



**HART**   
COMMUNICATION PROTOCOL

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# Rail Mounted Temperature Transmitter TTR200

## Operating Instruction

OI/TTR200-EN

08.2008

Rev. A

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## 1 Safety

Read these operating instructions carefully prior to installing and commissioning the device.

These instructions are intended as an overview and do not contain detailed information on all designs for this product or every possible aspect of installation, operation and maintenance.

For additional information or in case specific problems occur that are not discussed adequately in these instructions, contact the manufacturer. The content of these instructions is neither part of any previous or existing agreement, promise or legal relationship nor is it intended to change the same.

All obligations of ABB Automation Products GmbH are created by the relevant sales agreement, which contains the complete and solely binding warranty regulations. These contractual warranty provisions are neither extended nor limited by compliance with this manual.

### 1.1 General Safety Information

The “Safety” chapter provides an overview of the safety aspects to be observed for the operation of the device.

The device is built based on state-of-the-art technology and is operationally safe. It was tested and left the factory in a proper state. The requirements in the manual as well as the documentation and certificates must be observed and followed in order to maintain this state for the period of operation.

The general safety requirements must be complied with completely during operation of the device. In addition to the general information, the individual chapters of the manual contain descriptions about processes or procedural instructions with specific safety information.

Only the observance of all safety information enables the optimal protection of personnel as well as the environment from hazards and the safe and trouble-free operation of the device.

### 1.2 Intended use

This device is intended for the following uses:

- To measure the temperature of fluid, pulpy or pasty substances and gases or resistance/voltage values.

The following items are included in the intended use:

- Read and follow the instructions in this manual.
- Observe the technical ratings (refer to the section “Technical data” or data sheet).

Repairs, alterations and enhancements or the installation of replacement parts is only permissible as far as described in the manual. Further actions must be verified with ABB Automation Products GmbH. Excluded from this are repairs performed by ABB-authorized specialist shops.

1.3 Technical limits

The device is designed for use exclusively within the stated values on the name plate and in the technical specifications (see "Technical Specifications" chapter and data sheet). These must be complied with accordingly, e.g.:

- The maximum operating temperature may not be exceeded.
- The permitted operating temperature may not be exceeded.
- The housing protection system must be observed.

1.4 Warranty provision

A use contrary to the device's stipulated use, disregarding of this manual, the use of under-qualified personnel as well as unauthorized alterations excludes the manufacturer of liability from any resulting damages. The manufacturer's warranty expires.

1.5 Labels and symbols

1.5.1 Symbols and warnings



**Danger – <Serious damage to health / risk to life>**  
 One of these symbols in conjunction with the "Danger" warning indicates an imminent danger. If it is not avoided, death or serious injury will result.



**Warning – <Bodily injury>**  
 The symbol in conjunction with the "Warning" message indicates a possibly dangerous situation. If it is not avoided, death or serious injury could result.



**Caution – <Slight injuries>**  
 The symbol in conjunction with the "Caution" message indicates a possibly dangerous situation. If it is not avoided, slight or minor injury can result. May also be used for property damage warnings.



**Notice – <Property damage>**  
 The symbol indicates a possibly damaging situation. If it is not avoided, the product or something in its area can be damaged.



**Important**  
 The symbol indicates operator tips or especially useful information. This is not a message for a dangerous or damaging situation.

1.5.2 Name plate

The name plate is located on the transmitter housing.

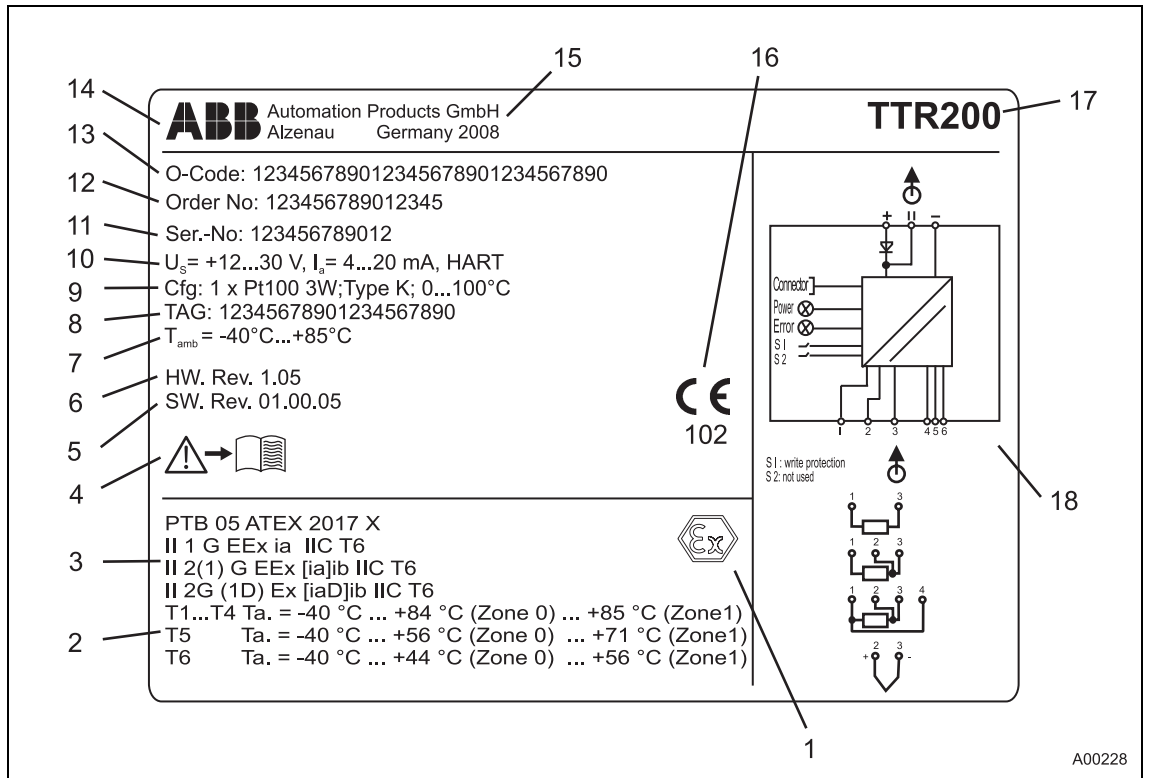


Fig. 1

- |  |                                    |
|--|------------------------------------|
| 1 Ex designation (option)                | 10 Technical data                  |
| 2 Temperature classes Ex design (option) | 11 Serial number                   |
| 3 Protection class Ex design (option)    | 12 Order no.                       |
| 4 Refer to product documentation         | 13 Order code                      |
| 5 Software revision number               | 14 Manufacturer of transmitter     |
| 6 Hardware revision number               | 15 Country and year of manufacture |
| 7 Ambient temperature                    | 16 CE mark (EC conformity)         |
| 8 TAG number                             | 17 Model name                      |
| 9 Sensor configuration                   | 18 Terminal connection diagram     |



**Important**

The temperature range on the name plate (7) refers only to the permissible ambient temperature range for the transmitter and not to the measuring element used in the measuring inset.

### **1.6 Operator liability**

Before the use of corrosive and abrasive measuring fluid, the operator must clarify the resistance of all parts that come into contact with the fluid to be measured. ABB will gladly support you with the selection, however, cannot accept any liability.

The operators must strictly observe the applicable national regulations in their countries with regards to installation, function tests, repairs, and maintenance of electrical devices.

### **1.7 Personnel qualification**

The installation, commissioning and maintenance of the device may only be carried out through trained specialist personell authorized by the plant operator. The specialist personnel must have read and understood the manual and comply with its instructions.

### **1.8 Returning devices**

Use the original packaging or a suitably secure packaging for returning the device for repair or for recalibration. Include the properly filled out return form (see attachment) with the device.

According to EC guidelines for hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for its shipping:

All delivered devices to ABB Automation Products GmbH must be free from any hazardous materials (acids, alkali, solvents, etc.).

### **1.9 Disposal**

ABB Automation Products GmbH actively promotes environmental consciousness and has an operational management system in accordance with DIN EN ISO 9001:2000, EN ISO 14001:2004 and OHSAS 18001. Our products and solutions should have minimum impact on the environment and persons during manufacture, storage, transport, use and disposal.

This includes the environmentally friendly use of natural resources. Through its publications ABB conducts an open dialog with the public.

This product/solution is manufactured from materials that can be reused by specialized recycling companies.

### 1.9.1 Information on WEEE directive 2002/96/EC (Waste Electrical and Electronic Equipment)

This product/solution is not subject to the WEEE directive 2002/96/EC and relevant national laws (e.g., ElektroG in Germany).

Dispose of the product/solution directly in a specialized recycling facility and do not use the municipal garbage. Only privately used products may be disposed of in the municipal garbage according to the WEEE directive 2002/96/EC. Proper disposal prevents negative effects on people and the environment, and supports the reuse of valuable raw materials.

If it is not possible to dispose of old equipment properly, ABB Service can accept and dispose of returns for a fee.

### 1.10 Transport safety information

Observe the following information:

- Do not expose the device to moisture during transport. Pack the device accordingly.
- Pack the device so that it is protected from vibration during transport, e.g. through air-cushioned packaging.

Check the devices for possible damage that may have occurred from improper transport. Damages in transit must be recorded on the transport documents. All claims for damages must be submitted to the shipper without delay and before installation.

### 1.11 Electrical installation safety information

The electrical connection may only be performed by authorized specialist personnel according to the electrical plans.

Comply with electrical connection information in the manual. Otherwise, the electrical protection class can be affected.

The secure separation of contact-dangerous electrical circuits is only guaranteed when the connected devices fulfil the requirements of the DIN EN 61140 (VDE 0140 Part 1) (basic requirements for secure separation).

For secure separation, run the supply lines separated from contact-dangerous electrical circuits or additionally insulate them.

### 1.12 Operating safety information

Before switching on, ensure that the specified environmental conditions in the “Technical Specifications” chapter and in the data sheet are complied with and that the power supply voltage corresponds with the voltage of the transmitter.

When there is a chance that safe operation is no longer possible, put the device out of operation and secure against unintended operation.

### 1.13 Safety information on deinstallation



#### **Warning - General hazards!**

Prior to deinstalling or disassembling the device, check for hazardous process conditions such as pressure, high temperatures, aggressive or toxic media, etc.

Read the instructions in the sections “Safety information” and “Electrical connection,” and perform the specified steps in reverse order.

#### 1.13.1 RoHS directive 2002/95/EC

With the Electrical and Electronic Equipment Act (ElektroG) in Germany, the European directives 2002/96/EC (WEEE) and 2002/95/EC (RoHs) are translated to national law. ElektroG defines the products that are subject to regulated collection and disposal or reuse in the event of disposal or at the end of their service life. ElektroG also prohibits the marketing of electrical and electronic equipment that contains a specific amount of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) (also known as hazardous substances with restricted uses).

The products provided to you by ABB Automation Products GmbH do not fall within the current scope of the directive on waste from electrical and electronic equipment according to ElektroG. If the necessary components are available on the market, these substances will no longer be used in new product development.

## 2 Use in areas requiring ignition protection

Special regulations must be observed in explosion-protection zones for the auxiliary power connection, signal inputs/outputs and ground connection. Information on ignition protection in the separate chapters must be observed.



### **Notice - Potential damage to parts!**

All parts must be installed in accordance with manufacturer information and relevant standards and regulations.

Startup and operation must comply with EN 60079-14 (Installation of equipment in potentially explosive atmospheres).

### 2.1 Approvals

The approvals for use of the TTR200 temperature transmitter in explosion-protection areas can be found in the section "Explosion-protection relevant information" in the operating instructions.

### 2.2 Level of protection

The adapters for the model TTR200 temperature transmitter meet the IP 20 level of protection in accordance with IEC 60529:1989.

### 2.3 Electrostatic charging

When using the transmitter in zone 0, make sure you prevent electrostatic charging of the TTR200-E1H temperature transmitter (observe warnings on equipment).

### 2.4 Grounding

If for functional reasons, the intrinsically safe circuit has to be grounded by connection to the equipotential bonding system, it may only be grounded at a single location.

### 2.5 Interconnection

If transmitters are operated in an intrinsically safe circuit, proof that the interconnection is intrinsically safe must be provided in accordance with DIN VDE 0165/Part1 (EN 60079-25/2004 and IEC 60079-25/2003). In general, intrinsically safe circuits require proof of interconnection.

### 2.6 Configuration

The TTR200-E1 temperature transmitters can be installed in the explosion-protection area in compliance with the proof of interconnection and directly in the explosion-protection area using approved handheld HART terminals as well as by coupling an ignition-proof modem to the circuit outside the explosion-protection area.

### 2.7 Explosion-protection relevant information

For additional information, refer to the section "Explosion-protection relevant information" or the data sheet.

### 3 Design and function

Digital transmitters are communication-ready devices with microprocessor-controlled electronics. For bidirectional communication, an FSK signal is superimposed on the 4 ... 20 mA output signal via the HART protocol. The transmitters meet the requirements of the IP 20 protection class and are designed for 35 mm rail mounting.

The graphic user interface (DTM) can be used to configure, poll and test the transmitter on a PC-specific basis. Handheld terminals also support communication.

### 4 Installation

The transmitter is mounted apart from the sensor on a 35 mm rail acc. to EN 60175.

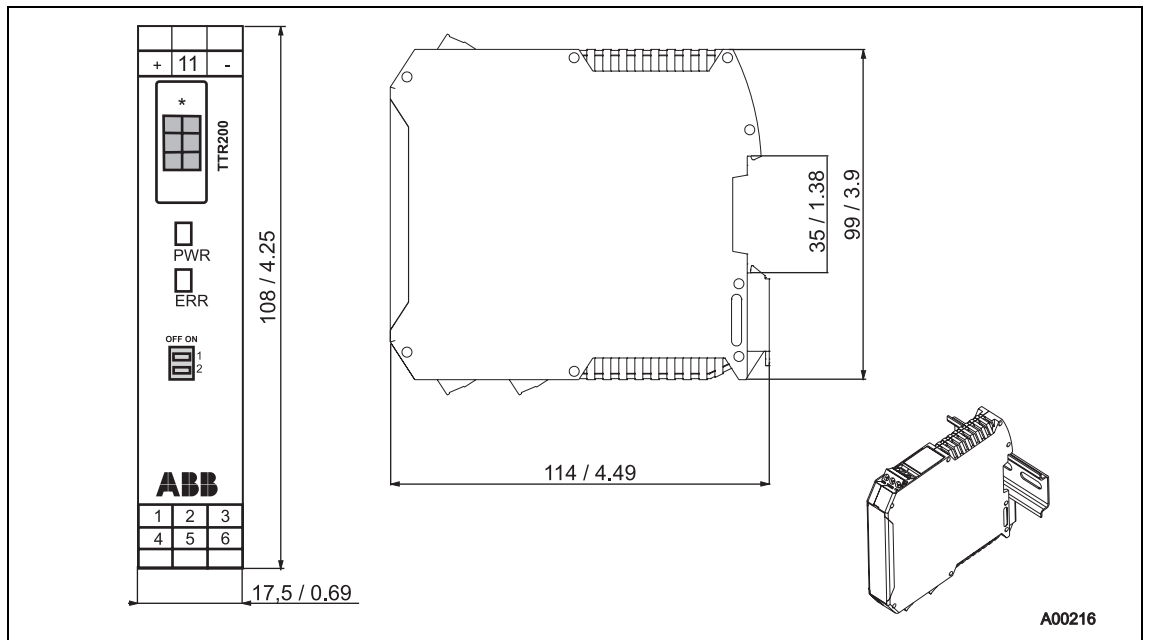


Fig. 2

## 5 Electrical connection



### Warning – Electrical voltage risk!

Observe the corresponding instructions for the electrical installation. Only connect in dead-voltage state!

Since the transmitter has no switch-off elements, overvoltage protection devices, lightning protection or voltage separation capacity must be provided on the plant side.

Energy supply and signal are routed in the same line and are to be implemented as SELV or PELV circuit according to norm (standard version). In the ignition-proof version, the guidelines according to the ignition-proof norms are to be adhered to.

It must be checked whether the existing power supply corresponds with the specifications on the model plate and in the technical specifications in the "Technical specifications" section or the data sheet.



### Important

The signal cable wires must be provided with wire end sleeves.

The slotted screws of the connection terminals are tightened with a size 1 screwdriver (3.5 mm).

### 5.1 Conductor material

- Standard conductor material must be used for the power supply cable.
- The maximum connectable conductor cross-section amounts to 2.5 mm<sup>2</sup>.



### Notice - Potential damage to parts!

A rigid conductor material can result in wire breaks.

The connecting cable must be flexible.

5.2 Pin configuration

5.2.1 Supply voltage / sensor connection

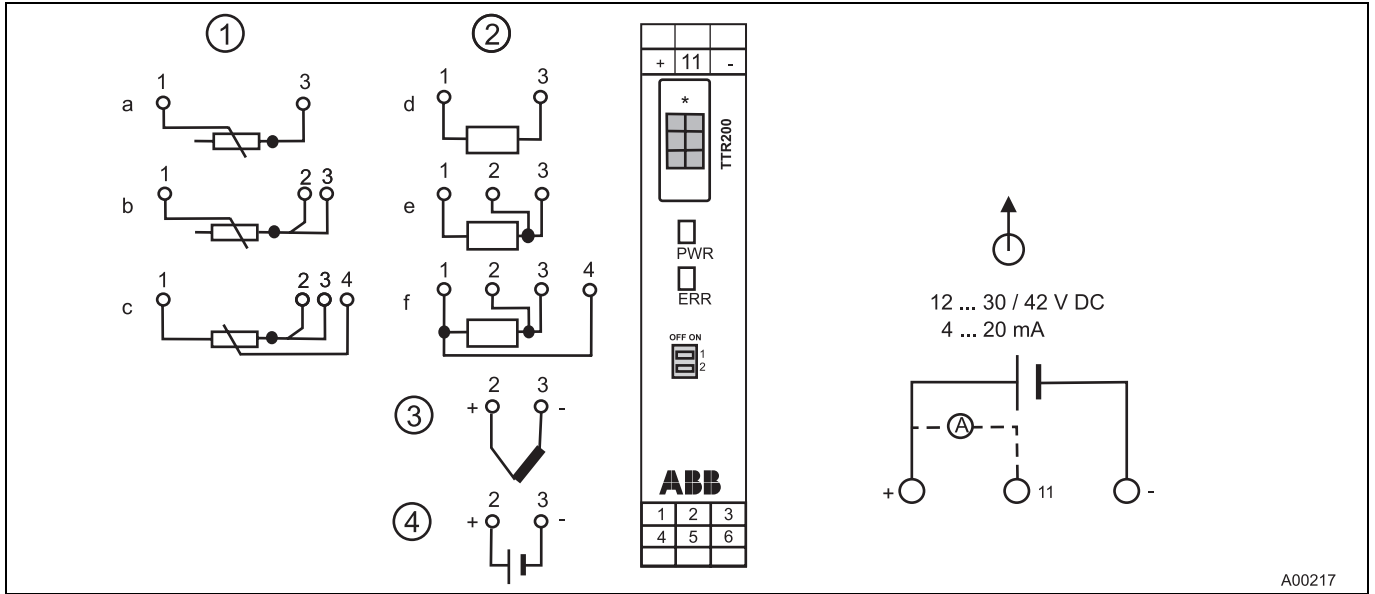


Fig. 3: \*(planned local configuration interface/inoperable)

**1 Potentiometer: 0 ... 500 Ω or 0 ... 5000 Ω**

- a Potentiometer, 2-wire circuit
- b Potentiometer, 3-wire circuit
- c Potentiometer, 4-wire circuit

**2 RTD resistance sensors (e.g., Pt100)**

- d RTD, 2-wire circuit
- e RTD, 3-wire circuit
- f RTD, 4-wire circuit

**3 Thermocouple**

Depending on the sensor model, a variety of line materials can be used for sensor connections. The integrated reference point makes it possible to directly connect thermal compensating lines.

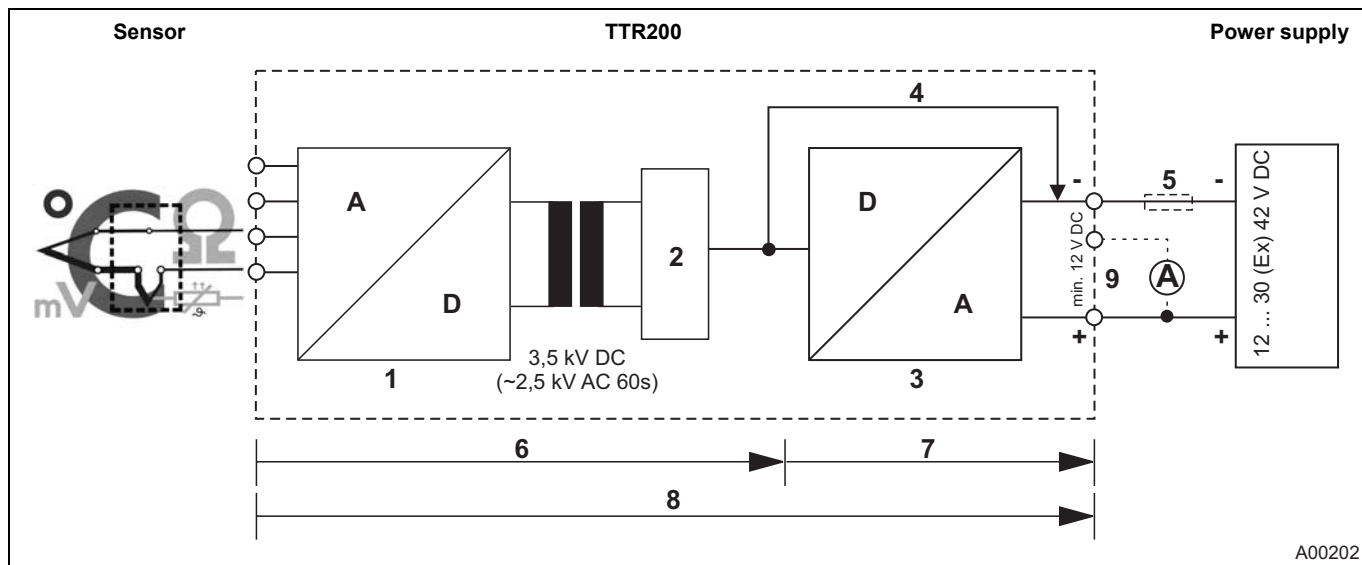
**4 Voltage measurement**

**Note**

Terminal 11: Measurement of 4 ... 20 mA output current without opening / interrupting the current loop (see chapter 5.3 Block diagram )

- PWR / green LED: Supply voltage display
- ERR / red LED: sensor, sensor lead & unit fault signaling
  
- DIP switch 1: on -> Hardware write protection is enabled
- DIP switch 2: no function

**5.3 Block diagram**



A00202

Fig. 4

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1 24-bit A/D converter</li> <li>2 Microcontroller</li> <li>3 16-bit D/A converter</li> <li>4 HART signal</li> <li>5 Load (observe voltage drop, refer to the section "Terminal connection diagrams")</li> </ul> | <ul style="list-style-type: none"> <li>6 Digital measuring accuracy</li> <li>7 D/A measuring accuracy</li> <li>8 Overall measuring accuracy</li> <li>9 Terminal 11, measurement of 4 ... 20 mA output current without opening / interrupting the current loop (internal resistance ammeter &lt; 15 Ω)</li> </ul> |
|--|--|

5.4 Standard application

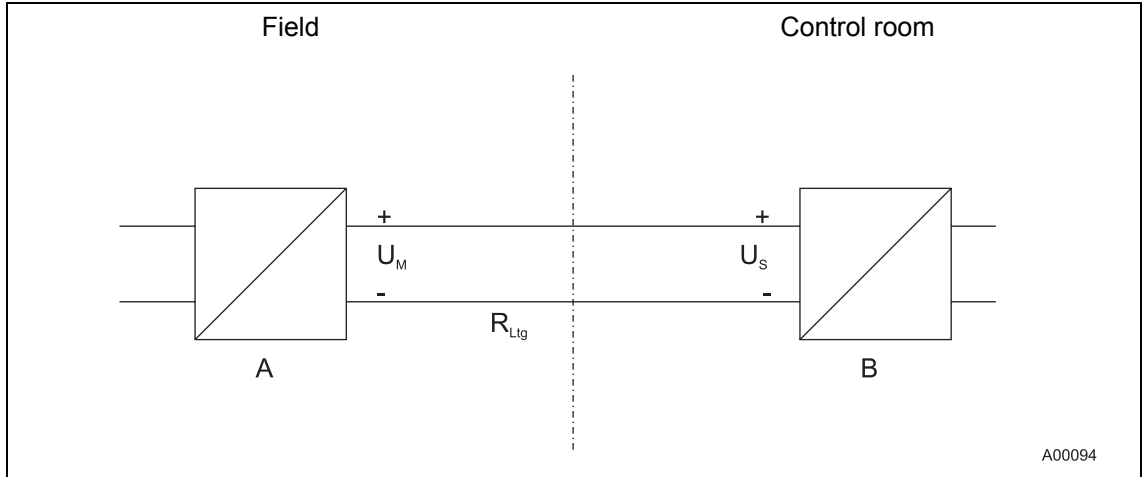


Fig. 5

A Transmitter

B Power supply / SPS input with supply

When connecting transmitters and power supplies, observe the following specification:

$$U_{Mmin} \leq U_{Smin} + 0.02A \times R_{Ltg}$$

Where

$U_{Mmin}$ : Minimum operating voltage of transmitter (refer to technical data for transmitter)

$U_{Smin}$ : Minimum supply voltage of repeater power supply / SPS input

$R_{Ltg}$ : Line resistance between transmitter and power supply

For HART functionality, use power supplies or SPS input cards with HART mark. If this is not possible, the interconnection must have a resistance  $\geq 250 \Omega$  ( $< 1100 \Omega$ ).

The signal line can be connected with or without ground. When connecting the ground (minus side), make sure that only one side of the contact is connected to the equipotential bonding system.

**Standard application with HART functionality**

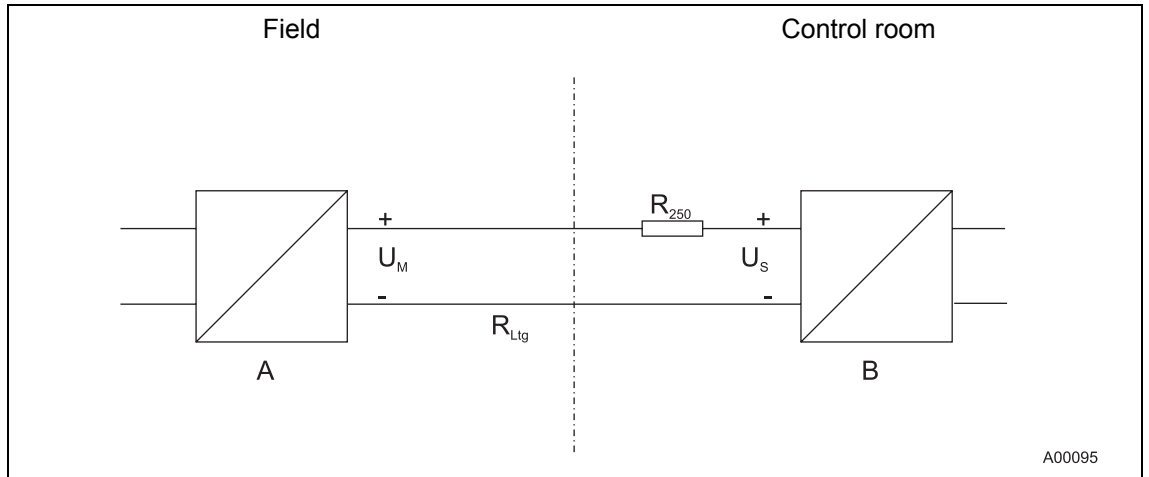


Fig. 6

A Transmitter

B Power supply / SPS input with supply

Adding resistance  $R_{250}$  increases the minimum supply voltage:

$$U_{Mmin} \leq U_{Smin} + 0.02A \times (R_{Ltg} + R_{250})$$

Where

$U_{Mmin}$ : Minimum operating voltage of transmitter (refer to technical data for transmitter)

$U_{Smin}$ : Minimum supply voltage of repeater power supply / SPS input

$R_{Ltg}$ : Line resistance between transmitter and power supply

$R_{250}$ : Resistance for HART functionality

5.5 Electrical interconnection in explosion risk area

Special interconnections are required for use in hazardous areas depending on the safety requirements.

**Intrinsic safety**

The Power supply SPS inputs must have corresponding input protection circuits available in order to eliminate a hazard (spark formation). An interconnection inspection must be performed. For proof of the intrinsic safety, the electrical limit values are to be used as the basis for the prototype test certificates of the apparatuses (devices), including capacitance and inductivity values of the wires. The proof of the intrinsic safety is given if the following conditions are fulfilled with comparison of the limit values of the apparatus.

Transmitter (intrinsically safe apparatus)		Power supply / SPS input (related apparatus)
$U_i$	$\geq$	$U_o$
$I_i$	$\geq$	$I_o$
$P_i$	$\geq$	$P_o$
$L_i + L_c$ (cable)	$\leq$	$L_o$
$C_i + C_c$ (cable)	$\leq$	$C_o$

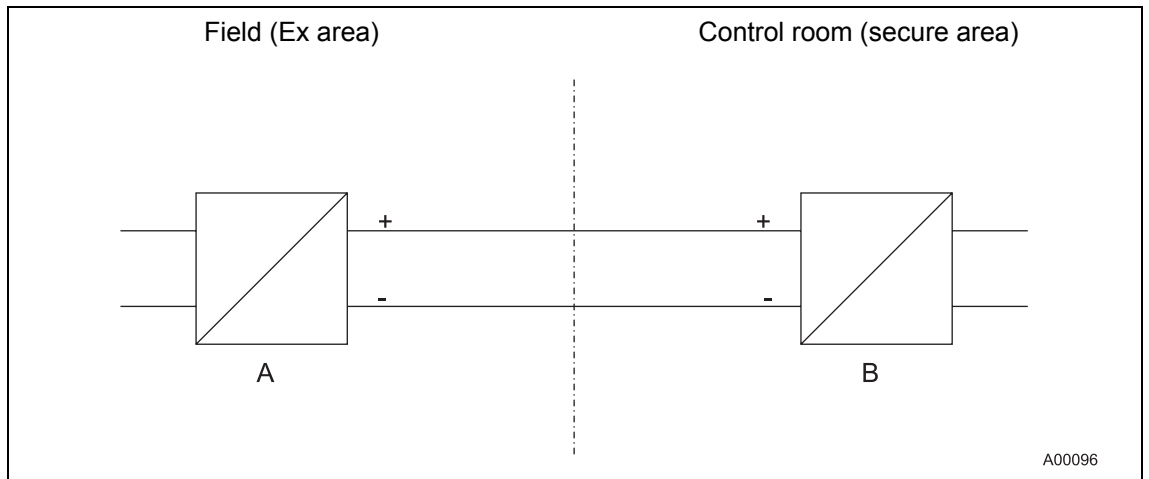


Fig. 7

A Transmitter

B Power supply SPS input



**Important**

Observe the “Technical specifications” and “Explosion-protection technical data” chapters (see data sheet and/or operating instructions).

**5.5.1 Installation in ignition protection areas**

Transmitters can be installed in a wide variety of industrial sectors. Systems that requires ignition protection are divided into zones. As a result, different instruments are also required. For additional information, refer to the section “Explosion-protection relevant information” or the data sheet.

**5.5.2 Zone 0**

Transmitter design: II 1G EEx ia IIC T6

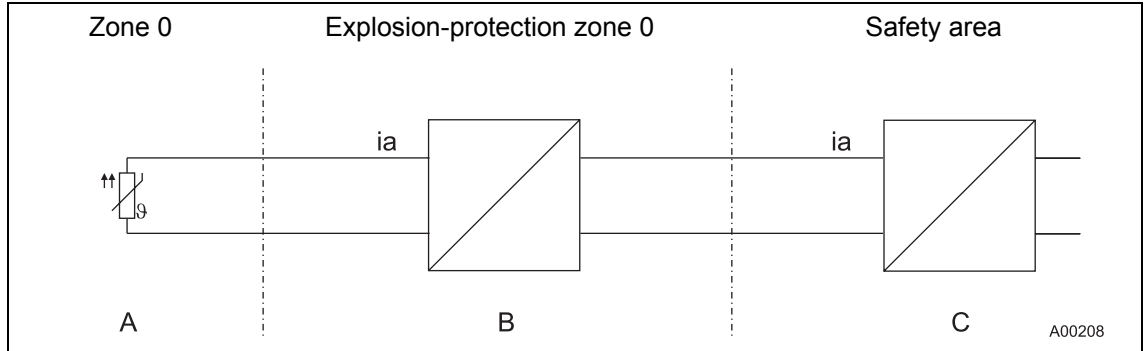


Fig. 8

- A Sensor
- B Transmitter in housing with IP 20 level of protection
- C Power supply [EEx ia]

For instruments in zone 0, the input for the repeater must be in [EEx ia] design.

When using the transmitter in zone 0, make sure you prevent electrostatic charging of the temperature transmitter (observe warnings on equipment).

The sensor must be used by the user in accordance with applicable ignition-protection standards.

5.5.3 Zone 1 (0)

Transmitter design: II 2 (1) G EEx [ia] ib IIC T6

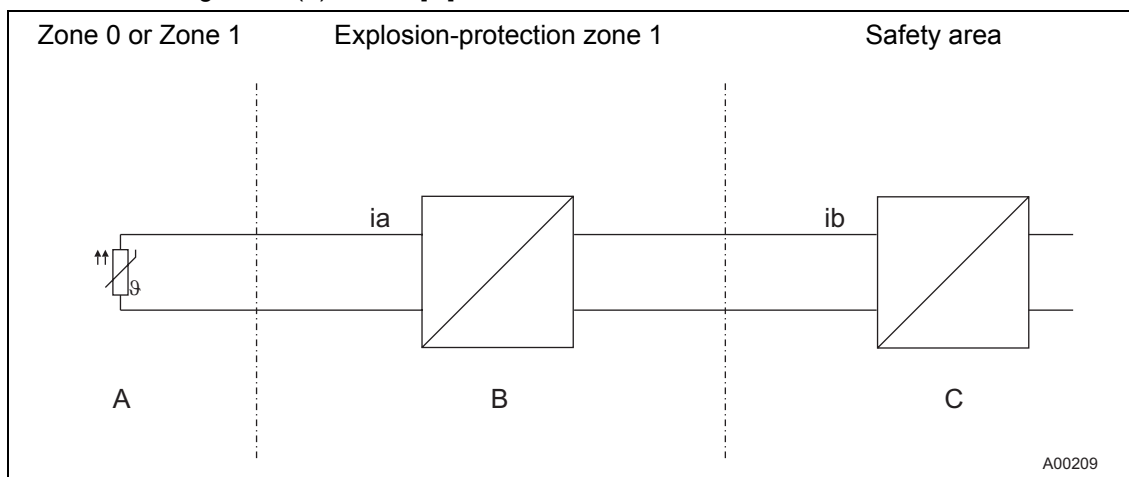


Fig. 9

- A Sensor
- B Transmitter in housing with IP 20 level of protection
- C Power supply [EEx ib]

For instruments in zone 1, the input for the repeater must be at minimum in [EEx ib] design.

The sensor must be used by the user in accordance with applicable ignition-protection standards. It can be installed in zone 1 or zone 0.

**5.5.4 Zone 1 (20)**

Transmitter design: II 2G (1D) EEx [iaD] ib IIC T6

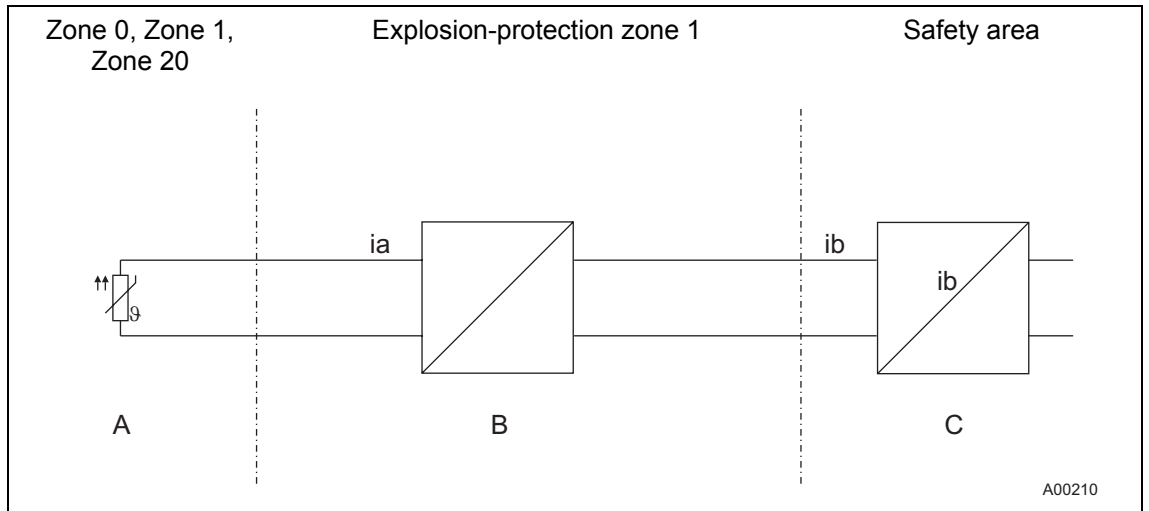


Fig. 10

- A Sensor
- B Transmitter in housing with IP 20 level of protection
- C Power supply [EEx ib]

For instruments in zone 1, the input for the repeater must be at minimum in [EEx ib] design.

The sensor must be used by the user in accordance with applicable ignition-protection standards. It can be installed in zone 0, zone 1 or zone 20.

5.5.5 Zone 2

Transmitter design: II 3G EEx nA II T6

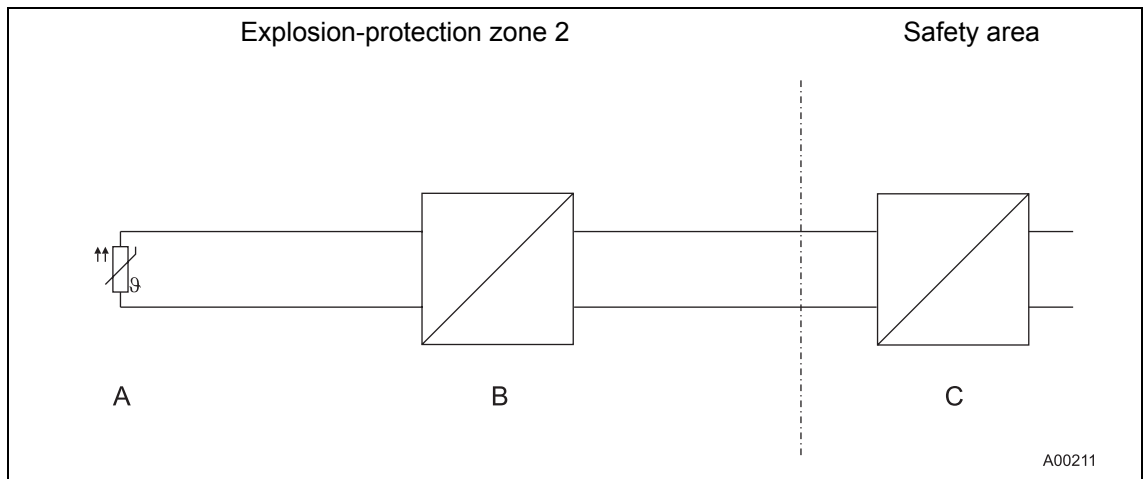


Fig. 11

- A Sensor
- B Transmitter in housing with IP 54 level of protection
- C Transmitter power supply

For instruments in zone 2, the transmitter must be installed in its own housing with a minimum of IP 54 level of protection.

Ensure that in case of a disturbance the supply voltage cannot exceed 40 % of the normal voltage.

## 6 Startup Operation

**i**

### Important

The transmitter is immediately ready for operation after mounting and installation of the connections. The parameters are set at the factory.

The connected wires must be checked for firm seating. Only firmly seated wires ensure full functionality.

## 7 Communication and configuration

### 7.1 Configurations

Transmitters can be configured as follows:

- via HART protocol and handheld terminal
- via HART protocol with FSK modem, PC and Smart Vision configuration software
- via DTM in FDT 1.2 network applications
- Configuration via field bus (PROFIBUS), if the superordinate I/O system is HART-enabled (e.g., ABB S800 or S900)

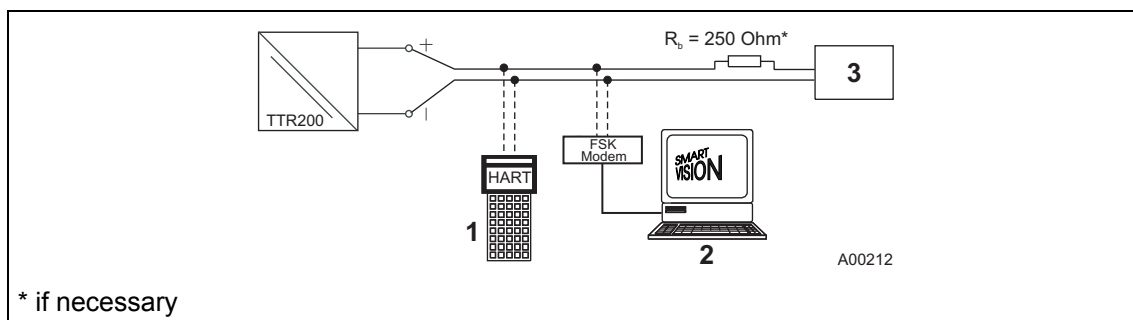


Fig. 12

- 1 DHH691 (691HT), STT04, HC275, FC375      3 Power supply (process interface)  
 2 FDT/DTM technology

#### 7.1.1 HART communication

Communication with the transmitter is supported by the HART protocol. The communication signal is modulated onto both wires of the signal line according to the HART FSK “Physical Layer” specification, version 8.1 (08/1999). The electrical connection is provided either by two test pins at the (+) and (-) terminals of the transmitter or by the power supply cable that is installed on-site. The advantage is that power supplies that are part of the industrial plant allow remote configuration.

### 7.1.2 Configuration with the handheld terminal

The configuration with the handheld terminal normally takes place at the factory before the installation of the transmitter in an industrial plant.

The installation is to be realized according to the figure in the "Configuration types" paragraph.



#### Important

The connection of the cable for the handheld terminal is performed without polarity.

The configuration of the transmitter via the HART protocol can also take place during the normal operation.

### 7.1.3 Configuration via DTM

Configuration can be performed with any FDT network applications that are approved for use with the DTM (e.g., Smart Vision). The bus can be connected via FSK modem as well as HART + USB, Profibus + remote I/O or HART Multiplexer.

### 7.1.4 Configuration via EDD

Configuration can also be performed with EDD master applications such as Siemens Simatic, which is approved for use with EDD. In contrast to DTM configuration, EDD has process-dependent, minor limitations such as configuration of a freestyle characteristic.

## 7.2 Write protection

To protect the device setup, the TTR200 provides write protection for software and hardware.

You can enable or disable the hardware write protection via the 2-pin DIP switch on the front of the unit (see Fig. 3 page 14). To activate hardware write protection, move the first switch of the 2-pin DIP switch to the "on" position.

(The second switch of the 2-pin DIP switch has no function.)

### 7.3 Sensor error adjustment (TTR200 DTM Adjust function) TTR200

Sensor error adjustment can be performed in the TTR200 DTM by navigating to Device / Maintenance / Adjust / Trim low or Trim high.

For sensor error adjustment, the sensor connected to the transmitter must be brought to the temperature at measurement start / trim low via water quench or oven. It is important to make sure the temperature is balanced and stable.

In the DTM, check that the proper adjustment temperature has been entered for the sensor before adjusting the sensor.

Based on the configured adjustment temperature (setpoints) and the digital temperature measured by the transmitter, which is available after linearization in the form of HART temperature information, the transmitter calculates the temperature deviation resulting from the sensor error.

The temperature deviation calculated results during single point adjustment in an offset shift of the linear characteristic output by the linearization module; the values correspond to the HART signal or are sent to the current output.

A sensor error two-point adjustment results in a change of the offset and gradient due to the linear temperature value characteristic output by the linearization module.

A pure sensor offset error can be corrected via the function "Set Measurement Start" or the "Trim low" adjustment function. A non-exclusively sensor offset error can, on the other hand, be corrected only with a two-point adjustment or two-point calibration.

### 7.4 D/A analog output compensation (4 and 20 mA trim)

Output compensation is used to correct errors in the power input of the superordinate system.

Analog output compensation for the transmitter can be used to modify the loop current so that the desired value is displayed in the superordinate system.

Error compensation for the superordinate system is possible at the LRL with 4 mA or 20 mA. (Single point error correction: Offset or two-point error correction offset + linear gradient)

The D/A analog output compensation can be accessed in the TTR200 DTM via the path Device / Maintenance / Adjust.

Prior to analog compensation, it is necessary to determine the loop current values based on iterative entry of current data in simulation mode; the superordinate I/O system displays exactly 4,000 mA, the LRL or 20,000 mA and the URL temperature. The current loop values are too measured via ampere meter and to record.

Simulate the LRL or 4,000 mA +/- 16  $\mu$ A in D/A analog output compensation mode using sensor simulation. Thereafter, enter the iteratively measured current at which the superordinate system displays exactly 4,000 mA or the LRL as adjustment value. Proceed in a similar manner for the URL or 20,000 mA.

The disadvantage of D/A analog output compensation is that the HART signal prior to the D/A conversion without correction differs from the analog output signal after D/A conversion due to the incoming error correction of the superordinate system.

### 7.5 HART variables

The TTR200 rail unit provides users with 3 HART variables.

The primary variable is mapped to the 4 ... 20 mA output as well as the secondary and tertiary variables.

The HART variables are assigned the following values:

- primary HART variable: Process data

(The primary HART variable is mapped permanently to the analog output and is mapped accordingly to the 4 ... 20 mA signal.)

- secondary HART variable: Electronic unit temperature
- tertiary HART variable: electrical input

### 7.6 Communication / HART tag / Device address

For ease of identification, each HART device features a configurable 8-digit HART tag. Standard devices are come with the HART tag "TI XXX".

(When storing HART tags with more than 8 digits in the device, use the "Report" parameter, which supports up to 32 characters.)

In addition to the HART tag, each device has a HART address.

This address is set by default to zero, in which state the device operates in HART standard communication mode (point-to-point operation). When an address in the range 1 to 15 is used, the device switches to HART multidrop mode. This operating mode enables users to connect up to 15 devices in parallel to a power supply.

In multidrop mode, an analog output signal that matches the process temperature is not available. The output signal in multidrop mode is a constant 3.6 mA and is used exclusively for the power supply.

In multidrop mode, sensor or process data information is available only as a HART signal.

**7.7 Description of parameters**

Device parameters	Description	DTM parameters	Effective range
<b>Write protection</b>	Activates write protection for the entire device.	<Basic Parameters> <General> <Write Protection>	Yes: locked ----- No: unlocked Enter password: 0110
<b>Sensor Type</b>	Select sensor type:	<Device> <Configuration> <Sensor / Sensor Type>	Pt100 (IEC751) Pt1000 (IEC751) Thermocouple type K (IEC584) Thermocouple type B (IEC584) Thermocouple type C (ASTME988) Thermocouple type D (ASTME988) Thermocouple type E (IEC584) Thermocouple type J (IEC584) Thermocouple type N (IEC584) Thermocouple type R (IEC584) Thermocouple type S (IEC584) Thermocouple type T (IEC584) Thermocouple type L (DIN43710) Thermovoltage – 125...125 mV Thermovoltage –125...1100mV Resistance 0 .... 500 Ω Resistance 0 .... 5000 Ω Pt10 (IEC751) Pt50 (IEC751) Pt200 (IEC751) Pt500 (IEC751) Pt10 (JIS1604) Pt50 (JIS1604) Pt200 (JIS1604) Pt10 (IMIL24388) Pt50 (IMIL24388) Pt100 (MIL24388) Pt200 (MIL24388) Pt1000 (MIL24388) Ni50 (DIN43760) Ni100 (DIN43760) Ni120 (DIN43760) Ni1000 (DIN43760) Cu10 (a=4270) Cu100 (a=4270)
<b>Type of connection</b>	Sensor connection type relevant for all Pt, Ni, Cu resistance sensor types	<Device> <Configuration> <Sensor / Connection>	2-wire 3-wire 4-wire
<b>Line resistance</b>	Sensor resistance relevant for all Pt, Ni, Cu resistance sensor types in 2-wire sensor transmitter connection type	<Device> <Configuration> <Sensor / Line Resistance>	0 ... max. 100 Ω

Device parameters	Description	DTM parameters	Effective range
<b>Reference point</b>	When using the transmitter reference point: <u>internally</u> relevant for all thermocouples except type B, if thermo/ equalizing conductor is clamped to the transmitter without using the transmitter reference point: <u>without</u> type B, <u>externally fixed</u> transfer of thermo/ equalizing conductor via copper material at constant thermostat temperature	<Device> <Configuration> <Sensor / Reference Point>	internal None externally - fixed
<b>Reference point ext.</b>	Relevant for external reference point, information on constant external reference point temperature	<Device> <Configuration> <Sensor / Reference Point Temp.>	-50 ... 100°C
<b>Unit</b>	Select the unit of measure for the sensor	<Device> <Parametrize> <Measuring Range of PV / Unit>	°C, °F, °R, K, mV, Ω
<b>Measurement start</b>	Defines the sensor measurement start	<Device> <Parametrize> <Measuring Range of PV / Lower Range Value>	Depending on sensor type
<b>Measurement end</b>	Defines the sensor measurement end	<Device> <Parametrize> <Measuring Range of PV / Upper Range Value>	Depending on sensor type
<b>Damping</b>	Configurable condensation 63 % output signal damping value	<Device > <Parametrize> <Voltage Output / Damping>	0 ... 100 s
<b>Factory reset</b>	Configuration data is reset to factory settings for Pt100 3-wire, 0 ... 100 °C damping off, override, adjustment data (trim high/low and DAC adjustment values are reset to factory settings)	<Device> <Maintenance> <Reset to Factory Setting>	Yes / OK
<b>Device reset</b>	Configuration data is reset to factory setting for Pt100 3-wire, 0 ... 100 °C damping off, override	<Device> <Maintenance> <Device Reset>	
<b>Override</b>	Generates a 3.6 mA high alarm signal for sensor or device errors, configurable from 20 ... 23.6 mA standard 22 mA	<Device> <Parametrize> <Current Output / Output with Fault>	Override
<b>Underdrive</b>	Generates for sensor or device error a low alarm signal, configurable from 3.5 ... 4 mA	<Device> <Parametrize> <Current Output / Output with Fault>	Underdrive
<b>HART tag</b>	Defines HART tag name	<Device> <Maintenance> <Poll Address / Tag>	8 characters, alphanumeric
<b>Address (Multidrop)</b>	Defines communication type	<Device> <Maintenance> <Poll Address / Tag>	Address = 0 conforms to HART operating mode: Point-to-point communication, 4 ... 20 mA output signal address = 1 ... 15 conforms to HART multidrop operating mode output signal 3.6 mA only the digital HART readings are available

Device parameters	Description	DTM parameters	Effective range
<b>Set measurement start</b>	Temperature correction for specified / simulated sensor LRL value to desired LRL temperature value	<Device> <Maintenance> <Adjust>	Trim low or Set Lower Range Value> ok
<b>Set measurement end</b>	Temperature correction for specified / simul. Sensor measurement value at desired URL temperature value	<Device> <Maintenance> <Adjust>	Trim high or Set Upper Range Value> ok
<b>Trim 4 mA</b>	Output signal correction for specified / simul. Sensor LRL at 4,000 mA setpoint	<Device> <Maintenance > <Adjust /DAC compensation fixed for zero point at 4 mA>	Analog current measurement value input min. 3,5 ... max. 4,5 mA
<b>Trim 20 mA</b>	Output signal correction for specified / simul. Sensor URL at 20,000 mA setpoint	<Device> <Maintenance > <Adjust /DAC compensation fixed for amplification at 20 mA>	Analog current measurement value input min. 19,5 ... max. 20,5 mA
<b>Simulation</b>	Output signal simulation corresponding to the value specified	<Device> <Simulation>	3,5 ... 23,6 mA

### 7.7.1 Factory settings

The transmitter is configured in the factory. The following table contains the values for the individual parameters.

Menu	Description	Parameters	Factory setting
DeviceConfig	Write Protect	-	No
	Input	Sensortype	Pt100 (IEC751)
		R-Connection	3-wire
		Measured Range Beginn	0
		Measured Range End	100
		Unit	Degrees C
		Damping	off
Process Alarm		Failure-signal	Override 22 mA
	HART Tag	-	-
	HART Descriptor	-	TIXXX-

## 8 TTR200 DTM diagnostic information

### 8.1 HART / DTM diagnostic information

#### Configuration changed



#### Important

The transmitter indicates that the parameters or configuration data has changed (HART: Configuration changed flag). After intentional or desired reconfiguration, the notification can be acknowledged via the <Reset> button.

### 8.2 Analog output / LED diagnostic information

The TTR200 features a green and a red diagnostic LED for fault signaling.

The green LED indicates that the supply voltage is connected and the red LED provides fault information about the sensor, sensor lead and unit; this information corresponds to "Over/underdrive" for the output signal in the 4 ... 20 mA current loop.



#### Important

After connecting or switching on the supply voltage, it may take up to 15 seconds before this is acknowledged by the green LED. If neither green nor red LED lights up after this period, the unit is defective.

As a rule, the green or the red LED lights up. For this reason, when faults related to the sensor, sensor lead or unit are signaled by the red LED, the green LED does not light up, although the supply voltage is connected. If a sensor or unit fault is detected, the red LED indirectly signals that the supply voltage is connected. Once the sensor or unit fault is eliminated and the red LED turns off, the supply voltage signal appears in the green LED.

## 9 Maintenance / Repair

### 9.1 General information

For transmitters that are used as intended under normal operation, no maintenance is required.  
No on-site repair or replacement of electronic parts is planned.

**Warning! Risk of explosion!**

Faulty transmitters may not be placed into operation by the user.  
Repairs must be performed in the production plant.

### 9.2 Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.

## 10 Explosion-protection relevant information

### 10.1 TTR200-E1... (intrinsically safe)

Approved for use in zone 0.

**Designation:**

- II 1G EEx ia IIC T6 (Zone 0)
- II 2 (1) G EEx [ia] ib IIC T6 (zone 1 [0])
- II 2 G (1D) Ex [iaD] ib IIC T6 (zone 1 [20])

**i Important**

The Ex or ignition-proof designation is provided on the name plate.

EC prototype test certificate: Refer to PTB 05 ATEX2017 X.

**Temperature table**

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	-40 ... 44 °C	-40 ... 56 °C
T5	-40 ... 56 °C	-40 ... 71 °C
T4, T3, T2, T1	-40 ... 60°C	-40 ... 85 °C

**Safety specifications**

**Intrinsically safe EEx ia IIC explosion protection**

	Supply circuit	Measurement current circuit / passive transducer (RTD)	Measurement current circuit / active transducer (RTD)
Max. voltage	$U_i = 30 \text{ V}$	$U_o = 6,5 \text{ V}$	$U_o = 1,2 \text{ V}$
Short-circuit current	$I_i = 130 \text{ mA}$	$I_o = 25 \text{ mA}$	$I_o = 50 \text{ mA}$
Max. power	$P_i = 0,8 \text{ W}$	$P_o = 38 \text{ mW}$	$P_o = 60 \text{ mW}$
Internal inductance	$L_i = 0,5 \text{ mH}$	$L_i = 0 \text{ mH}$	$L_i = 0 \text{ mH}$
Internal capacitance	$C_i = 5 \text{ nF}$	$C_i = 49 \text{ nF}$	$C_i = 49 \text{ nF}$
Maximum permissible external inductance		$L_o = 5 \text{ mH}$	$L_o = 5 \text{ mH}$
Maximum permissible external capacitance		$C_o = 1,55 \text{ }\mu\text{F}$	$C_o = 1,05 \text{ }\mu\text{F}$

### 10.2 TTR200-E2... (non-incendive)

Approved for use in zone 2.

**Designation:**

- II 3 G EEx n A II T6

**i Important**

The Ex or ignition-proof designation is provided on the name plate.

ABB manufacturer's declaration in accordance with ATEX directive

**Temperature table**

Temp.- class	Device category 2 use
T6	-40 ... 56 °C
T5	-40 ... 71 °C
T4	-40 ... 85 °C

## 11 Approvals

**CE mark:**

The TTR200 meets all requirements for the CE mark in accordance with IEC 61326 (2006).

**Ignition protection:**

The TTR200 complies with the requirements of ATEX directive 94/9 EC. For additional information, refer to the section "Explosion-protection relevant information".

## 12 Technical data

### 12.1 Input

#### 12.1.1 Resistance

##### RTD resistance thermometer

Pt100 in acc. with DIN IEC 60751, JIS, MIL, Ni in acc. with DIN 43760, Cu  
(for additional information, see the section "Measuring accuracy")

##### Resistance measurement

0 ... 500 Ω  
0 ... 5000 Ω

##### Sensor connections

2-, 3-, 4-wire circuit

##### Connecting cables

2-, 3-, 4-wire max. sensor line resistance ( $R_W$ ) for each wire 50 Ω in acc. with NE 89 (March 2003);  
(3-wire balanced, 2-wire circuit compensation up to 100 Ω sensor total line resistance)

##### Measurement current

< 300 μA

##### Sensor short-circuit

< 5 Ω (for RTD)

##### Sensor wire break (temperature resistance measurement 2-, 3-, 4-wire)

Measuring range 0 ... 500 Ω > 0.6 ... 10 kΩ  
Measuring range 0 ... 5 kΩ > 5.3 ... 10 kΩ

##### Corrosion detection in accordance with NAMUR NE 89

3-wire resistance reading > 50 Ω  
4-wire resistance reading > 50 Ω

#### 12.1.2 Thermocouples/Voltages

##### Types

B, E, J, K, L, N, R, S, T, U, C, D

##### Voltages

-125 ... 125 mV  
-125 ... 1100 mV

##### Connecting cables

Max. sensor line resistance ( $R_W$ ) for each line 1.5 kΩ, total 3 kΩ

##### Sensor wire break monitoring in accordance with Namur NE 89

pulsed with 1 μA outside the measurement interval  
Thermocouple measurement 5.3 ... 10 kΩ  
Voltage measurement 5.3 ... 10 kΩ

##### Input resistance

> 10 MΩ

##### Internal reference junction

Pt1000, DIN IEC 60751 Cl. B  
(no jumpers necessary)

##### Sensor matching

via single point (offset adjustment)  
via two point adjustment

##### Sensor fault signaling

RTD sensor: Short circuit and wire break  
Linear resistance measurement: Wire break  
Thermocouple: Wire break  
Linear voltage measurement: Wire break

### 12.2 Output

##### Transmission characteristics

temperature linear  
resistance linear  
voltage linear

##### Output signal

Configurable 4 ... 20 mA (standard)  
Configurable 20 ... 4 mA  
(NE43 dynamic range: 3.8 ... 20.5 mA)

##### Simulation mode

3.5 ... 23.6 mA

##### Induced current consumption

< 3.5 mA

##### Maximum output current

23.6 mA

##### Configurable error current signal

override 22 mA (20.0 ... 23.6 mA)  
underdrive 3.6 mA (3.5 ... 4.0 mA)

## General information

### 12.3 Power supply (polarity safe)

(2-wire technique; power lines = signal lines)

#### Supply voltage

Non ignition-proof application:

$$U_s = 12 \dots 42 \text{ V DC}$$

Ignition-proof applications:

$$U_s = 12 \dots 30 \text{ V DC}$$

#### Max. permissible residual ripple for supply voltage

Max. permissible ripple for supply voltage during communication in accordance with HART FSK "Physical Layer" specification, version 8.1 (08/1999) Section 8.1

#### Undervoltage detection

$$U_{\text{Terminal-Mu}} < 11 \text{ V results in } I_a = 3.6 \text{ mA}$$

#### Max. load

$$R_{\text{Load}} = (\text{supply voltage} - 12 \text{ V}) / 0.022 \text{ A}$$

#### Max. load ( $\Omega$ depending on supply voltage (V DC))

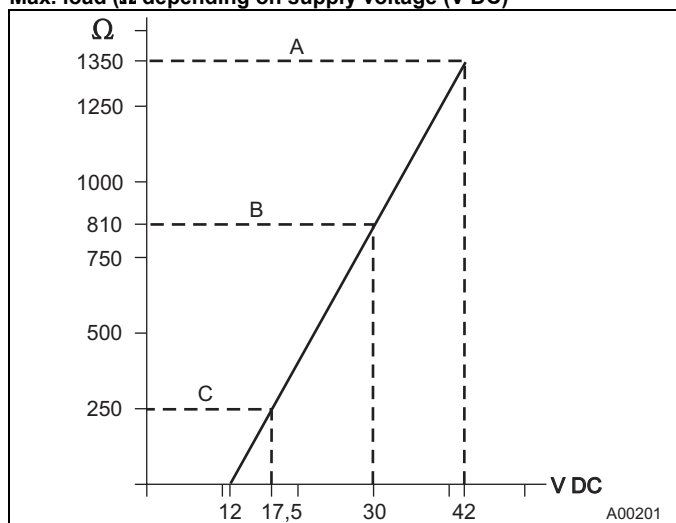


Fig. 13

A TTR200  
 B TTR200 in EEx ia design  
 C HART communication - resistor

#### Max. power consumption

$$P = U_s \times 0.022 \text{ mA}$$

e.g.,  $U_s = 24 \text{ V} \rightarrow P_{\text{max}} = 0.528 \text{ W}$

### 13.1 Ambient conditions

**Ambient temperature:** Standard:  $-40 \dots 85 \text{ }^\circ\text{C} / -40 \dots 185 \text{ }^\circ\text{F}$   
 For ignition-proof design, see prototype test certificate PTB 05 ATEX 2017 X.

**Transport / storage temperature:**  $-40 \dots 85 \text{ }^\circ\text{C} / -40 \dots 185 \text{ }^\circ\text{F}$

**Climate class:** Cx ( $-40 \dots 85 \text{ }^\circ\text{C} / -40 \dots 185 \text{ }^\circ\text{F}$ ,  
 5 ... 95% relative humidity)  
 DIN EN 60654-1

**Max. permissible humidity:** 95% relative humidity IEC 60068-2-30

**Vibration resistance\*:** 10 ... 2000 Hz at 5 g acc. to IEC 68-2-6  
 gn = 30 in accordance with IEC 68-2-27

**Shock\*:** IP 20, or IP class of bay

\* applies to operation and transport

### 13.2 Electromagnetic compatibility

Emitted interference in accordance with IEC 61326 (2006) and Namur NE21 (02/2004)

### 13.3 EMI/RFI shielding

Interference immune in accordance with IEC 61326 (2006) and Namur NE21 (02/2004)

Pt100: Measuring range 0 ... 100  $^\circ\text{C}$ , span 100 K

Type of test	Testing accuracy	Influence
Burst to signal/data lines	2 kV	< 0,5%
Static discharge		
• Contact plate (indirect)	8 kV	no
• Supply terminals <sup>1)</sup>	6 kV	no
• Sensor terminals <sup>1)</sup>	4 kV	no
Radiated field		
80 MHz ... 2 GHz	10 V / m	< 0,5%
Coupling		
150 kHz ... 80 MHz	10 V	< 0,5%
Surge		
between the supply lines	0,5 kV	no malfunction
Line to earth	1 kV	no malfunction

<sup>1)</sup> Air discharge (at 1 mm distance)

## 13 General information

<b>Electrical isolation</b> (input/output)	3.5 kV DC (approx. 2.5 kV AC) 60 s
<b>MTBF time</b>	28 years at 60 $^\circ\text{C}$ ambient temperature
<b>Input filter</b>	50 / 60 Hz
<b>Switch-on delay</b>	< 10 s ( $I_a \leq 3.6 \text{ mA}$ during starting cycle)
<b>Warm-up time</b>	5 min.
<b>Ramp-up time t90</b>	400 ... 1000 ms
<b>Reading updated<sup>1)</sup></b>	10/sec
<b>Output filter</b>	Digital filter 1st order: 0 ... 100 s



<sup>1)</sup> depending on sensor type and sensor circuit

**14 Appendix**

**14.1 Additional documents**

- Commissioning Instruction (CI/TTR200)
- Data Sheet (DS/TTR200)

**14.2 Permits and certifications**

	Symbol	Description
CE mark		By placing the CE mark on the name plate, ABB Automation Products GmbH declares its conformance with the following directives: - EMC directive 89/336/EEC
Ex approvals		By placing the Ex mark on the name plate, ABB Automation Products GmbH also declares its conformance with the following directive: - ATEX directive 94/9/EC



**Important**

All documentation, declarations of conformity and certificates are available in the download area of ABB.

[www.abb.com/temperature](http://www.abb.com/temperature)



## EG-Konformitätserklärung *EC-Certificate of Compliance*

**ABB Automation Products GmbH**  
**Borsigstr. 2**  
**D-63755 Alzenau**  
**Germany**

<p><b>Erklärt, dass die Produkte der Geräteart:</b>  <i>Declare that the products of device type:</i></p> <p><b>Modell- / Typebezeichnung:</b>  <i>Model- / type name:</i></p> <p><b>Produktnummer:</b>  <i>Product number:</i></p> <p><b>Konform zu EG-Richtlinien:</b>  <i>Conform to EC-directives:</i></p> <p><b>EG-Baumusterprüfbescheinigung:</b>  <i>EC-Type examination certificate:</i></p> <p><b>Relevante Normen:</b>  <i>Related Standards:</i></p> <p><b>Qualitätssicherung Produktion</b>  <i>Production Quality notification:</i></p> <p><b>entspricht.</b>  <i>complies.</i></p>	<p><b>Temperatur Messumformer</b>  <b>Temperature Transmitter</b></p> <p><b>TTR200, TTR300</b></p> <p><b>TTR200-..., TTR300-...</b></p> <p><b>94/9/EG ( ATEX )</b>  <b>89/336/EWG ( EMV/EMC )</b></p> <p><b>PTB 05 ATEX 2017 X</b></p> <p><b>EN61326-1 : 2006</b>  <b>EN50014 (1997), EN50020 (2002),</b></p> <p><b>PTB 99 ATEX -Q004-...</b></p>
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Alzenau 19 March 2008


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**ABB Automation Products GmbH**

## Statement about the contamination of devices and components

The repair and/or maintenance of devices and components will only be performed when a completely filled out explanation is present.

Otherwise, the shipment can be rejected. This explanation may only be filled out and signed by authorized specialist personnel of the operator.

### Customer details:

Company:

Address:

Contact person:

Telephone:

Fax:

E-Mail:

### Device details:

Type:

Serial no.:

Reason for the return/description of the defect:

### Was this device used for working with substances which pose a threat or health risk?

Yes       No

If yes, which type of contamination (please place an X next to the applicable items)

biological	<input type="checkbox"/>	corrosive/irritating	<input type="checkbox"/>	combustible (highly/extremely combustible)	<input type="checkbox"/>
toxic	<input type="checkbox"/>	explosive	<input type="checkbox"/>	other harmful substances	<input type="checkbox"/>
radioactive	<input type="checkbox"/>				

Which substances have had contact with the device?

1.

2.

3.

We hereby certify that the devices/parts shipped were cleaned and are free from any dangerous or poisonous materials.

City, Date

Signature and company stamp

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