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01.01 (device version)

# Operating Instructions
# **F2058**

4-20 mA temperature transmitter



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# 1 About this document

## 1.1 Document function

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

## 1.2 Safety instructions

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!

## 1.3 Symbols

### 1.3.1 Safety symbols

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

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

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

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

### 1.3.2 Symbols for certain types of information

| Symbol | Meaning |
|---|---|
| ✓ | **Permitted**<br>Procedures, processes or actions that are permitted. |
| ✓✓ | **Preferred**<br>Procedures, processes or actions that are preferred. |
| ✗ | **Forbidden**<br>Procedures, processes or actions that are forbidden. |
| ℹ | **Tip**<br>Indicates additional information. |
| 📖 | Reference to documentation |
| 📄 | Reference to page |
| 🖼 | Reference to graphic |

| Symbol | Meaning |
|---|---|
| ▶ | 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 |

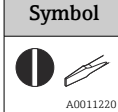
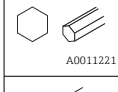
### 1.3.3 Electrical symbols

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

### 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 |
|  | Hazardous area |  | Safe area (non-hazardous area) |

## 1.4 Tool symbols

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

## 1.5 Change history

Revision history

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

XX Change to main version. No longer compatible. The device and Operating Instructions change.

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

ZZ Bug fixes and internal changes. No changes to the Operating Instructions.

| Date | Version | Firmware version | Changes | Documentation |
|---|---|---|---|---|
| 12/2021 | RTD | 01.01.zz | Original firmware | BA02222O/01.21 |
| 03/2025 | RTD<br>TC | 01.01.zz | DIN rail transmitter functions added | BA02222O/02.25 |
| 07/2026 | RTD<br>TC | 01.01.zz | Formal changes to the document | BA02222O/03.26 |

# 2 Basic safety instructions

## 2.1 Requirements for the personnel

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

The operating personnel must fulfill the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

## 2.2 Intended use

The device is a configurable temperature transmitter with a sensor input for resistance thermometers (RTD) or thermocouples (TC). The head transmitter version of the device is intended for mounting in a terminal head (flat face) as per DIN EN 50446. It is also possible to mount the device on a DIN rail using the optional DIN rail clip. The device is also optionally available in a version suitable for DIN rail mounting as per IEC 60715 (TH35).

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

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

For work on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.

## 2.4 Operational safety

Risk of injury!
- Operate the device only if it is in proper technical condition, free from errors and faults.
- 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 instrumented system):
- Based on the technical data on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area. The nameplate can be found on the side of the transmitter housing.
- Comply with the instructions in the separate supplementary documentation, which is an integral part of this manual.

**Electromagnetic compatibility**
The measuring system complies with the 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

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

## 2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

## 2.6 IT security

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

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

# 3 Incoming acceptance and product identification

## 3.1 Incoming acceptance

On receipt of the delivery:

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

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

### 3.1.1 Product identification

**Nameplate**

**Do you have the correct device?**

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Serial number
- Tag name (TAG) (optional)
- Technical values, e.g. supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols

▶ Compare the information on the nameplate with the order.

**Name and address of manufacturer**

| | |
|---|---|
| **Name of manufacturer:** | Endress+Hauser Wetzer GmbH + Co. KG |
| **Address of manufacturer:** | Obere Wank 1, D-87484 Nesselwang |

## 3.2 Storage and transport

Carefully remove each package and protection relative to the transportation packaging.

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

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

Storage temperature
- Head transmitter: −50 to +100 °C (−58 to +212 °F)
- DIN rail transmitter: −50 to +100 °C (−58 to +212 °F)

# 4 Installation

## 4.1 Installation requirements

### 4.1.1 Dimensions

The device dimensions can be found in the "Technical data" section of the Operating Instructions.

### 4.1.2 Installation location

- Head transmitter:
  In terminal head form B in accordance with DIN EN 50446, direct installation onto insert with cable entry (middle hole 7 mm (0.28 in))
- DIN rail transmitter:
  Designed for installation on DIN rail (TH35) in accordance with IEC 60715 TH35.

Make sure there is enough space in the terminal head.

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

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

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

NOTICE

**When a DIN rail-mounted transmitter using thermocouple measurement is installed, increased measurement errors or deviations may occur, depending on the installation conditions and ambient conditions.**

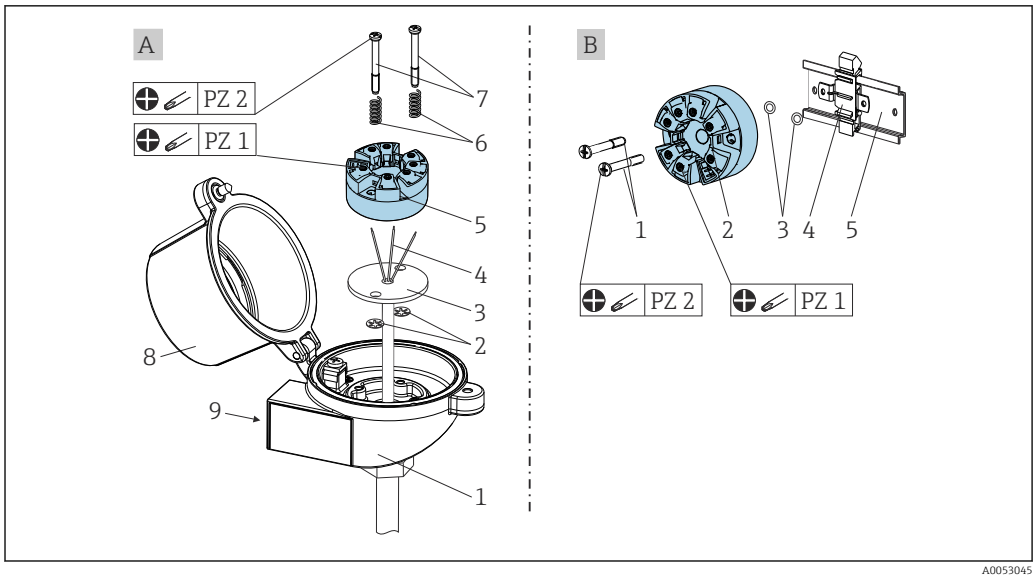
- ▶ If the DIN rail transmitter is mounted on the DIN rail without any adjacent devices, this may result in deviations of up to ± 1.3 °C. Greater deviations may occur if the DIN rail-mounted device is mounted in series between other DIN rail-mounted devices.

## 4.2 Installing the measuring instrument

### 4.2.1 Installing the head transmitter

Required tools: Phillips screwdriver:

- Maximum torque for securing screws = 1 Nm (¾ foot-pound), screwdriver: Pozidriv Z2
- Maximum torque for screw terminals = 0.35 Nm (¼ foot-pound), screwdriver: Pozidriv Z1




1 *Head transmitter mounting*

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

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

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

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

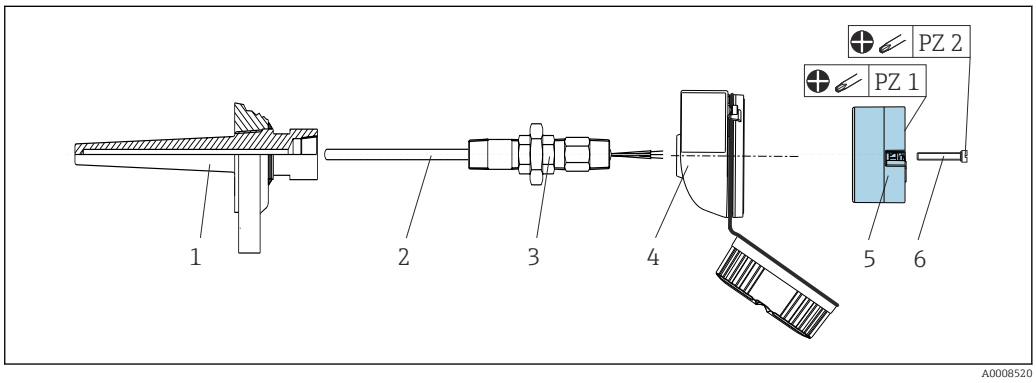
1. Open the terminal head cover (8) on the terminal head.
2. Guide the connection wires (4) of the insert (3) through the center hole in the head transmitter (5).
3. Fit the mounting springs (6) on the mounting screws (7).
4. Guide the mounting screws (7) through the side boreholes of the head transmitter 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, close the terminal head cover (8) tightly again.

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

Procedure for installation on a DIN rail, position B:

1. Press the DIN rail clip (4) onto the DIN rail (5) until it engages with a click.
2. Guide the mounting screws (1) through the lateral bores in 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).

### Installation with central spring-loaded insert




2 *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.
8. Screw the terminal head (4), with the integrated and wired head transmitter, onto the ready-mounted nipple and adapter (3).

**NOTICE**

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

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

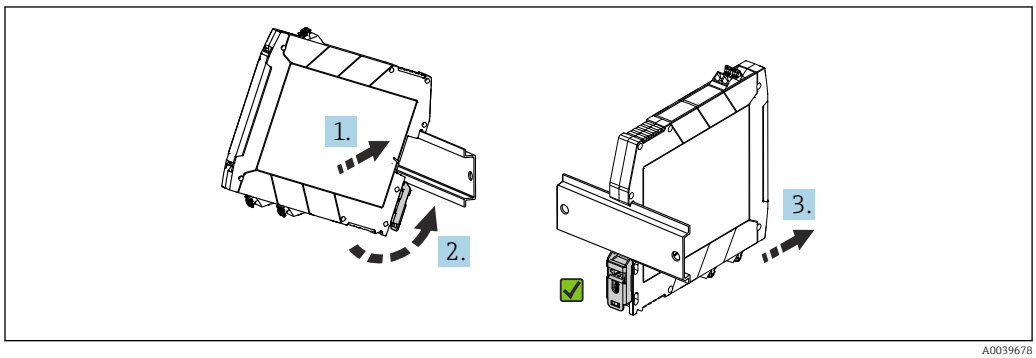
### 4.2.2 Installing the DIN rail transmitter

NOTICE

**Incorrect orientation**

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

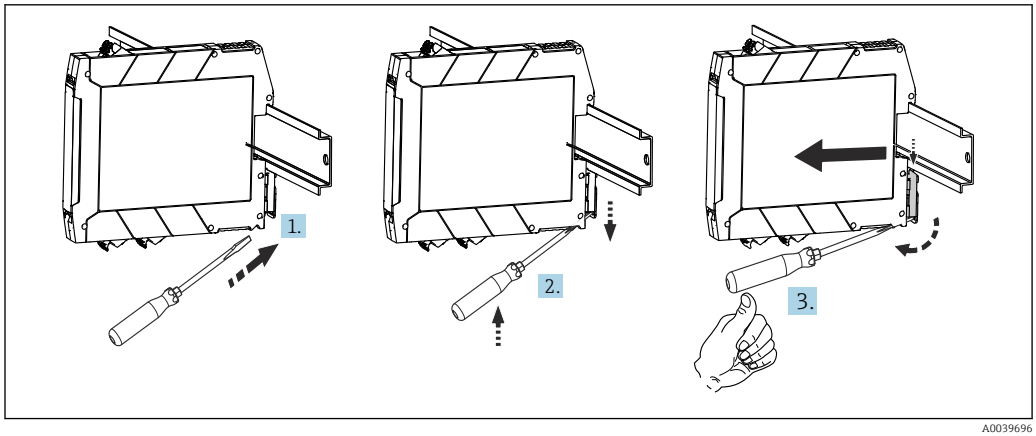
▶ Mount the device vertically and ensure it is correctly oriented.




3 *Installing the DIN rail transmitter*

1. Position the top DIN rail groove at the top end of the DIN rail.
2. Slide the bottom of the device over the bottom end of the DIN rail until you can hear the lower DIN rail clip click into place on the DIN rail.
3. Pull gently on the device to check if it is correctly mounted on the DIN rail.

If it doesn't move, the DIN rail transmitter is correctly mounted.




4 *Dismantling the DIN rail transmitter*

Dismantling the DIN rail transmitter:

1. Insert a screwdriver into the tab of the DIN rail clip.
2. Use the screwdriver to pull down on the DIN rail clip as shown in the diagram.
3. Hold down the screwdriver to remove the device from the DIN rail.

## 4.3 Post-installation check

After installing the device, always perform the following checks:

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

# 5 Electrical connection

## 5.1 Connecting requirements

**⚠ CAUTION**

**Destruction of parts of the electronics**

- ▶ Do not install or wire the device when it is connected to the operating voltage.
- ▶ Do not occupy the CDI connection.

For information on the connection data, see the "Technical data" section.

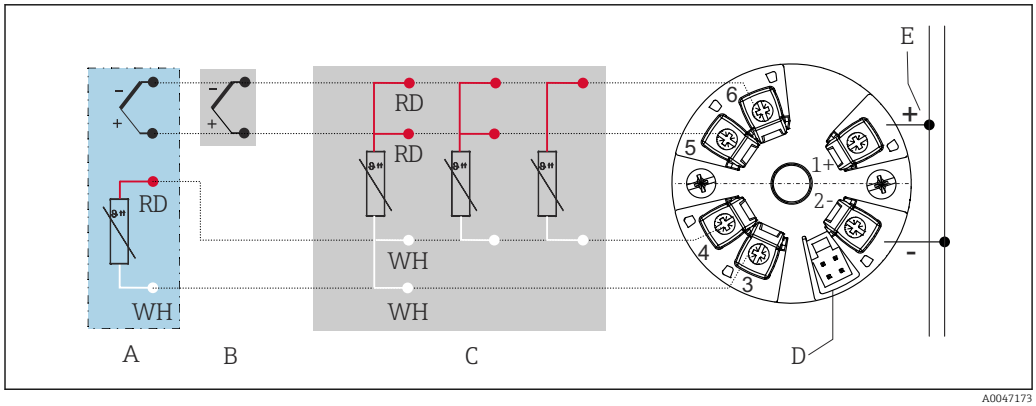
A Phillips head screwdriver is required to wire the head transmitter with screw terminals. Use a flat blade screwdriver for the DIN rail housing version with screw terminals. The version with push-in terminals can be wired without any tools.

Proceed as follows to wire a mounted head transmitter:

1. Open the cable gland and the housing cover on the terminal head or the field housing.
2. Feed the cables through the opening in the cable gland.
3. Connect the cables as shown in → 16. If the head transmitter is fitted with push-in terminals, pay particular attention to the information in the "Connecting to push-in terminals" section.
4. Tighten the cable gland again and close the housing cover.

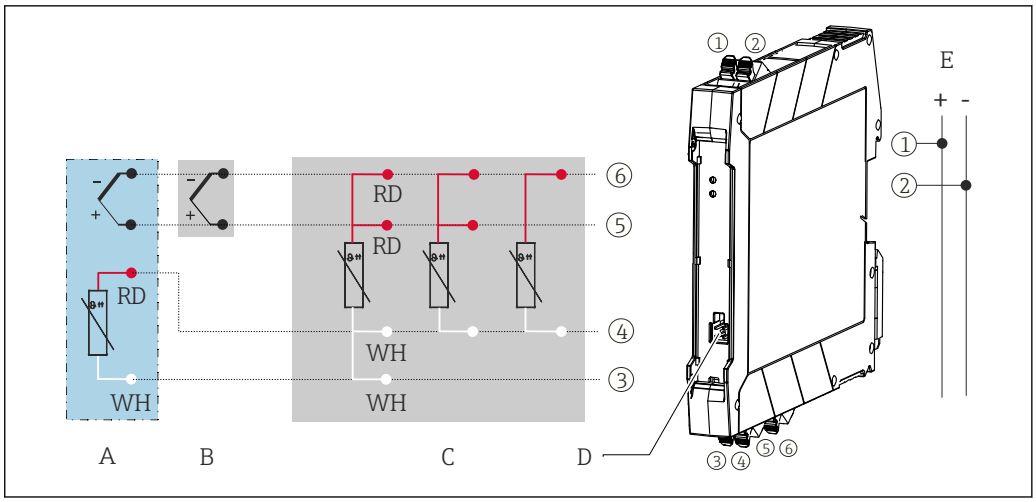
In order to avoid connection errors, always follow the instructions in the post-connection check section before commissioning.

## 5.2 Quick wiring guide




5 *Terminal assignment for head transmitter*

*A TC sensor input, external cold junction (CJ) Pt1000*
*B TC sensor input, internal cold junction (CJ)*
*C RTD sensor input: 4-, 3- and 2-wire*
*D CDI interface*
*E Power supply*




6 *Terminal assignment for DIN rail transmitter*

*A TC sensor input, external cold junction (CJ) Pt1000*
*B TC sensor input, internal cold junction (CJ)*
*C RTD sensor input: 4-, 3- and 2-wire*
*D CDI interface*
*E Power supply*

In the case of a thermocouple (TC) measurement, a 2-wire RTD can be connected to measure the cold junction temperature. This is connected to terminals 3 and 4.

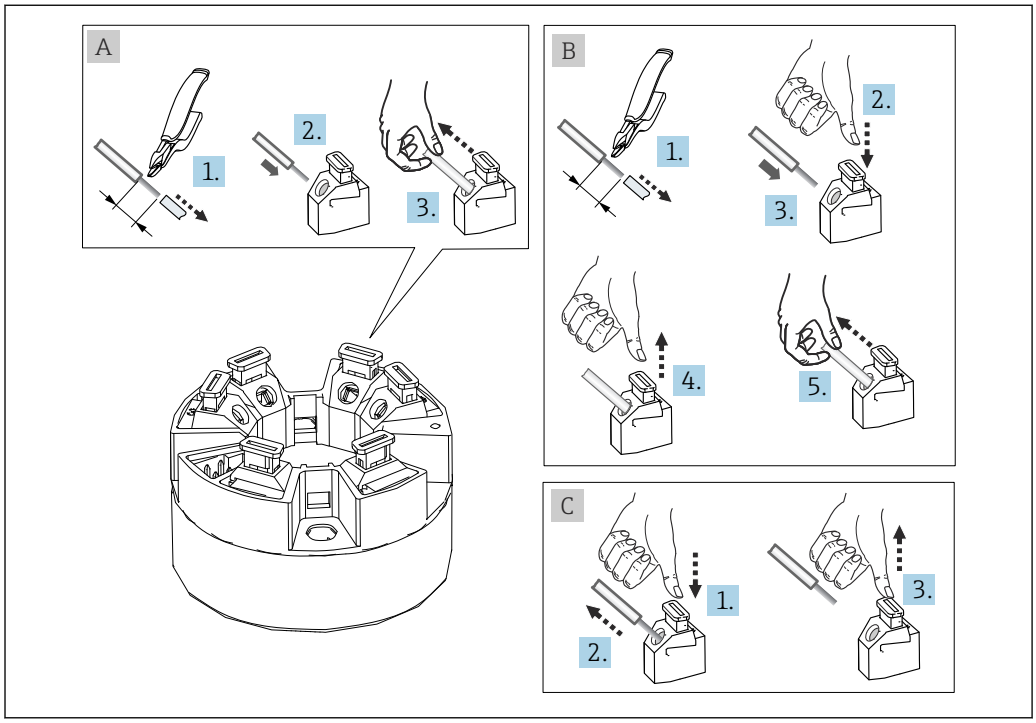
**NOTICE**

- 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.

Maximum torque for screw terminals = 0.35 Nm (¼ lbf ft), screwdriver: Pozidriv Z1

## 5.3 Connecting the sensor input

### 5.3.1 Connecting the sensor to push-in terminals




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

**Fig. A, solid wire, fine-strand wire with ferrule:**

1. Strip wire end to length of at least 10 mm (0.39 in).
2. Insert the wire end into the terminal.
3. Pull the wire gently to ensure it is connected correctly. If the wire is not secure, repeat from step 1.

**Fig. B, fine-strand wire without ferrule:**

1. Strip wire end to length of at least 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. If the wire is not secure, repeat from step 1.

**Fig. C, releasing the connection:**

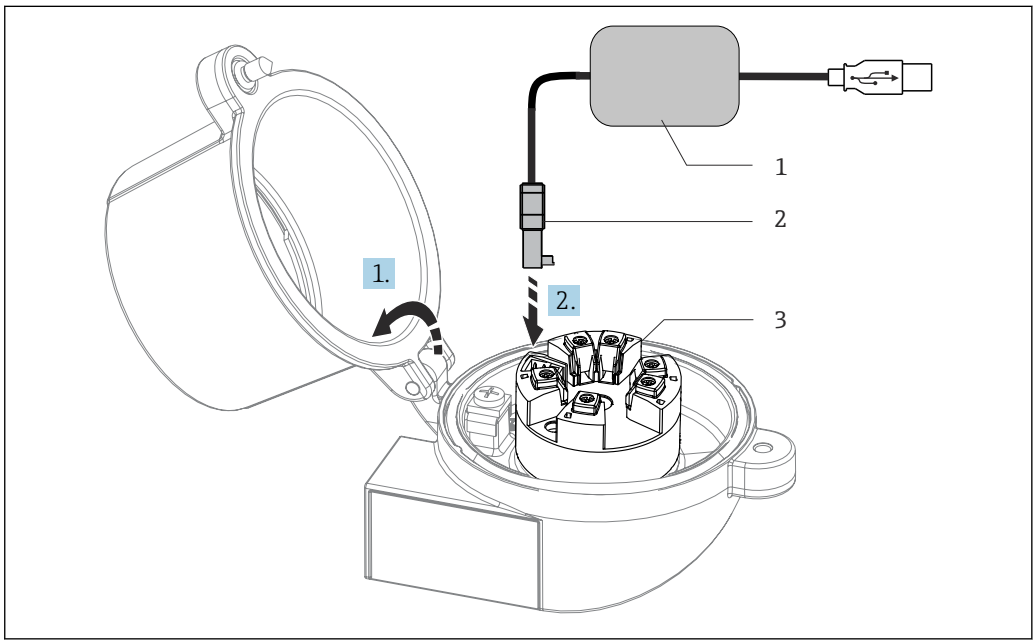
1. Press down on the lever opener.
2. Remove the wire from the terminal.
3. Release lever opener.

## 5.4 Connecting the transmitter

**Cable specifications**
No special requirements, such as shielding, apply to the instrument cable. The exception is the DIN rail version with RTD input, for which shielded cables must be used.

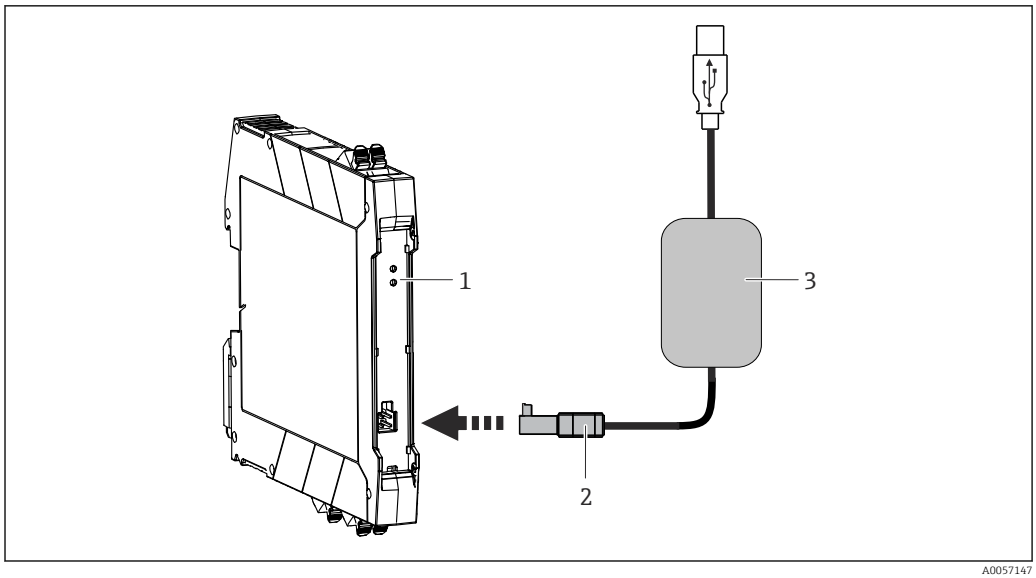
Also follow the general procedure described in → 16.

- The terminals for the power supply (1+ and 2-) are protected against reverse polarity.
- Cable cross-section; see the "Technical data", → 32




8 *Fitting the CDI connector of the configuration kit for configuration, visualization and maintenance of the head transmitter via PC and configuration software*

1 *Configuration kit with USB port*
2 *CDI connector*
3 *Installed head transmitter with CDI interface*




9 *Connecting the CDI connector of the configuration kit for configuration, visualization and maintenance of the DIN rail transmitter via PC and configuration software*

1 *DIN rail transmitter*
2 *CDI connector*
3 *Configuration kit with USB port*

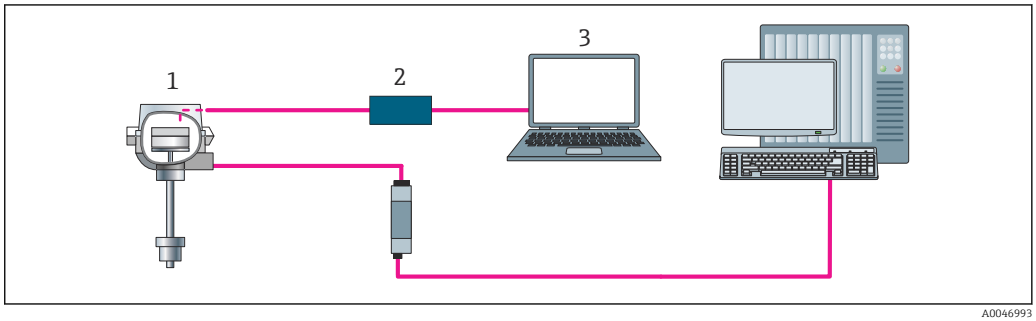
For parameter configuration, the power supplied via the communication kit (CDI) is sufficient. No additional power supply is required.

## 5.5 Post-connection check

| Device condition and specifications | Notes |
|---|---|
| Are the device and cables free from damage (visual check)? | -- |
| Do the ambient conditions match the device specification (e.g. ambient temperature, measuring range, etc.)? | See "Technical data". |
| **Electrical connection** | **Notes** |
| Does the supply voltage match the specifications on the nameplate? | U = e.g. 10 to 36 $V_{DC}$ |
| Are the mounted cables strain-relieved? | -- |
| Are the power supply and signal cables connected correctly? | → 16 |
| 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? | -- |

# 6 Operation options

## 6.1 Overview of operation options



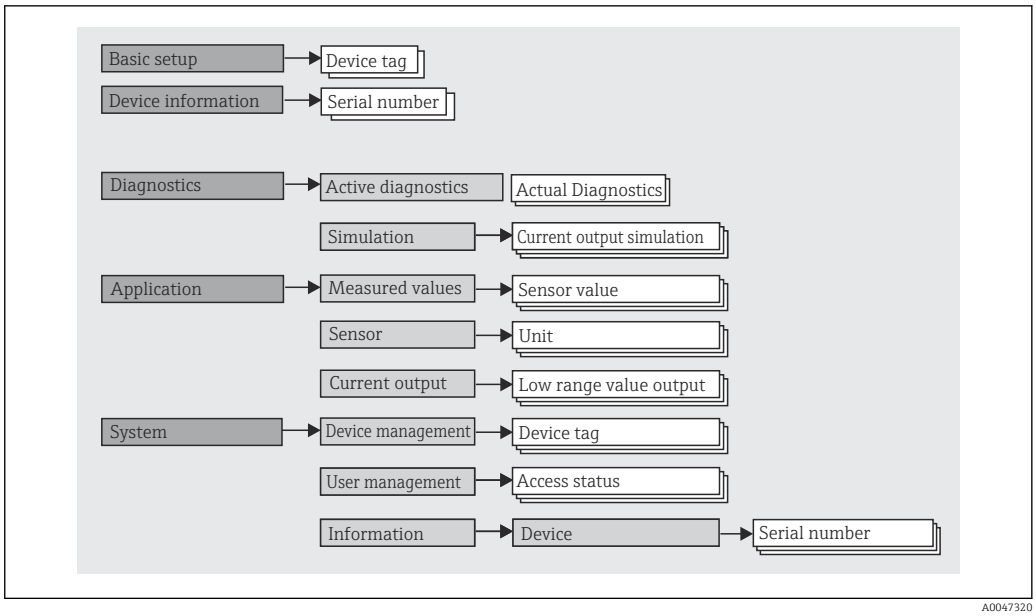

10 *Operation options for the transmitter via the CDI interface*

1 *Transmitter*
2 *Configuration kit*
3 *Configuration software*

CDI (Common Data Interface) is a service and communication interface. It enables parameter configuration, diagnostics and data transfer between the device and a configuration tool via a serial UART connection.

## 6.2 Structure and function of the operating menu

### 6.2.1 Structure of the operating menu




**User roles**

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

- **Operator**
  The plant operator can only change settings that do not affect the application - and particularly the measuring path - and simple, application-specific functions that are used during operation. The operator is able to read all the parameters, however.
- **Maintenance**
  The **Maintenance** user role refers to configuration situations: commissioning and process adaptations as well as troubleshooting. It allows the user to configure and modify all available parameters. In contrast to the **Operator** user role, in the Maintenance role the user has read and write access to all the parameters.
- **Changing the user role**
  A user role - and therefore existing read and write authorization - is changed by selecting the desired user role (already pre-selected depending on the operating tool) and entering the correct password when subsequently prompted. When a user logs out, system access always returns to the lowest level in the hierarchy. A user logs out by actively selecting the logout function when operating the device.
- **As-delivered state**
  The **Operator** user role is not enabled when the device is delivered from the factory, i.e. the **Maintenance** role is the lowest level in the hierarchy ex-works. This state makes it possible to commission the device and make other process adaptations without having to enter a password. Afterwards, a password can be assigned for the **Maintenance** user role to protect this configuration. If the option *Configuration locked when delivered* was selected during device configuration, the device is set to the **Operator** user role when delivered. It is therefore not possible to change the configuration. The delivery password stored can be reset and reassigned.
- **Password**
  The **Maintenance** user role can assign a password in order to restrict access to device functions. This activates the **Operator** user role, which is now the lowest hierarchy level where the user is not asked to enter a password. The password can only be changed or disabled in the **Maintenance** user role.

### Submenus

The **Standard** or **Expert** mode can be selected in the FDC operating tool. The following operating menus appear depending on the setting:

**Navigation** **Standard**

| Menu | Typical tasks | Content/meaning |
|---|---|---|
| "Basic setup" | Commissioning:<br>▪ Configuration of the measurement.<br>▪ Configuration of data processing (scaling, linearization, etc.).<br>▪ Configuration of the analog measured value output. | Contains parameters for basic commissioning: configuration of the measurement and the analog current output |
| "Device information" | Tasks during operation:<br>▪ Reading measured values.<br>▪ Information for device identification. | Contains all the current measured values and parameters for the unique identification of the device. |

**Navigation** **Expert**

| Menu | Typical tasks | Content/meaning |
|---|---|---|
| "Diagnostics" | Troubleshooting:<br>▪ Diagnosing and eliminating process errors.<br>▪ Error diagnostics in difficult cases.<br>▪ Interpretation of device error messages and correcting associated errors. | Contains all parameters for detecting and analyzing errors:<br>▪ **Active diagnostics**<br>Displays the error message that is currently active<br>▪ **"Current output simulation" submenu**<br>Used to simulate output values. |
| "Application" | Commissioning:<br>▪ Configuration of the measurement.<br>▪ Configuration of data processing (scaling, linearization, etc.).<br>▪ Configuration of the analog measured value output.<br>Tasks during operation:<br>Reading measured values. | Contains all the parameters for commissioning:<br>▪ **"Measured values" submenu**<br>Contains all the current measured values<br>▪ **"Sensor" submenu**<br>Contains all the parameters for configuring the measurement<br>▪ **"Output" submenu**<br>Contains all the parameters for configuring the analog current output |
| "System" | Tasks that require detailed knowledge of the system administration of the device:<br>▪ Optimum adaptation of the measurement for system integration.<br>▪ User and access administration, password control<br>▪ Information for device identification | Contains all higher-level device parameters that are assigned to system, device and user management.<br>▪ **"Device management" submenu**<br>Contains parameters for general device management<br>▪ **"User management" submenu**<br>Parameters for access authorization, password assignment, etc.<br>▪ **"Information" submenu**<br>Contains all the parameters for the unique identification of the device |

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

### 6.3.1 Field Device Configurator (FDC) Tool

#### Range of functions

The FDC Tool is a configuration tool that is available free of charge. The devices can be connected directly via a modem (point-to-point). DeviceCare is fast, easy and intuitive to use. It can run on a PC, laptop or tablet with a Windows operating system.

Please contact your sales organization for tool availability.

# 7 Commissioning

## 7.1 Post-installation check

Before commissioning the measuring point, ensure that all final checks have been completed:
- "Post-installation check" checklist → 11
- "Post-connection check" checklist → 16

## 7.2 Switching on the device

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

The device works after approx. 5 seconds. Normal measuring mode commences as soon as the switch-on procedure is completed.

## 7.3 Configuring the device

For offline configuration outside normal measuring operation, the power supplied by the communication kit (CDI) is sufficient. No additional power supply is required.

The starting point is in the **Basic setup** menu. Parameter settings that require specific access permissions may be disabled. In order to use a device for the designated application, one of the first steps that need to be performed is the basic setup.

**Navigation** **Basic setup**

*The following parameters can be configured:*

**RTD version:**
Unit
Sensor type
Connection type
2-wire compensation
Lower range value output
Upper range value output
Failure mode

**TC version:**
Unit
Sensor type
Cold junction
Lower range value output
Upper range value output
Failure mode

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

**Navigation** **System → User management**

Access status
Logout
Delete password

1. In the "Access status" field, the **Maintenance** role appears with the two entry fields **Logout** and **Delete password**.
2. **Logout** function:
   Enable the **Logout** entry field.
   ↳ The **Operator** role appears in the "Access status" field. The **Enter access code** entry field is displayed.
3. To return to the **Maintenance** role, enter a four-digit access code, which you have already defined, in this entry field.
   ↳ The **Maintenance** role appears in the "Access status" field.
4. **Delete password** function:
   Enable the **Delete password** entry field.
5. In the **Define software write protection code** entry field, enter a user-defined password that meets the specifications in the online help.
   ↳ The startup screen as described in Step 1 appears.

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

## 7.4 Protecting settings from unauthorized access

### 7.4.1 Software locking

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

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

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

User role concept → 21

# 8 Diagnostics and troubleshooting

## 8.1 General troubleshooting

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

Due to its design, the device cannot be repaired. However, it can be returned for inspection. See the information in the "Return" section.

*General faults*

| Fault | Possible cause | Remedial action |
|---|---|---|
| Device is not responding. | Supply voltage does not match the voltage specified on the nameplate. | Check the voltage at the transmitter directly using a voltmeter and correct. |
| | Connecting cables are not making contact with the terminals. | Check the electrical contact between the cable and terminals and correct if necessary. |
| | Electronics module is defective. | Replace the device. |
| Output current <3.6 mA | Signal cable is not wired correctly. | Check wiring. |
| | Electronics module is defective. | Replace the device. |
| | 'Low Alarm' failure current is set | Set the failure current to 'High Alarm'. |

| Error messages in the configuration software |
|---|
| → 27 |

*Application errors without diagnostic messages for RTD sensor connection*

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

*Application errors without diagnostic messages for TC sensor connection*

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

## 8.2 Diagnostic information via communication interface

*Status signals*

| Letter/ symbol [1] | Event category | Meaning |
|---|---|---|
| **F** | Operating error | An operating error has occurred. |
| **C** | Service mode | The device is in the service mode (e.g., during a simulation). |
| **S** | Out of specification | The device is being operated outside its technical specifications (e.g. during startup or cleaning processes). |
| **M** | Maintenance required | Maintenance is required. |
| **N** - | No effect | |

1) As per NAMUR NE 107

*Diagnostic behavior*

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

If several diagnostic events are pending at the same time, only the current diagnostic message is displayed. The status signal dictates the priority in which the diagnostic messages are displayed. The following order of priority applies: F, C, S, M.

## 8.3 Overview of diagnostic events

Each diagnostic event is assigned a specific diagnostic behavior ex works.

| Diagnostic number | Short text | Remedy instructions | Status signal [from the factory] | Diagnostic behavior [from the factory] |
|---|---|---|---|---|
| **Diagnostic of sensor** | | | | |
| 041 | Sensor breakage detected | 1. Check electrical connection<br>2. Replace sensor<br>3. Check configuration of connection type | F | Alarm |
| 043 | Short circuit | 1. Check electrical connection<br>2. Check sensor<br>3. Replace sensor or cable | F | Alarm |
| 047 | Sensor limit reached | 1. Check sensor<br>2. Check process conditions | S | Warning |
| 145 | Compensation reference point | 1. Check terminal temperature<br>2. Check external reference point | F | Alarm |
| **Diagnostic of electronic** | | | | |
| 201 | Electronics faulty | 1. Restart device<br>2. Replace electronics | F | Alarm |
| **Diagnostic of configuration** | | | | |
| 402 | Initialization active | Initialization in progress, please wait | C | Warning |
| 410 | Data transfer failed | 1. Check connection<br>2. Repeat data transfer | F | Alarm |
| 411 | Up-/download active | Up-/download in progress, please wait | C | Warning |
| 435 | Linearization faulty | Check linearization | F | Alarm |
| 485 | Process variable simulation active | Deactivate simulation | C | Warning |
| 491 | Output simulation | Deactivate simulation | C | Warning |
| 531 | Factory adjustment missing | 1. Contact service organization<br>2. Replace device | F | Alarm |
| 537 | Configuration | 1. Check device configuration<br>2. Up- and download new configuration | F | Alarm |
| 537 | Configuration | Check current output configuration | F | Alarm |
| **Diagnostic of process** | | | | |
| 801 | Supply voltage too low | Increase supply voltage | S | Alarm |
| 825 | Operating temperature | 1. Check ambient temperature<br>2. Check process temperature | S | Warning |
| 844 | Process value out of specification | 1. Check process value<br>2. Check application<br>3. Check sensor | S | Warning |

The device always outputs the Low alarm state (output current < 3.6 mA) when diagnostic event 801 occurs.

# 9 Maintenance

## 9.1 Maintenance work

The device does not require specific maintenance work.

## 9.2 Cleaning of surfaces not in contact with the medium

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

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

# 10 Repair

## 10.1 General information

Due to its design, the device cannot be repaired.

## 10.2 Spare parts

*Ask your supplier for information on spare parts available.*

| Type |
|---|
| Standard - DIN securing set (2 screws and springs, 4 shaft lock-down rings, 1 plug for the display interface) |
| US - M4 securing set (2 screws and 1 plug for the display interface) |

## 10.3 Return

The requirements for safe device return can vary depending on the device type and national legislation. Please contact your supplier for further information.

## 10.4 Disposal

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

# 11 Accessories

Various accessories, which can be ordered separately from your supplier, are available for the device.

## 11.1 Device-specific accessories

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

## 11.2 Communication-specific accessories

| Accessories | Description |
|---|---|
| FDC Tool | The FDC Tool is a configuration tool that is available free of charge. The devices can be connected directly via a modem (point-to-point). It is fast, easy and intuitive to use. It can run on a PC, laptop or tablet with a Windows operating system. |
| Configuration kit | Configuration kit for PC-programmable transmitter – FDT/DTM-based plant asset management tool and interface cable (4-pin plug-in connector) for PC with USB port. |

# 12 Technical data

## 12.1 Input

Measured variable: Temperature (temperature-linear transmission behavior)

| Resistance thermometer (RTD) as per standard | Description | α | Measuring range limits | Min. measuring span |
|---|---|---|---|---|
| IEC 60751:2008 | Pt100 (1)<br>Pt1000 (4) | 0.003851 | −200 to 850 °C (−328 to 1 562 °F)<br>−200 to 500 °C (−328 to 932 °F) | 10 K<br>(18 °F) |
| JIS C1604:1984 | Pt100 (5) | 0.003916 | −200 to 510 °C (−328 to 950 °F) | 10 K<br>(18 °F) |
| GOST 6651-94 | Pt100 (9) | 0.003910 | −200 to 850 °C (−328 to 1 562 °F) | 10 K<br>(18 °F) |
| - | Pt100 (Callendar Van Dusen) | - | The measuring range limits are specified by entering the limit values that depend on the coefficients A to C and R0. | 10 K<br>(18 °F) |
| | ▪ Type of connection: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA<br>▪ With 2-wire circuit, compensation of the wire resistance possible (0 to 30 Ω )<br>▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire | | | |

| Thermocouples as per standard | Description | Measuring range limits | | Min. measuring span |
|---|---|---|---|---|
| IEC 60584, Part 1 | Type A (W5Re-W20Re) (30)<br>Type B (PtRh30-PtRh6) (31)<br>Type E (NiCr-CuNi) (34)<br>Type J (Fe-CuNi) (35)<br>Type K (NiCr-Ni) (36)<br>Type N (NiCrSi-NiSi) (37)<br>Type R (PtRh13-Pt) (38)<br>Type S (PtRh10-Pt) (39)<br>Type T (Cu-CuNi) (40) | 0 to 2 500 °C (32 to 4 532 °F)<br>40 to 1 820 °C (104 to 3 308 °F)<br>−250 to 1 000 °C (−418 to 1 832 °F)<br>−210 to 1 200 °C (−346 to 2 192 °F)<br>−270 to 1 372 °C (−454 to 2 502 °F)<br>−270 to 1 300 °C (−454 to 2 372 °F)<br>−50 to 1 768 °C (−58 to 3 214 °F)<br>−50 to 1 768 °C (−58 to 3 214 °F)<br>−200 to 400 °C (−328 to 752 °F) | Recommended temperature range:<br>0 to 2 500 °C (32 to 4 532 °F)<br>500 to 1 820 °C (932 to 3 308 °F)<br>−150 to 1 000 °C (−238 to 1 832 °F)<br>−150 to 1 200 °C (−238 to 2 192 °F)<br>−150 to 1 200 °C (−238 to 2 192 °F)<br>−150 to 1 300 °C (−238 to 2 372 °F)<br>200 to 1 768 °C (392 to 3 214 °F)<br>200 to 1 768 °C (392 to 3 214 °F)<br>−150 to 400 °C (−238 to 752 °F) | 50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F)<br>50 K (90 °F) |
| IEC 60584, Part 1<br>ASTM E230-3<br>ASTM 988-96 | Type C (W5Re-W26Re) (32) | 0 to 2 315 °C (32 to 4 199 °F) | 0 to 2 000 °C (32 to 3 632 °F) | 50 K (90 °F) |
| ASTM 988-96 | Type D (W3Re-W25Re) (33) | 0 to 2 315 °C (32 to 4 199 °F) | 0 to 2 000 °C (32 to 3 632 °F) | 50 K (90 °F) |
| DIN 43710 | Type L (Fe-CuNi) (41) | −200 to 900 °C (−328 to 1 652 °F) | −150 to 900 °C (−238 to 1 652 °F) | 50 K (90 °F) |
| | ▪ Internal cold junction (Pt1000)<br>▪ External preset value: Configurable value −40 to 85 °C (−40 to 185 °F)<br>▪ 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.) | | | |

## 12.2 Output

Output signal

| | |
|---|---|
| Analog output | 4 to 20 mA, 20 to 4 mA (can be inverted) |
| Galvanic isolation (TC) | U = 1.5 kV AC for 1 minute (input/output) |

Failure signal: **Failure information as per NAMUR NE43:**

Failure information is created if the measuring information is missing or not valid. The error with the highest priority is displayed.

| | |
|---|---|
| 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 |

Linearization/transmission behavior

Temperature linear

Filter

1st order digital filter: 0 to 120 s

Network frequency filter: 50/60 Hz (cannot be adjusted)

Switch-on delay

≤ 5 s, until the first valid measured value signal is present at the current output. While switch-on delay = $I_a$ ≤ 3.8 mA

## 12.3 Electrical connection

Supply voltage

Values for non-hazardous areas, protected against polarity reversal:
10 V ≤ Vcc ≤ 36 V (standard)

Values for hazardous area, see Ex documentation.

Current consumption

3.5 to 22.5 mA

Terminals

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 | ≤ 1.5 mm² (16 AWG) |
| **Push-in terminals** [1] (Cable design, 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) |

1) For push-in terminals, flexible conductors with a conductor cross-section ≤ 0.3 mm² must be fitted with ferrules.

## 12.4 Performance characteristics

Response time

| | |
|---|---|
| Resistance thermometers (RTD) | 0.5 s |
| Thermocouples (TC) | 0.5 s |
| Cold junction (CJ) | 2.0 s |

Update time

Approx. 500 ms

Reference operating conditions

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

Maximum measurement error

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

MV = Measured value

LRL = Lower range limit of relevant sensor

*Measurement error for resistance thermometers (RTD)*

| | Measurement error (±) | |
|---|---|---|
| | Increased accuracy in limited measuring range, −50 to 250 °C (−58 to 482 °F) | in the entire measuring range |
| RTD | 0.1 °C (0.18 °F) or 0.07 % of measuring span [1] | 0.15 °C (0.27 °F) or 0.07 % of measuring span [1] |

1) Whichever is greater

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

*Measurement error for thermocouples (TC)*

| Standard | Description | Measuring range | Measurement error (±) | Measurement error (±) |
|---|---|---|---|---|
| | | | Measuring span ≤ 500 K | Measuring span > 500 K |
| IEC 60584-1<br>ASTM E230-3 | Type A (30) | 0 to 2 500 °C (32 to 4 532 °F) | 1.63 °C (2.93 °F) | 1.75 °C (3.15 °F) or 0.08% of the measuring span [1] |
| | Type B (31) | 500 to 1 820 °C (932 to 3 308 °F) | 1.55 °C (2.79 °F) | 1.58 °C (2.84 °F) or 0.15 % of measuring span [1] |
| IEC 60584-1<br>ASTM E230-3<br>ASTM E988-96 | Type C (32) | 0 to 2 000 °C (32 to 3 632 °F) | 0.88 °C (1.58 °F) | 1.00 °C (1.80 °F) or 0.06 % of measuring span [1] |
| ASTM E988-96 | Type D (33) | | 0.81 °C (1.46 °F) | 0.92 °C (1.34 °F) or 0.06 % of measuring span [1] |
| IEC 60584-1<br>ASTM E230-3 | Type E (34) | −150 to 1 000 °C (−238 to 1 832 °F) | 0.30 °C (0.54 °F) | 0.33 °C (0.59 °F) or 0.05 % of measuring span [1] |
| | Type J (35) | −150 to 1 200 °C (−238 to 2 192 °F) | 0.33 °C (0.59 °F) | 0.44 °C (0.79 °F) or 0.04 % of measuring span [1] |
| | Type K (36) | | 0.41 °C (0.74 °F) | 0.50 °C (0.90 °F) or 0.05 % of measuring span [1] |
| | Type N (37) | −150 to 1 300 °C (−238 to 2 372 °F) | 0.54 °C (0.97 °F) | 0.60 °C (1.08 °F) or 0.06 % of measuring span [1] |
| | Type R (38) | 200 to 1 768 °C (−392 to 3 214 °F) | 0.91 °C (1.64 °F) | 0.99 °C (1.78 °F) or 0.07 % of measuring span [1] |
| | Type S (39) | 200 to 1 768 °C (392 to 3 214 °F) | 0.97 °C (1.75 °F) | 1.06 °C (1.91 °F) or 0.07 % of measuring span [1] |
| | Type T (40) | −150 to 400 °C (−238 to 752 °F) | 0.42 °C (0.76 °F) | 0.43 °C (0.77 °F) |
| DIN 43710 | Type L (41) | −150 to 900 °C (−238 to 1 652 °F) | 0.36 °C (0.65 °F) | 0.41 °C (0.74 °F) or 0.05 % of measuring span [1] |

1) Whichever is greater

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

*Operating influences of ambient temperature and supply voltage on resistance thermometers (RTD)*

| Description | Standard | Ambient temperature: Influence (±) per 1 °C (1.8 °F) change | | Supply voltage: Influence (±) per V change | |
|---|---|---|---|---|---|
| | | 0 to 200 °C (32 to 392 °F) | Entire measuring range | 0 to 200 °C (32 to 392 °F) | Entire measuring range |
| Pt100 (1) | IEC 60751:2008 | 0.02 °C (0.04 °F) | 0.04 °C (0.07 °F) | 0.01 °C (0.014 °F) | 0.02 °C (0.04 °F) |
| Pt1000 (4) | | 0.01 °C (0.02 °F) | 0.02 °C (0.03 °F) | 0.01 °C (0.009 °F) | 0.01 °C (0.02 °F) |
| Pt100 (5) | JIS C1604:1984 | 0.01 °C (0.03 °F) | 0.03 °C (0.05 °F) | 0.01 °C (0.011 °F) | 0.02 °C (0.03 °F) |
| Pt100 (9) | GOST 6651-94 | 0.02 °C (0.04 °F) | 0.04 °C (0.07 °F) | 0.01 °C (0.014 °F) | 0.02 °C (0.04 °F) |

*Operating influences of ambient temperature and supply voltage on thermocouples (TC)*

| Description | Standard | Ambient temperature: Influence (±) per 1 °C (1.8 °F) change | | Supply voltage: Influence (±) per V change | |
|---|---|---|---|---|---|
| | | Measuring span ≤ 500 K | Measuring span > 500 K | Measuring span ≤ 500 K | Measuring span > 500 K |
| Type A (30) | IEC 60584-1 ASTM E230-3 | 0.07 °C (0.126 °F) | 0.1 °C (0.18 °F) | 0.04 °C (0.07 °F) | 0.07 °C (0.13 °F) |
| Type B (31) | | 0.04 °C (0.072 °F) | 0.07 °C (0.126 °F) | 0.03 °C (0.05 °F) | 0.05 °C (0.09 °F) |
| Type C (32) | IEC 60584-1 ASTM E230-3 ASTM E988-96 | | | | |
| Type D (33) | ASTM E988-96 | | | | |
| Type E (34) | IEC 60584-1 ASTM E230-3 | 0.02 °C (0.036 °F) | 0.04 °C (0.072 °F) | 0.02 °C (0.04 °F) | 0.03 °C (0.05 °F) |
| Type J (35) | | | | | |
| Type K (36) | | 0.03 °C (0.05 °F) | 0.05 °C (0.09 °F) | 0.02 °C (0.04 °F) | 0.04 °C (0.07 °F) |
| Type N (37) | | | | | |
| Type R (38) | | | | | |
| Type S (39) | | | | | |
| Type T (40) | | 0.02 °C (0.04 °F) | 0.03 °C (0.05 °F) | 0.01 °C (0.02 °F) | 0.02 °C (0.04 °F) |
| Type L (41) | DIN 43710 | | | | |

*Long-term drift, resistance thermometers (RTD)*

| Long-term drift (±) [1] | | |
|---|---|---|
| after 1 year | after 3 years | after 5 years |
| Based on measured value | | |
| 0.05 °C (0.09 °F) or 0.03 % of the measuring span | 0.06 °C (0.11 °F) or 0.04 % of the measuring span | 0.07 °C (0.13 °F) or 0.05 % of the measuring span |

1) Whichever is greater

*Long-term drift, thermocouples (TC)*

| Long-term drift (±) [1] | | | |
|---|---|---|---|
| | after 1 year | after 3 years | after 5 years |
| Type A | 1.25 °C (2.25 °F) or 0.065 % of the measuring span | 1.60 °C (2.88 °F) or 0.085 % of the measuring span | 1.75 °C (3.15 °F) or 0.100 % of the measuring span |
| Type B | 1.71 °C (3.078 °F) | 2.24 °C (4.032 °F) | 2.44 °C (4.392 °F) |

| Long-term drift (±) [1] | | | |
|---|---|---|---|
| Type C | 0.85 °C (1.53 °F) or 0.055 % of the measuring span | 1.08 °C (1.944 °F) or 0.070 % of the measuring span | 1.20 °C (2.16 °F) or 0.070 % of the measuring span |
| Type D | 0.97 °C (1.746 °F) or 0.070 % of the measuring span | 1.27 °C (2.286 °F) or 0.085 % of the measuring span | 1.38 °C (2.484 °F) or 0.100 % of the measuring span |
| Type E | 0.35 °C (0.63 °F) or 0.050 % of the measuring span | 0.45 °C (0.81 °F) or 0.055 % of the measuring span | 0.50 °C (0.9 °F) or 0.060 % of the measuring span |
| Type J | 0.4 °C (0.72 °F) or 0.050 % of the measuring span | 0.53 °C (0.954 °F) or 0.055 % of the measuring span | 0.57 °C (1.026 °F) or 0.065 % of the measuring span |
| Type K | 0.48 °C (0.864 °F) or 0.045 % of the measuring span | 0.55 °C (0.99 °F) or 0.070 % of the measuring span | 0.61 °C (1.098 °F) or 0.070 % of the measuring span |
| Type N | 0.62 °C (1.116 °F) or 0.055 % of the measuring span | 0.80 °C (1.44 °F) or 0.070 % of the measuring span | 0.86 °C (1.548 °F) or 0.080 % of the measuring span |
| Type R | 1.02 °C (1.836 °F) or 0.080 % of the measuring span | 1.31 °C (2.358 °F) or 0.115 % of the measuring span | 1.48 °C (2.664 °F) |
| Type S | 1.10 °C (1.98 °F) | 1.42 °C (2.556 °F) | 1.54 °C (2.772 °F) |
| Type T | 0.41 °C (0.738 °F) | 0.53 °C (0.954 °F) | 0.58 °C (1.044 °F) |
| Type L | 0.34 °C (0.612 °F) or 0.045 % of the measuring span | 0.4 °C (0.72 °F) or 0.065 % of the measuring span | 0.47 °C (0.846 °F) or 0.060 % of the measuring span |

1) Whichever is greater

**Calculation of the maximum measurement error for analog value (current output):**
$\sqrt{(\text{Measurement error}^2 + \text{Influence of ambient temperature}^2 + \text{Influence of supply voltage}^2)}$

Influence of the cold junction

Pt1000 DIN IEC 60751 Cl. B (internal cold junction with thermocouples TC)

A 2-wire Pt1000 resistor must be used for external cold junction measurement. The Pt1000 must be positioned directly at the sensor terminals of the device, as the temperature difference between the Pt1000 and the terminal must be added to the measurement error of the sensor element and sensor input Pt1000.

Sensor adjustment

**Sensor-Transmitter-Matching**

The device enables the following method to improve the temperature measurement accuracy of RTD sensors significantly:

Callendar Van Dusen coefficient (Pt100 resistance thermometer)
The Callendar Van Dusen equation is described as:
$R_T = R_0[1+AT+BT^2+C(T-100)T^3]$

The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 60751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically with the aid of sensor calibration.

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

**1-point adjustment (offset)**

Offset adjustment of the sensor value

| | |
|---|---|
| Current output adjustment | Correction of the 4 and/or 20 mA current output value |

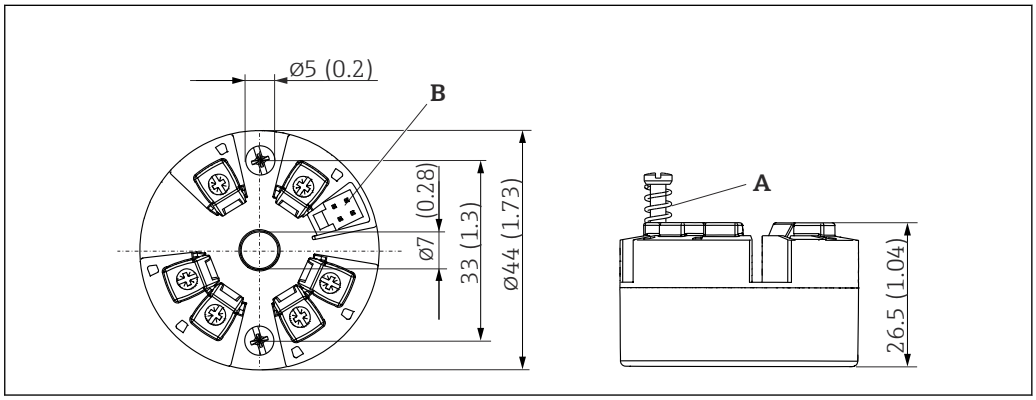
## 12.5 Environment

| | |
|---|---|
| Ambient temperature range | −40 to 85 °C (−40 to 185 °F) |
| Storage temperature | −50 to 100 °C (−58 to 212 °F) |
| Operating height | Up to 4 000 m (13 123 ft) above sea level. |
| Relative humidity | Condensation:<br>▪ Permitted for head transmitters (95% r.h. according to IEC 60068-2-30)<br>▪ Not permitted for DIN rail transmitters (95% r.h. IEC 60068-2-78) |
| Climate class | ▪ Head transmitter climate class: C1 (−5 to 45 °C, 5 to 95r.h.) according to IEC 60654-1<br>▪ DIN rail transmitter climate class: B2 (−5 to 45 °C, 5 to 95r.h.) according to IEC 60654-1 |
| Degree of protection | ▪ Head transmitter with screw terminals: IP 20, head transmitter with push-in terminals: IP 30. When the device is installed, the degree of protection depends on the terminal head or housing used for field mounting.<br>▪ DIN rail transmitter: IP 20 |
| Vibration and shock resistance | Vibration resistance according to IEC 60068-2-6 (DNV):<br>▪ Head transmitter:<br>  ▪ 2 to 10 Hz, 10 mm<br>  ▪ 10 to 150 Hz at 4 g<br>▪ DIN rail transmitter:<br>  ▪ 2 to 13.2 Hz, 1 mm<br>  ▪ 13.2 to 100 Hz at 0.7 g<br><br>Vibration resistance according to IEC 60068-2-27:<br>▪ 30g, 18 ms<br>▪ 30g, 11 ms (KTA 3505) |
| Electromagnetic compatibility (EMC) | **CE conformity**<br>Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE 21). For details, refer to the Declaration of Conformity.<br>Maximum measurement error <1% of measuring range.<br>Interference immunity as per IEC/EN 61326 series, industrial requirements<br>Interference emission as per IEC/EN 61326 series (CISPR 11), Class B equipment, Group 1 |
| Overvoltage category | Overvoltage category II |
| Pollution level | Pollution degree 2 as per IEC 61010-1 |

## 12.6 Mechanical construction

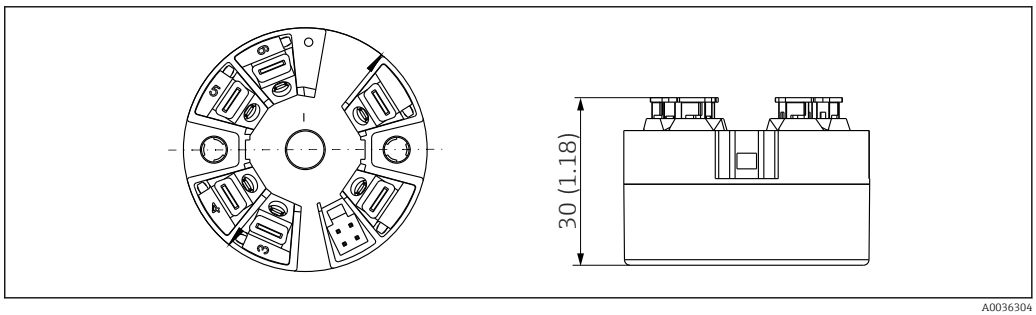
Design and dimensions

Dimensions in mm (in)



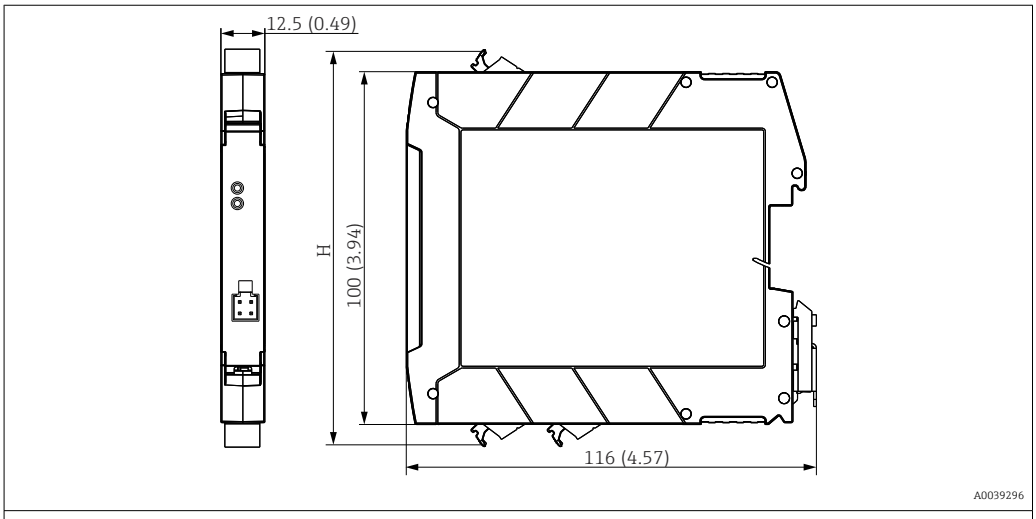

11 *Version with screw terminals*

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




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

*DIN rail transmitter*




Height of housing H varies depending on the terminal version:
- Screw terminals: H = 114 mm (4.49 in)
- Push-in terminals: H = 111.5 mm (4.39 in)

Weight

**Head transmitter:**

40 to 50 g (1.4 to 1.8 oz)

**DIN rail transmitter:**

Approx. 100 g (3.53 oz)

Materials

All the materials used are RoHS-compliant.

- Housing: polycarbonate (PC)
- Terminals:
  - Screw terminals: nickel-plated brass
  - Push-in terminals: tin-plated brass, contact springs 1.4310, 301 (AISI)
- Potting compound: SIL gel

## 12.7 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.

Hazardous area approvals

More detailed information on the hazardous area versions that are currently available can be provided by the manufacturer. Separate Ex documentation contains all the relevant data for explosion protection.

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)"

External 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)

MTTF

- **RTD input:**
  418 years
- **TC input:**
  350 years

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


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