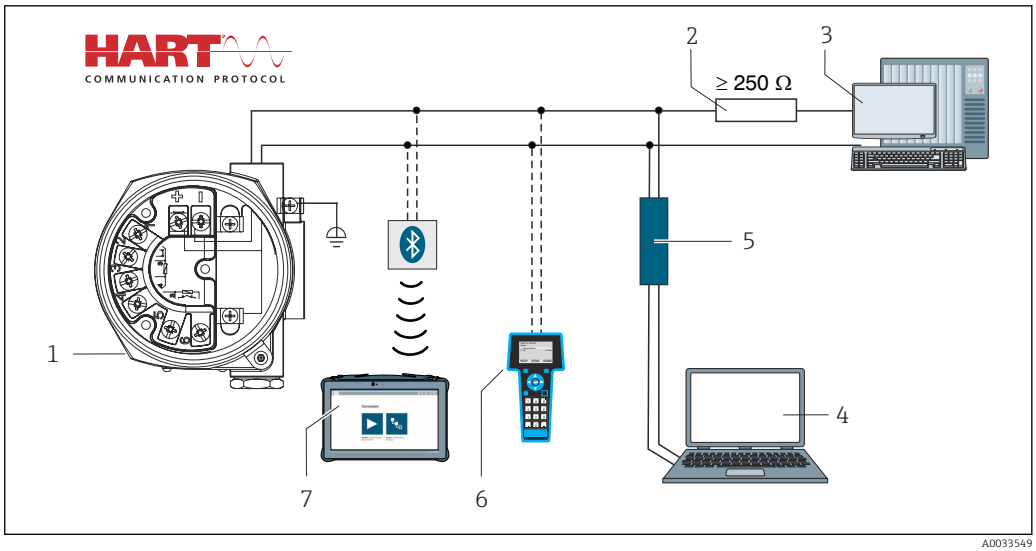
5.3.2 Connecting HART communication resistor

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 FieldComm Group, particularly HCF LIT 20: "HART, a technical summary".



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

1 *Temperature field transmitter*
2 *HART handheld communicator*
3 *PLC/process control system*
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*

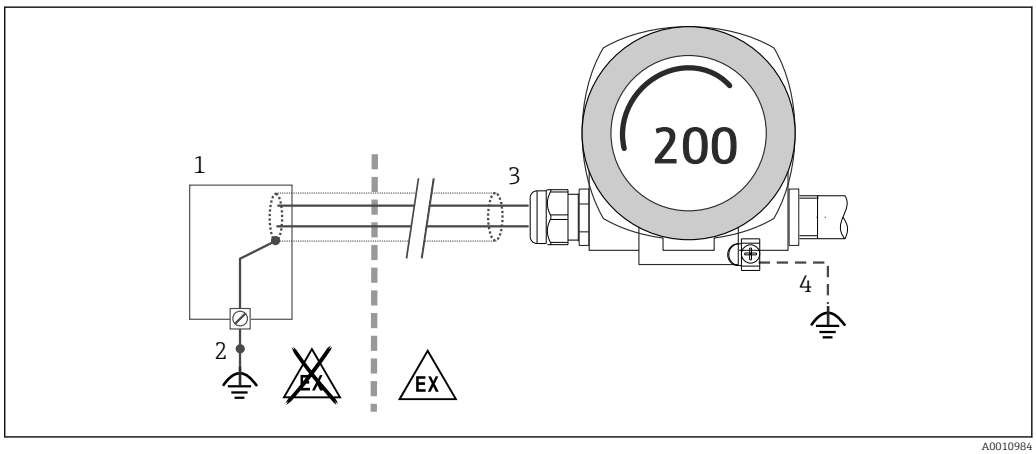


8 *HART connection with other power supply units that do not have a built-in HART communication resistor*

1 *Temperature field transmitter*
2 *HART communication resistor*
3 *PLC/process control system*
4 *Configuration software, e.g. FieldCare, DeviceCare*
5 *HART Modem*
6 *HART handheld communicator*
7 *Configuration via Field Xpert SMT70*

5.3.3 Shielding and grounding

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

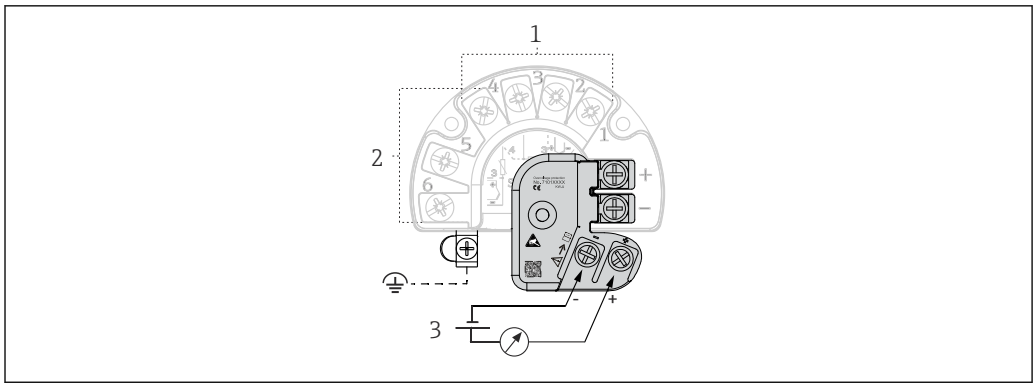


9 *Shielding and grounding the signal cable at one end with HART communication*

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

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.



10 *Electrical connection of surge arrester*

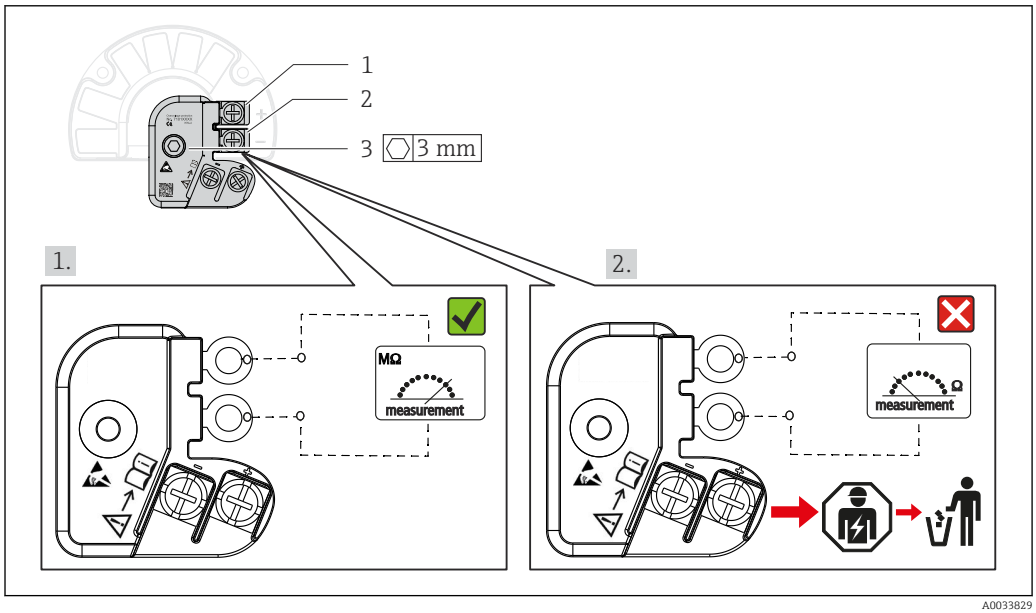
1 *Sensor 1*
2 *Sensor 2*
3 *Bus connector and power supply*

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.



11 *Surge arrester function test*

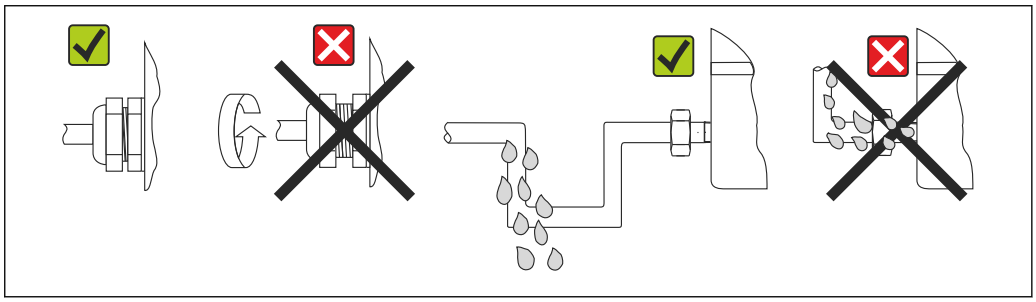
Ohmmeter in high-impedance range = surge arrester working ☑.

Ohmmeter in low-impedance range = surge arrester 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, 21
- 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, 21
- Replace unused cable glands with dummy plugs.
- Do not remove the grommet from the cable gland.



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12 *Connection tips to retain IP66/IP67 protection*

5.6 Post-connection check

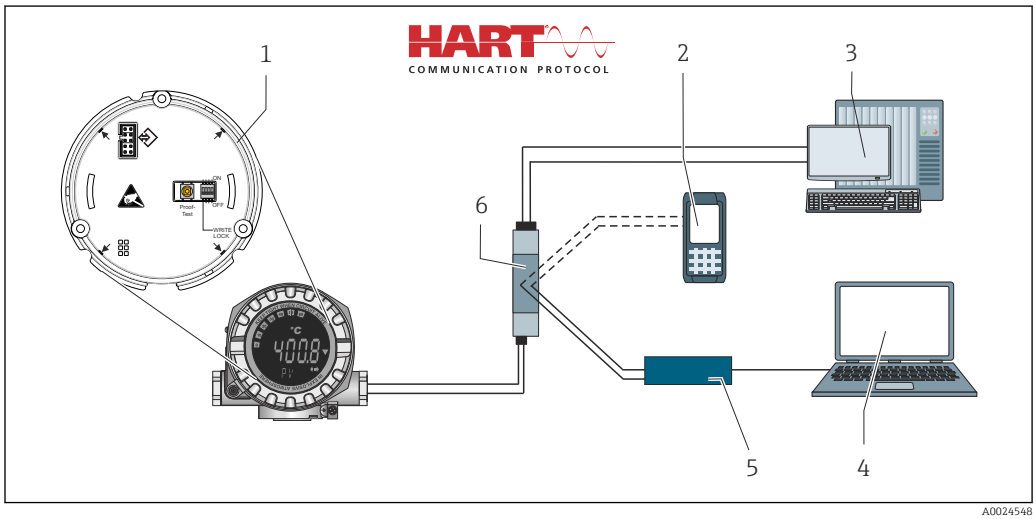
Device condition and specifications	Notes
Are the device and cables undamaged (visual check)?	--
Electrical connection	**Notes**
Does the supply voltage match the information on the nameplate?	Standard mode and SIL mode: U = 11.5 to 42 V_{DC}
Are the mounted cables strain-relieved?	Visual inspection
Are the power supply and signal cables connected correctly?	→ 17
Are all the screw terminals sufficiently tightened?	→ 15
Are all the cable entries installed, tightened and leak-tight?	→ 21
Are all housing covers installed and securely tightened?	→ 22

6 Operation options

6.1 Overview of operation options

Operators have a number of options for configuring and commissioning the device:

- **Configuration programs** → 27
  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.

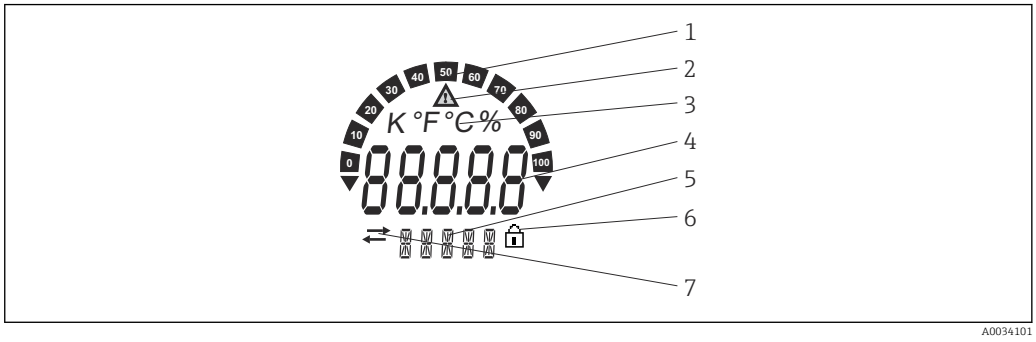


13 *Operation options of the device*

1 *Hardware settings via DIP switch and proof-test button*
2 *HART handheld communicator*
3 *PLC/process control system*
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



14 *LC display of the field transmitter (backlit, attachable in 90° increments)*

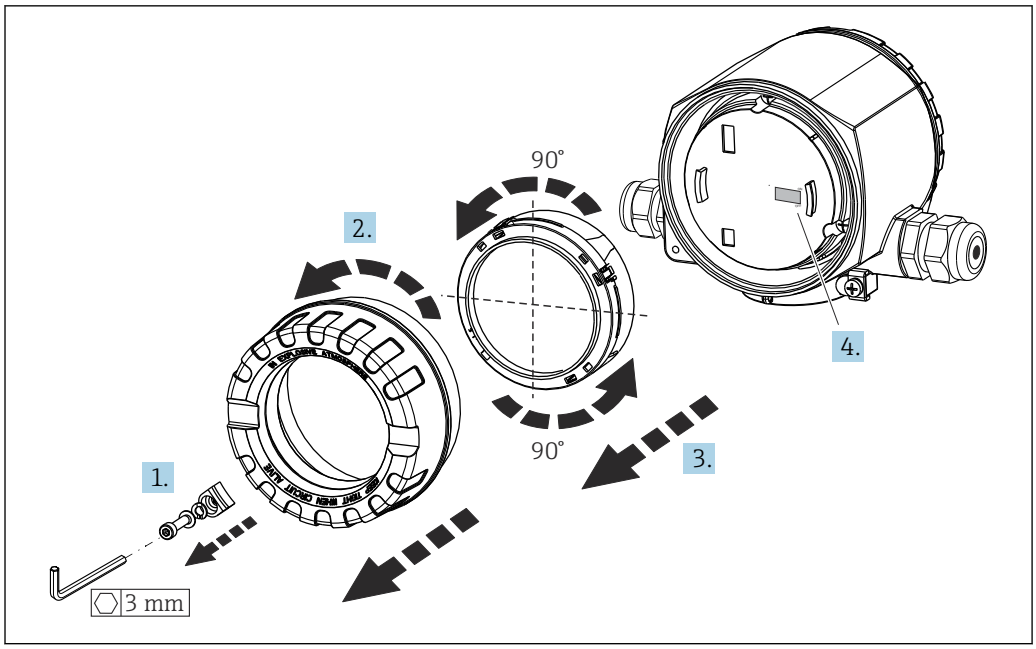
Item no.	Function	Description
1	Bar graph display	In increments of 10% with indicators for underranging and overranging.
2	'Caution' symbol	This is displayed when an error or warning occurs.
3	Unit display K, °F, °C or %	Unit display for the internal measured value shown.
4	Measured value display, digit height 20.5 mm	Displays the current measured value. In the event of an error or warning, the corresponding diagnostics information is displayed. → 37
5	Status and information display	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**
6	'Configuration locked' symbol	The 'configuration locked' symbol appears when configuration is locked via the hardware or software
7	'Communication' symbol	The communication symbol appears when HART communication is active.

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.



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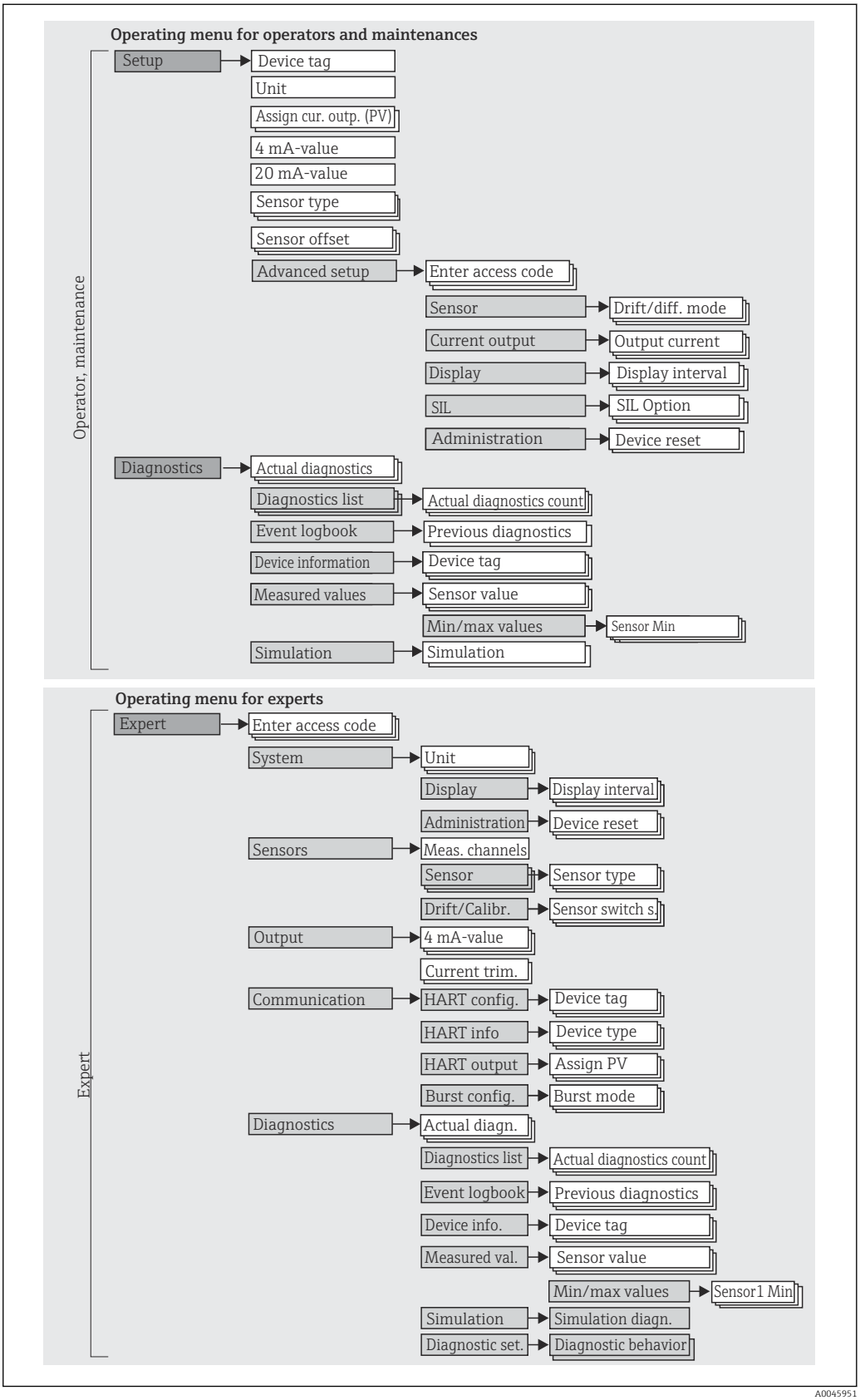
Procedure for setting the DIP switch or activating the proof test:

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 (FY01106T).

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.

User role	Typical tasks	Menu	Content/meaning
Maintenance Operator	Commissioning: ▪ Configuration of the measurement. ▪ Configuration of data processing (scaling, linearization, etc.). ▪ Configuration of the analog measured value output. Tasks during operation: ▪ Configuration of the display. ▪ Reading measured values.	"Setup"	Contains all parameters for commissioning: ▪ **Setup parameters** Once values have been set for these parameters, the measurement should usually be fully configured. ▪ **"Extended setup" submenu** Contains additional submenus and parameters: ▪ For more accurate configuration of the measurement (adaptation to special measuring conditions). ▪ For converting the measured value (scaling, linearization). ▪ For scaling the output signal. ▪ Required in ongoing operation: configuration of the measured value display (displayed values, display format, etc.).
	Troubleshooting: ▪ Diagnosing and eliminating process errors. ▪ Interpretation of device error messages and correcting associated errors.	"Diagnostics"	Contains all parameters for detecting and analyzing errors: ▪ **Diagnostic list** Contains up to 3 currently pending error messages. ▪ **Event logbook** Contains the last 5 error messages. ▪ **"Device information" submenu** Contains information for identifying the device. ▪ **"Measured values" submenu** Contains all current measured values. ▪ **"Simulation" submenu** Used to simulate measured values, output values or diagnostic messages.
Expert	Tasks that require detailed knowledge of the function of the device: ▪ Commissioning measurements under difficult conditions. ▪ Optimal adaptation of the measurement to difficult conditions. ▪ Detailed configuration of the communication interface. ▪ Error diagnostics in difficult cases.	"Expert"	Contains all the parameters of the device (including those already contained in one of the other menus). The structure of this menu is based on the function blocks of the device: ▪ **"System" submenu** Contains all higher-level device parameters that do not affect measurement or measured value communication. ▪ **"Sensor" submenu** Contains all parameters for configuring the measurement. ▪ **"Output" submenu** Contains all parameters for configuring the analog current output. ▪ **"Communication" submenu** Contains all parameters for configuring the digital communication interface. ▪ **"Diagnostics" submenu** Contains all parameters needed to detect and analyze operational errors.

6.3 Access to the operating menu via the operating tool

6.3.1 FieldCare

Range of functions

FDT/DTM-based plant asset management tool from Endress+Hauser. It can configure all intelligent 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).

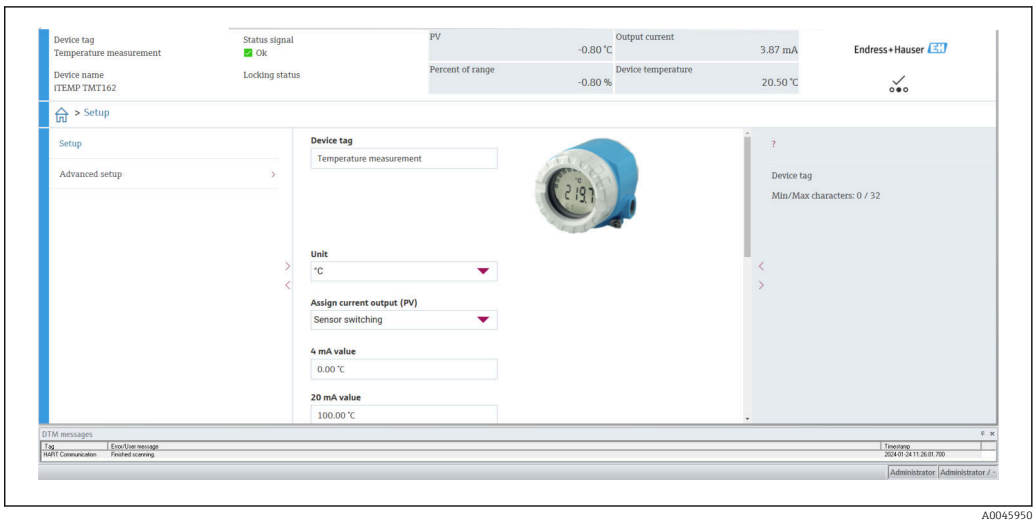
Typical functions:
- Parameter configuration of transmitters
- Loading and saving of device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook

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

Source for device description files

For details, see → 30

User interface



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6.3.2 DeviceCare

Range of functions

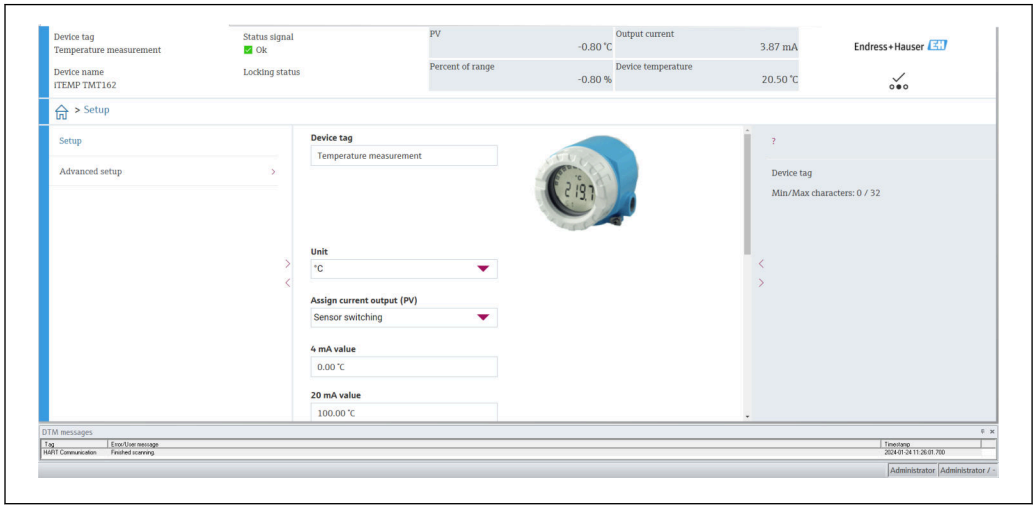
The fastest way to configure Endress+Hauser field devices is to use the dedicated DeviceCare tool. DeviceCare's user-friendly design allows transparent and intuitive device connection and configuration. Intuitive menus and step-by-step instructions with status information ensure optimum transparency.

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 → 30

User interface



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6.3.3 Field Xpert

Range of functions

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 → 30

6.3.4 AMS Device Manager

Range of functions

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

Source for device description files

For details, see → 30

6.3.5 SIMATIC PDM

Range of functions

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

Source for device description files

For details, see → 30

6.3.6 AMS Trex Device Communicator

Range of functions

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

Source for device description files

For details, see → 30

7 System integration

Version data for the device

Firmware version	04.02.zz	▪ On the title page of the manual ▪ On the nameplate ▪ **Firmware version** parameter Diagnostics → Device information → Firmware version
Manufacturer ID	0x0011	**Manufacturer ID** parameter Diagnostics → Device information → Manufacturer ID
Device type ID	0x11CE	**Device type** parameter Diagnostics → Device information → Device type
HART protocol revision	7	---
Device revision	5	▪ On the transmitter nameplate ▪ **Device revision** parameter Diagnostics → Device information → Device revision

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

Operating tool	Sources for obtaining device descriptions (DD) or device type managers (DTM)
FieldCare, DeviceCare, FieldXpert SMT70 (Endress+Hauser)	www.endress.com→ Downloads → Device driver: Enter type, product root and process communication.
SIMATIC PDM (Siemens)	
Yokogawa, Plant Resource Manager	
Control Builder, Field Device Manager (Honeywell)	
Schneider Invensys, Archestra IDE	
PACTware	
AMS Trex Device Communicator (Emerson Process Management)	Use update function of handheld terminal

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

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

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:

Device variable code	Measured value
0	Sensor 1
1	Sensor 2
2	Device temperature
3	Average of sensor 1 and sensor 2
4	Difference between sensor 1 and sensor 2
5	Sensor 1 (backup sensor 2)
6	Sensor 1 with switchover to sensor 2 if a limit value is exceeded
7	Average of sensor 1 and sensor 2 with backup

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.

Command No.	Designation
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

Command No.	Designation
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
36, Cmd036	Set primary variable upper range value
37, Cmd037	Set primary variable lower range value
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
51, Cmd051	Write dynamic variable assignments
54, Cmd054	Read device variable information
59, Cmd059	Write number of response preambles
72, Cmd072	Squawk
95, Cmd095	Read device communications statistics
100, Cmd100	Write primary variable alarm code
103, Cmd103	Write burst period
104, Cmd104	Write burst trigger
105, Cmd105	Read burst mode configuration
107, Cmd107	Write burst device variables
108, Cmd108	Write burst mode command number
109, Cmd109	Burst mode control
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

Command No.	Designation
524, Cmd524	Write condensed status mapping
525, Cmd525	Reset condensed status map
526, Cmd526	Write status 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:
- "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:

Step	Indication
1	Text "Display" and firmware version of the display
2	Firm logo
3	Device name (scrolling text)
4	Firmware, hardware revision, device revision and device address
5	For devices in SIL mode: SIL-CRC is displayed
6a	Current measured value or
6b	Current status message 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.

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. → 75

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 Diagnosis 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. → 44

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, → 42
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 → 14 2. Display module defective → order spare part, → 42 3. Measuring electronics defective → order spare part, → 42

Local error messages on the display
→ 37

Faulty connection to the fieldbus host system		
Fault	**Possible cause**	**Remedial action**
Device is not responding.	Supply voltage does not match the voltage specified on the nameplate.	Apply correct voltage
	Connecting cables are not in contact with the terminals.	Check the electrical contact between the cable and terminals and correct if necessary.
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.

Error messages in the configuration software
→ 38

Application errors without status messages for RTD sensor connection		
Fault	**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.
	Incorrect sensor connection.	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		
Fault	**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 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

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

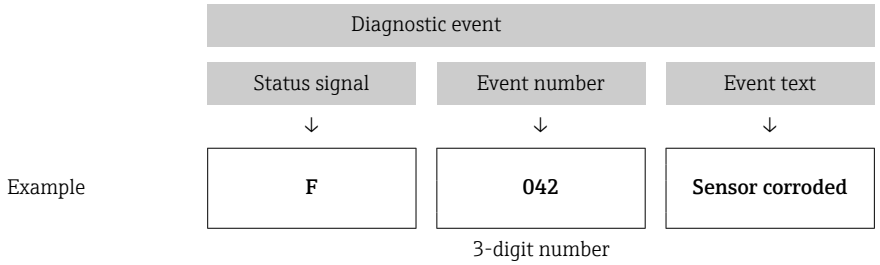
- If a valid measured value is not available, the display alternates between "- - -- -" and the error message plus the defined error number and the '⚠' symbol.
- If a valid measured value is present, the display alternates between the status plus the defined error number (7-segment display) and the primary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

Diagnostic behavior

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

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.



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 → 87. 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.

Previous diagnostic messages that are no longer pending are displayed → 88in **the Event logbook** submenu.

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:

		Settings		Device behavior			
Configuration examples	**Diagnostic number**	**Status signal**	**Diagnostic behavior from the factory**	**Status signal (output via HART communication)**	**Current output**	**PV, status**	**Indication**
1. Default setting	047	S	Warning	S	Measured value	Measured value, UNCERTAIN	S047
2. Manual setting: status signal S changed to F	047	F	Warning	F	Measured value	Measured value, UNCERTAIN	F047
3. Manual setting: **Warning** diagnostic behavior changed to **Alarm**	047	S	Alarm	S	Configured failure current	Measured value, BAD	S047
4. Manual setting: **Warning** changed to **Disabled**	047	S [1]	Disabled	- [2]	Last valid measured value [3]	Last valid measured value, GOOD	S047

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.

Diagnostic number	Short text	Corrective measure	Status signal from the factory	☑ Customizable [1] / ☒ Cannot be adjusted	Diagnostic behavior from the factory	☑ Customizable [2] / ☒ Cannot be adjusted
Diagnostics for the sensor						
001	Device failure	1. Restart device 2. Replace electronics	F	☒	Alarm	☒
016	Sensor available again	Confirm change back to normal operation or restart device.	M	☒	Warning	☒
041	Sensor breakage detected	1. Check electrical wiring. 2. Replace sensor. 3. Check connection type.	F	☑	Alarm	☑
042	Sensor corroded	1. Check sensor. 2. Replace sensor.	M	☑	Warning	☑
043	Sensor short circuit detected	1. Check electrical connection. 2. Check sensor. 3. Replace sensor or cable.	F	☑	Alarm	☑
044	Sensor drift detected	1. Check sensor or main electronics. 2. Replace sensor or main electronics.	M	☑	Warning	☑
047	Sensor limit 1/2 reached	1. Check sensor. 2. Check process conditions.	S	☑	Warning	☑
048	Drift detection not possible	1. Check electrical connection. 2. Check sensor. 3. Replace sensor.	M	☑	Warning	☑
062	Sensor connection faulty	Check sensor connection.	F	☑	Alarm	☑
105	Calibration interval	1. Execute calibration and reset calibration interval. 2. Switch off calibration counter.	M	☑	Warning	☑
145	Compensation reference point	1. Check terminal temperature. 2. Check external reference measuring point.	F	☑	Alarm	☑
Diagnostics for the electronics						
201	Electronics faulty	1. Restart device. 2. Replace electronics.	F	☑	Alarm	☑
221	Reference sensor defective	Replace device.	M	☑	Alarm	☑
241	Firmware faulty	1. Restart device. 2. Power cycle device. 3. Replace electronics.	F	☑	Alarm	☑
242	Firmware incompatible	1. Check firmware version. 2. Flash or replace main electronics.	F	☑	Alarm	☑
261	Electronics module is defective	1. Restart device. 2. Replace main electronics module.	F	☑	Alarm	☑
283	Memory content inconsistent	1. Restart device. 2. Replace electronics.	F	☑	Alarm	☑
286	Data storage inconsistent	1. Repeat safe parameter configuration. 2. Replace electronics.	F	☑	Alarm	☑
Diagnostics for the configuration						

Diagnostic number	Short text	Corrective measure	Status signal from the factory	Customizable [1] / Cannot be adjusted	Diagnostic behavior from the factory	Customizable [2] / Cannot be adjusted
401	Factory reset active	Factory reset in progress, please wait.	C	✗	Warning	✗
402	Initialization active	Initialization in progress, please wait.	C	✗	Warning	✗
410	Data transfer failed	1. Check connection. 2. Repeat data transfer.	F	✗	Alarm	✗
411	Upload/download active	Upload/download in progress, please wait.	C	✗	Warning	✗
412	Processing download	Download active, please wait	C	✓	Warning	✓
435	Linearization faulty	Check linearization.	F	✗	Alarm	✗
438	Dataset different	1. Check data set file. 2. Check device configuration. 3. Download new device configuration.	M	✗	Warning	✗
439	Dataset different	Repeat safe parameter configuration.	F	✗	Alarm	✗
485	Simulation of the process variable is active	Deactivate simulation.	C	-	Warning	-
491	Simulation of the current output is active	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. Upload and download new configuration. (In case of current output: check configuration of analog output.)	F	✗	Alarm	✗
583	Simulation input	Deactivate simulation.	C	✓	Warning	✓
Diagnostics for the process						
801	Supply voltage too low [3]	Increase supply voltage.	S	✓	Alarm	✗
825	Electronics temperature out of range	1. Check ambient temperature. 2. Check process temperature.	S	✓	Warning	✓
844	Process value out of specification	1. Check process value. 2. Check application. Check sensor.	S	✓	Warning	✓

1) Can be set to F, C, S, M, N
2) Can be set to 'Alarm', 'Warning' and 'Disabled'
3) 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.

Date	Firmware version	Changes	Documentation
07/2017	04.01.zz	HART protocol version 7.6 and addition of operating parameters for functional safety (SIL3)	BA01801T/09/en/01.17
09/2023	--	--	BA01801T/09/en/03.23
06/2024	04.02.zz	New operating parameters for sensor backup reset	BA01801T/09/EN/04.24

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.

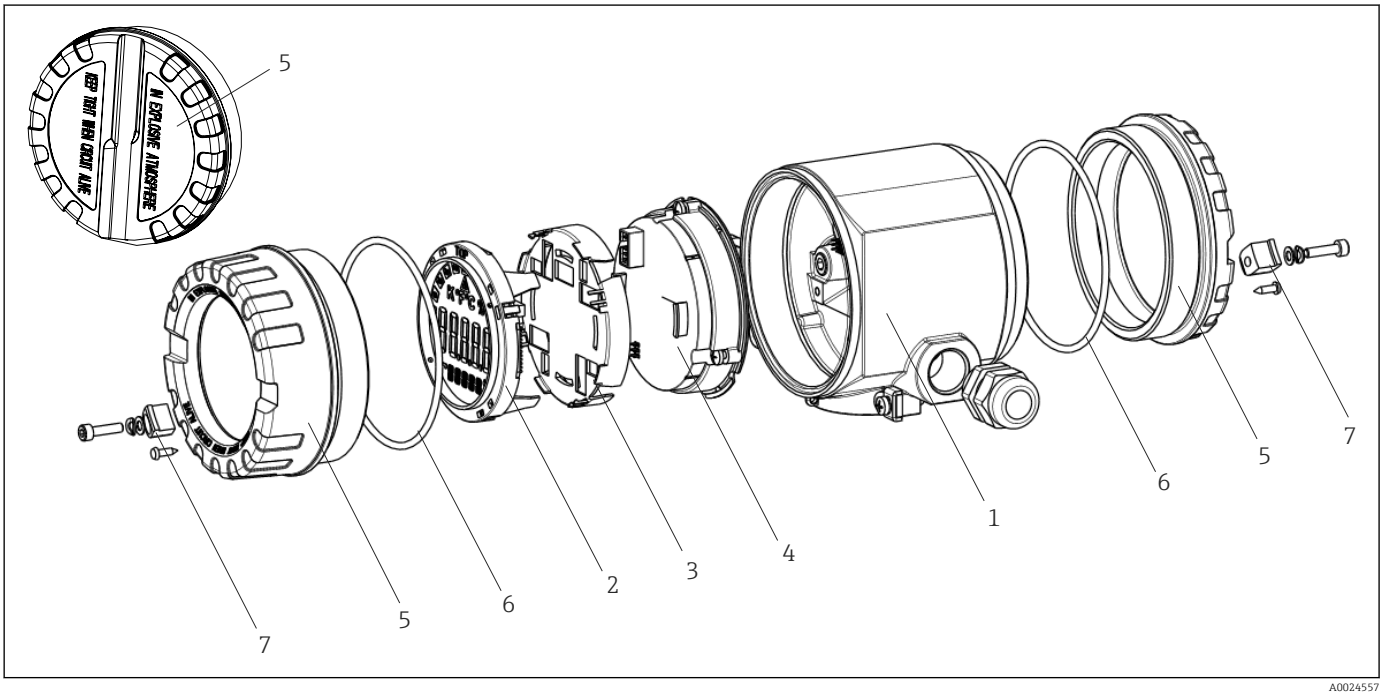
11 Repair

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

For spare parts currently available for the product, see online at:
https://www.endress.com/deviceviewer (→ Enter serial number)



15 *Field transmitter spare parts*

Item no. 1	Housing		
	Certificates:		
	A	Non-hazardous area + Ex ia	
	B	ATEX Ex d	
		Material:	
		A	Aluminum, HART 5
		B	Stainless steel 316L, HART 5
		F	Aluminum, FF/PA
		G	Stainless steel 316L, FF/PA
		K	Aluminum, HART 7
		L	Stainless steel 316L, HART 7
			Cable entry:

Item no. 1	Housing				
			1	2 x thread NPT ½" + terminal block + 1 dummy plug	
			2	2 x thread M20x1.5 + terminal block + 1 dummy plug	
			4	2 x thread G ½" + terminal block + 1 dummy plug	
				Version:	
				A	Standard
TMT162G-				**A**	**← order code**

Item no. 4	Electronics module			
	Certificates:			
	A	Non-hazardous area		
	B	ATEX Ex ia, FM IS, CSA IS		
		Sensor input; communication:		
		D	2x; PROFIBUS PA, DevRev02	
		E	2x; FOUNDATION Fieldbus FW 01.01.zz, Device Revision 2	
		F	2x; FOUNDATION Fieldbus FW 02.00.zz, Device Revision 3	
		H	1x; HART7, Fw 04.01.zz, DevRev04	
		I	2x; HART7; FW 04.01.zz, DevRev04, config. output sensor 1	
		J	1x; HART7, Fw 04.01.zz, DevRev04; SIL	
		K	2x; HART7, Fw 04.01.zz, DevRev04; SIL, config. output sensor 1	
		O	1x; HART7, Fw 04.02.zz, DevRev05	
		P	2x; HART7; FW 04.02.zz, DevRev05, config. output sensor 1	
		Q	1x; HART7, Fw 04.02.zz, DevRev05; SIL	
		R	2x; HART7, Fw 04.02.zz, DevRev05; SIL, config. output sensor 1	
			Configuration:	
			A	50 Hz mains filter
			B	Produced as per original order (quote serial number) 50 Hz mains filter
			K	60 Hz mains filter
			L	Produced as per original order (quote serial number) 60 Hz mains filter
TMT162E-				**← order code**

Item no.	Spare parts
2,3	Display PA/FF + retainer + twist protection
2,3	Display retainer + twist protection
2,3	Display HART 7 + retainer + twist protection
5	Housing cover blind, aluminum Ex d, FM XP with seal, CSA approval, only as cover of connection compartment
5	Housing cover blind, aluminum + seal
5	Housing cover cpl. display, aluminum Ex d with seal
5	Housing cover cpl. display, aluminum with seal
5	Housing cover blind, stainless steel 316L Ex d, ATEX Ex d, FM XP with seal, CSA approval, only as cover of connection compartment
5	Housing cover blind, stainless steel 316L, with seal
5	Housing cover cpl. display, Ex d, stainless steel 316L, ATEX Ex d, FM XP, CSA XP, with seal

Item no.	Spare parts
5	Housing cover cpl. display, stainless steel 316L, with seal
5	Housing cover cpl. display, polycarbonate, 316L
6	O-ring 88x3 HNBR 70° Shore PTFE coating
7	Cover clamp spare part set: screw, disk, spring washer

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/support/return-material
   ↳ Select the region.
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

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.

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

12.1 Device-specific accessories

Accessories	Description
Dummy plugs	▪ M20x1.5 EEx-d/XP ▪ G ½" EEx-d/XP ▪ NPT ½" ALU ▪ NPT ½" V4A
Cable glands	▪ M20x1.5 ▪ NPT ½" D4-8.5, IP68 ▪ NPT ½" cable gland 2 x D0.5 cable for 2 sensors ▪ M20x1.5 cable gland 2 x D0.5 cable for 2 sensors
Adapters for cable gland	M20x1.5 external/M24x1.5 internal
Wall and pipe mounting bracket	Stainless steel wall/2" pipe Stainless steel 2" pipe V4A
Surge arrester	The module protects the electronics from overvoltage.

12.2 Service-specific accessories

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:
https://portal.endress.com/webapp/applicator

Configurator
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

FieldCare SFE500
FDT-based plant asset management tool
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.

Technical Information TI00028S

DeviceCare SFE100
Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices
DeviceCare is available for download at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.

Technical Information TI01134S

12.3 System products

Advanced Data Manager Memograph M

The Advanced Data Manager Memograph M is a flexible and powerful system for organizing process values. Optional HART input cards are available, each having 4 inputs (4/8/12/16/20), with highly accurate process values from the HART devices directly connected for the purpose of calculation and data logging. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. Via common communication protocols, the measured and calculated values can be easily communicated to higher-level systems or individual plant modules can be interconnected.

Technical information: TI01180R

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 V_{DC}.

Technical Information TI01515K

RN42

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 $V_{AC/DC}$.

Technical Information TI01584K

RIA15

Process display, digital loop-powered display for 4 to 20 mA circuit, panel mounting, with optional HART communication. Displays 4 to 20 mA or up to 4 HART process variables

Technical Information TI01043K

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.

Resistance thermometer (RTD) as per standard	Description	α	Measuring range limits	Min. measuring span
IEC 60751:2008	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)
	▪ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ▪ With 2-wire circuit, compensation of the 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

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	Description	Measuring range limits		Min. measuring span
IEC 60584, Part 1 ASTM E230-3	Type A (W5Re-W20Re) (30) Type B (PtRh30-PtRh6) (31) Type E (NiCr-CuNi) (34) Type J (Fe-CuNi) (35) Type K (NiCr-Ni) (36) Type N (NiCrSi-NiSi) (37) Type R (PtRh13-Pt) (38) Type S (PtRh10-Pt) (39) Type T (Cu-CuNi) (40)	0 to +2 500 °C (+32 to +4 532 °F) +40 to +1 820 °C (+104 to +3 308 °F) −250 to +1 000 °C (−418 to +1 832 °F) −210 to +1 200 °C (−346 to +2 192 °F) −270 to +1 372 °C (−454 to +2 501 °F) −270 to +1 300 °C (−454 to +2 372 °F) −50 to +1 768 °C (−58 to +3 214 °F) −50 to +1 768 °C (−58 to +3 214 °F) −200 to +400 °C (−328 to +752 °F)	Recommended temperature range: 0 to +2 500 °C (+32 to +4 532 °F) +500 to +1 820 °C (+932 to +3 308 °F) −150 to +1 000 °C (−238 to +1 832 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 300 °C (−238 to +2 372 °F) +200 to +1 768 °C (+392 to +3 214 °F) +200 to +1 768 °C (+392 to +3 214 °F) −150 to +400 °C (−238 to +752 °F)	50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °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) Type U (Cu-CuNi) (42)	−200 to +900 °C (−328 to +1 652 °F) −200 to +600 °C (−328 to +1 112 °F)	−150 to +900 °C (−238 to +1 652 °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)
	▪ 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:

		Sensor input 1			
		RTD or resistance transmitter, 2-wire	**RTD or resistance transmitter, 3-wire**	**RTD or resistance transmitter, 4-wire**	**Thermocouple (TC), voltage transmitter**
Sensor input 2	**RTD or resistance transmitter, 2-wire**	☑	☑	-	☑
	RTD or resistance transmitter, 3-wire	☑	☑	-	☑
	RTD or resistance transmitter, 4-wire	-	-	-	-
	Thermocouple (TC), voltage transmitter	☑	☑	☑	☑

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

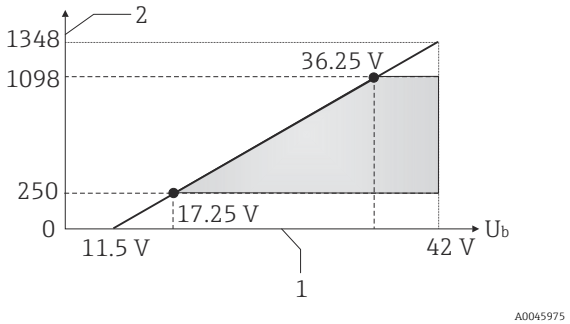
Failure information as per NAMUR NE43:

Failure information is created if the measuring information is missing or not valid. A complete list of all the 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 The "high" alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

Load

$R_{b\,max.}$= ($U_{b\,max.}$ - 11.5 V) / 0.023 A (current output)



1 Supply voltage U_b (V_{DC})
2 Load (Ω)

Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Mains frequency filter

50/60 Hz

Filter

1st order digital filter: 0 to 120 s

Protocol-specific data

Manufacturer ID	17 (0x11)
Device type ID	0x11CE
HART specification	7
Device address in the multi-drop mode [1)]	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	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 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)
Supported functions	▪ Burst mode [1)] ▪ Squawk ▪ Condensed status

1) Not possible in the SIL mode, see Functional Safety Manual FY01106T.

Wireless HART data

Minimum starting voltage	11.5 V_{DC}
Starting current	3.58 mA
Starting time	▪ Normal operation: 6 s ▪ SIL mode: 29 s
Minimum operating voltage	11.5 V_{AC}
Multidrop current	4.0 mA [1)]
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_a ≤ 3.6 mA
▪ Until the first valid measured value signal is present at the current output, approx. 28 s, while switch-on delay = I_a ≤ 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_{DC} 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

Current consumption	3.6 to 23 mA
Minimum current consumption	≤ 3.5 mA, Multidrop mode 4 mA (not possible in SIL mode)
Current limit	≤ 23 mA

Terminals

2.5 mm^2 (12 AWG) plus ferrule

Cable entries

Version	Type
Thread	2x thread ½" NPT
	2x thread M20
	2x thread G½"
Cable gland	2x coupling M20

Residual ripple

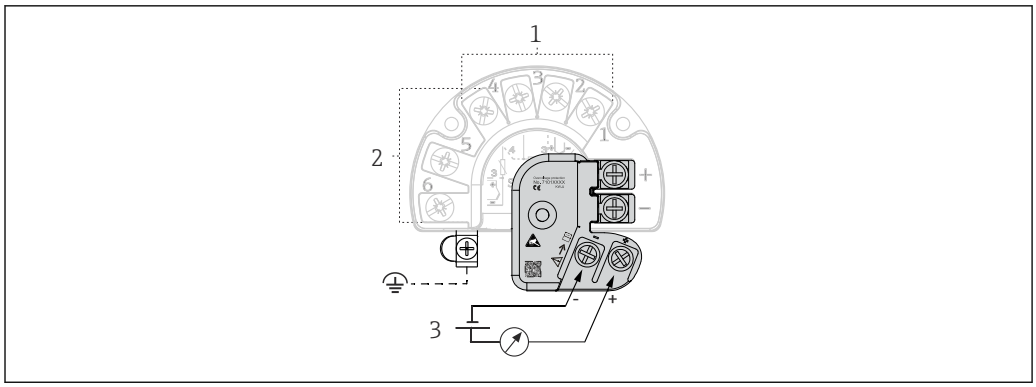
Permanent residual ripple U_{SS} ≤ 3 V at U_b ≥ 13.5 V, $f_{max.}$ = 1 kHz

Surge arrester

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 lines is diverted to ground. The functionality of the transmitter is not affected as no problematic voltage drop occurs.

Connection data:

Maximum continuous voltage (rated voltage)	U_C = 42 V_{DC}
Nominal current	I = 0.5 A at $T_{amb.}$ = 80 °C (176 °F)
Surge current resistance ▪ Lightning surge current D1 (10/350 µs) ▪ Nominal discharge current C1/C2 (8/20 µs)	 ▪ I_{imp} = 1 kA (per wire) ▪ I_n = 5 kA (per wire) I_n = 10 kA (total)
Series resistance per wire	1.8 Ω, tolerance ±5 %



16 *Electrical connection of surge arrester*

1 Sensor 1
2 Sensor 2
3 Bus connector 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:

Resistance temperature detector (RTD)	0.9 to 1.3 s (depends on the connection method 2-wire/3-wire/4-wire)
Thermocouples (TC)	0.8 s
Reference temperature	0.9 s

When recording step responses, it must be taken 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.

Update time

≤ 100 ms

Reference 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 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

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)	0.08 °C (0.14 °F)	0.1 °C (0.18 °F)
IEC 60751:2008	Pt1000 (4)		0.06 °C (0.11 °F)	0.1 °C (0.18 °F)
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)	0.09 °C (0.16 °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 +1 472 °F)	0.22 °C (0.4 °F)	0.33 °C (0.59 °F)
	Type S (PtRh10-Pt) (39)		0.57 °C (1.03 °F)	0.63 °C (1.1 °F)
	Type R (PtRh13-Pt) (38)		0.46 °C (0.83 °F)	0.52 °C (0.94 °F)

1) Measured value transmitted via HART

Measurement error for resistance thermometers (RTD) and resistance transmitters

Standard	Designation	Measuring range	Measurement error (±)	
			Digital [1] Based on measured value [3]	D/A [2]
IEC 60751:2008	Pt100 (1)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Pt200 (2)		ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))	
	Pt500 (3)	−200 to +500 °C (−328 to +932 °F)	ME = ± (0.03 °C (0.05 °F) + 0.012% * (MV - LRV))	
	Pt1000 (4)	−200 to +250 °C (−328 to +482 °F)	ME = ± (0.02 °C (0.04 °F) + 0.012% * (MV - LRV))	
JIS C1604:1984	Pt100 (5)	−200 to +510 °C (−328 to +950 °F)	ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))	
GOST 6651-94	Pt50 (8)	−185 to +1 100 °C (−301 to +2 012 °F)	ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))	
	Pt100 (9)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))	
DIN 43760 IPTS-68	Ni100 (6)	−60 to +250 °C (−76 to +482 °F)	ME = ± (0.05 °C (0.09 °F) - 0.006% * (MV - LRV))	
	Ni120 (7)			
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.10 °C (0.18 °F) + 0.006% * (MV - LRV))	
	Cu100 (11)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV)) ME = ± (0.06 °C (0.11 °F) - 0.005% * (MV - LRV))	
	Ni100 (12)	−60 to +180 °C (−76 to +356 °F)		
	Ni120 (13)		ME = ± (0.05 °C (0.09 °F) - 0.005% * (MV - LRV))	
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to +200 °C (−58 to +392 °F)	ME = ± (0.1 °C (0.18 °F) + 0.004% * (MV - LRV))	
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± (21 mΩ + 0.003% * (MV - LRV))	0.03 % (≙ 4.8 µA)
		10 to 2 000 Ω	ME = ± (35 mΩ + 0.010% * (MV - LRV))	

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

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 = ± (0.63 °C (1.13 °F) + 0.017% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Type B (31)	+500 to +1 820 °C (+932 to +3 308 °F)	ME = ± (0.95 °C (1.71 °F) - 0.04% * (MV - LRV))	
IEC 60584-1 ASTM E988-96 ASTM E230-3	Type C (32)	0 to +2 000 °C (+32 to +3 632 °F)	ME = ± (0.33 °C (0.59 °F) + 0.0065% * MV - LRV))	
ASTM E988-96	Type D (33)		ME = ± (0.48 °C (0.86 °F) - 0.005% * MV - LRV))	
IEC 60584-1 ASTM E230-3	Type E (34)	−150 to +1 000 °C (−238 to +1 832 °F)	ME = ± (0.14 °C (0.25 °F) - 0.003% * (MV - LRV))	
	Type J (35)	−150 to +1 200 °C (−238 to +2 192 °F)	ME = ± (0.18 °C (0.32 °F) - 0.0025% * (MV - LRV))	
	Type K (36)		ME = ± (0.25 °C (0.45 °F) - 0.003% * (MV - LRV))	
	Type N (37)	−150 to +1 300 °C (−238 to +2 372 °F)	ME = ± (0.32 °C (0.58 °F) - 0.008% * (MV - LRV))	
	Type R (38)	+200 to +1 768 °C (+360 to +3 214 °F)	ME = ± (0.55 °C (0.99 °F) - 0.009% * (MV - LRV))	
	Type S (39)		ME = ± (0.60 °C (1.08 °F) - 0.005% * (MV - LRV))	
	Type T (40)	−150 to +400 °C (−238 to +752 °F)	ME = ± (0.25 °C (0.45 °F) - 0.027% * (MV - LRV))	
DIN 43710	Type L (41)	−150 to +900 °C (−238 to +1 652 °F)	ME = ± (0.21 °C (0.38 °F) - 0.005% * (MV - LRV))	
	Type U (42)	−150 to +600 °C (−238 to +1 112 °F)	ME = ± (0.29 °C (0.52 °F) - 0.023% * (MV - LRV))	
GOST R8.585-2001	Type L (43)	−200 to +800 °C (−328 to +1 472 °F)	ME = ± (2.2 °C (3.96 °F) - 0.015% * (MV - LRV))	
Voltage transmitter (mV)		−20 to +100 mV	ME = ±10 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.

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:

Measurement error digital = 0.06 °C + 0.005% * (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measurement 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:

Measurement error digital = 0.06 °C + 0.005% * (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measurement error D/A = 0.03 % * 200 °C (360 °F)	0.06 °C (0.11 °F)
Influence of ambient temperature (digital) = (35 - 25) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) * (0.001% * 200 °C)	0.02 °C (0.04 °F)
Influence of ambient temperature (digital) = (30 - 24) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) * (0.001% * 200 °C)	0.01 °C (0.02 °F)
Measurement error digital value (HART): √(Measurement error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.13 °C (0.23 °F)**
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	**0.14 °C (0.25 °F)**

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

MV = measured value

LRV = lower range value of the sensor in question

Physical input measuring range of sensors	
10 to 400 Ω	Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120
10 to 2 000 Ω	Pt200, Pt500, Pt1000
–20 to 100 mV	Thermocouples type: A, B, C, D, E, J, K, L, N, R, S, T, U

Other measurement errors apply in SIL mode.

For detailed information, see the Functional Safety Manual FY01106T.

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 σ (Gaussian distribution), i.e. 95.45%.

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

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
		Digital [1]		D/A [2].	Digital [1]		D/A [2]
		Maximum	Based on measured value		Maximum	Based on measured value	
Pt100 (1)	IEC 60751:2008	≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	0.001 %	≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	0.001 %
Pt200 (2)		≤ 0.026 °C (0.047 °F)	-		≤ 0.026 °C (0.047 °F)	-	
Pt500 (3)		≤ 0.013 °C (0.023 °F)	0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)		≤ 0.013 °C (0.023 °F)	0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)	
Pt1000 (4)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)		≤ 0.008 °C (0.014 °F)	0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)	
Pt100 (5)	JIS C1604:1984	≤ 0.013 °C (0.023 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)		≤ 0.013 °C (0.023 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	
Pt50 (8)	GOST 6651-94	≤ 0.03 °C (0.054 °F)	0.002% * (MV - LRV), at least 0.01 °C (0.018 °F)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRV), at least 0.01 °C (0.018 °F)	
Pt100 (9)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Ni100 (6)	DIN 43760 IPTS-68	≤ 0.004 °C (0.007 °F)	-		≤ 0.005 °C (0.009 °F)	-	
Ni120 (7)			-			-	
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.007 °C (0.013 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Cu100 (11)			0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)		≤ 0.004 °C (0.007 °F)	0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)	
Ni100 (12)		≤ 0.004 °C (0.007 °F)	-			-	
Ni120 (13)			-			-	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.007 °C (0.013 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Resistance transmitter (Ω)							
10 to 400 Ω		≤ 6 mΩ	0.0015% * (MV - LRV), at least 1.5 mΩ	0.001 %	≤ 6 mΩ	0.0015% * (MV - LRV), at least 1.5 mΩ	0.001 %
10 to 2 000 Ω		≤ 30 mΩ	0.0015% * (MV - LRV), at least 15 mΩ		≤ 30 mΩ	0.0015% * (MV - LRV), at least 15 mΩ	

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	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]
		Maximum	Based on measured value		Maximum	Based on measured value	
Type A (30)	IEC 60584-1	≤ 0.13 °C (0.23 °F)	0.0055% * (MV - LRV), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.07 °C (0.13 °F)	0.0054% * (MV - LRV), at least 0.02 °C (0.036 °F)	0.001 %
Type B (31)		≤ 0.06 °C (0.11 °F)	-		≤ 0.06 °C (0.11 °F)	-	
Type C (32)	IEC 60584-1/ ASTM E988-96	≤ 0.08 °C (0.14 °F)	0.0045% * (MV - LRV), at least 0.03 °C (0.054 °F)		≤ 0.04 °C (0.07 °F)	0.0045% * (MV - LRV), at least 0.03 °C (0.054 °F)	
Type D (33)	ASTM E988-96		0.004% * (MV - LRV), at least 0.035 °C (0.063 °F)			0.004% * (MV - LRV), at least 0.035 °C (0.063 °F)	
Type E (34)	IEC 60584-1	≤ 0.03 °C (0.05 °F)	0.003% * (MV - LRV), at least 0.016 °C (0.029 °F)		≤ 0.02 °C (0.04 °F)	0.003% * (MV - LRV), at least 0.016 °C (0.029 °F)	
Type J (35)		≤ 0.04 °C (0.07 °F)	0.0028% * (MV - LRV), at least 0.02 °C (0.036 °F)			0.0028% * (MV - LRV), at least 0.02 °C (0.036 °F)	
Type K (36)			0.003% * (MV - LRV), at least 0.013 °C (0.023 °F)			0.003% * (MV - LRV), at least 0.013 °C (0.023 °F)	
Type N (37)			0.0028% * (MV - LRV), at least 0.020 °C (0.036 °F)			0.0028% * (MV - LRV), at least 0.020 °C (0.036 °F)	
Type R (38)		≤ 0.05 °C (0.09 °F)	0.0035% * (MV - LRV), at least 0.047 °C (0.085 °F)		≤ 0.05 °C (0.09 °F)	0.0035% * (MV - LRV), at least 0.047 °C (0.085 °F)	
Type S (39)			-			-	
Type T (40)		≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °F)	-	
Type L (41)	DIN 43710	≤ 0.02 °C (0.04 °F)	-			-	
Type U (42)		≤ 0.01 °C (0.02 °F)	-			-	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Type L (43)	GOST R8.585-2001	≤ 0.02 °C (0.04 °F)	-			-	
Voltage transmitter (mV)				0.001 %			0.001 %
−20 to 100 mV	-	≤ 3 µV	-		≤ 3 µV	-	

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 = √(Measurement error digital² + Measurement error D/A²)

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	≤ 0.016% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRV) or 0.05 °C (0.09 °F)	≤ 0.028% * (MV - LRV) or 0.06 °C (0.10 °F)
Pt200 (2)		0.25 °C (0.44 °F)	0.41 °C (0.73 °F)	0.50 °C (0.91 °F)
Pt500 (3)		≤ 0.018% * (MV - LRV) or 0.08 °C (0.14 °F)	≤ 0.03% * (MV - LRV) or 0.14 °C (0.25 °F)	≤ 0.036% * (MV - LRV) or 0.17 °C (0.31 °F)
Pt1000 (4)		≤ 0.0185% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.031% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.038% * (MV - LRV) or 0.08 °C (0.14 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.015% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.024% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.027% * (MV - LRV) or 0.08 °C (0.14 °F)
Pt50 (8)	GOST 6651-94	≤ 0.017% * (MV - LRV) or 0.07 °C (0.13 °F)	≤ 0.027% * (MV - LRV) or 0.12 °C (0.22 °F)	≤ 0.03% * (MV - LRV) or 0.14 °C (0.25 °F)
Pt100 (9)		≤ 0.016% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.028% * (MV - LRV) or 0.07 °C (0.13 °F)
Ni100 (6)	DIN 43760 IPTS-68	0.04 °C (0.06 °F)	0.05 °C (0.10 °F)	0.06 °C (0.11 °F)
Ni120 (7)				
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.11 °C (0.20 °F)
Cu100 (11)		≤ 0.015% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.024% * (MV - LRV) or 0.06 °C (0.10 °F)	≤ 0.027% * (MV - LRV) or 0.06 °C (0.11 °F)
Ni100 (12)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)
Ni120 (13)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.10 °C (0.18 °F)
Resistance transmitter				
10 to 400 Ω		≤ 0.0122% * (MV - LRV) or 12 mΩ	≤ 0.02% * (MV - LRV) or 20 mΩ	≤ 0.022% * (MV - LRV) or 22 mΩ
10 to 2 000 Ω		≤ 0.015% * (MV - LRV) or 144 mΩ	≤ 0.024% * (MV - LRV) or 240 mΩ	≤ 0.03% * (MV - LRV) or 295 mΩ

1) The larger value is valid

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

Designation	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Type A (30)	IEC 60584-1	≤ 0.048% * (MV - LRV) or 0.46 °C (0.83 °F)	≤ 0.072% * (MV - LRV) or 0.69 °C (1.24 °F)	≤ 0.1% * (MV - LRV) or 0.94 °C (1.69 °F)
Type B (31)		1.08 °C (1.94 °F)	1.63 °C (2.93 °F)	2.23 °C (4.01 °F)
Type C (32)	IEC 60584-1/ASTM E988-96	≤ 0.038% * (MV - LRV) or 0.41 °C (0.74 °F)	≤ 0.057% * (MV - LRV) or 0.62 °C (1.12 °F)	≤ 0.078% * (MV - LRV) or 0.85 °C (1.53 °F)
Type D (33)	ASTM E988-96	≤ 0.035% * (MV - LRV) or 0.57 °C (1.03 °F)	≤ 0.052% * (MV - LRV) or 0.86 °C (1.55 °F)	≤ 0.071% * (MV - LRV) or 1.17 °C (2.11 °F)
Type E (34)	IEC 60584-1	≤ 0.024% * (MV - LRV) or 0.15 °C (0.27 °F)	≤ 0.037% * (MV - LRV) or 0.23 °C (0.41 °F)	≤ 0.05% * (MV - LRV) or 0.31 °C (0.56 °F)
Type J (35)		≤ 0.025% * (MV - LRV) or 0.17 °C (0.31 °F)	≤ 0.037% * (MV - LRV) or 0.25 °C (0.45 °F)	≤ 0.051% * (MV - LRV) or 0.34 °C (0.61 °F)
Type K (36)		≤ 0.027% * (MV - LRV) or 0.23 °C (0.41 °F)	≤ 0.041% * (MV - LRV) or 0.35 °C (0.63 °F)	≤ 0.056% * (MV - LRV) or 0.48 °C (0.86 °F)
Type N (37)		0.36 °C (0.65 °F)	0.55 °C (0.99 °F)	0.75 °C (1.35 °F)
Type R (38)		0.83 °C (1.49 °F)	1.26 °C (2.27 °F)	1.72 °C (3.10 °F)
Type S (39)		0.84 °C (1.51 °F)	1.27 °C (2.29 °F)	2.23 °C (4.01 °F)
Type T (40)		0.25 °C (0.45 °F)	0.37 °C (0.67 °F)	0.51 °C (0.92 °F)
Type L (41)	DIN 43710	0.20 °C (0.36 °F)	0.31 °C (0.56 °F)	0.42 °C (0.76 °F)
Type U (42)		0.24 °C (0.43 °F)	0.37 °C (0.67 °F)	0.50 °C (0.90 °F)
Type L (43)	GOST R8.585-2001	0.22 °C (0.40 °F)	0.33 °C (0.59 °F)	0.45 °C (0.81 °F)
Voltage transmitter (mV)				
–20 to 100 mV		≤ 0.027% * (MV - LRV) or 5.5µV	≤ 0.041% * (MV - LRV) or 8.2µV	≤ 0.056% * (MV - LRV) or 11.2µV

1) The larger value is valid

Long-term drift analog output

Long-term drift D/A [1] (±)		
after 1 year	after 3 years	after 5 years
0.021%	0.029%	0.031%

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

Ambient temperature

For hazardous areas, see Ex documentation.

Without display	–40 to +85 °C (–40 to +185 °F)
With display	–40 to +80 °C (–40 to +176 °F)

With surge arrester module	−40 to +85 °C (−40 to +185 °F)
SIL mode	−40 to +75 °C (−40 to +167 °F)

The display may react slowly at temperatures < −20 °C (−4 °F). The readability of the display cannot be guaranteed at temperatures < −30 °C (−22 °F).

Storage temperature

Without display	−40 to +100 °C (−40 to +212 °F)
With display	−40 to +80 °C (−40 to +176 °F)
With surge arrester module	−40 to +100 °C (−40 to +212 °F)

Relative humidity

Permitted: 0 to 95 %

Operating altitude

Up to 2 000 m (6 560 ft) above sea level

Climate class

As per IEC 60654-1, Class Dx

Degree of protection

Die-cast aluminum or stainless steel housing: IP66/67, Type 4X

Shock and vibration resistance

Shock resistance as per KTA 3505 (section 5.8.4 Shock test)

IEC 60068-2-6 test

Fc: Vibration (sinusoidal)

Vibration resistance:
Vibration resistance as per DNVGL-CG-0339 : 2021 and DIN EN 60068-2-6:
- 25 to 100 Hz at 4g
- 5 to 25 Hz, 1.6 mm

The use of L-shaped mounting brackets can cause resonance (see wall/pipe 2" mounting bracket in the 'Accessories' section). Caution: Vibrations on the field transmitter must not exceed specifications.

Electromagnetic compatibility (EMC)

CE compliance

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.

Maximum measurement error <1% of measuring range.

Interference immunity as per IEC/EN 61326 series, industrial requirements

Interference emission as per IEC/EN 61326 series, Class B equipment

SIL conformity according to IEC 61326-3-1 or IEC 61326-3-2

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.

Connection of the functional grounding may be needed for functional purposes. Compliance with the electrical codes of individual countries is mandatory.

Overvoltage category

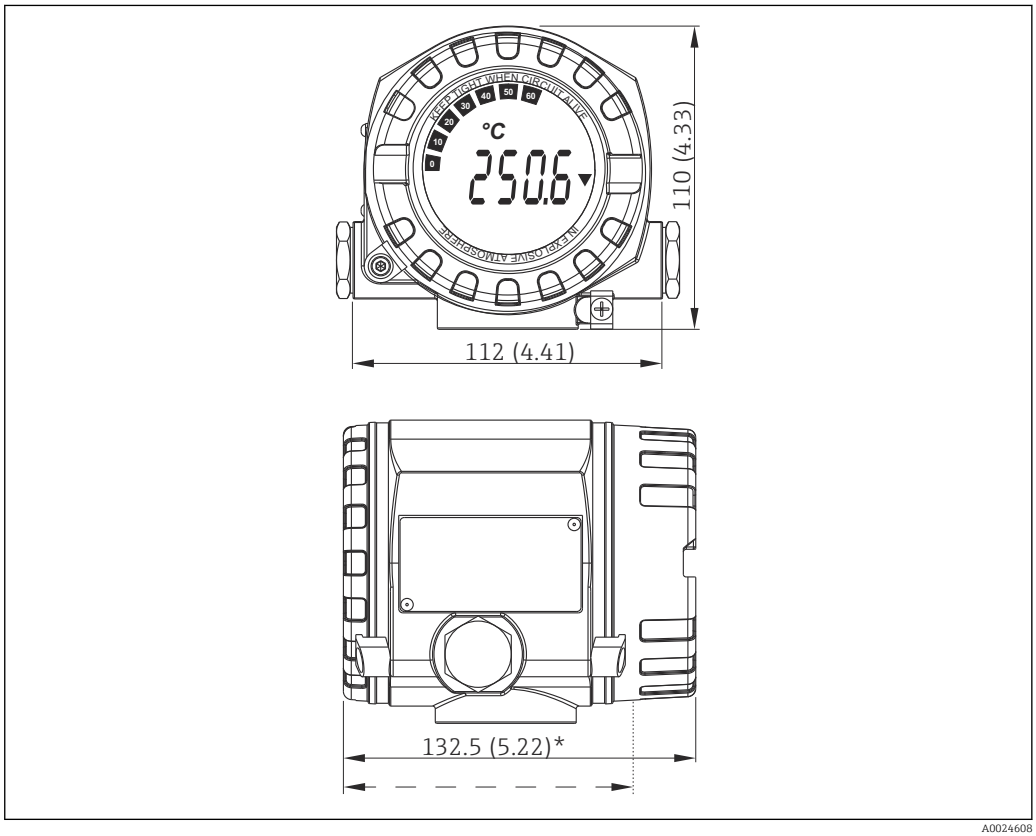
II

Pollution degree	2

13.6 Mechanical construction

Design, dimensions

Dimensions in mm (in)



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

Housing	Sensor terminals	Nameplate
Die-cast aluminum housing AlSi10Mg/ AlSi12 with powder coating on polyester base	Nickel-plated brass0.3 µm gold flashed/cpl., corrosion-free	Aluminum AlMgl, anodized in black
316L		1.4404 (AISI 316L)
		-
Display O-ring 88x3: HNBR 70° Shore PTFE coating	-	-

Cable entries

Version	Type
Thread	2x thread ½" NPT
	2x thread M20
	2x thread G½"
Cable gland	2x coupling M20

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

142 a 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 FieldComm Group. The device meets the requirements of the FieldComm Group HART Specifications, Revision 7.

14 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, see the Functional Safety Manual FY01106T.

Setup →	Device tag	→ 70
	Unit	→ 71
	Assign current output (PV)	→ 71
	Reset sensor backup	→ 71
	4mA value	→ 72
	20mA value	→ 72
	Sensor type 1	→ 72
	Connection type 1	→ 73
	2-wire compensation 1	→ 73
	Reference junction 1	→ 73
	RJ preset value 1	→ 74
	Sensor offset 1	→ 74
	Sensor type 2	→ 72
	Connection type 2	→ 73
	2-wire compensation 2	→ 73
	Reference junction 2	→ 73
	RJ preset value 2	→ 74
	Sensor offset 2	→ 74

Setup →	**Advanced setup →**	Enter access code	→ 75
		Access status tooling	→ 75
		Locking status	→ 76

Setup →	**Advanced setup →**	**Sensor →**	Drift/difference mode	→ 77
			Drift/difference alarm delay	→ 77
			Drift/difference set point	→ 77
			Sensor switch set point	→ 78

Setup →	**Advanced setup →**	**Current output →**	Output current	→ 79
			Failure mode	→ 79
			Failure current	→ 79
			4 mA current trimming	→ 79
			20 mA current trimming	→ 80
			Reset trim	→ 80

Setup →	**Advanced setup →**	**Display →**	Display interval	→ 80
			Value 1 display	→ 81
			Display text 1	→ 81
			Decimal places 1	→ 81
			Value 2 display	→ 81
			Display text 2	→ 81
			Decimal places 2	→ 81
			Value 3 display	→ 81
			Display text 3	→ 81
			Decimal places 3	→ 81

Setup →	**Advanced setup →**	**SIL →**	SIL option	→ 82
			Operational state	→ 82
			SIL checksum	→ 83
			Force safe state	→ 83
			Deactivate SIL	→ 83
			Restart device	→ 84
			Expert mode	→ 84

Setup →	**Advanced setup →**	**Administration →**	Device reset	→ 84
			Define device write protection code	→ 84

Diagnostics →	Actual diagnostics 1	→ 86
	Previous diagnostics 1	→ 86
	Reset backup	→ 86
	Operating time	→ 86

Diagnostics →	**Diagnostic list →**	Actual diagnostics count	→ 87
		Actual diagnostics 1 to 3	→ 87
		Actual diag 1 to 3 channel	→ 87

Diagnostics →	**Event logbook →**	Previous diagnostics n	→ 88
		Previous diag channel n	→ 88

Diagnostics →	**Device information →**	Device tag		→ 70
		Serial number		→ 89
		Firmware version		→ 89
		Device name		→ 89
		Order code		→ 89
		Configuration counter		→ 90

Diagnostics →	**Measured values →**	Sensor 1 value		→ 90
		Sensor 2 value		→ 90
		Device temperature		→ 90

Diagnostics →	**Measured values →**	**Min/max values →**	Sensor n min value	→ 91
			Sensor n max value	→ 91
			Device temperature min.	→ 91
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Diagnostics →	**Simulation →**	Current output simulation	→ 92
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Expert →	Enter access code	→ 75
	Access status tooling	→ 75
	Locking status	→ 76

Expert →	**System →**	Unit	→ 71
		Damping	→ 93
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			Value 1 display	→ 81
			Display text 1	→ 81
			Decimal places 1	→ 81
			Value 2 display	→ 81
			Display text 2	→ 81
			Decimal places 2	→ 81
			Value 3 display	→ 81
			Display text 3	→ 81
			Decimal places 3	→ 81

Expert →	**System →**	**Administration →**	Define device write protection code	→ 84
			Device reset	→ 84

Expert →	**Sensor →**	Measurement channels	→ 94

Expert →	**Sensor →**	**Sensor n** [1] **→**	Sensor type n	→ 72
			Connection type n	→ 73
			2-wire compensation n	→ 73
			Reference junction n	→ 73
			RJ preset value n	→ 74
			Sensor offset n	→ 74
			Sensor serial number	→ 96

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

Expert →	**Sensor →**	**Sensor n →**	**Sensor trimming →**	Sensor trimming	→ 96
				Sensor trimming lower value	→ 97
				Sensor trimming upper value	→ 97
				Sensor trimming min span	→ 97
				Reset trim	→ 97

Expert →	**Sensor →**	**Sensor n** [1] **→**	**Linearization →**	Call./v. Dusen coeff. R0, A, B, C	→ 98
				Polynomial coeff. R0, A, B	→ 99
				Sensor n lower limit	
				Sensor n upper limit	

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

Expert →	**Sensor →**	**Drift/calibration →**	Sensor switch set point	→ 78
			Drift/difference mode	→ 77
			Drift/difference alarm delay	→ 77
			Drift/difference set point	→ 77
			Control	→ 101
			Start value	→ 101
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Expert →	**Output →**	4mA value	→ 72
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		Failure mode	→ 79
		Failure current	→ 79
		4 mA current trimming	→ 79
		20 mA current trimming	→ 80
		Reset trim	→ 80

Expert →	**Communication →**	**HART configuration →**	Device tag	→ 70
			HART short tag	→ 103
			HART address	→ 103
			No. of preambles	→ 103
			Configuration changed	→ 103
			Reset configuration changed	→ 104

Expert →	**Communication →**	**HART info →**	Device type	→ 104
			Device revision	→ 104
			Device ID	→ 104
			Manufacturer ID	→ 105
			HART revision	→ 105
			HART descriptor	→ 105
			HART message	→ 105
			Hardware revision	→ 105
			Software revision	→ 106
			HART date code	→ 106
			Process unit tag	→ 106
			Location description	→ 106
			Longitude	→ 107
			Latitude	→ 107
			Altitude	→ 107
			Location method	→ 107

Expert →	**Communication →**	**HART output →**	Assign current output (PV)	→ 71
			PV	→ 108
			Reset sensor backup	→ 71
			Assign SV	→ 108
			SV	→ 109
			Assign TV	→ 109
			TV	→ 109
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			QV	→ 109

Expert →	**Communication →**	**Burst configuration 1 to 3 →**	Burst mode	→ 110
			Burst command	→ 110
			Burst variable n	→ 111
			Burst trigger mode	→ 111
			Burst trigger level	→ 112
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Expert →	**Diagnostics →**	Actual diagnostics 1	→ 86
		Previous diagnostics 1	→ 86
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		Operating time	→ 86

Expert →	**Diagnostics →**	**Diagnostic list →**	Actual diagnostics count	→ 87
			Actual diagnostics 1 to 3	→ 86
			Actual diag 1 to 3 channel	→ 87

Expert →	**Diagnostics →**	**Event logbook →**	Previous diagnostics n	→ 88
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Expert →	**Diagnostics →**	**Device information →**	Device tag	→ 70
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			Serial number	→ 89
			Firmware version	→ 89
			Device name	→ 89
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			Extended order code	→ 114
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			Extended order code 3	→ 114
			Manufacturer ID	→ 105
			Manufacturer	→ 115
			Hardware revision	→ 105
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Expert →	**Diagnostics →**	**Measured values →**	Sensor n value	→ 90
			Sensor n raw value	→ 115
			Device temperature	→ 90

Expert →	**Diagnostics →**	**Measured values →**	**Min/max values →**	Sensor n min value	→ 91
				Sensor n max value	→ 91
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				Device temperature min.	→ 91
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Expert →	**Diagnostics →**	**Simulation →**	Diagnostic event simulation	→ 116
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Expert →	**Diagnostics →**	**Diagnostic settings →**	**Diagnostic behavior →** Sensor, electronics, process, configuration	→ 117

Expert →	**Diagnostics →**	**Diagnostic settings →**	**Status signal →** Sensor, electronics, process, configuration	→ 117

Additional functions →	Compare datasets [1]
	Save / restore [1]
	Create documentation [1]

1) These parameters only appear in FDT/DTM-based operating tools, such as Endress+Hauser's FieldCare and DeviceCare

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)

Backup function

If the option **Sensor 1 (backup sensor 2)** or **Average: 0.5 x (SV1+SV2) with backup** is selected in the **Assign current output (PV)** parameter, the corresponding backup function is active.

If **Sensor 1 (backup sensor 2)** is selected, the transmitter automatically switches to sensor 2 as the primary measured value in the event of a sensor 1 failure. The measured value of sensor 2 is used as PV. The 4 to 20 mA signal is not interrupted. The status of the faulty sensor is output via HART. If a display unit is connected, a diagnostic message is shown there.

Three scenarios can occur if **Average: 0.5 x (SV1+SV2) with backup** is selected:
- If sensor 1 fails, the average corresponds to the measured value of sensor 2, the 4 to 20 mA signal is not interrupted and a diagnosis is output via HART.
- If sensor 2 fails, the average corresponds to the measured value of sensor 1, the 4 to 20 mA signal is not interrupted and a diagnosis is output via HART.
- If both sensors fail at the same time, the transmitter follows the set failure mode and a diagnosis is output via HART.

The **Reset sensor backup** parameter defines how the transmitter behaves after the sensor error has been rectified.

Reset sensor backup parameter	Assign current output (PV) parameter	
	Sensor 1 selected (backup sensor 2)	Average selected: 0.5 x (SV1+SV2) with backup
Automatic selection	The transmitter automatically switches back to sensor 1 after the sensor error on sensor 1 has been rectified and sensor 1 is used as PV.	After the sensor error has been rectified, the transmitter automatically switches back to the average value and this is used as the PV.
Manual selection	After the sensor error at sensor 1 has been rectified, the transmitter resumes normal operation only upon manual confirmation via the **Reset backup** button in the **Diagnostics** menu, with sensor 1 used as PV. Alternatively, you can restore normal operation by switching the transmitter off and on again. Until confirmation, sensor 2 is used as PV and a diagnosis is output via HART.	After the sensor error has been rectified, the transmitter resumes normal operation only upon manual confirmation via the **Reset backup** button in the **Diagnostics** menu, with the average used as PV. Alternatively, you can restore normal operation by switching the transmitter off and on again. Until confirmation, sensor 1 or sensor 2 is used as PV depending on the scenario and a diagnosis is output via HART.

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.

Options
- °C
- °F
- K
- °R
- Ohm
- mV

Factory setting
°C

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).

Options
- 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** → 78 parameter. With temperature-dependent switching, it is possible to combine 2 sensors that offer advantages in different temperature ranges.

Factory setting
Sensor 1

Reset sensor backup

Navigation
Setup → Reset sensor backup
Expert → Communication → HART output → Reset sensor backup

Prerequisite

In the **Assign current output (PV)** parameter, the option **Sensor 1 (Backup sensor 2)** or **0.5 x (SV1+SV2) with backup** must be configured.

Description

Select the method for resetting the device from the sensor backup function to normal measuring mode.

If **Automatic** is selected: The device is automatically reset to the normal measuring mode once all sensor errors at sensor 1 are rectified.
If **Manual** is selected: The device is manually reset to the normal measuring mode once all sensor errors at sensor 1 have been rectified. Manual acknowledgement is carried out via the **Reset backup** parameter in the **Diagnostics** menu.

Options

- Automatic
- Manual

Factory setting

Automatic

4mA value

Navigation

Setup → 4 mA value
Expert → Output → 4 mA 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** → 72 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

20mA value

Navigation

Setup → 20 mA value
Expert → Output → 20 mA 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** → 72 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

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.

Options A list of all the possible sensor types is provided in the 'Technical data' section → 47.

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

Options
- 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

Sensor offset n

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...+10.0

Factory setting 0.0

14.1.1 "Advanced setup" submenu

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. In the event of entering an incorrect access code, users retain their current access authorization.

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

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

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

User entry
0 to 9 999

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.

Options
- 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 provided on the electronics module. When write protection is activated, write access to the parameters is disabled.

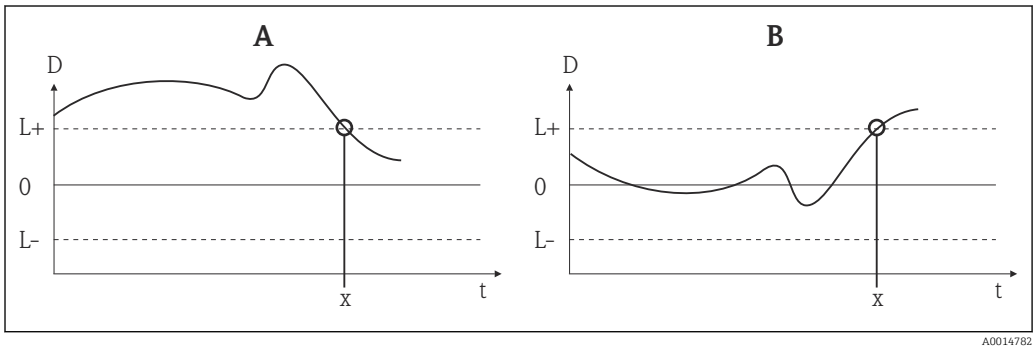
"Sensor" submenu

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



18 Drift/difference mode

A Value under range
B Value over range
D Drift
L+, L- Upper (+) or lower (-) set point
t Time
x Diagnostic event, status signal is generated

Drift/difference mode

Navigation
Setup → Advanced setup → Sensor → Drift/difference mode
Expert → Sensor → Drift/calibration → Drift/difference monitoring

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

Can only be selected for 2-channel operation.

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.

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

Factory setting
Off

Drift/difference alarm delay

Navigation
Setup → Advanced setup → Sensor → Drift/difference alarm delay
Expert → Sensor → Drift/calibration → Drift/difference alarm delay

Prerequisite
The **Drift/difference mode** parameter must be activated with the **Out band (drift)** or **In band** option. → 77

Description
Alarm delay for drift detection monitoring.

Useful for example in the event of different thermal mass ratings for the sensors in conjunction with a high temperature gradient in the process.

User entry
5 to 255 s

Factory setting
5 s

Drift/difference set point

Navigation
Setup → Advanced setup → Sensor → Drift/difference set point
Expert → Sensor → Drift/calibration → 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 configure the maximum permissible measured value deviation between sensor 1 and sensor 2 which results in drift/difference detection.

Options 0.1 to 999.0 K (0.18 to 1 798.2 °F)

Factory setting 999.0

Sensor switch set point

Navigation Setup → Advanced setup → Sensor → Sensor switch set point
Expert → Sensor → Drift/calibration → Sensor switch set point

Description Use this function to set the threshold value for sensor switching → 71.

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

Options Depends on the sensor types selected.

Factory setting 850 °C

"Current output" submenu

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

Current trimming is used to compensate the analog output (D/A conversion). Here, the output current of the transmitter can be adapted to align with the value expected at the higher-level system.

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 n → Sensor trimming.

Procedure

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

↓
8. End

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

Selection
- High alarm
- Low alarm

Factory setting Low alarm

Failure current

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

Prerequisite The **High alarm** 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 → 78.

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 → 78.

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 Set the display duration of the measured values on the local display if they are displayed in alternation. 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 → 81.

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)
Expert → System → Display → Value 1 display (value 2 or 3 display)

Description Use this function to select a measured value that is 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) → 81.

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

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, you must run the **Expert mode** wizard.

For detailed information, see the Functional Safety Manual **FY01106T**.

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

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.

Options
- 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.

Expert mode

Navigation Setup → Advanced setup → SIL → Expert mode

Description For the detailed procedure on activating SIL mode in the **Expert mode** wizard, see the Functional Safety Manual (FY01106T).

"Administration" submenu

Device reset

Navigation Setup → Advanced setup → Administration → Device reset
Expert → System → Administration → 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 software write protection code

Navigation

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

Description

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

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.

User entry

0 to 9 999

Factory setting

0

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. → 23

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 1

Navigation Diagnostics → Actual diagnostics 1
Expert → Diagnostics → Actual diagnostics 1

Description Displays the current diagnostic message. If several 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

Reset backup

Navigation Diagnostics → Reset backup
Expert → Diagnostics → Reset backup

Prerequisite In the **Assign current output (PV)** parameter, the option **Sensor 1 (Backup sensor 2)** or **0.5 x (SV1+SV2) with backup** must be configured.
The **Manual** option must be set in **Reset sensor backup** parameter.

Description Click the button to reset the device manually from backup mode to the normal measuring mode.

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 diagnostic messages → 37.

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 1 to 3

Navigation Diagnostics → Diagnostic list → Actual diagnostics 1-3
Expert → Diagnostics → Diagnostic list → Actual diagnostics 1-3

Description Displays the current diagnostic 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 1 to 3 channel

Navigation Diagnostics → Diagnostic list → Actual diag 1 to 3 channel
Expert → Diagnostics → Diagnostic list → Actual diag 1 to 3 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 info" 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. → 23

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 instrument using the Device Viewer: www.endress.com/deviceviewer

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

Firmware version

Navigation Diagnostics → Device information → Firmware version
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.

Useful applications of the order code
- To order an identical replacement device.
- To identify the measuring instrument quickly and easily, e.g. when contacting the manufacturer.

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.

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 (peakhold 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 (peakhold 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 3.58 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" → 70 and "Diagnostics menu"→ 86 sections.

Enter access code→ 75

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

Access status tooling→ 75

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

Locking status→ 76

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 → 80

"Administration" submenu

Detailed information → 84

14.3.2 "Sensor" submenu

Measurement channels

Navigation Expert → Sensor → Number of measurement channels

Description Displays information on the connected and configured measurement channels

Options
- 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 → 72

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

Connection type n → 73

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

2-wire compensation n → 73

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

Reference junction n → 73

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

RJ preset value n → 74

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

Sensor offset n → 74

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 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 - none -

"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.

Options
- 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 → 96.

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

"Linearization" submenu

Procedure for configuring a linearization using Callendar van Dusen coefficients from a calibration certificate

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

Call./v. Dusen coeff. R0

Navigation Expert → Sensor → Sensor n → Linearization → Call./v.- Dusen coeff. R0

Prerequisite The RTD platinum (Callendar van Dusen) option is enabled in the **Sensor type** parameter.

Description Use this function to set the R0 Value only for linearization with the Callendar van Dusen polynomial.

User entry 10 to 2 000 Ohm

Factory setting 100 Ohm

Call./v. Dusen coeff. A, B and C

Navigation Expert → Sensor → Sensor n → Linearization → Call./v.- Dusen coeff. A, B, C

Prerequisite The RTD platinum (Callendar van Dusen) option is enabled in the **Sensor type** parameter.

Description Use this function to set the coefficients for sensor linearization based on the Callendar van Dusen method.

Factory setting
- A: 3.910000e-003
- B: -5.780000e-007
- C: -4.180000e-012

Polynomial coeff. R0

Navigation Expert → Sensor → Sensor n → Linearization → Polynomial coeff. R0

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

Description Use this function to set the R0 Value only for linearization of nickel/copper sensors.

User entry 10 to 2 000 Ohm

Factory setting 100 Ohm

Polynomial coeff. A, B

Navigation Expert → Sensor → Sensor n → Linearization → 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 = 5.49630e-003

Polynomial coeff. B = 6.75560e-006

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.

"Drift/calibration" submenu

Sensor switch set point → 78

Navigation Setup → Advanced setup → Sensor → Sensor switch set point
Expert → Sensor → Drift/calibration → Sensor switch set point

Drift/difference mode → 77

Navigation Setup → Advanced setup → Sensor → Drift/difference mode
Expert → Sensor → Drift/calibration → Drift/difference monitoring

Drift/difference alarm delay → 77

Navigation Setup → Advanced setup → Sensor → Drift/difference alarm delay
Expert → Sensor → Drift/calibration → Drift/difference alarm delay

Drift/difference set point → 77

Navigation Setup → Advanced setup → Sensor → Drift/difference set point
Expert → Sensor → Drift/calibration → Drift/difference set point

Control

Navigation Expert → Sensor → Drift/calibration → Control

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

Options
- **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 → Drift/calibration → 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 → Drift/calibration → 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 1 January 2021 and the device is without power for 100 days, the calibration alarm will appear on 10 April 2022.

14.3.3 "Output" submenu

4 mA value → 72

Navigation Setup → 4 mA value
Expert → Output → 4 mA value

20 mA value → 72

Navigation Setup → 20 mA value
Expert → Output → 20 mA value

Failure mode → 79

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

Failure current → 79

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

4 mA current trimming → 79

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

20 mA current trimming → 80

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

Reset trim → 80

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

14.3.4 "Communication" submenu

"HART configuration" submenu

Device tag → **88**

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

User entry 0 … 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

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

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

User entry 2 … 20

Factory setting 5

Configuration changed

Navigation Expert → Communication → HART configuration → Configuration changed

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

Reset configuration changed

Navigation Expert → Communication → HART configuration → Reset configuration changed

Description The **Configuration changed** information is reset by a master (primary or secondary).

User entry Activate the button

"HART info" submenu

Device type

Navigation Expert → Communication → HART info → Device type

Description 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.

Display 4-digit hexadecimal number

Factory setting 0x11CE

Device revision

Navigation Expert → Communication → HART info → Device revision

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

Display 5

Factory setting 5 (0x05)

Device ID

Navigation Expert → Communication → HART info → 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 under which the device is registered with the 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 Use this function to display 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 Expert → Communication → HART info → Process unit tag

Description Use this function to enter the process unit in which the device is installed.

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

Factory setting 32 x '?'

Location description

Navigation Expert → Communication → HART info → Location description

Description Use this function to enter a description of the location so that the device can be located in the plant.

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

Factory setting 32 x '?'

Longitude

Navigation Expert → Communication → HART info → Longitude

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

User entry −180.000 to +180.000 °

Factory setting 0

Latitude

Navigation Expert → Communication → HART info → Latitude

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

User entry −90.000 to +90.000 °

Factory setting 0

Altitude

Navigation Expert → Communication → HART info → Altitude

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

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

Factory setting 0 m

Location method

Navigation Expert → Communication → HART info → Location method

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

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

Factory setting Manual input mode

"HART output" submenu

Assign current output (PV) → 70

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

PV

Navigation Expert → Communication → HART output → PV

Description Use this function to display the primary HART value

Reset sensor backup → 71

Navigation Setup → Reset sensor backup
Expert → Communication → HART output → Reset sensor backup

Assign SV

Navigation Expert → Communication → HART output → Assign SV

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

Options See **Assign current output (PV)** parameter → 70.

Factory setting Device temperature

SV

Navigation Expert → Communication → HART output → SV

Description Use this function to display the secondary HART value

Assign TV

Navigation Expert → Communication → HART output → Assign TV

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

Options See **Assign current output (PV)** parameter, → 70

Factory setting Sensor 1

TV

Navigation Expert → Communication → HART output → TV

Description Use this function to display the tertiary HART value

Assign QV

Navigation Expert → Communication → HART output → Assign QV

Description Use this function to assign a measured variable to the quaternary (fourth) HART value (QV).

Options See **Assign current output (PV)** parameter, → 70

Factory setting Sensor 1

QV

Navigation Expert → Communication → HART output → QV

Description Use this function to display the quaternary HART value

"Burst configuration 1 to 3" submenu

Up to 3 burst modes can be configured.

Burst mode

Navigation Expert → Communication → Burst configuration 1 to 3 → 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.

Options
- **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 1 to 3 → Burst command

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

Options
- 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 7)

Navigation Expert → Communication → Burst configuration 1 to 3 → 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 7.

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 .

Options

- 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)

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 x (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 0 to 7: Not used

Burst trigger mode

Navigation Expert → Communication → Burst configuration 1 to 3 → 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.

Options
- Continuous
- Range
- Rising
- In band
- Change

Factory setting Continuous

Burst trigger level

Navigation Expert → Communication → Burst configuration 1 to 3 → Burst trigger level

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

Navigation Expert → Communication → Burst configuration 1 to 3 → Min. update period

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

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 1 to 3 → Max. update period

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

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 → 86

"Diagnostic list" submenu

For a detailed description, see → 87

"Event logbook" submenu

For a detailed description, see → 88

"Device info" submenu

Device tag → 88

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.

Options
- **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 → 89

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

Firmware version → 89

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

Device name → 89

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

Order code → 89

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 → **105**

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 → 90

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

"Measured values" submenu

Sensor n value → 90

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 → 90

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

"Min/Max values" submenu

For a detailed description, see → 91

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.

Options
- 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.

Options
- No
- Yes

Factory setting No

"Simulation" submenu

Diagnostic event simulation

Navigation Expert → Diagnostics → Simulation → Diagnostic event simulation

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

Display If simulation is active, the relevant diagnostic event is displayed with the configured status signal. → 37

Options Off,
or a diagnostic event from the defined list of diagnostic events → 37

Factory setting Off

Current output simulation → 92

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

Value current output → 92

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. → 38

Options
- Alarm
- Warning
- Disabled

Factory setting For detailed information see the 'Overview of diagnostic events' → 38

Status signal

Navigation Expert → Diagnostics → Diagnostic settings → Status signal

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. → 38

1) Digital information available via HART communication

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

Factory setting For detailed information see the 'Overview of diagnostic events' → 38

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