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Valid as of version
01.02 (device version)

Operating Instructions
iTEMP TMT82

Dual-input temperature transmitter with HART® protocol

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

1.1 Document function

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

1.2 Safety instructions (XA)

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

1.3 Symbols used

1.3.1 Safety symbols

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

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

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

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

1.3.2 Electrical symbols

Symbol	Meaning
⎓	Direct current
~	Alternating current
⎓ ~	Direct current and alternating current

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

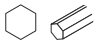
1.3.3 Symbols for certain types of information

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

1.3.4 Symbols in graphics

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

1.4 Tool symbols

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

1.5 Documentation

Document	Purpose and content of the document
Technical Information TI01010T	**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 KA01095T	**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.

The document types listed are available:
In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

1.6 Registered trademarks

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

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists: must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before 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 fulfill 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 user-configurable temperature transmitter with either one or two sensor inputs for a resistance thermometer (RTD), thermocouples (TC), resistance and voltage transmitters. The head transmitter version of the device is intended for mounting in a terminal head (flat face) as per DIN EN 50446. The device is also optionally available in a version that is integrated into a field housing. It is also possible to mount the device on a DIN rail using the optional DIN rail clip. The device is also optionally available in a version suitable for DIN rail mounting as per IEC 60715 (TH35).

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

The manufacturer is not liable for damage caused by improper or non-intended use.

The head transmitter must not be operated as a DIN rail substitute in a cabinet by using the DIN rail clip with remote sensors.

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

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 that is 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.

NOTICE

- The device must only be powered by a power unit that operates using an energy-limited electric circuit according to UL/EN/IEC 61010-1, chapter 9.4 and requirements of table 18.

2.5 Product safety

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

2.6 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

1. Unpack the temperature transmitter carefully. Is the packaging or content free from damage?
   ↳ Damaged components must not be installed as the manufacturer can otherwise not guarantee compliance with the original safety requirements or the material resistance, and can therefore not be held responsible for any resulting damage.
2. Is the delivery complete or is anything missing? Check the scope of delivery against your order.
3. Does the nameplate match the ordering information on the delivery note?
4. Are the technical documentation and all other necessary documents provided? If applicable: are the Safety Instructions (e.g. XA) for hazardous areas provided?

If one of these conditions is not satisfied, contact your Endress+Hauser Sales Center.

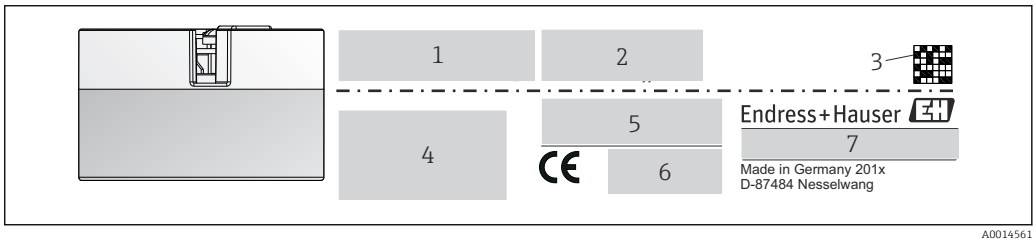
3.2 Product identification

The following options are available for the identification of the device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- Enter the serial number from the nameplate in the *W@M Device Viewer* (www.endress.com/deviceviewer): All data relating to the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number on the nameplate into the *Endress+Hauser Operations App* or scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations App*: all the information about the device and the technical documentation pertaining to the device is displayed.

3.2.1 Nameplate

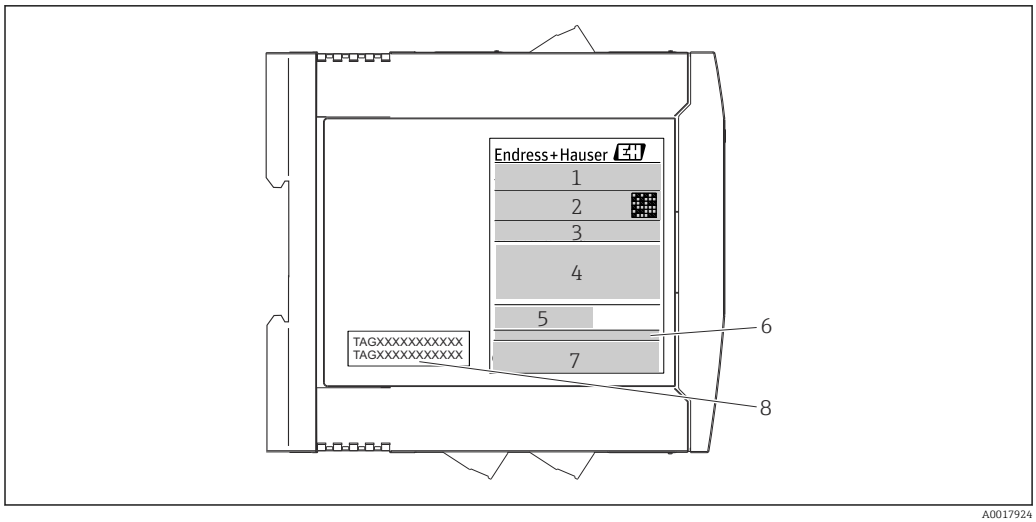
The right device?

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



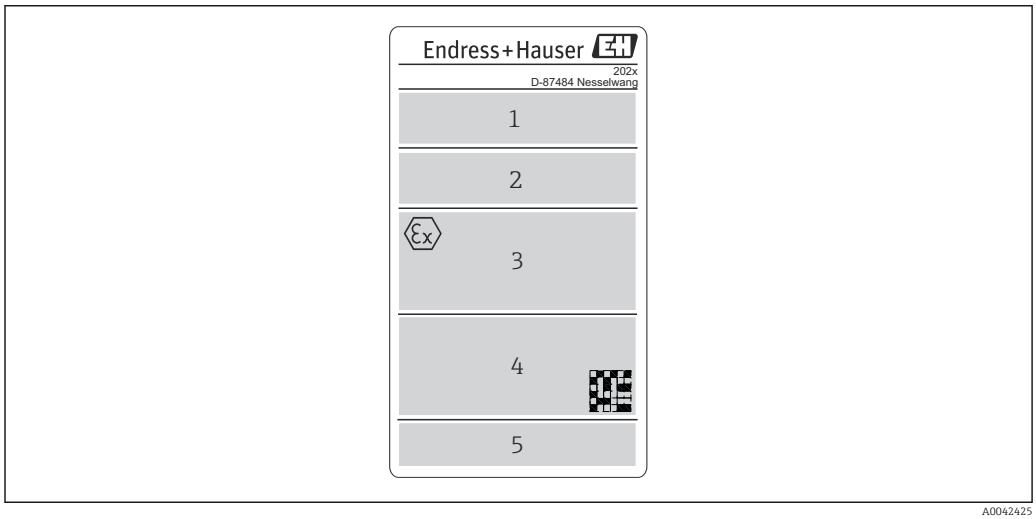
1 Nameplate of the head transmitter (example, Ex version)

1 Power supply, current consumption and extended order code
2 Serial number, device revision, firmware version and hardware version
3 Data Matrix 2D code
4 2 lines for the TAG name
5 Approval in hazardous area with number of the relevant Ex documentation (XA...)
6 Approvals with symbols
7 Order code and manufacturer ID



2 Nameplate of DIN rail transmitter (example, Ex version)

1 *Product name and manufacturer ID*
2 *Order code, extended order code and serial number, DataMatrix 2D code, FCC-ID (if applicable)*
3 *Power supply and current consumption, output*
4 *Approval in hazardous area with number of the relevant Ex documentation (XA...)*
5 *Fieldbus communication logo*
6 *Firmware version and device revision*
7 *Approval logos*
8 *2 lines for the TAG name*



3 Nameplate of the field mount housing version (example, Ex version)

1 *Order code, extended order code, serial number and manufacturer ID*
2 *Power supply and current consumption, IP-code and ambient temperature, firmware, hardware and device revision*
3 *Approval in hazardous area with number of the relevant Ex documentation (XA....) and ambient temperature range*
4 *Approval logos and data matrix 2D code*
5 *2 lines for the TAG name*

3.3 Name and address of manufacturer

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

3.4 Scope of delivery

The scope of delivery of the device comprises:
- Temperature transmitter
- Mounting material (head transmitter), optional
- Printed copy of the Brief Operating Instructions in English
- Functional Safety Manual (SIL mode)
- Additional documentation for devices which are suitable for use in the hazardous area (ATEX, FM, CSA), such as Safety Instructions (XA)

3.5 Certificates and approvals

The device left the factory in a safe operating condition. The device complies with the requirements of the standards EN 61010-1 "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use" and with the EMC requirements as per the IEC/EN 61326 series.

3.5.1 CE/EAC mark, Declaration of Conformity

The device meets the legal requirements of the EU/EEU guidelines. The manufacturer confirms that the device is compliant with the relevant guidelines by applying the CE/EAC mark.

3.5.2 HART® protocol certification

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

3.5.3 Functional safety

The two device versions (head transmitter/DIN rail device) are optionally available for use in safety systems as per IEC 61508.
- SIL 2: Hardware version
- SIL 3: Software version

3.6 Storage and transport

Dimensions: (device-specific), → 62

Storage temperature
- Head transmitter: −50 to +100 °C (−58 to +212 °F)
  Option: −52 to +85 °C (−62 to +185 °F), Product Configurator, order code for "Test, Certificate, Declaration", option "JN"
- Head transmitter, field mount housing with separate terminal compartment incl. display: −35 to +85 °C (−31 to +185 °F), Product Configurator, order code for "Field housing", option "R" and "S"
- DIN rail device: −40 to +100 °C (−40 to +212 °F)
- Humidity: (device-specific): max. rel. humidity: 95 % as per IEC 60068-2-30

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

Avoid the following environmental influences during storage:
- Direct sunlight
- Vibration
- Aggressive media

4 Mounting

4.1 Mounting requirements

4.1.1 Dimensions

The dimensions of the device are provided in the "Technical data" section → 📄 50.

4.1.2 Mounting location

- Head transmitter:
  - In the terminal head, flat face, as per DIN EN 50446, direct mounting on insert with cable entry (middle hole 7 mm)
  - In the field mount housing with separate terminal compartment, if stable sensors are used, the device can be fitted directly on the assembly, otherwise it has to be mounted separately from the process
  - In the field housing, separately from the process→ 📄 39
- DIN rail transmitter:
  Designed for mounting on DIN rail (IEC 60715 TH35).

It is also possible to mount the head transmitter on a DIN rail as per IEC 60715 using the DIN rail clip as an accessory. → 📄 39

The head transmitter must not be operated as a DIN rail substitute in a cabinet by using the DIN rail clip with remote sensors.

Information about the conditions (such as the ambient temperature, degree of protection, climate class etc.) that must be met at the mounting point so that the device can be mounted correctly is provided in the "Technical data" section→ 📄 50.

When using the device in hazardous areas, the limit values of the certificates and approvals must be observed (see Ex Safety Instructions).

4.2 Mounting the device

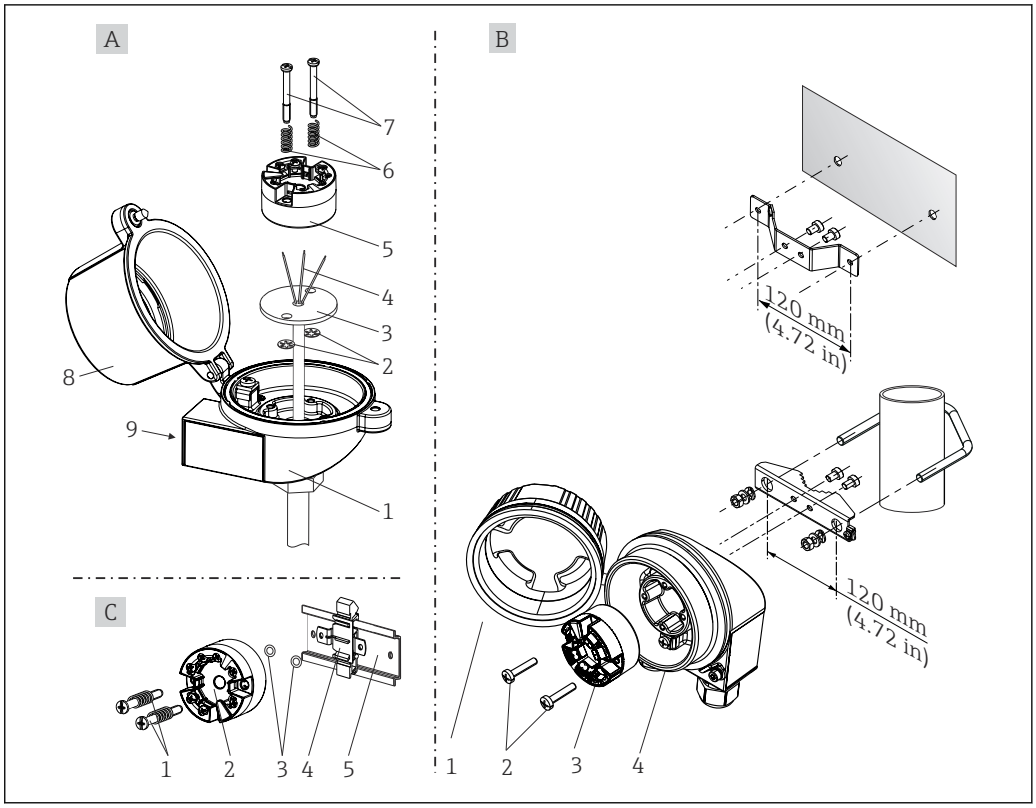
A Phillips head screwdriver is required to mount the head transmitter.

NOTICE

Do not overtighten the mounting screws as this could damage the head transmitter.

▶ Maximum torque = 1 Nm (¾ pound-feet).

4.2.1 Mounting the head transmitter



4 *Head transmitter mounting (three versions)*

The head transmitter must not be operated as a DIN rail substitute in a cabinet by using the DIN rail clip with remote sensors.

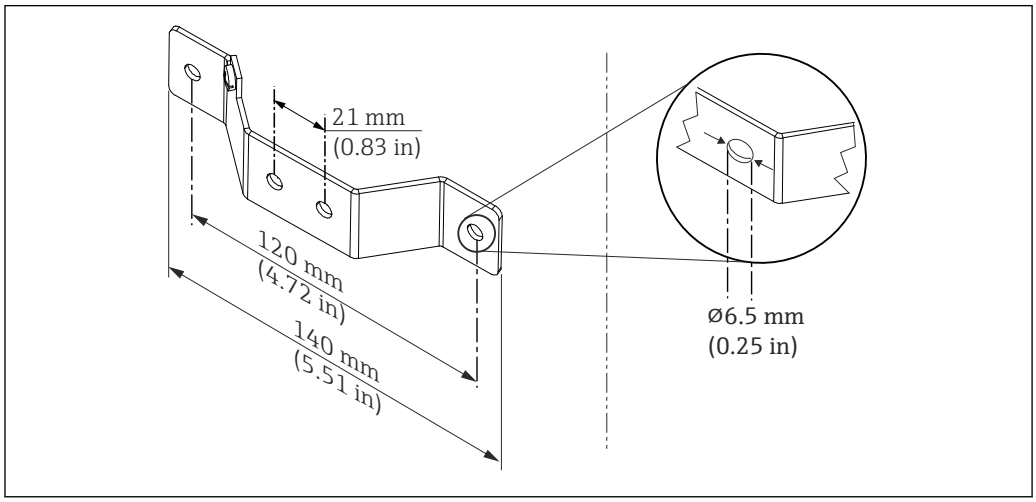
Item A	Mounting in a terminal head (terminal head flat face as per DIN 43729)
1	Terminal head
2	Circlips
3	Insert
4	Connection wires
5	Head transmitter
6	Mounting springs
7	Mounting screws
8	Terminal head cover
9	Cable entry

Procedure for mounting in a terminal head, pos. A:

1. Open the terminal head cover (8) on the terminal head.
2. Guide the connection wires (4) of the insert (3) through the center hole in the head transmitter (5).
3. Fit the mounting springs (6) on the mounting screws (7).
4. Guide the mounting screws (7) through the side boreholes of the head transmitter and the insert (3). Then fix both mounting screws with the snap rings (2).
5. Then tighten the head transmitter (5) along with the insert (3) in the terminal head.

6. After wiring→ 19, close the terminal head cover (8) tightly again.

Item B	Mounting in a field housing
1	Field housing cover
2	Mounting screws with springs
3	Head transmitter
4	Field housing



5 Dimensions of angle bracket for wall mount (complete wall mounting set available as accessory)

Procedure for mounting in a field housing, pos. B:

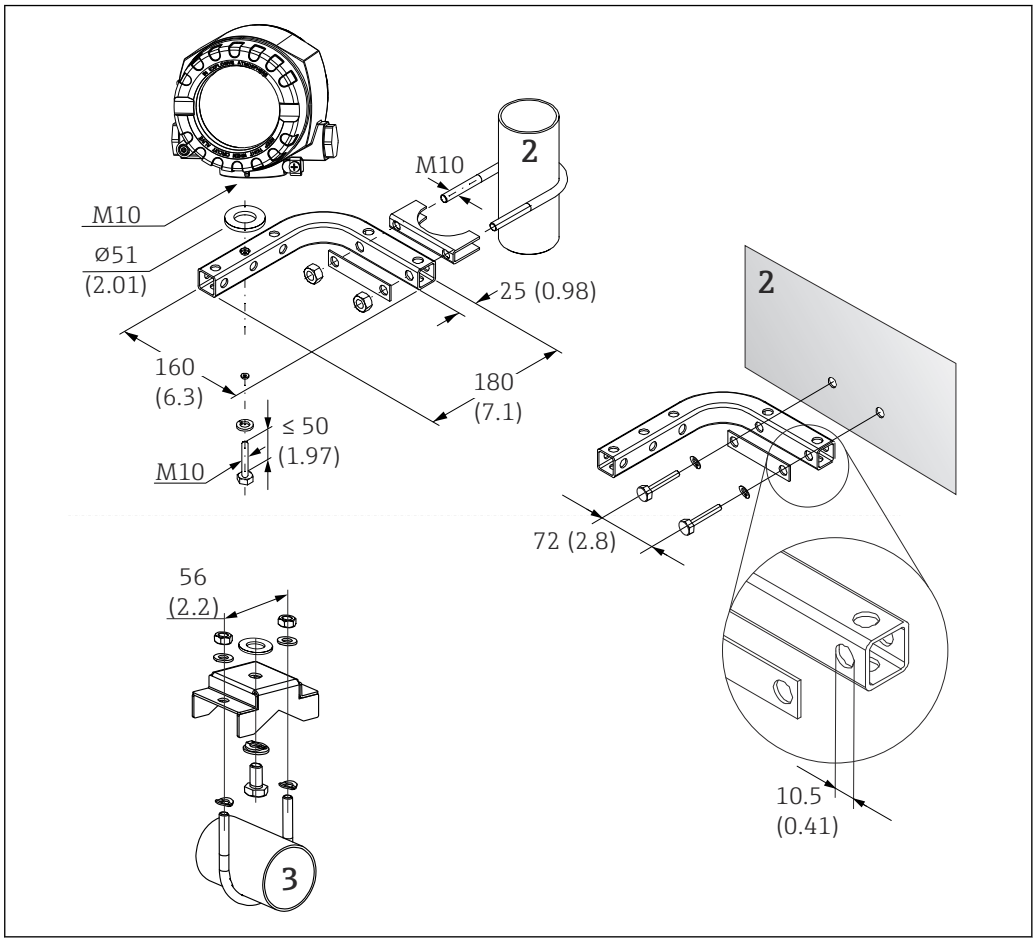
1. Open the cover (1) of the field housing (4).
2. Guide the mounting screws (2) through the lateral bores in the head transmitter (3).
3. Screw the head transmitter to the field housing.
4. After wiring, close the field housing cover (1) again.→ 19

Item C	Mounting on DIN rail (DIN rail as per IEC 60715)
1	Mounting screws with springs
2	Head transmitter
3	Circlips
4	DIN rail clip
5	DIN rail

Procedure for mounting on a DIN rail, pos. C:

1. Press the DIN rail clip (4) onto the DIN rail (5) until it engages with a click.
2. Fit the mounting springs on the mounting screws (1) and guide the screws through the side boreholes of the head transmitter (2). Then fix both mounting screws with the snap rings (3).
3. Screw the head transmitter (2) onto the DIN rail clip (4).

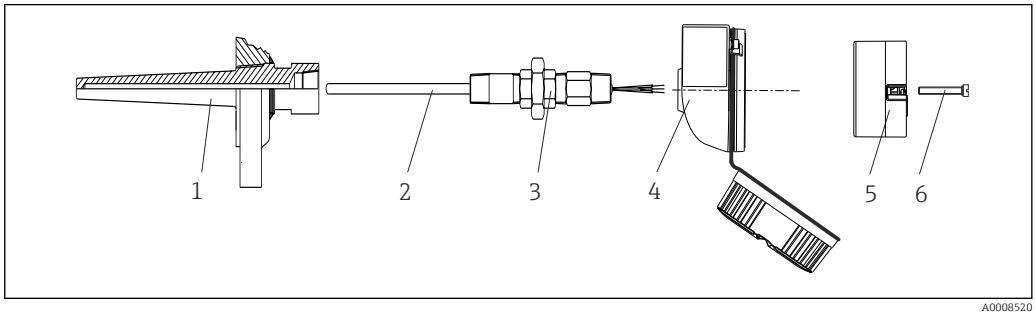
Remotely mounting the field mount housing



6 *Mounting the field mount housing using special mounting bracket, see chapter 'Accessories'. Dimensions in mm (in)*

1 *Mounting with combined wall/pipe mounting bracket*
2 *Mounting with pipe mounting bracket 2"/V4A*
3 *Mounting with wall mounting bracket*

Mounting typical of North America



7 *Head transmitter mounting*

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

Thermometer design with thermocouples or RTD sensors and head transmitter:

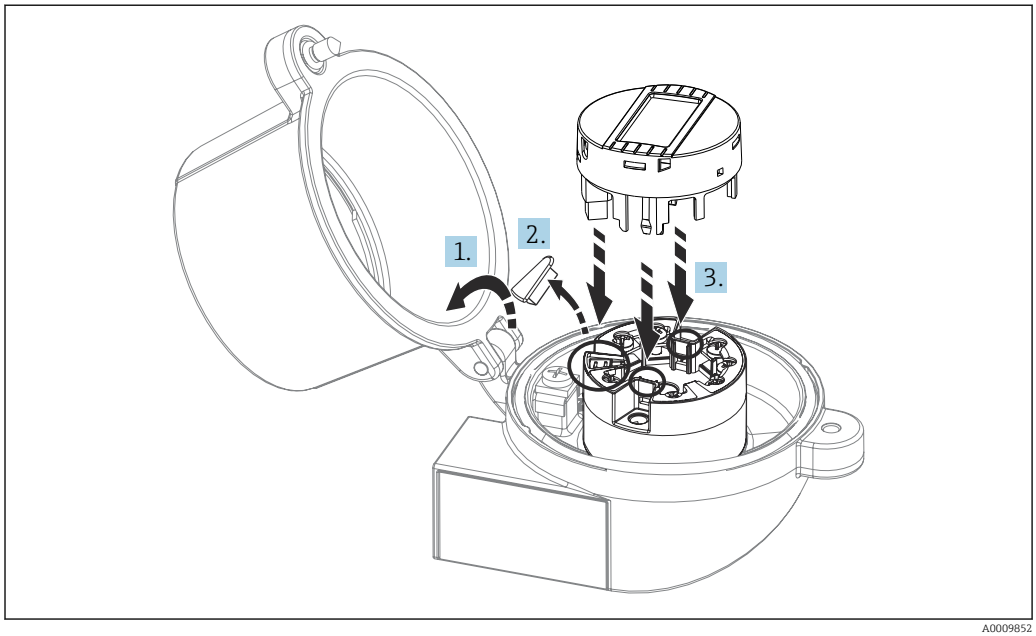
1. Fit the thermowell (1) on the process pipe or the container wall. Secure the thermowell according to the instructions before the process pressure is applied.
2. Fit the necessary neck tube nipples and adapter (3) on the thermowell.
3. Make sure sealing rings are installed if such rings are needed for harsh environmental conditions or special regulations.
4. Guide the mounting screws (6) through the lateral bores of the head transmitter (5).
5. Position the head transmitter (5) in the terminal head (4) in such a way that the bus cable (terminals 1 and 2) point to the cable entry.
6. Using a screwdriver, screw down the head transmitter (5) in the terminal head (4).
7. Guide the connection wires of the insert (3) through the lower cable entry of the terminal head (4) and through the middle hole in the head transmitter (5). Wire the connection wires up to the transmitter → 20.
8. Screw the terminal head (4), with the integrated and wired head transmitter, onto the ready-mounted nipple and adapter (3).

NOTICE

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

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

Mounting the display on the head transmitter



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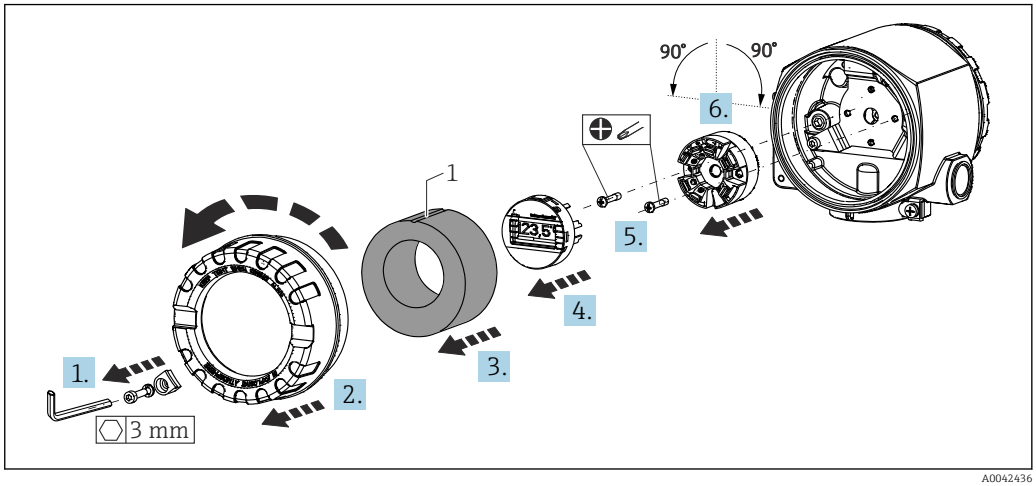
8 Mounting the display

1. Loosen the screw on the terminal head cover. Flip back the terminal head cover.
2. Remove the cover of the display connection area.
3. Fit the display module onto the mounted and wired head transmitter. The fastening pins must click securely into place on the head transmitter. After mounting, securely tighten the terminal head cover.

The display can be used only with the appropriate terminal heads - cover with viewing window (e.g. TA30 from Endress+Hauser). In the field mount housing with separate terminal compartment the display is already installed.

Display installation positions in the field mount housing with separate terminal compartment



9 *Display installation positions, attachable in 90° stages*

1 *Marking foam ring*

1. Remove the cover clamp.
2. Unscrew the housing cover together with the O-ring.
3. Remove the foam ring.
4. Remove the attached display from the head transmitter.
5. Unscrew the mounting screws situated in the lateral bores in the head transmitter. Do not unwire the head transmitter.
6. Fit the head transmitter in the desired position in 90° stages as shown in the drawing. For turning it to 180° use the hardware setting via DIP switch on the attached display.
7. Then fix the head transmitter with the mounting screws again.

On completion of the display position installation, follow the action steps in reverse order.

Refit the display module onto the mounted and wired head transmitter. The fastening pins must click securely into place on the head transmitter.

Put the foam ring back into the field housing. The marking (1) must point upwards.

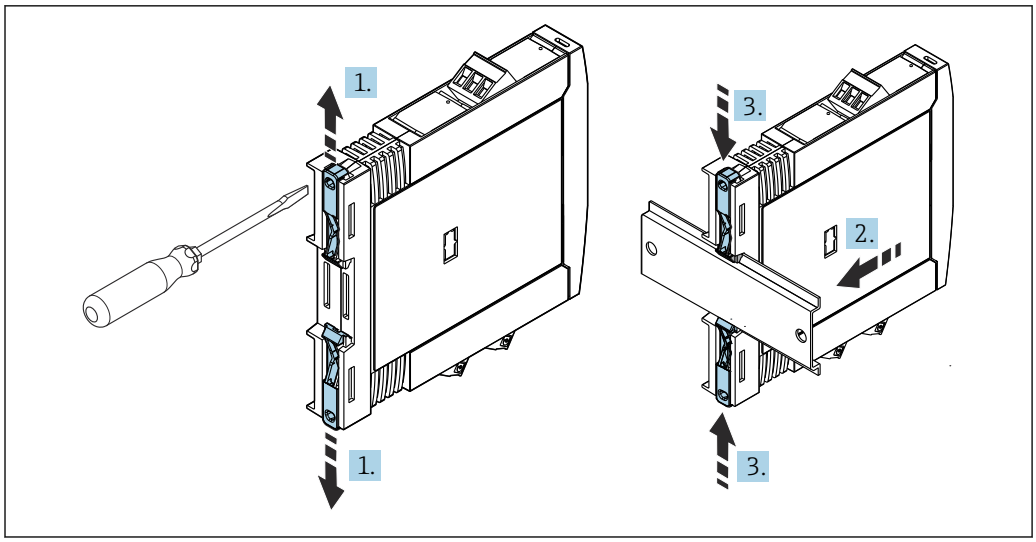
4.2.2 Mounting the DIN rail transmitter

NOTICE

Wrong alignment

Measurement deviates from the maximum accuracy rating when a thermocouple is connected and the internal reference junction is used.

- Mount the device vertically and ensure it is aligned correctly (sensor connection at the bottom / power supply at the top)!



10 Mounting the DIN rail transmitter

1. Slide the upper DIN rail clip upwards and the lower clip downwards until they click into place.
2. Fit the device on the DIN rail from the front.
3. Slide the two DIN rail clips back together until they click into place.

4.3 Post-mounting check

After mounting the device, always run the following final 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.)?	See "Technical data" section → 50

5 Electrical connection

⚠ CAUTION

- Switch off the power supply before installing or connecting the device. Failure to observe this may result in the destruction of parts of the electronics.
- Do not occupy the display connection. An incorrect connection can destroy the electronics.

NOTICE

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

- Maximum tightening torque = 1 Nm (¾ lbf ft).

5.1 Connecting requirements

A Phillips head screwdriver is required to wire the head transmitter with screw terminals. Use a flat blade screwdriver for the DIN rail housing version with screw terminals. The push-in terminal version can be wired without any tools.

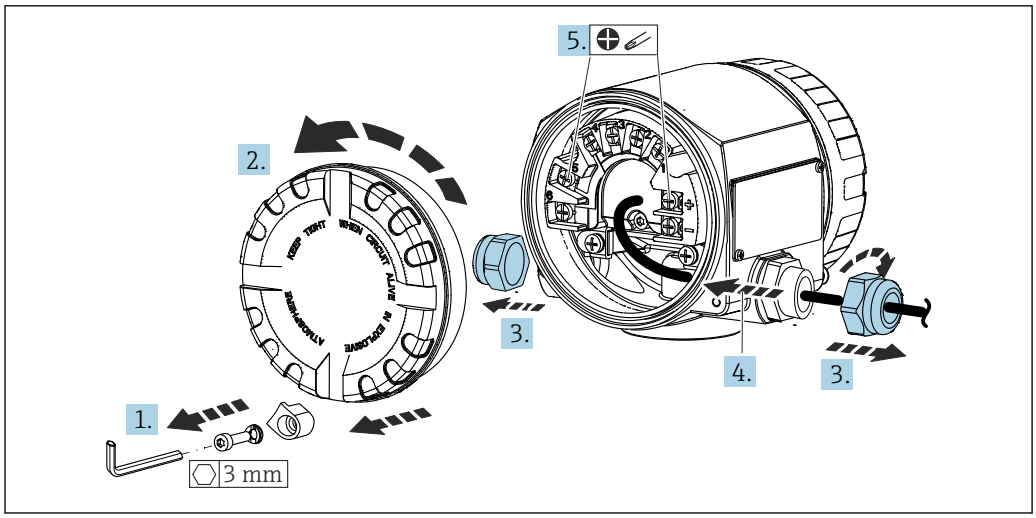
Proceed as follows to wire a head transmitter mounted in the terminal head or field housing:

1. Open the cable gland and the housing cover on the terminal head or the field housing.
2. Feed the cables through the opening in the cable gland.
3. Connect the cables as shown in → 20. If the head transmitter is fitted with push-in terminals, pay particular attention to the information in the "Connecting to push-in terminals" section. → 23
4. Tighten the cable gland again and close the housing cover.

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

Proceed as follows to wire the transmitter in a field mount housing:

1. Remove the cover clamp.
2. Unscrew the housing cover on the terminal compartment. The terminal compartment is opposite the electronics module together with the display cover.
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 as described in the sections: "Connecting the sensor cables" and "Connecting the transmitter". → 23, → 24



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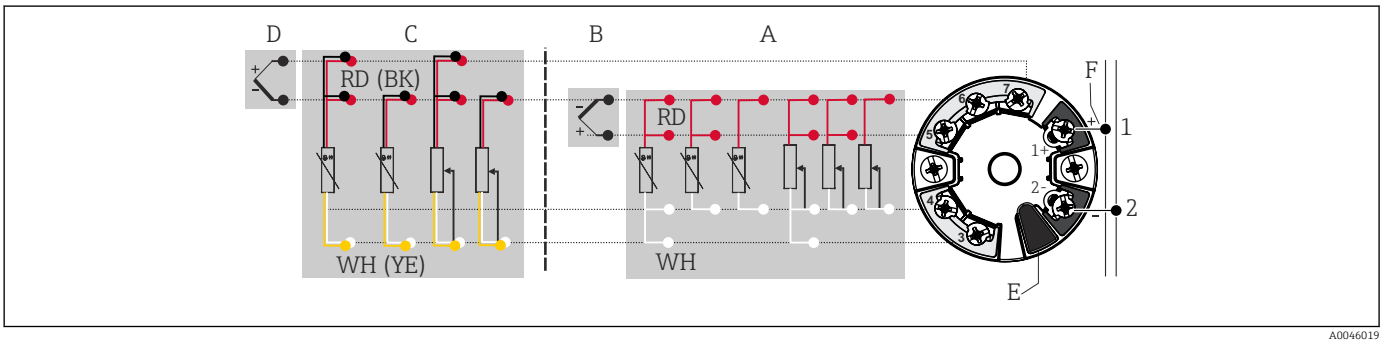
On completion of the wiring, screw the screw terminals tight. Tighten the cable glands again. Refer to the information provided in the "Ensuring the degree of protection" section. Screw the housing cover tight again and fit the cover clamp back on. → 26

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

5.2 Quick wiring guide



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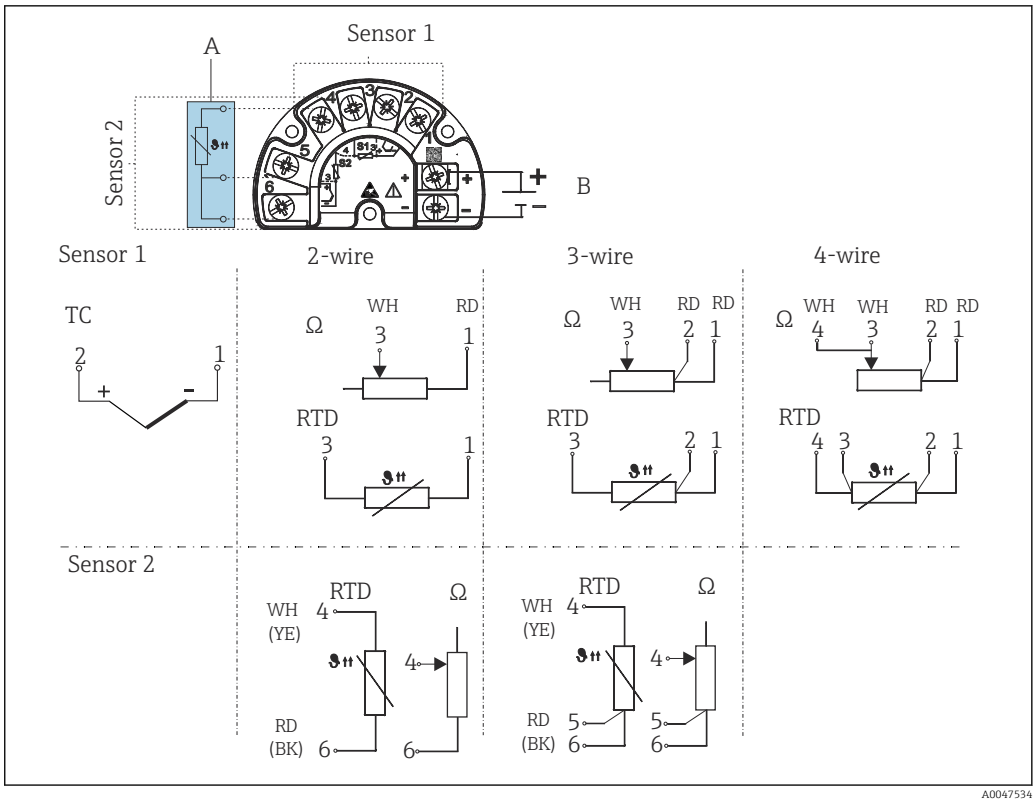
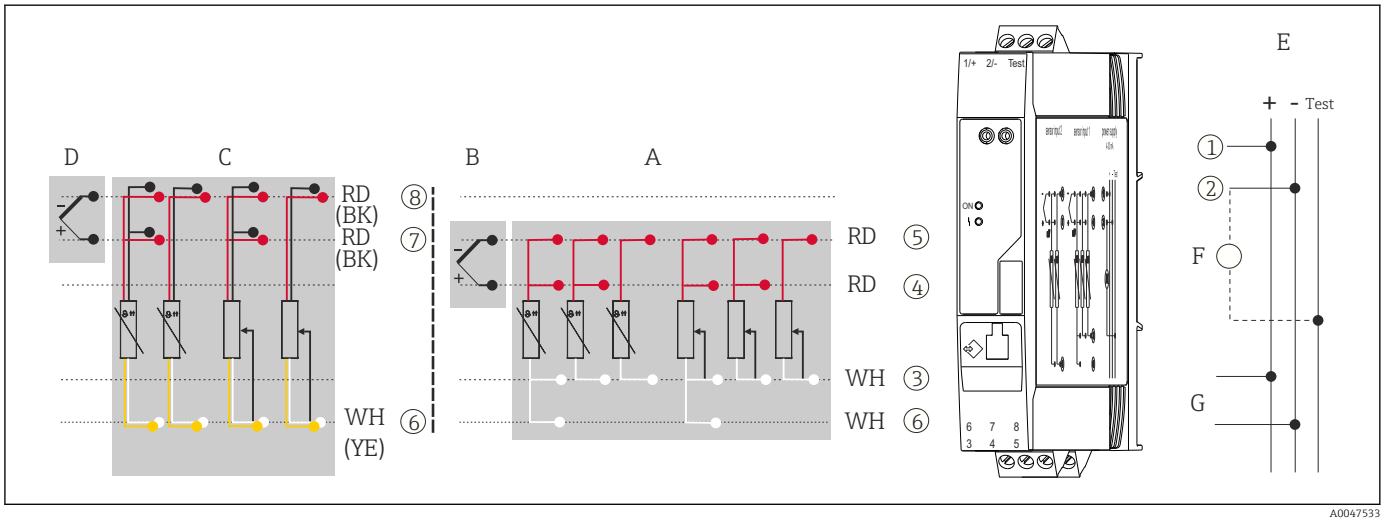
11 *Assignment of terminal connections for head transmitter*

A Sensor input 1, RTD and Ω, 4-, 3- and 2-wire
B Sensor input 1, TC and mV
C Sensor input 2, RTD and Ω, 3- and 2-wire
D Sensor input 2, TC and mV
E Display connection, service interface
F Bus terminator and power supply



12 *Terminal assignment of the field mount housing with separate terminal compartment*

A Fixed connection of the external reference junction, terminals 4, 5 and 6 (Pt100, IEC 60751, class B, 3-wire). It is not possible to connect a second thermocouple (TC) on sensor 2.
B Bus terminator and power supply



13 *Assignment of terminal connections for DIN rail device*

A Sensor input 1, RTD and Ω, 4-, 3- and 2-wire
B Sensor input 1, TC and mV
C Sensor input 2, RTD and Ω, 3- and 2-wire
D Sensor input 2, TC and mV
E Power supply 4 to 20 mA
F To check the output current, an ammeter (DC measurement) can be connected between the "Test" and "-" terminals.
G HART® connection

As of a sensor cable length of 30 m (98.4 ft), a shielded cable must be used for a head transmitter in the field mount housing with a separate terminal compartment and for the DIN rail version. The use of shielded sensor cables is generally recommended.

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

NOTICE

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

5.3 Connecting the sensor cables

Terminal assignment of the sensor connections .

NOTICE

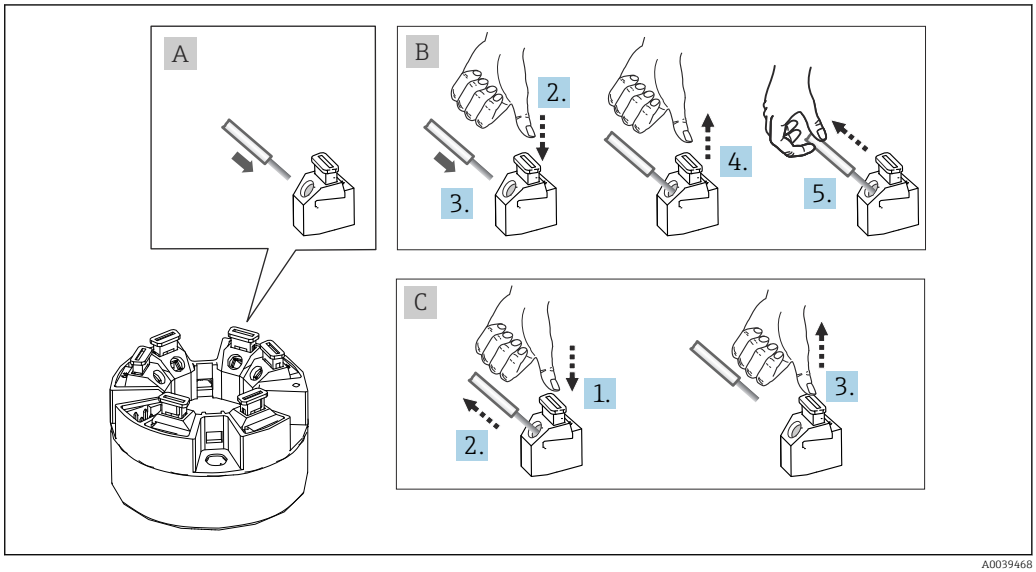
When connecting 2 sensors ensure that there is no galvanic connection between the sensors (e.g. caused by sensor elements that are not isolated from the thermowell). The resulting equalizing currents distort the measurements considerably.

- 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	☑	☑	☑	☑
	For field mount housing with sensor input 1 thermocouple: It is not possible to connect a second thermocouple (TC), RTD, resistance transmitter or voltage transmitter on sensor input 2 as this input is needed for the external reference junction.				

5.3.1 Connecting to push-in terminals



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14 *Push-in terminal connection, using the example of a head transmitter*

Fig. A, solid wire:

1. Strip wire end. Minimum stripping length 10 mm (0.39 in).
2. Insert the wire end into the terminal.

3. Pull the wire gently to ensure it is connected correctly. Repeat starting from step 1 if necessary.

Fig. B, fine-strand wire without ferrule:

1. Strip wire end. Minimum stripping length 10 mm (0.39 in).
2. Press down on the lever opener.
3. Insert the wire end into the terminal.
4. Release lever opener.
5. Pull the wire gently to ensure it is connected correctly. Repeat starting from step 1 if necessary.

Fig. C, releasing the connection:

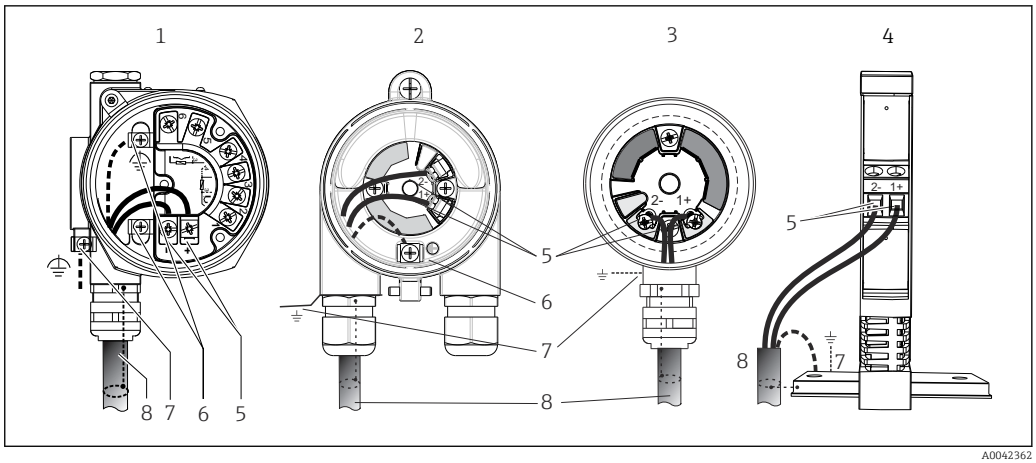
1. Press down on the lever opener.
2. Remove the wire from the terminal.
3. Release lever opener.

5.4 Connecting the transmitter

Cable specification

- A normal device cable suffices if only the analog signal is used.
- A shielded cable is recommended for HART® communication. Observe grounding concept of the plant.
- As of a sensor cable length of 30 m (98.4 ft), a shielded cable must be used for a head transmitter in the field mount housing with a separate terminal compartment and for the DIN rail version. The use of shielded sensor cables is generally recommended.

Also observe the general procedure on → 19.



15 *Connecting the signal cables and power supply*

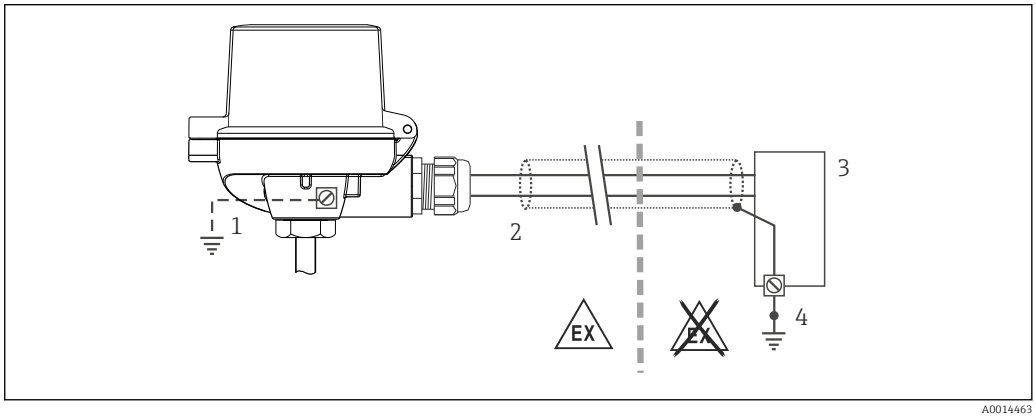
1 *Head transmitter installed in field mount housing with separate terminal compartment*
2 *Head transmitter installed in field housing*
3 *Head transmitter installed in terminal head*
4 *DIN rail transmitter mounted on DIN rail*
5 *Terminals for HART® protocol and power supply*
6 *Internal ground connection*
7 *External ground connection*
8 *Shielded signal cable (recommended for HART® protocol)*

- The terminals for the signal cable connection (1+ and 2-) are protected against reverse polarity.
- Conductor cross-section:
  - Max. 2.5 mm² for screw terminals
  - Max. 1.5 mm² for push-in terminals. Stripping length of wire at least 10 mm (0.39 in).

5.5 Special connection instructions

Shielding and grounding

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



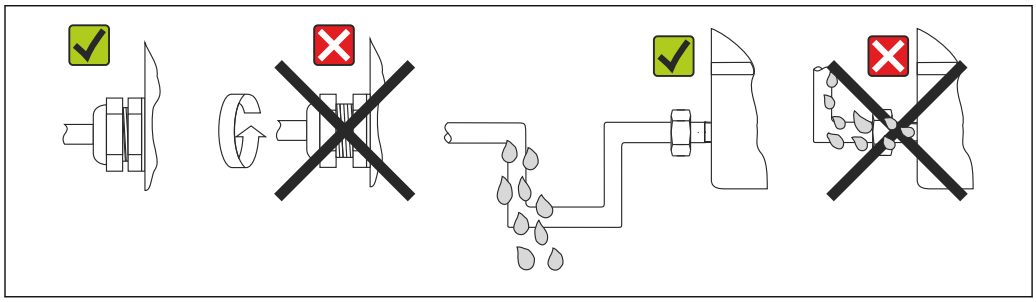
16 *Shielding and grounding the signal cable at one end with HART® communication*

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

5.6 Ensuring the degree of protection

Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP67 protection is maintained:

- The transmitter must be mounted in a terminal head with the appropriate degree of protection.
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- The connecting cables used must have the specified external diameter (e.g. M20x1.5, cable diameter 8 to 12 mm).
- Firmly tighten the cable gland. → 17, 26
- The cables must loop down before they enter the cable glands ("water trap"). This means that any moisture that may form cannot enter the gland. Install the device in such a way that the cable glands are not facing upwards. → 17, 26
- Replace unused cable glands with dummy plugs.
- Do not remove the grommet from the cable gland.



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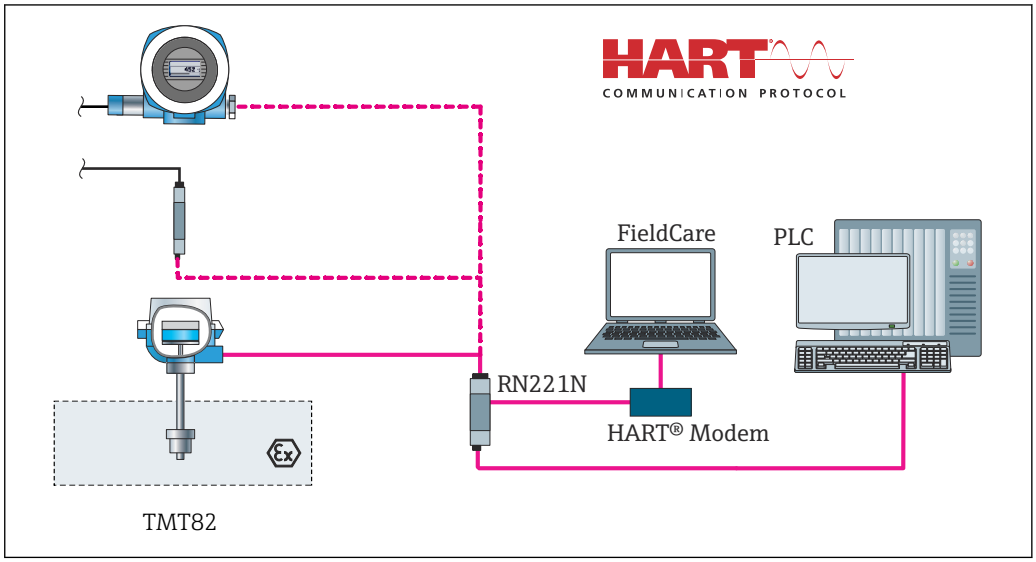
17 *Connection tips to retain IP67 protection*

5.7 Post-connection check

Device condition and specifications	Notes
Is the device or cable undamaged (visual check)?	--
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ Head transmitter: U = 11 to 42 V_{DC} ▪ DIN rail transmitter: U = 12 to 42 V_{DC} ▪ SIL mode: U = 11 to 32 V_{DC} for the head transmitter or U = 12 to 32 V_{DC} for the DIN rail transmitter ▪ Other values apply in the hazardous area, see the corresponding Ex Safety Instructions (XA).
Are the mounted cables relieved of tension?	--
Are the power supply and signal cables connected correctly?	→ 20
Are all the screw terminals firmly tightened and have the push-in terminal connections been checked?	--
Are all the cable entries installed, tightened and leak-tight?	--
Are all housing covers installed and firmly tightened?	--

6 Operation options

6.1 Overview of operation options

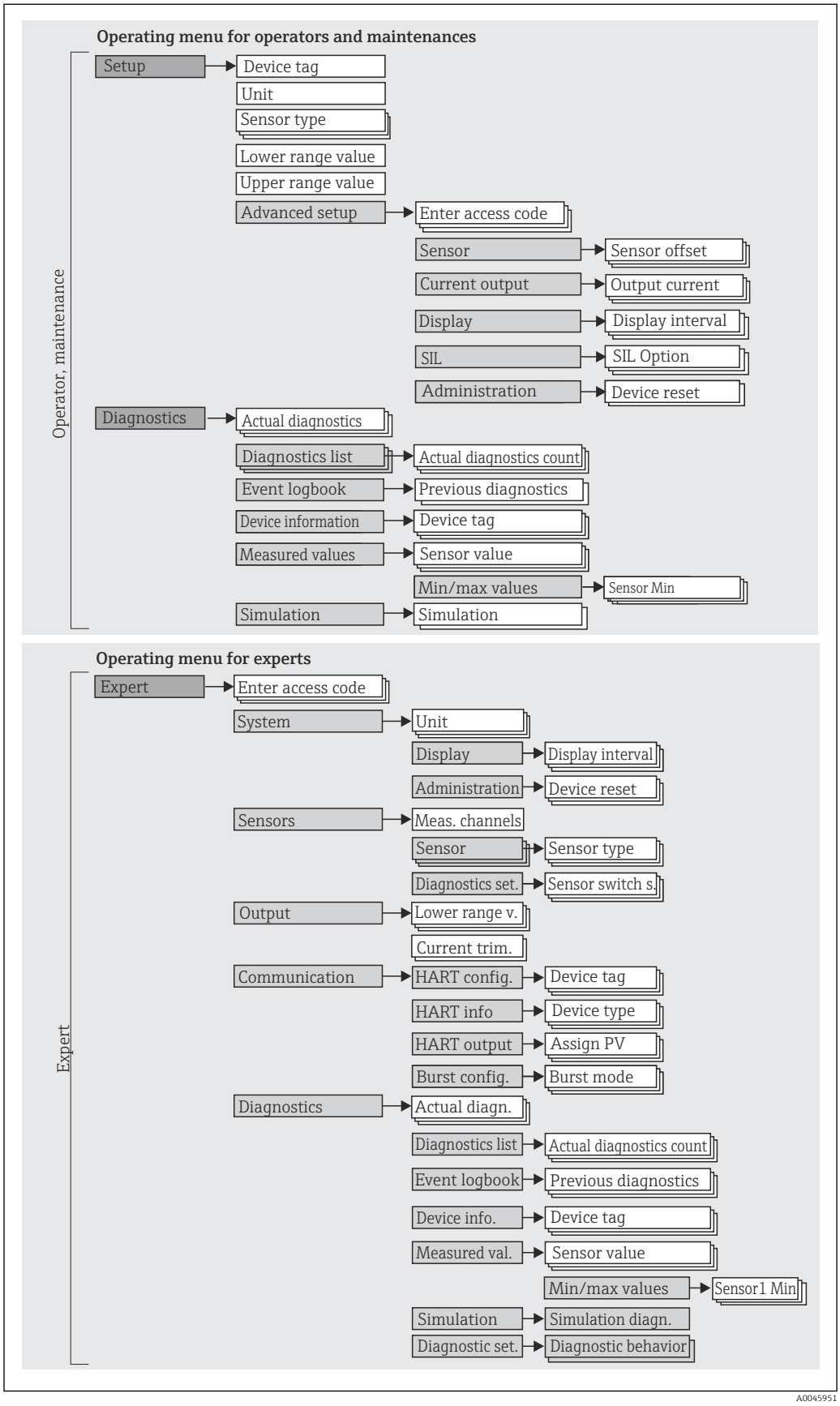


18 *Operation options for the transmitter via HART® communication*

For the head transmitter, display and operating elements are available locally only if the head transmitter was ordered with a display unit!

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 (SD01172T/09).

Submenus and user roles

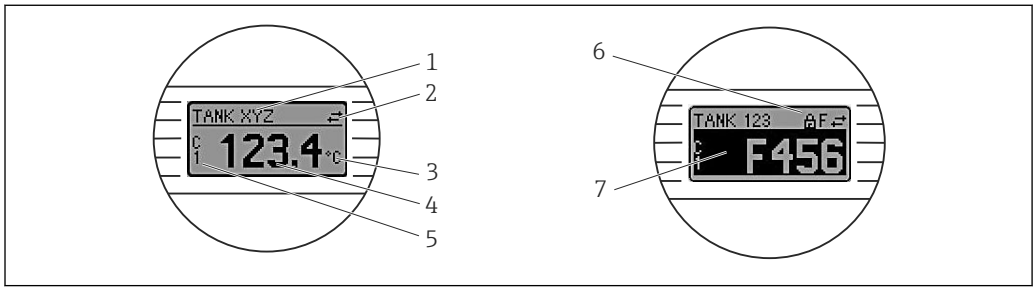
Certain parts of the menu are assigned to certain user roles. Each user role corresponds to typical tasks within the life cycle of the device.

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 generally be completely configured. ▪ **"Advanced 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 active 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. ▪ **"Device reset" submenu**
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 parameters of the device (including those that are already in one of the other menus). The structure of this menu is based on the function blocks of the device: ▪ **"System" submenu** Contains all higher-order device parameters which do not concern the measurement or the communication interface. ▪ **"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 Measured value display and operating elements

6.3.1 Display elements

Head transmitter



19 *Optional LC display for head transmitter*

Item no.	Function	Description
1	Displays the TAG	TAG, 32 characters long.
2	'Communication' symbol	The communication symbol appears when read and write-accessing via the fieldbus protocol.
3	Unit display	Unit display for the measured value displayed.
4	Measured value display	Displays the current measured value.
5	Value/channel display S1, S2, DT, PV, I, %	e.g. S1 for a measured value from channel 1 or DT for the device temperature
6	'Configuration locked' symbol	The 'configuration locked' symbol appears when configuration is locked via the hardware.
7	Status signals	
	Symbols	Meaning
	F	**Error message "Failure detected"** An operating error has occurred. The measured value is no longer valid. The display alternates between the error message and "- - - -" (no valid measured value present), see "Diagnostic events" section. The display alternates between the error message and "- - - -" (no valid measured value present). Detailed information on the error messages can be found in the Operating Instructions.
	C	**"Service mode"** The device is in service mode (e.g. during a simulation).
	S	**"Out of specification"** The device is being operated outside its technical specifications (e.g. during warm-up or cleaning processes).
	M	**"Maintenance required"** Maintenance is required. The measured value is still valid. The display alternates between the measured value and the status message.

DIN rail transmitter

The DIN rail transmitter version does not have an interface to the LC display and therefore does not have a local display either.

Two LEDs on the front indicate the device status.

Type	Function and characteristic
Status LED (red)	When the device is operating without errors, the device status is displayed. This function can no longer be guaranteed in the event of an error. ▪ LED off: without diagnostic message ▪ LED is lit: diagnostics display, category F ▪ LED flashing: diagnostics display of categories C, S or M
Power LED (green) 'ON'	When the device is operating without errors, the operating status is displayed. This function can no longer be guaranteed in the event of an error. ▪ LED off: Power failure or insufficient supply voltage ▪ LED is lit: Supply voltage is OK (either via CDI or via supply voltage, terminals 1+, 2-)

6.3.2 Local operation

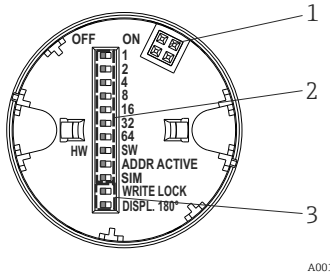
You can make hardware settings for the fieldbus interface using miniature switches (DIP switches) on the rear of the optional display.

The user has the option of ordering the display with the head transmitter, or as an accessory for subsequent mounting. → 39

If the head transmitter was ordered with the field mount housing with separate terminal compartment, the display is included already.

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.



20 Hardware settings via DIP switches

1: Connection to head transmitter

2: DIP switches (1 - 64, SW/HW, ADDR and SIM = simulation mode) no function for this head transmitter

3: DIP switch (WRITE LOCK = write protection; DISPL. 180° = switch, turn the display monitor 180°)

Procedure for setting the DIP switch:

1. Open the cover of the terminal head or field housing.
2. Remove the attached display from the head transmitter.
3. Configure the DIP switch on the rear of the display accordingly. In general: switch to ON = function enabled, switch to OFF = function disabled.
4. Fit the display onto the head transmitter in the correct position. The head transmitter accepts the settings within one second.
5. Secure the cover back onto the terminal head or field housing.

Switching write protection on/off

Write protection is switched on and off via a DIP switch on the rear of the optional attachable display. 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. Write protection remains active even when the display is

removed. To disable the write protection, the device must be restarted with the display attached and the DIP switch deactivated (WRITE LOCK = OFF). Alternatively, the display can be removed and reattached during operation to disable write protection.

Turning the display

The display can be rotated 180° using the "DISPL. 180°" DIP switch. The setting is retained when the display is removed.

6.4 Access to the operating menu via the operating tool

6.4.1 FieldCare

Function range

FDT/DTM-based plant asset management tool from Endress+Hauser. It can configure all smart field units in a system and help you to manage them. By using the status information, it is also a simple but effective way of checking their status and condition. Access is via the HART® protocol or CDI (= Endress+Hauser Common Data Interface).

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

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

NOTICE

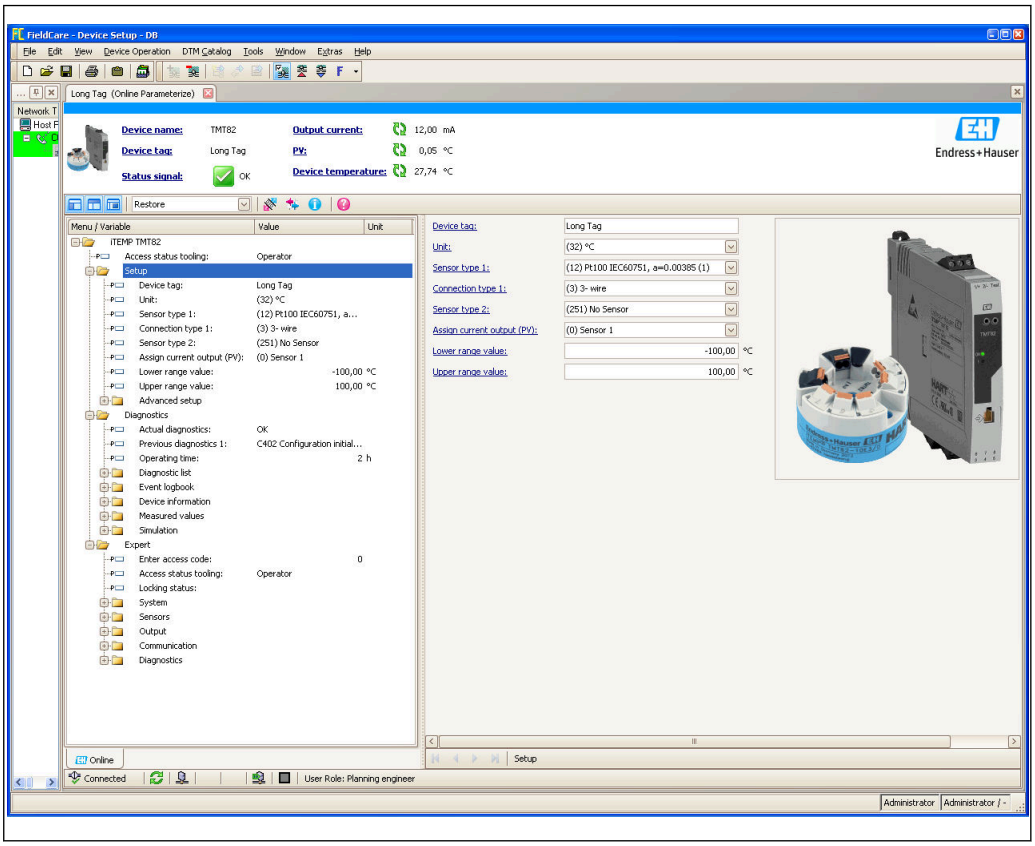
The following applies if using the device in hazardous areas: Before accessing the device with the Commubox FXA291 via the CDI (= Endress+Hauser Common Data Interface), disconnect the transmitter from the power supply, terminals (1+) and (2-).

► Failure to comply with this instruction can result in damage to parts of the electronics.

Source for device description files

See information → 35

User interface



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6.4.2 Field Xpert

Function range

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.

6.4.3 Source for device description files

See information → 35.

6.4.4 AMS Device Manager

Function range

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

Source for device description files

See information → 35.

6.4.5 SIMATIC PDM

Function range

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

Source for device description files

See information → 35.

6.4.6 Field Communicator 375/475

Function range

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

Source for device description files

See information → 35.

7 Integrating transmitter using HART® protocol

Version data for the device

Firmware version	01.02.zz	▪ On the title page of the Operating Instructions ▪ On the nameplate ▪ **Firmware version** parameter Diagnosis → Instrument info → Firmware version
Manufacturer ID	0x11	**Manufacturer ID** parameter Diagnosis → Instrument info → Manufacturer ID
Device type ID	0x11CC	**Device type** parameter Diagnosis → Instrument info → Device type
HART protocol revision	7	---
Device revision	3	▪ On the transmitter nameplate ▪ **Device revision** parameter Diagnosis → Instrument info → Device revision

The suitable device driver software (DD/DTM) for the individual operating tools can be acquired from a variety of sources:
- www.endress.com --> Downloads --> Search field: device driver --> Type: Device type manager (DTM) --> Product root, e.g. TMTxy
- www.endress.com --> Products: individual product page, e.g. TMTxy --> Documents/ Manuals/Software: Electronic Data Description (EDD) or Device Type Manager (DTM).

Endress+Hauser supports all common operating tools from a variety of manufacturers (e.g. Emerson Process Management, ABB, Siemens, Yokogawa, Honeywell and many others). The Endress+Hauser FieldCare and DeviceCare operating tools are also available for download (www. endress.com --> Downloads --> Search field: Software --> Application software) or on the data storage medium.

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

Device variable code	Measured value
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 from 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
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

Command No.	Designation
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
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

8 Commissioning

8.1 Post-installation check

Before commissioning the measuring point make sure that all final checks have been carried out:
- Checklist “Post-mounting check”,
- Checklist “Post-connection check”, → 26

8.2 Switching on the transmitter

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The transmitter performs a number of internal test functions after power-up. During this process, a sequence containing device information appears on the display.

Step	Display
1	"Display" text and firmware version of the display
2	Device name with firmware and hardware versions
3	Information on the sensor configuration (sensor element and type of connection)
4	Set measuring range
5a	Current measured value or
5b	Current status message If the switch-on procedure is not successful, the relevant diagnostics event, depending on the cause, is displayed. A detailed list of diagnostic events and the corresponding troubleshooting instructions can be found in the "Diagnostics and troubleshooting" section .

The device is operational after approx. 30 seconds, and the plug-in display after approx. 33 seconds in normal operating mode! Normal measuring mode commences as soon as the switch-on procedure is completed. Measured values and status values appear on the display.

8.3 Enabling configuration

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 appears in the header of the measured value 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. → 92
- deactivate the software write protection via the operating tool. See the description for the **'Define device write protection'** parameter in the Operating Instructions.

When hardware write protection is active (write protection switch on the back of the display 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.

9 Maintenance

No special maintenance work is required for the device.

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

10 Repair

10.1 General information

The version of the device is such that it cannot be repaired.

10.2 Spare parts

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

Type	Order number
Standard - DIN securing set (2 screws and springs, 4 shaft lock-down rings, 1 plug for the display interface)	71044061
US - M4 securing set (2 screws and 1 plug for the display interface)	71044062
TID10 service cable; connecting cable for service interface, 40 cm	71086650
Commubox FXA195 HART®, for intrinsically safe HART communication with FieldCare via the USB interface.	FXA195-.....
Spare parts kit for DIN rail transmitter (terminals and fixing lever housing)	XPT0003-A1
Spare parts especially for field mount housing with separate terminal compartment	
Display to plug on transmitter electronics	TID10-
Foam insert	71524431

10.3 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.

11 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.

Accessories included in the scope of delivery:
- Printed version of Brief Operating Instructions in English
- Optional: Functional safety manual (SIL mode)
- ATEX supplementary documentation: ATEX Safety instructions (XA), **C**ontrol **D**rawings (CD)
- Mounting material for head transmitter

11.1 Device-specific accessories

Accessories for the head transmitter
TID10 display unit for Endress+Hauser head transmitter iTEMP TMT8x [1] or TMT7x, attachable
TID10 service cable; connecting cable for service interface, 40 cm
Field housing TA30x for Endress+Hauser head transmitter
Adapter for DIN rail mounting, clip as per IEC 60715 (TH35) without securing screws
Standard - DIN mounting kit (2 screws + springs, 4 securing disks and 1 display connector cover)
US - M4 mounting screws (2 M4 screws and 1 display connector cover)
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket

1) Without TMT80

Accessories for field mount housing with separate terminal compartment
Cover locking
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket
Cable glands M20x1.5 and NPT ½"
Adapter M20x1.5 outside/M24x1.5 inside
Dummy plugs M20x1.5 and NPT ½"

11.2 Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART® communication with FieldCare via the USB interface. For details, see Technical Information TI404F/00
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see Technical Information TI405C/07

Accessories	Description
WirelessHART adapter	Is used for the wireless connection of field devices. The WirelessHART® adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks. For details, see Operating Instructions BA061S/04
Field Xpert SMT70	Universal, high-performance tablet PC for device configuration The tablet PC enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as a comprehensive, all-in-one solution. With a pre-installed driver library, it is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. For details, see Technical Information TI01342S/04

11.3 Service-specific accessories

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

Accessories	Description
Configurator	Product Configurator - the tool for individual product configuration ▪ Up-to-the-minute configuration data ▪ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language ▪ Automatic verification of exclusion criteria ▪ Automatic creation of the order code and its breakdown in PDF or Excel output format ▪ Ability to order directly in the Endress+Hauser Online Shop The Configurator is available on the Endress+Hauser website at: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.

DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. For details, see Operating Instructions BA00027S

FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00065S

Accessories	Description
W@M	Life cycle management for your plant W@M offers assistance with a wide range of software applications over the entire process: from planning and procurement to the installation, commissioning and operation of the measuring devices. All the relevant information is available for every measuring device over the entire life cycle, such as the device status, device-specific documentation, spare parts etc. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: Via the Internet: www.endress.com/lifecyclemanagement

11.4 System components

Accessories	Description
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}. For details, see 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 $V_{AC/DC}$. For details, see Technical Information TI01584K
RIA15	Process display, digital, loop-powered display unit for 4 to 20 mA circuits, panel mounting, with optional HART® communication. Displays 4 to 20 mA or up to 4 HART® process variables For details, see Technical Information TI01043K
Graphic 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 providing four inputs (4/8/12/16/20). They transmit highly accurate process values from the directly connected HART® devices, so that they are available for 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 very easily communicated to higher-level systems or individual plant modules can be interconnected. For details, see Technical Information TI01180R

12 Diagnostics and troubleshooting

12.1 Troubleshooting

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

Due to its design, the device cannot be repaired. However, it is possible to send the device in for examination. See the information in the "Return" section. → 48

General errors

Problem	Possible cause	Remedy
Device is not responding.	Supply voltage does not match that specified on the nameplate.	Apply correct voltage.
	Connecting cables are not in contact with the terminals.	Check the contacting of the cables and correct it if necessary.
Output current < 3.6 mA	Signal line is not wired correctly.	Check wiring.
	Electronics unit 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 not properly connected.	Connect Commubox correctly .
	Commubox is not set to "HART®".	Set Commubox selector switch to "HART®".
Status LED is lit or flashing red (DIN rail transmitter only).	Diagnostic events as per NAMUR NE107 → 45	Check diagnostic events: ▪ LED is lit: diagnostics display, category F ▪ LED flashing: diagnostics display of categories C, S or M
Power LED is not lit green (DIN rail transmitter only).	Power failure or insufficient supply voltage	Check the supply voltage and check if wiring is correct.

Check display (optional in conjunction with head transmitter)

Problem	Possible cause	Remedy
Display is blank	No supply voltage	▪ Check the supply voltage at the head transmitter, terminals + and -. ▪ Ensure that the display module holders are correctly seated and that the display module is properly connected to the head transmitter, . ▪ If possible, test the display module with other suitable head transmitters, e.g. an Endress+Hauser head transmitter.
	The display module is defective.	Replace the module.
	The electronics of the head transmitter are defective.	Replace the head transmitter.

Application errors without status messages for RTD sensor connection

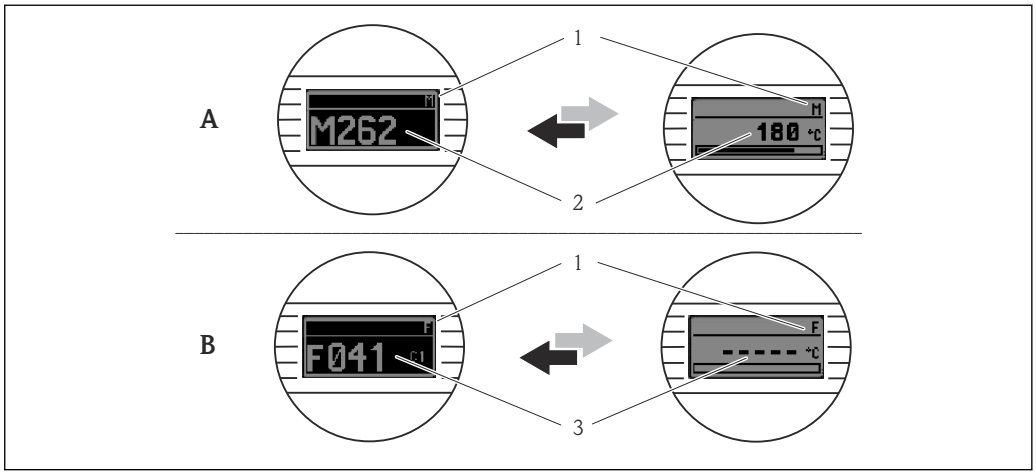
Problem	Possible cause	Remedy
Measured value is incorrect/ inaccurate	Incorrect sensor orientation.	Install the sensor correctly.
	Heat conducted by sensor.	Observe the installed length of the sensor.
	Device programming is incorrect (number of wires).	Change the **Connection type** device function.
	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)	Faulty sensor.	Check the sensor.
	RTD connected incorrectly.	Connect 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

Problem	Possible cause	Remedy
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)	Faulty sensor.	Check the sensor.
	Sensor is connected incorrectly.	Connect the connecting cables correctly (terminal diagram).
	Incorrect programming.	Incorrect sensor type set in the **Sensor type** device function. Set the correct sensor type.

12.2 Diagnostic events

12.2.1 Displaying diagnostic events



A Display in the event of a warning
B Display in the event of an alarm
1 Status signal in the header
2 The display alternates between the primary measured value and the status - indicated by the appropriate letter (M, C or S) - plus the defined error number.
3 The display alternates between "- - - -" (no valid measured value) and the status - indicated by the appropriate letter (F) - plus the defined error number.

Status signals

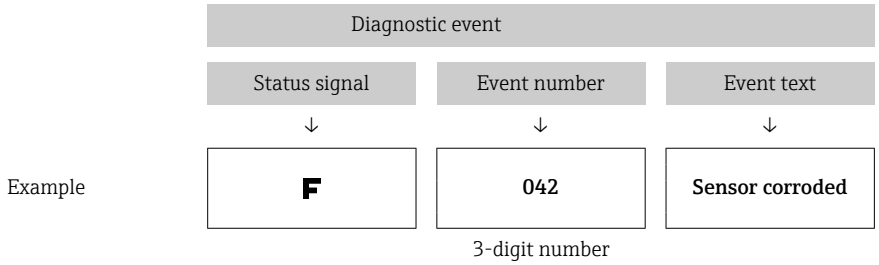
Symbol	Event category	Meaning
F	Operating error	An operating error has occurred. The measured value is no longer valid.
C	Service mode	The device is in service mode (e.g. during a simulation).
S	Out of specification	The device is being operated outside its technical specifications (e.g. during warm-up or cleaning processes).
M	Maintenance required	Maintenance is required. The measured value is still valid.

Diagnostic behavior

Alarm	Measurement is interrupted. The signal outputs adopt the defined alarm condition. A diagnostic message is generated (status signal F).
Warning	The device continues to measure. A diagnostic message is generated (status signals M, C or S).

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 two or more diagnostic events occur simultaneously, only the message with the highest priority is shown. Additional pending diagnostic messages are shown in the **Diagnostic list** submenu → 95.

Past diagnostic messages that are no longer pending are shown in the **Event logbook** submenu→ 96.

12.2.2 Overview of diagnostic events

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

The relevant sensor input for these diagnostic events can be identified by the **Actual diag. channel** parameter or on the optional attachable display.

Diagnostic number	Short text	Corrective measure	Status signal from the factory / Can be changed to	Diagnostic behavior from the factory
Diagnostics for the sensor				
001	Device malfunction	1. Restart device 2. Check electrical connection of sensor 1 3. Check/replace sensor 1 4. Replace electronics	F	Alarm
006	Redundancy active	1. Check electrical wiring. 2. Replace sensor. 3. Check connection type.	M	Warning
041	Sensor broken	1. Check electrical wiring. 2. Replace sensor. 3. Check connection type.	F	Alarm
042	Sensor corroded	1. Check electrical wiring of sensor. 2. Replace sensor.	M F	Warning [1]
043	Short circuit	1. Check electronic wiring. 2. Replace sensor.	F	Alarm
044	Sensor drift	1. Check sensors. 2. Check process temperatures.	M F, S	Warning [1]
045	Working area	1. Check ambient temperature. 2. Check external reference measuring point.	F	Alarm

Diagnostic number	Short text	Corrective measure	Status signal from the factory Can be changed to	Diagnostic behavior from the factory
062	Sensor connection	1. Check electronic wiring. 2. Replace sensor. 3. Check connection type. 4. Contact service.	F	Alarm
101	Sensor value too low	1. Check process temperatures. 2. Check sensor. 3. Check sensor type.	S F	Warning
102	Sensor value too high	1. Check process temperatures. 2. Check sensor. 3. Check sensor type.	S F	Warning
104	Backup active	1. Check electrical wiring of sensor 1. 2. Replace sensor 1. 3. Check connection type.	M	Warning
105	Calibration interval	1. Execute calibration and reset calibration interval. 2. Switch off calibration counter.	M F	Warning [1])
106	Backup not available	1. Check electrical wiring of sensor 2. 2. Replace sensor 2. 3. Check connection type.	M	Warning
Diagnostics for the electronics				
201	Device malfunction	Replace electronics.	F	Alarm
221	Reference measurement	Replace electronics.	F	Alarm
241	Software	1. Restart device. 2. Perform device reset. 3. Replace device.	F	Alarm
242	Software incompatible	Contact service.	F	Alarm
261	Electronic modules	Replace electronics.	F	Alarm
262	Module connection short circuit	1. Ensure that display module is correctly seated on the head transmitter. 2. Test the display module using other suitable head transmitters. 3. Display module defective? Replace module.	M	Warning
282	Electronic memory	Replace device.	F	Alarm
283	Memory content	Replace electronics.	F	Alarm
301	Supply voltage	1. Increase supply voltage. 2. Check connection wires for corrosion.	F	Alarm
Diagnostics for the configuration				
401	Factory reset	Please wait until the reset procedure is complete.	C	Warning
402	Initialization	Please wait until the start-up procedure is complete.	C	Warning
410	Data transfer	Check HART communication.	F	Alarm
411	Download active	Please wait until the upload/download is complete.	F, M or C [2])	-
431	Factory calibration [3])	Replace electronics.	F	Alarm

Diagnostic number	Short text	Corrective measure	Status signal from the factory / Can be changed to	Diagnostic behavior from the factory
435	Linearization	1. Check configuration of sensor parameters. 2. Check configuration of special sensor linearization. 3. Contact service. 4. Replace electronics.	F	Alarm
437	Configuration	1. Check configuration of sensor parameters. 2. Check configuration of special sensor linearization. 3. Check configuration of transmitter settings. 4. Contact service.	F	Alarm
438	Dataset	Repeat a new parameterization.	F	Alarm
451	Data processing	Please wait until data processing is complete.	C	Warning
483	Simulation input	Deactivate simulation.	C	Warning
485	Measured value simulation			
491	Simulation current output			
501	CDI connection	Disconnect CDI plug.	C	Warning
525	HART communication	1. Check communication path. 2. Check HART master. 3. Sufficient power supply? 4. Check HART communication settings. 5. Contact service.	F	Alarm
Diagnostics for the process				
803	Current loop	1. Check wiring. 2. Replace electronics.	F	Alarm
842	Process limit value	Check scaling of analog output.	M F, S	Warning [1]
925	Device temperature	Observe ambient temperature in accordance with specification.	S F	Warning

1) Diagnostic behavior can be changed in: "Alarm" or "Warning"
2) Status signal depends on used communication system and cannot be changed.
3) In the case of this diagnostic event, the device always issues a "low" alarm status (output current ≤ 3.6 mA).

12.3 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:
   http://www.endress.com/support/return-material
   ↳ Select the region.
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

12.4 Software history and overview of compatibility

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	Modifications	Documentation
01/11	01.00.zz	Original firmware	BA01028T/09/en/13.10
10/12	01.00.zz	No changes to functions and operation.	BA01028T/09/en/14.12
02/14	01.01.zz	Functional safety (SIL3)	BA01028T/09/en/15.13
02/17	01.01.zz	Changes in configuration parameter for Functional safety (SIL3)	BA01028T/09/en/17.17
04/19	01.02.zz	Changes in device behavior for Functional safety (SIL3)	BA01028T/09/en/19.19

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. 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 is possible (0 to 30 Ω) ▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire			
Resistance transmitter	Resistance Ω		10 to 400 Ω 10 to 2 000 Ω	10 Ω 10 Ω

Thermocouples as per standard	Description	Measuring range limits		Min. 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) +50 to +1 768 °C (+122 to +3 214 °F) +50 to +1 768 °C (+122 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)

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. span
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	☑	☑	☑	☑
	For field mount housing with sensor input 1 thermocouple: It is not possible to connect a second thermocouple (TC), RTD, resistance transmitter or voltage transmitter on sensor input 2 as this input is needed for the external reference junction.				

13.2 Output

Output signal

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

Failure information

Failure information as per NAMUR NE43:

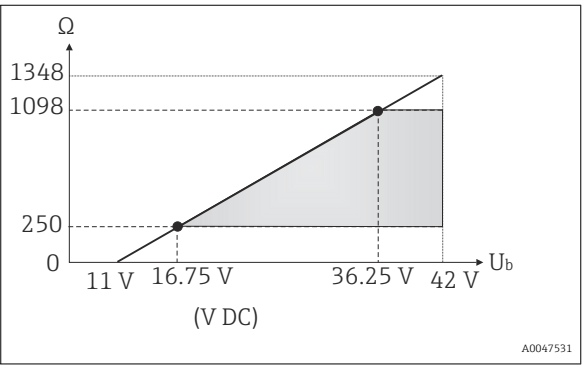
Failure information is created if the measuring information is missing or not valid. A complete list of all the errors occurring in the measuring system is created.

Underranging	Linear decrease from 4.0 to 3.8 mA
Overranging	Linear increase from 20.0 to 20.5 mA
Failure e.g. sensor failure; sensor short-circuit	≤ 3.6 mA ("low") or ≥ 21 mA ("high"), can be selected The "high" alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

Load

$R_{b\ max.}$ = ($U_{b\ max.}$ - 11 V) / 0.023 A (current output). Valid for head transmitter

Load in Ohm
U_b = supply voltage in V DC



Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Mains filter

50/60 Hz

Filter

1st order digital filter: 0 to 120 s

Protocol-specific data

HART® version	7
Device address in the multi-drop mode [1]	Software setting addresses 0 to 63
Device description files (DD)	Information and files are available free of charge at: www.endress.com www.hartcomm.org
Load (communication resistor)	min. 250 Ω

1) Not possible in the SIL mode, see Functional Safety Manual SD01172T/09

Write protection for device parameters

- Hardware: Write protection for head transmitter on optional display using DIP switch
- Software: Write protection using password

Switch-on delay

- Until the start of HART® communication, approx. 6 s [2], while switch-on delay = I_a ≤3.8 mA
- Until the first valid measured value signal is present for HART® communication and at the current output, approx. 15 s, while switch-on delay = I_a ≤ 3.8 mA

13.3 Power supply

Supply voltage

Values for non-hazardous areas, protected against polarity reversal:
- Head transmitter
  - 11 V ≤ Vcc ≤ 42 V (standard)
  - 11 V ≤ Vcc ≤ 32 V (SIL mode)
  - I: ≤ 23 mA
- DIN rail device
  - 12 V ≤ Vcc ≤ 42 V (standard)
  - 12 V ≤ Vcc ≤ 32 V (SIL mode)
  - I: ≤ 23 mA

Values for hazardous area, see Ex documentation.

2) Does not apply to the SIL mode

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

Terminal

Choice of screw terminals or push-in terminals for sensor and power supply cables:

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	≤ 2.5 mm² (14 AWG)
		Field mount housing: 2.5 mm² (12 AWG) plus ferrule
Push-in terminals (cable version, stripping length = min. 10 mm (0.39 in)	Rigid or flexible	0.2 to 1.5 mm² (24 to 16 AWG)
	Flexible with wire end ferrules with/without plastic ferrule	0.25 to 1.5 mm² (24 to 16 AWG)

Ferrules must be used with push-in terminals and when using flexible cables with a cable cross-section of ≤ 0.3 mm². Otherwise, the use of ferrules when connecting flexible cables to push-in terminals is not recommended.

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 thermometer (RTD)	0.9 to 1.5 s (depends on the connection method 2/3/4-wire)
Thermocouples (TC)	1.1 s
Reference temperature	1.1 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

Approx. 100 ms

Reference operating conditions

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

Maximum measured error

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

Typical

Standard	Description	Measuring range	Typical measured 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)		0.08 K (0.14 °F)	0.1 °C (0.18 °F)

Standard	Description	Measuring range	Typical measured error (±)	
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)	0.09 °C (0.16 °F)
Thermocouples (TC) as per standard			Digital value	Value at current output
IEC 60584, Part 1 ASTM E230-3	Type K (NiCr-Ni) (36)	0 to +800 °C (32 to +1 472 °F)	0.31 °C (0.56 °F)	0.39 °C (0.7 °F)
IEC 60584, Part 1 ASTM E230-3	Type S (PtRh10-Pt) (39)		0.97 °C (1.75 °F)	1.0 °C (1.8 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.18 °C (3.92 °F)	2.2 °C (3.96 °F)

1) Measured value transmitted via HART®.

Measured error for resistance thermometers (RTD) and resistance transmitters

Standard	Description	Measuring range	Measured 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) + 0.006% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Pt200 (2)		ME = ± (0.12 °C (0.22 °F) + 0.015% * (MV - LRV))	
	Pt500 (3)	−200 to +500 °C (−328 to +932 °F)	ME = ± (0.05 °C (0.09 °F) + 0.014% * (MV - LRV))	
	Pt1000 (4)	−200 to +250 °C (−328 to +482 °F)	ME = ± (0.03 °C (0.05 °F) + 0.013% * (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 = ± (0.10 °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))	
	Ni100 (12)	−60 to +180 °C (−76 to +356 °F)	ME = ± (0.06 °C (0.11 °F) - 0.006% * (MV - LRV))	
	Ni120 (13)		ME = ± (0.05 °C (0.09 °F) - 0.006% * (MV - LRV))	
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to +200 °C (−58 to +392 °F)	ME = ± (0.10 °C (0.18 °F) + 0.004% * (MV - LRV))	
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± 21 mΩ + 0.003% * MV	0.03 % (≙ 4.8 µA)
		10 to 2 000 Ω	ME = ± 90 mΩ + 0.011% * MV	

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

Measured error for thermocouples (TC) and voltage transmitters

Standard	Description	Measuring range	Measured error (±)	
			Digital [1] Based on measured value [3]	D/A [2]
IEC 60584-1 ASTM E230-3	Type A (30)	0 to +2 500 °C (+32 to +4 532 °F)	ME = ± (0.8 °C (1.52 °F) + 0.021% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Type B (31)	+500 to +1 820 °C (+932 to +3 308 °F)	ME = ± (1.43 °C (2.57 °F) - 0.06% * (MV - LRV))	

Standard	Description	Measuring range	Measured error (±)	
IEC 60584-1 ASTM E230-3 ASTM E988-96	Type C (32)	0 to +2 000 °C (+32 to +3 632 °F)	ME = ± (0.55 °C (0.99 °F) + 0.0055% * (MV - LRV))	
ASTM E988-96	Type D (33)	0 to +2 000 °C (+32 to +3 632 °F)	ME = ± (0.85 °C (1.53 °F) - 0.008% * (MV - LRV))	
IEC 60584-1 ASTM E230-3	Type E (34)	−150 to +1 200 °C (−238 to +2 192 °F)	ME = ± (0.22 °C (0.40 °F) - 0.006% * (MV - LRV))	
	Type J (35)	−150 to +1 200 °C (−238 to +2 192 °F)	ME = ± (0.27 °C (0.49 °F) - 0.005% * (MV - LRV))	
	Type K (36)		ME = ± (0.35 °C (0.63 °F) - 0.005% * (MV - LRV))	
	Type N (37)	−150 to +1 300 °C (−238 to +2 372 °F)	ME = ± (0.48 °C (0.86 °F) - 0.014% * (MV - LRV))	
	Type R (38)	+50 to +1 768 °C (+122 to +3 214 °F)	ME = ± (1.12 °C (2.02 °F) - 0.03% * (MV - LRV))	
	Type S (39)		ME = ± (1.15 °C (2.07 °F) - 0.022% * (MV - LRV))	
	Type T (40)	−150 to +400 °C (−238 to +752 °F)	ME = ± (0.35 °C (0.63 °F) - 0.04% * (MV - LRV))	
DIN 43710	Type L (41)	−150 to +900 °C (−238 to +1 652 °F)	ME = ± (0.29 °C (0.52 °F) - 0.009% * (MV - LRV))	
	Type U (42)	−150 to +600 °C (−238 to +1 112 °F)	ME = ± (0.33 °C (0.59 °F) - 0.028% * (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 = ± (7.7 µV + 0.0025% * (MV - LRV))	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 measured error due to rounding is possible.

MV = Measured Value

LRV = Lower Range Value of relevant sensor

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

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

Measured error digital = 0.06 °C + 0.006% x (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measured error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Measured error digital value (HART):	0.08 °C (0.15 °F)
Measured error analog value (current output): √(Measured error digital² + Measured error D/A²)	0.10 °C (0.19 °F)

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

Measured error digital = 0.06 °C + 0.006% x (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measured error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Influence of ambient temperature (digital) = (35 - 25) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) x (0.001% x 200 °C)	0.02 °C (0.04 °F)

Influence of supply voltage (digital) = (30 - 24) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) x (0.001% x 200 °C)	0.01 °C (0.02 °F)
Measured error digital value (HART): √(Measured error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.13 °C (0.23 °F)**
Measured error analog value (current output): √(Measured error digital² + Measured error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + Influence of supply voltage (D/A)²	**0.14 °C (0.25 °F)**

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

MV = Measured Value

LRV = Lower Range Value of relevant sensor

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 measured errors apply in SIL mode.

For more information please refer to the Functional Safety Manual SD01172T/09.

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 explained 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 measured error data correspond to ±2 σ (Gaussian distribution).

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

Description	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
		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)		≤ 0.014 °C (0.025 °F)	0.002% * (MV -LRV), at least 0.009 °C (0.016 °F)		≤ 0.014 °C (0.025 °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)		≤ 0.01 °C (0.018 °F)	0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)	
Pt100 (5)	JIS C1604:1984		0.002% * (MV -LRV), at least 0.005 °C (0.009 °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)		≤ 0.03 °C (0.054 °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)	
Ni100 (6)	DIN 43760 IPTS-68	≤ 0.005 °C (0.009 °F)	-		≤ 0.005 °C (0.009 °F)	-	
Ni120 (7)			-			-	
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.008 °C (0.014 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Cu100 (11)			0.002% * (MV -LRV), at least 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)	-		≤ 0.004 °C (0.007 °F)	-	
Ni120 (13)			-			-	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.008 °C (0.014 °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

Description	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
		Maximum	Based on measured value		Maximum	Based on measured value	
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 0.14 °C (0.25 °F)	0.0055% * (MV -LRV), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.14 °C (0.25 °F)	0.0055% * (MV -LRV), at least 0.03 °C (0.054 °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 E230-3 ASTM E988-96	≤ 0.09 °C (0.16 °F)	0.0045% * (MV -LRV), at least 0.03 °C (0.054 °F)		≤ 0.09 °C (0.16 °F)	0.0045% * (MV -LRV), at least 0.03 °C (0.054 °F)	
Type D (33)	ASTM E988-96	≤ 0.08 °C (0.14 °F)	0.004% * (MV -LRV), at least 0.035 °C (0.063 °F)		≤ 0.08 °C (0.14 °F)	0.004% * (MV -LRV), at least 0.035 °C (0.063 °F)	
Type E (34)	IEC 60584-1 ASTM E230-3	≤ 0.03 °C (0.05 °F)	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)		≤ 0.03 °C (0.05 °F)	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)	
Type J (35)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV -LRV), at least 0.02 °C (0.036 °F)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV -LRV), at least 0.02 °C (0.036 °F)	
Type K (36)		≤ 0.04 °C (0.07 °F)	0.003% * (MV -LRV), at least 0.013 °C (0.023 °F)		≤ 0.04 °C (0.07 °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)		≤ 0.06 °C (0.11 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)		≤ 0.06 °C (0.11 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)	
Type S (39)		≤ 0.05 °C (0.09 °F)	-		≤ 0.05 °C (0.09 °F)	-	
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)	-		≤ 0.02 °C (0.04 °F)	-	
Type U (42)		≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °F)	-	
Type L (43)	GOST R8.585-2001	≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °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 relevant sensor

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

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

Description	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)

Description	Standard	Long-term drift (±) [1]		
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) Whichever is greater

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

Description	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 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 E230-3 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 ASTM E230-3	≤ 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)	1.73 °C (3.11 °F)

Description	Standard	Long-term drift (±) [1]		
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 5.5 µV	≤ 0.041% * (MV - LRV) or 8.2 µV	≤ 0.056% * (MV - LRV) or 11.2 µV

1) Whichever is greater

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 cold junction with thermocouples TC)
- Field mount housing with separate terminal compartment: Pt100 DIN IEC 60751 Cl. B (external cold junction with thermocouples TC)

13.5 Environment

Ambient temperature range

- −40 to +85 °C (−40 to +185 °F), for hazardous areas see Ex documentation
- −50 to +85 °C (−58 to +185 °F), for hazardous areas see Ex documentation , Product Configurator order code for "Test, certificate, declaration", option "JM" [3]
- −52 to +85 °C (−62 to +185 °F), for hazardous areas see Ex documentation , Product Configurator order code for "Test, certificate, declaration", option "JN" [3]
- Head transmitter, field mount housing with separate terminal compartment incl. display: −30 to +85 °C (−22 to +185 °F). At temperatures < −20 °C (−4 °F) the display may react slowly, Product Configurator, order code for "Field housing", option "R" and "S"
- SIL mode: −40 to +70 °C (−40 to +158 °F)

Storage temperature

- Head transmitter: −50 to +100 °C (−58 to +212 °F)
- Option: −52 to 85 °C (−62 to 185 °F), Product Configurator order code for "Test, certificate, declaration", option "JN" [4]
- Head transmitter, field mount housing with separate terminal compartment incl. display: −30 to +85 °C (−22 to +185 °F). At temperatures < −20 °C (−4 °F) the display may react slowly, Product Configurator, order code for "Field housing", option "R" and "S"
- DIN rail device: −40 to +100 °C (−40 to +212 °F)

Altitude

Up to 4000 m (4374.5 yards) above mean sea level.

3) If the temperature is below −40 °C (−40 °F), increased failure rates are likely.
4) If the temperature is below −50 °C (−58 °F), increased failure rates are likely.

Humidity	▪ Condensation:
	  ▪ Head transmitter permitted
	  ▪ DIN rail transmitter not permitted
	▪ Max. rel. humidity: 95% as per IEC 60068-2-30

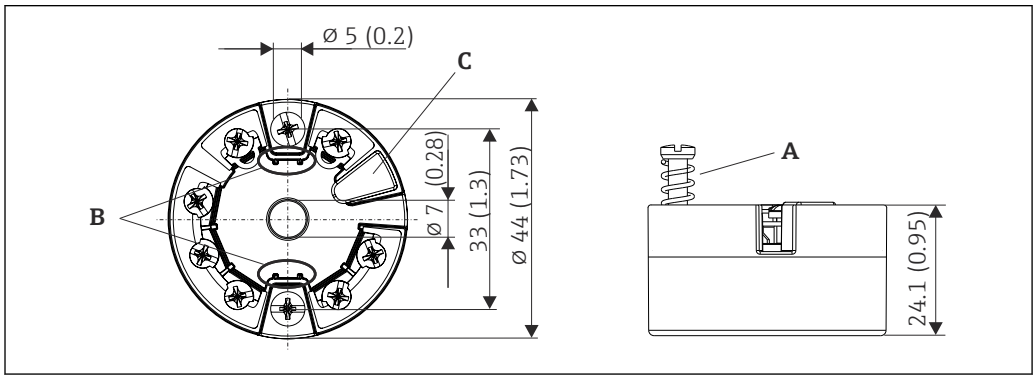
Climate class	▪ Head transmitter: climate class C1 as per IEC 60654-1 ▪ DIN rail device: climate class B2 as per IEC 60654-1 ▪ Head transmitter, field mount housing with separate terminal compartment including display: climate Class Dx as per IEC 60654-1
Degree of protection	▪ Head transmitter with screw terminals: IP 00, with push-in terminals: IP 30. In installed state, depends on the terminal head or field housing used. ▪ When installing in field housing TA30A, TA30D or TA30H: IP 66/68 (NEMA Type 4x encl.) ▪ When installing in field mount housing with separate terminal compartment: IP 67, NEMA Type 4x ▪ DIN rail device: IP 20
Shock and vibration resistance	Vibration resistance as per DNVGL-CG-0339 : 2015 and DIN EN 60068-2-27 ▪ Head transmitter: 2 to 100 Hz at 4g (increased vibration stress) ▪ DIN rail device: 2 to 100 Hz at 0.7g (general vibration stress) Shock resistance as per KTA 3505 (section 5.8.4 Shock test)
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. All tests were passed both with and without ongoing digital HART®-communication. Maximum measured 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
Overvoltage category	Overvoltage category II
Degree of contamination	Pollution degree 2

13.6 Mechanical construction

Design, dimensions

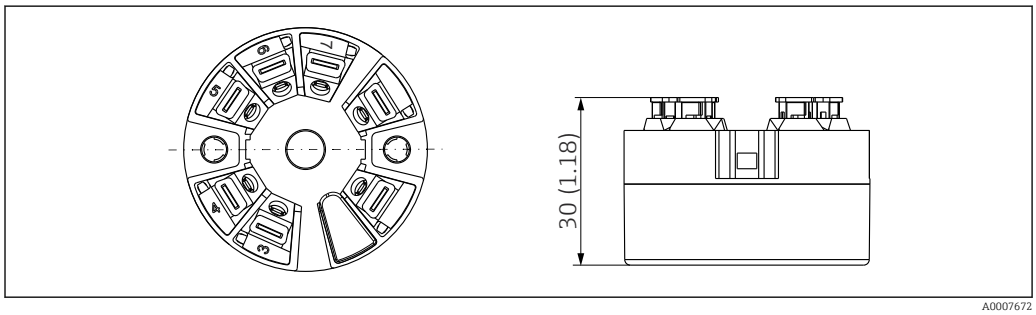
Dimensions in mm (in)

Head transmitter



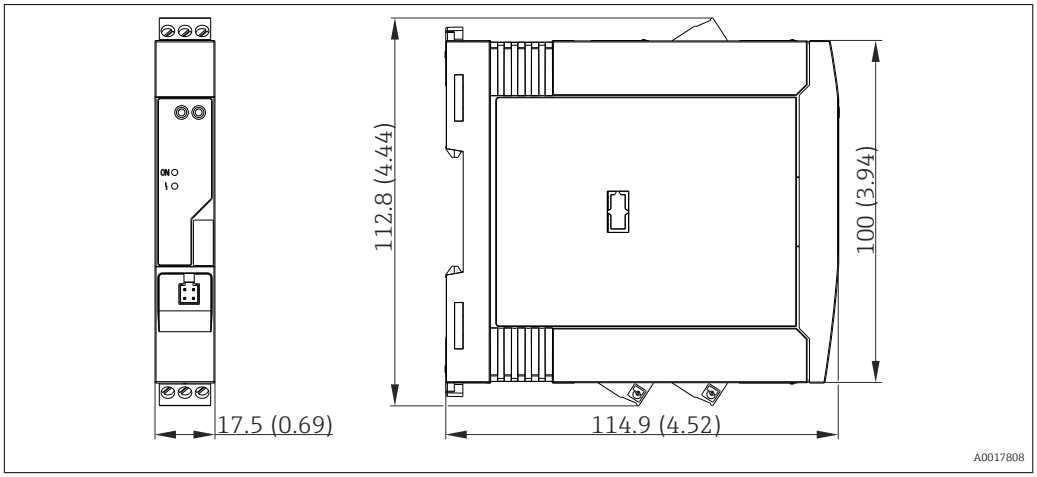
21 *Version with screw terminals*

A Spring travel L ≥ 5 mm (not for US - M4 securing screws)
B Mounting elements for attachable measured value display TID10
C Service interface for connecting measured value display or configuration tool



22 *Version with push-in terminals. Dimensions are identical to the version with screw terminals, apart from housing height.*

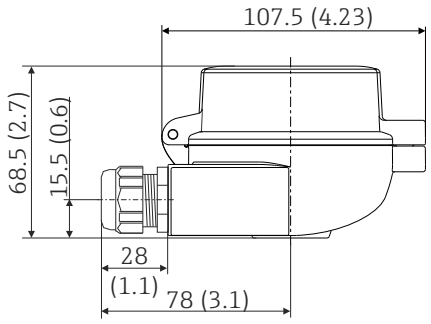
DIN rail device

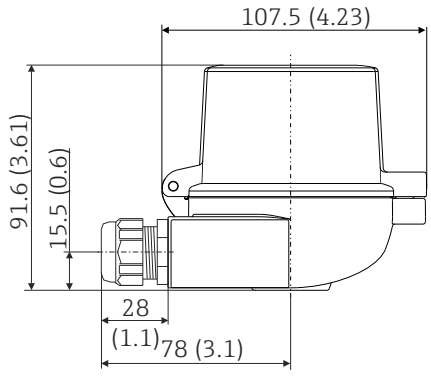


Field housing

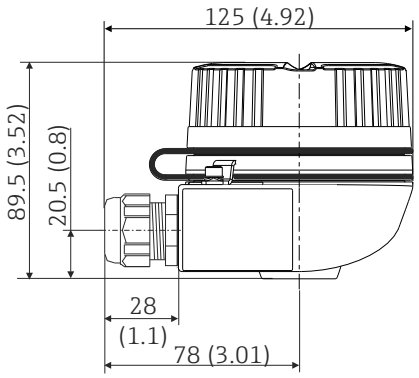
All field housings have an internal geometry in accordance with DIN EN 50446, form B (flat face). Cable glands in the diagrams: M20x1.5

Maximum ambient temperatures for cable glands	
Type	**Temperature range**
Polyamide cable gland ½" NPT, M20x1.5 (non-Ex)	–40 to +100 °C (–40 to 212 °F)
Polyamide cable gland M20x1.5 (for dust ignition-proof area)	–20 to +95 °C (–4 to 203 °F)
Brass cable gland ½" NPT, M20x1.5 (for dust ignition-proof area)	–20 to +130 °C (–4 to +266 °F)

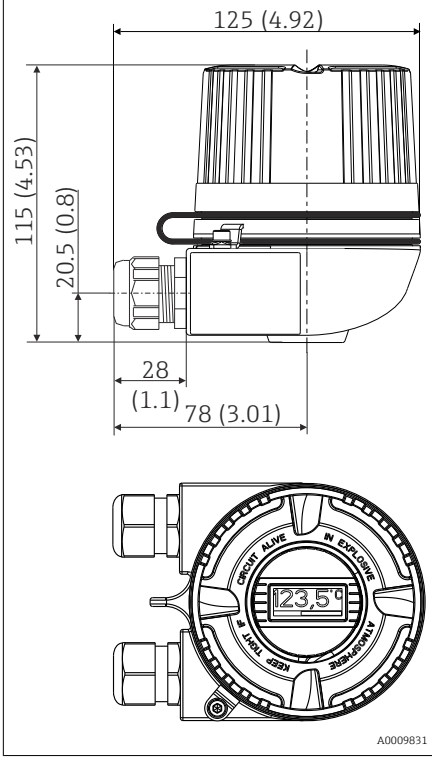
TA30A	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Cable entry glands: 1/2" NPT and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz)

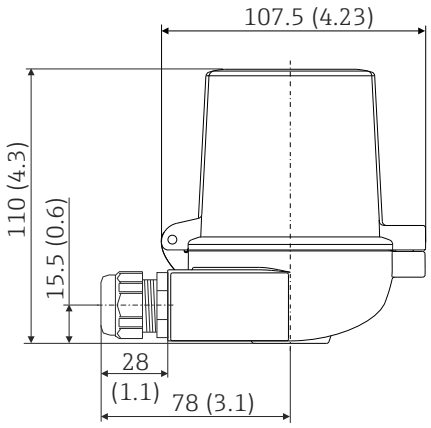
TA30A with display window in cover	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Cable entry glands: 1/2" NPT and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz)

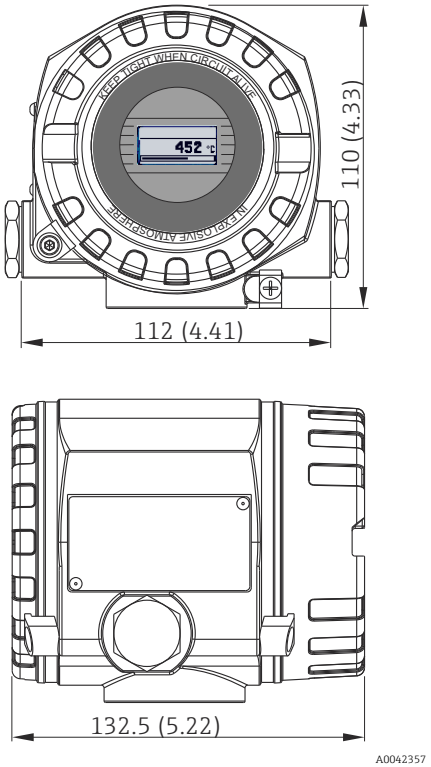
TA30H	Specification

	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries
	▪ Protection class: NEMA Type 4x Encl.
	▪ Material:
	  ▪ Aluminum, with polyester powder coating
	  ▪ Stainless steel 316L without coating
	▪ Cable entry glands: ½" NPT, M20x1.5
	▪ Color of aluminum head: blue, RAL 5012
	▪ Color of aluminum cap: gray, RAL 7035
	▪ Weight:
	  ▪ Aluminium approx. 640 g (22.6 oz)
	  ▪ Stainless steel approx. 2 400 g (84.7 oz)

TA30H with display window in cover	Specification

	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries
	▪ Protection class: NEMA Type 4x Encl.
	▪ Material:
	  ▪ Aluminum with polyester powder coating
	  ▪ Stainless steel 316L without coating
	▪ Cable entry glands: ½" NPT, M20x1.5
	▪ Color of aluminum head: blue, RAL 5012
	▪ Color of aluminum cap: gray, RAL 7035
	▪ Weight:
	  ▪ Aluminium approx. 860 g (30.33 oz)
	  ▪ Stainless steel approx. 2 900 g (102.3 oz)

TA30D	Specification
	▪ 2 cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Cable entry glands: 1/2" NPT and M20x1.5 ▪ Two head transmitters can be mounted. In the standard configuration one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz)

Field mount housing with separate terminal compartment	Specification
	▪ Separate electronics compartment and terminal compartment ▪ Display rotatable in 90° increments ▪ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base ▪ Cable entry: 2x ½" NPT, 2x M20x1.5 ▪ Protection class: IP67, NEMA type 4x ▪ Color: blue, RAL 5012 ▪ Weight: approx. 1.4 kg (3 lb)

Weight

- Head transmitter: approx. 40 to 50 g (1.4 to 1.8 oz)
- Field housing: see specifications
- DIN rail device: approx. 100 g (3.53 oz)

Materials

All the materials used are RoHS-compliant.

- Housing: polycarbonate (PC)
- Terminals:
  - Screw terminals: nickel-plated brass and gold-plated or tin-plated contacts
  - Push-in terminals: tin-plated brass, contact springs 1.4310, 301 (AISI)
- Potting compound:
  - Head transmitter: QSIL 553
  - DIN rail housing: Silgel612EH

Field housing: see specifications

13.7 Certificates and approvals

CE mark	The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.
EAC mark	The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark.
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in separate documentation which is available upon request.
UL approval	More information under UL Product iq™, search for keyword "E225237")
CSA C/US	The device meets the requirements of "CLASS 2252 06 - Process Control Equipment" and "CLASS 2252 86 - Process Control Equipment (Certified to US Standards)"
Functional safety	**SIL 2/3 (hardware/software) certified to:** - IEC 61508-1:2010 (Management) - IEC 61508-2:2010 (Hardware) - IEC 61508-3:2010 (Software)
HART® certification	The temperature transmitter is registered by the HART® Communication Foundation. The device meets the requirements of the HART® Communication Protocol Specifications, Revision 7.
Marine approvals	For the type approval certificates (DNVGL, etc.) currently available, please contact your Sales Center for information. All data relating to shipbuilding can be found in separate type approval certificates which can be requested as needed.
Test certificate	Compliant with: - WELMEC 8.8, only in SIL mode: "Guide on the General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring Instruments". - OIML R117-1 Edition 2007 (E) "Dynamic measuring systems for liquids other than water". - EN 12405-1/A2 Edition 2010 "Gas meters – Conversion devices – Part 1: Volume conversion". - OIML R140-1 Edition 2007 (E) "Measuring systems for gaseous fuel"

Other standards and guidelines

- IEC 60529:
  Degrees of protection provided by enclosures (IP code)
- IEC/EN 61010-1:
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326 series:
  Electromagnetic compatibility (EMC requirements)

13.8 Documentation

- Functional Safety Manual 'iTEMP TMT82' (SD01172T)
- Supplementary ATEX documentation:
  ATEX II 1G Ex ia IIC: XA00102T
  ATEX II2G Ex d IIC: XA01007T (transmitter in field housing)
  ATEX II2(1)G Ex ia IIC: XA01012T (transmitter in field housing)

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

For more information please refer to the Functional Safety Manual SD01172T/09.

Setup →	Device tag	→ 75
	Unit	→ 75
	Sensor type 1	→ 75
	Connection type 1	→ 76
	2-wire compensation 1	→ 76
	Reference junction 1	→ 76
	RJ preset value 1	→ 77
	Sensor type 2	→ 75
	Connection type 2	→ 76
	2-wire compensation 2	→ 76
	Reference junction 2	→ 76
	RJ preset value 2	→ 77
	Assign current output (PV)	→ 77
	Lower range value	→ 78
	Upper range value	→ 78

Setup →	**Advanced setup→**	Enter access code	→ 79
		Access status tooling	→ 80
		Locking status	→ 80
		Device temperature alarm	→ 81

Setup →	**Advanced setup→**	**Sensor →**	Sensor offset 1	→ 81
			Sensor offset 2	→ 81
			Corrosion detection	→ 81
			Drift/difference mode	→ 82
			Drift/difference alarm category	→ 82
			Drift/difference alarm delay	→ 83
			Drift/difference set point	→ 83
			Sensor switch set point	→ 83

Setup →	**Advanced setup→**	**Current output →**	Output current	→ 84
			Measuring mode	→ 84
			Out of range category	→ 85
			Failure mode	→ 85
			Failure current	→ 85
			Current trimming 4 mA	→ 86
			Current trimming 20 mA	→ 86

Setup →	**Advanced setup→**	**Display →**	Display interval	→ 86
			Format display	→ 87
			Value 1 display	→ 87
			Decimal places 1	→ 88
			Value 2 display	→ 88
			Decimal places 2	→ 89
			Value 3 display	→ 89
			Decimal places 3	→ 90

Setup →	**Advanced setup→**	**SIL →**	SIL option	→ 90
			Operational state	→ 90
			SIL checksum	→ 90
			Timestamp SIL configuration	→ 90
			Force safe state	→ 90

Setup →	**Advanced setup→**	**Administration →**	Device reset	→ 92
			Define device write protection code	→ 92

Diagnostics →	Actual diagnostics	→ 94
	Remedy information	→ 94
	Previous diagnostics 1	→ 94
	Operating time	→ 94

Diagnostics →	**Diagnostic list→**	Actual diagnostics count	→ 95
		Actual diagnostics n [1]	→ 94
		Actual diag channel	→ 95

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

Diagnostics →	**Event logbook →**	Previous diagnostics n [1]	→ 96
		Previous diag channel n	→ 96

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

Diagnostics →	**Device information →**	Device tag	→ 75
		Serial number	→ 97
		Firmware version	→ 97
		Device name	→ 97
		Order code	→ 97
		Extended order code	→ 119
		Extended order code 2	→ 119
		Extended order code 3	→ 119
		ENP version	→ 119
		Device revision	→ 112
		Manufacturer ID	→ 120
		Manufacturer	→ 120
		Hardware revision	→ 120
		Configuration counter	→ 99

Diagnostics →	**Measured values →**	Sensor 1 value	→ 99
		Sensor 1 raw value	→ 100
		Sensor 2 value	→ 99
		Sensor 2 raw value	→ 100
		Device temperature	→ 100

Diagnostics →	**Measured values →**	**Min/max values →**	Sensor n [1] min value	→ 100
			Sensor n max value	→ 100
			Reset sensor min/max values	→ 100
			Device temperature min.	→ 101
			Device temperature max.	→ 101
			Reset device temperature min/max	→ 101

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

Diagnostics →	**Simulation →**	Simulation current output	→ 102
		Value current output	→ 102

Expert →	Enter access code		→ 79
	Access status tooling		→ 80
	Locking status		→ 80

Expert →	**System →**	Unit	→ 75
		Damping	→ 103
		Alarm delay	→ 103
		Mains filter	→ 103
		Device temperature alarm	→ 104

Expert →	**System →**	**Display →**	Display interval	→ 86
			Format display	→ 87
			Value 1 display	→ 87
			Decimal places 1	→ 88
			Value 2 display	→ 88
			Decimal places 2	→ 89
			Value 3 display	→ 89
			Decimal places 3	→ 90

Expert →	**System →**	**Administration →**	Device reset	→ 92
			Define device write protection code	→ 92

Expert →	**Sensor →**	**Sensor n** [1] **→**	Sensor type n	→ 75
			Connection type n	→ 76
			2-wire compensation n	→ 76
			Reference junction n	→ 76
			RJ preset value	→ 77
			Sensor offset n	→ 81
			Sensor n lower limit	→ 104
			Sensor n upper limit	→ 104
			Sensor n serial number	→ 104

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

Expert →	**Sensor →**	**Sensor n** [1] **→**	**Sensor trimming →**	Sensor trimming	→ 105
				Sensor trimming lower value	→ 105
				Sensor trimming upper value	→ 106
				Sensor trimming min span	→ 106

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

Expert →	**Sensor →**	**Sensor n** [1] **→**	**Linearization →**	Sensor n lower limit	→ 104
				Sensor n upper limit	→ 104
				Call./v. Dusen coeff. R0, A, B, C	→ 107
				Polynomial coeff. R0, A, B	→ 108

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

Expert →	**Sensor →**	**Diagnostic settings →**	Corrosion detection	→ 81
			Drift/difference mode	→ 82
			Drift/difference alarm category	→ 82
			Drift/difference alarm delay	→ 83
			Drift/difference set point	→ 83

			Sensor switch set point	→ 83
			Calibration counter start	→ 108
			Calibration alarm category	→ 109
			Calibration counter start value	→ 109
			Count value	→ 109

Expert →	**Output →**		Output current	→ 84
			Measuring mode	→ 110
			Lower range value	→ 78
			Upper range value	→ 78
			Out of range category	→ 85
			Failure mode	→ 85
			Failure current	→ 85
			Current trimming 4 mA	→ 86
			Current trimming 20 mA	→ 86

Expert →	**Communication →**	**HART configuration →**	Device tag	→ 110
			HART short tag	→ 110
			HART address	→ 110
			No. of preambles	→ 111
			Configuration changed	→ 111
			Reset configuration changed flag	→ 111

Expert →	**Communication →**	**HART info→**	Device type	→ 111
			Device revision	→ 112
			Device ID	→ 112
			Manufacturer ID	→ 112
			HART revision	→ 112
			HART descriptor	→ 112
			HART message	→ 113
			Hardware revision	→ 120
			Software revision	→ 113
			HART date code	→ 113

Expert →	**Communication →**	**HART output→**	Assign current output (PV)	
			PV	→ 114
			Assign SV	→ 114
			SV	→ 114
			Assign TV	→ 115
			TV	→ 115
			Assign QV	→ 115
			QV	→ 115

Expert →	**Communication →**	**Burst configuration →**	Burst mode	→ 116
			Burst command	→ 116
			Burst variables 0-3	→ 116
			Burst trigger mode	→ 117
			Burst trigger level	→ 118
			Burst min period	→ 118
			Burst max period	→ 118

Expert →	**Diagnostics →**	Actual diagnostics	→ 94
		Remedy information	→ 94
		Previous diagnostics 1	→ 94
		Operating time	→ 94

Expert →	**Diagnostics →**	**Diagnostic list→**	Actual diagnostics count	→ 95
			Actual diagnostics	→ 94
			Actual diag channel	→ 95

Expert →	**Diagnostics →**	**Event logbook →**	Previous diagnostics n [1]	→ 96
			Previous diag channel	→ 96

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

Expert →	**Diagnostics →**	**Device information →**	Device tag	→ 75
			Serial number	→ 97
			Firmware version	→ 97
			Device name	→ 97
			Order code	→ 97
			Extended order code	→ 119
			Extended order code 2	→ 119
			Extended order code 3	→ 119
			ENP version	→ 119
			Device revision	→ 112
			Manufacturer ID	→ 120
			Manufacturer	→ 120
			Hardware revision	→ 120
			Configuration counter	→ 99

Expert →	**Diagnostics →**	**Measured values →**	Value sensor n [1]	→ 99
			Sensor n raw value	→ 120
			Device temperature	→ 100

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

Expert →	**Diagnostics →**	**Measured values →**	**Min/max values →**	Sensor n [1] min value	→ 100
				Sensor n max value	→ 100
				Reset sensor min/max values	→ 100
				Device temperature min.	→ 101
				Device temperature max.	→ 101
				Reset device temperature min/max	→ 101

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

Expert →	**Diagnostics →**	**Simulation →**	Simulation current output	→ 102
			Value current output	→ 102

14.1 "Setup" menu

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

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

Device tag

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

Description
Use this function to enter a unique name for the measuring point so it can be identified quickly within the plant. The name is displayed in the header of the plug-in display.

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

Factory setting
EH_TMT82_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

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.

Note for the version field mount housing with separate terminal compartment:
If a thermocouple (TC) is selected as sensor type, it is only possible to select it for sensor 1. The reference junction will be measured on the second channel (sensor 2). In this case do not change the setup of the reference junction as well as for the second channel

Options A list of all the possible sensor types is provided in the "Technical data" section.→ 50

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.

Options
- 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): 2-wire

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.
- Preset value: a fixed preset value is used.
- Measured value sensor 2: the measured value of sensor 2 is used.

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

Note for the version field mount housing with separate terminal compartment:
If a thermocouple (TC) is selected as sensor type, it is only possible to select it for sensor 1. The reference junction will be measured on the second channel (sensor 2). In this case do not change the setup of the reference junction as well as for the second channel.

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 +85 °C

Factory setting
0.00

Assign current output (PV)

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

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

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

Factory setting

Sensor 1

Lower range value

Navigation

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

Description

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

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

User entry

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

Factory setting

0

Upper range value

Navigation

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

Description

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

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

User entry

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

Factory setting

100

14.1.1 "Advanced setup" submenu

Corrosion monitoring

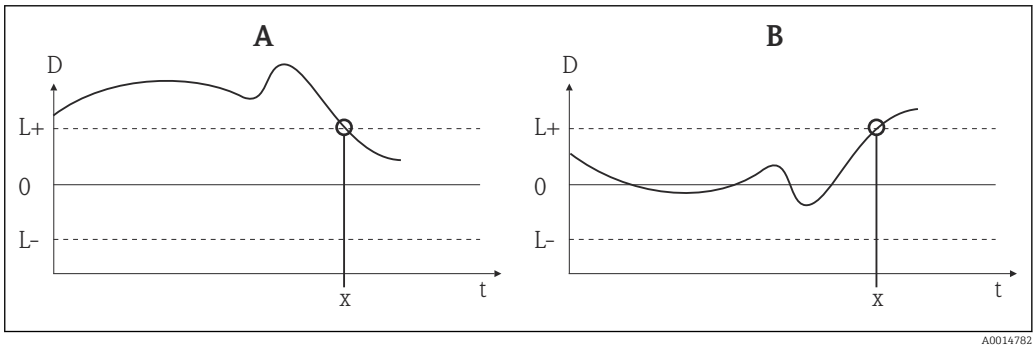
Sensor connection cable corrosion can lead to false measured value readings. Therefore the unit offers the possibility of recognizing any corrosion before a measured value is affected. Corrosion monitoring is only possible for RTDs with a 4-wire connection and thermocouples.

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 alarm category for drift/difference monitoring to **Out of specification (S)**, **Maintenance required (M)** or **Failure (F)** as required.
↓
4. Set the set point for drift/difference monitoring to the desired value.
↓
5. End



23 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

Enter access code

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

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

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

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

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

User entry 0 to 9 999

Factory setting 0

Access status tooling

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

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

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

Options
- Operator
- Service

Factory setting Operator

Locking status

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

Description Use this function to view the device locking status. The DIP switch for hardware locking is fitted on the display module. When write protection is activated, write access to the parameters is disabled.

Device temperature alarm

Navigation Setup → Advanced setup → Device temperature alarm

Description Use this function to select the category (status signal) as to how the device reacts when the electronics temperature of the transmitter exceeds or falls below the limit value < -40 °C (-40 °F) or > +85 °C (+185 °F).

Options
- Off
- Out of specification (S)
- Failure (F)

Factory setting Out of specification (S)

"Sensor" submenu

Sensor offset n

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

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

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

User entry -10.0 to +10.0

Factory setting 0.0

Corrosion detection

Navigation Setup → Advanced setup → Sensor → Corrosion detection
Expert → Sensor → Diagnostic settings → Corrosion detection

Description Use this function to select the category (status signal) which is displayed when corrosion is detected in the sensor connection cables.

Only possible for RTD sensors with 4-wire connection and thermocouples (TC).

Options
- Maintenance required (M)
- Failure (F)

Factory setting Maintenance required (M)

Drift/difference mode

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

Description Use this function to choose whether the device reacts to the drift/difference limit value 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 category

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

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

Description Use this function to select the category (status signal) as to how the device reacts when a drift/difference is detected between sensor 1 and sensor 2.

Options
- Out of specification (S)
- Maintenance required (M)
- Failure (F)

Factory setting Maintenance required (M)

Drift/difference alarm delay

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

Prerequisite The **Drift/difference mode** parameter must be activated with the **Out band (drift)** or **In band** option. → 82

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 0 to 255 s

Factory setting 0 s

Drift/difference set point

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

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

Description Use this function to 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 → Diagnostic settings → Sensor switch set point

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

Additional information The threshold value is relevant if the sensor switching 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 must be adapted so that it suits the value expected at the higher-order system.

NOTICE

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

- ▶ The digital measured values can be adapted with the sensor trimming parameter in the menu Expert → Sensor → 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 **Current trimming 4 mA / 20 mA** parameters
↓
8. End

Output current

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

Description Use this function to view the calculated output current in mA.

Measuring mode

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

Description Enables the inversion of the output signal.

Additional information
- **Standard**
  The output current increases with increasing temperatures
- **inverted**
  The output current decreases with increasing temperatures

Options
- Standard
- inverted

Factory setting Standard

Out of range category

Navigation Setup → Advanced setup → Current output → Out of range category
Expert → Output → Out of range category

Description Use this function to select the category (status signal) as to how the device reacts when the value is outside the set measuring range.

Options
- Out of specification (S)
- Maintenance required (M)
- Failure (F)

Factory setting Maintenance required (M)

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 an event of an error.

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

Options
- Min.
- Max.

Factory setting Max.

Failure current

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

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

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

User entry 21.5 to 23.0 mA

Factory setting 22.5

Current trimming 4 mA

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

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

User entry 3.85 to 4.15 mA

Factory setting 4 mA

Current trimming 20 mA

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

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

User entry 19.850 to 20.15 mA

Factory setting 20.000 mA

"Display" submenu

The settings for displaying the measured value on the optional plug-in display (only for head transmitter) are made in the "Display" menu.

These settings do not affect the output values of the transmitter, and are only used to specify the display format on the screen.

Display interval

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

Description

Use this function to set the display time of the measured values on the local display if the values are displayed in alternation. The display only alternates between values if more than one measured value is defined.

- The **Value 1 display - Value 3 display** parameters are used to specify which measured values are shown on the display → 87.
- The display format of the displayed measured values is specified using the **Format display** parameter.

User entry

4 to 20 s

Factory setting

4 s

Format display

Navigation

Setup → Advanced setup → Display → Format display
Expert → System → Display → Format display

Description

Use this function to select how the measured value is shown on the local display. The display format **Measured value** or **Measured value with bar graph** can be configured.

Options

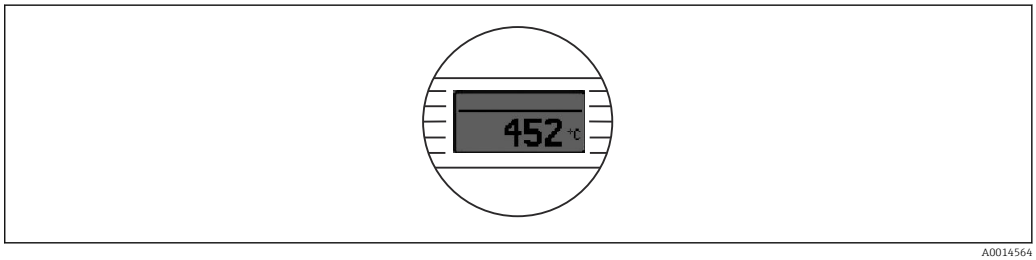
- Value
- Value + Bargraph

Factory setting

Value

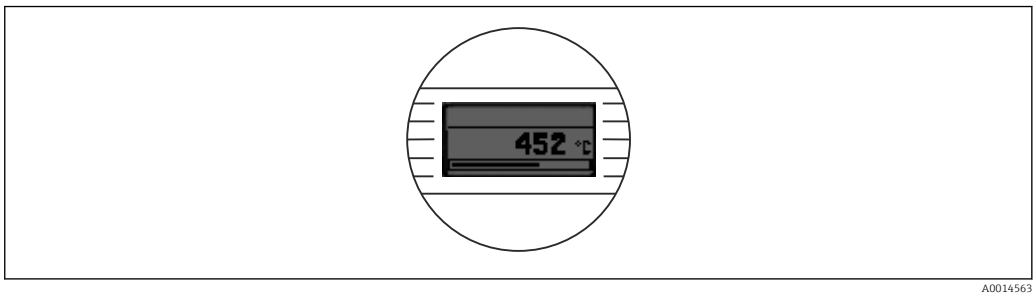
Additional information

Value



A0014564

Value + Bargraph



A0014563

Value 1 display

Navigation Setup → Advanced setup → Display → Value 1 display
Expert → System → Display → Value 1 display

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

The **Format display** parameter is used to specify how the measured values are displayed → 87.

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

Factory setting Process value

Decimal places 1

Navigation Setup → Advanced setup → Display → Decimal places 1
Expert → System → Display → Decimal places 1

Prerequisite A measured value is specified in the **Value 1 display** parameter → 87.

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

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

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

Factory setting Automatic

Value 2 display

Navigation Setup → Advanced setup → Display → Value 2 display
Expert → System → Display → Value 2 display

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

The **Format display** parameter is used to specify how the measured values are displayed.

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

Factory setting Off

Decimal places 2

Navigation Setup → Advanced setup → Display → Decimal places 2
Expert → System → Display → Decimal places 2

Prerequisite A measured value is specified in the **Value 2 display** parameter.

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

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

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

Factory setting Automatic

Value 3 display

Navigation Setup → Advanced setup → Display → Value 3 display
Expert → System → Display → Value 3 display

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

The **Format display** parameter is used to specify how the measured values are displayed.

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

Factory setting Off

Decimal places 3

Navigation Setup → Advanced setup → Display → Decimal places 3
Expert → System → Display → Decimal places 3

Prerequisite A measured value is specified in the **Value 3 display** parameter.

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

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

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

Factory setting Automatic

"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, menu-guided operation for **Enable SIL** must be performed.

A detailed description is provided in the Functional Safety Manual **SD01172T**.

SIL option

Navigation Setup → Advanced setup → SIL → SIL option

Description Indicates whether the device has been ordered with SIL certification. SIL certificate of the device

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

Options
- 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
- 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
- Temporary safe state

Factory setting Checking SIL option

SIL checksum

Navigation Setup → Advanced setup → SIL → SIL checksum

Description Use this function to display the SIL checksum entered.

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.

Timestamp SIL configuration

Navigation Setup → Advanced setup → SIL → Timestamp SIL configuration

Description Use this function to enter the date and time when the SIL parameterization has been completed and the SIL checksum has been calculated.

The date and time must be entered manually. This information is not generated automatically by the device.

User entry DD.MM.YYYY hh:mm

Factory setting 0

Force safe state

Navigation Setup → Advanced setup → SIL → Force safe state

Prerequisite The **Operational state** parameter displays **SIL mode active**.

Description This parameter is used to test error detection and the safe state of the device.

Options
- On
- Off

Factory setting Off

"Administration" submenu

Device reset

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

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

Options
- **Not active**
  No action is executed and the user exits the parameter.
- **To factory defaults**
  All the parameters are reset to the factory setting.
- **To delivery settings**
  All the parameters are reset to the order configuration. The order configuration can differ from the factory setting if customer-specific parameter values were defined when the device was ordered.
- **Restart device**
  The device is restarted but the device configuration remains unchanged.

Factory setting Not active

Define device write protection code

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

Description Sets 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 for viewing.

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.

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

14.2 "Diagnostics" menu

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

Actual diagnostics

Navigation Diagnostics → Actual diagnostics
Expert → Diagnostics → Actual diagnostics

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

Display Symbol for event behavior and diagnostic event.

Additional information Example for display format:
F261-Electronics modules

Remedy information

Navigation Diagnostics → Remedy information
Expert → Diagnostics → Remedy information

Description Use this function to display the remedial action to be taken for the current diagnostic message.

Previous diagnostics 1

Navigation Diagnostics → Previous diagnostics 1
Expert → Diagnostics → Previous diagnostics 1

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

Display Symbol for event behavior and diagnostic event.

Additional information Example for display format:
F261-Electronics modules

Operating time

Navigation Diagnostics → Operating time
Expert → Diagnostics → Operating time

Description Use this function to display 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 diagnostic measures in the device and an overview of all the diagnostic messages → 📄 43.

Actual diagnostics count

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

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

Actual diagnostics

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

Description Use this function to display 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 channel

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

Description Use this function to display the sensor input to which the diagnostic message refers.

Display
- - - - - - -
- Sensor 1
- Sensor 2

14.2.2 "Event logbook" submenu

Previous diagnostics n

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

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

Description
Use this function to display 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
Use this function to display the possible sensor input to which the diagnostic message refers.

Display
- - - - - - -
- Sensor 1
- Sensor 2

14.2.3 "Device information" submenu

Device tag

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

Description
Use this function to enter a unique name for the measuring point so it can be identified quickly within the plant. The name is displayed in the header of the plug-in display.
→ 30

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

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

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

Display

Max. 11-digit character string comprising letters and numbers

Firmware version

Navigation

Diagnostics → Device information → Firmware version
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

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

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

Extended order code 1-3

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

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 spare device.
- To check the ordered device features using the delivery note.

ENP version

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

Description
Displays the version of the electronic nameplate.

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

Device revision

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

Description
Use this function to view the device revision with which the device is registered with the HART FieldComm Group. It is needed to assign the appropriate device description file (DD) to the device.

Display
2-digit hexadecimal number

Manufacturer ID → 112

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

Manufacturer

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

Description Displays the manufacturer name.

Hardware revision

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

Description Displays the hardware revision of the device.

Configuration counter

Navigation Diagnostics → Device info. → Configuration counter
Expert → Diagnostics → Device info. → Configuration counter

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

Static parameters, whose values change during optimization or configuration, cause this parameter to increment by 1. This supports parameter version management. If several parameters change, e.g. 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 Use this function to display the current measured value at the sensor input.

Sensor n raw 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 non-linearized mV/Ohm value at the specific sensor input.

Device temperature

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

Description
Use this function to display 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
Use this function to display 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
Use this function to display the maximum temperature measured in the past at sensor input 1 or 2 (peakhold indicator).

Reset sensor min/max values

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

Device temperature min.

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

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

Reset device temp. min/max values

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

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 diagnostic message of the "function check" category (C) while simulation is in progress.

Display Measured value display ↔ C491 (current output simulation)

Options
- Off
- On

Factory setting Off

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

Value current output

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

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

Description Use this function to set a current value for the simulation. In this way, users can verify the correct adjustment of the current output and the correct function of downstream switching units.

User entry 3.59 to 23.0 mA

Factory setting 3.58 mA

14.3 "Expert" menu

The parameter groups for the Expert setup contain all the parameters of the "Setup" and "Diagnostics" operating menus, as well as other parameters that are solely reserved for experts. Descriptions of the additional parameters can be found in this section. All the fundamental parameter settings for transmitter commissioning and diagnostic evaluation are described in the "Setup menu"→ 🖹 75 and "Diagnostics menu"→ 🖹 94 sections.

14.3.1 "System" submenu

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.

Options
- 50 Hz
- 60 Hz

Factory setting 50 Hz

Device temperature alarm → 81

Navigation Expert → System → Device temperature alarm

"Display" submenu
→ 86

"Administration" submenu
→ 92

14.3.2 "Sensor" submenu

"Sensor 1/2" submenu
n = Stands for the number of sensor inputs (1 and 2)

Sensor n lower limit

Navigation Expert → Sensor → Sensor n → Sensor n lower limit

Description Displays the minimum physical full scale value.

Sensor n upper limit

Navigation Expert → Sensor → Sensor n → Sensor n upper limit

Description Displays the maximum physical full scale value.

Sensor serial number

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

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

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

Factory setting "" (no text)

"Sensor trimming" submenu

Sensor error adjustment (sensor trimming)

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

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

Procedure

1. Start
↓
2. Set the **Sensor trimming** parameter to the **Customer-specific** setting.
↓
3. Using a water/oil bath, bring the sensor connected to the transmitter to a known and stable temperature. A temperature which is close to the set start of the measuring range is recommended.
↓
4. Enter the reference temperature for the value at the start of the measuring range for the **Sensor trimming lower value** parameter. Based on the difference between the specified reference temperature and the temperature actually measured at the input, the transmitter internally calculates a correction factor which is now used to linearize the input signal.
↓
5. Using a water/oil bath, bring the sensor connected to the transmitter to a known and stable temperature close to the set end of the measuring range.
↓
6. Enter the reference temperature for the value at the end of the measuring range for the **Sensor trimming upper value** parameter.
↓
7. End

Sensor trimming

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

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

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

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→ 105.

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 Use this function to view the minimum possible span between the sensor trimming upper and lower value.

"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

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 -200 °C

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 850 °C

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 100.000 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 100.00 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

"Diagnostic settings" submenu

Calibration counter start

Navigation Expert → Sensor → Diagnostic settings → Calibration counter start

Description Option to control the calibration counter.

- The countdown duration (in days) is specified with the **Calibration counter start value** parameter.
- The status signal issued when the limit value is reached is defined with the **Calibration alarm category** 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

Calibration alarm category

Navigation Expert → Sensor → Diagnostic settings → Calibration alarm category

Description Use this function to select the category (status signal) as to how the device reacts when the set calibration countdown expires.

Options
- Maintenance required (M)
- Failure (F)

Factory setting Maintenance required (M)

Calibration counter start value

Navigation Expert → Sensor → Diagnostic settings → Calibration counter start value

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

User entry 0 to 365 d (days)

Factory setting 365

Count value

Navigation Expert → Sensor → Diagnostic settings → Count value

Description Use this function to view the time remaining until the next calibration.

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

14.3.3 "Output" submenu

Measuring mode

Navigation Expert → Output → Measuring mode

Description Enables the inversion of the output signal.

Additional information
- **Standard**
  The output current increases with increasing temperatures
- **inverted**
  The output current decreases with increasing temperatures

Options
- Standard
- inverted

Factory setting Standard

14.3.4 "Communication" submenu

"HART configuration" submenu

Device tag → 96

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 SHORTTAG

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

Reset configuration changed flag

Navigation Expert → Communication → HART configuration → Reset configuration changed flag

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

"HART info" submenu

Device type

Navigation Expert → Communication → HART info → Device type

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

Factory setting 0x11CC or TMT82 (depends on the configuration tool)

Device revision

Navigation Expert → Communication → HART info → Device revision

Description Use this function to view the device revision with which the device is registered with the HART® FieldComm Group. It is needed to assign the appropriate device description file (DD) to the device.

Factory setting 3

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

Factory setting 0x11 (hexadecimal) or 17 (decimal)

HART revision

Navigation Expert → Communication → HART info → HART revision

Description Use this function to display 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 16 x spaces

HART message

Navigation Expert → Communication → HART info → HART message

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

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

Factory setting 32 x spaces

Hardware revision

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

Description Displays the hardware revision of the device.

Software revision

Navigation Expert → Communication → HART info → Software revision

Description Displays the software revision of the device.

HART date code

Navigation Expert → Communication → HART info → HART date code

Description Use this function to define date information for individual use.

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

Factory setting 2010-01-01

"HART output" submenu

Assign current output (PV)

Navigation 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 set with the **Sensor switching limit value** parameter. With temperature-dependent switching, it is possible to combine 2 sensors that offer advantages in different temperature ranges.

Factory setting Sensor 1

PV

Navigation Expert → Communication → HART output → PV

Description Use this function to display the primary HART value

Assign SV

Navigation Expert → Communication → HART output → Assign SV

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

Options See **Assign current output (PV)** parameter, → 114

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, → 114

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, → 114

Factory setting Sensor 1

QV

Navigation Expert → Communication → HART output → QV

Description Use this function to display the quaternary HART value

"Burst configuration" submenu

Up to 3 burst modes can be configured.

Burst mode

Navigation Expert → Communication → Burst configuration → Burst mode

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

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

Factory setting Off

Burst command

Navigation Expert → Communication → Burst configuration → Burst command

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

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

Factory setting Command 2

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

Burst variable n

n = Number of burst variables (0 to 3)

Navigation Expert → Communication → Burst configuration → Burst variable n

Prerequisite

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

Description

Use this function to assign a measured variable to slots 0 to 3.

This assignment is **only** relevant for the burst mode. The measured variables are assigned to the 4 HART variables (PV, SV, TV, QV) in the **HART output** menu → 114.

Selection

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

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

Burst trigger mode

Navigation

Expert → Communication → Burst configuration → Burst trigger mode

Description

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

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

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

Factory setting Continuous

Burst trigger level

Navigation Expert → Communication → Burst configuration → Burst trigger value

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

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

User entry $-1.0e^{+20}$ to $+1.0e^{+20}$

Factory setting -10.000

Min. update period

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

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

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

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

Factory setting 1000

Max. update period

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

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

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

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

Factory setting 2000

14.3.5 "Diagnostics" submenu

"Diagnostic list" submenu

Detailed description → 95

"Event logbook" submenu

Detailed description → 96

"Device information" submenu

Extended order code 1-3

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

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 spare device.
- To check the ordered device features using the delivery note.

ENP version

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

Description Displays the version of the electronic nameplate.

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

Device revision

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

Description Use this function to view the device revision with which the device is registered with the HART FieldComm Group. It is needed to assign the appropriate device description file (DD) to the device.

Display 2-digit hexadecimal number

Manufacturer ID → 112

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

Manufacturer

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

Description Displays the manufacturer name.

Hardware revision

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

Description Displays the hardware revision of the device.

"Measured values" submenu

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.

"Min/max values" submenu
Detailed description → 100

"Simulation" submenu
Detailed description → 102

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