Operating Instruction
OI/TTH200-EN

Head mounted Temperature Transmitter TTH200

HART COMMUNICATION PROTOCOL

ABB

Head mounted Temperature Transmitter
TTH200

Operating Instruction

OI/TTH200-EN

02.2009

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1 Safety

1.1 General information and notes for the reader

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

These instructions are an important part of the product and must be kept for later use.

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 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.

This product is built based on state-of-the-art technology and is operationally safe. It has been tested and left the factory in a safe, maintenance-free state. The information in the manual must be observed and followed in order to maintain this state throughout the period of operation.

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.

Only by observing all of the safety information and all safety/warning symbols in these instructions can optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device, be ensured.

Information and symbols directly on the product must be observed. They may not be removed and must be fully legible at all times.

1.2 Intended use

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

The device is designed for use exclusively within the stated values on the name plate and in the technical specifications (see section "Specifications").

- The maximum operating temperature must not be exceeded.
- The permitted operating temperature must not be exceeded.
- The housing degree of protection must be observed.

1.3 Target groups and qualifications

Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator to do so. The specialist personnel must have read and understood the manual and comply with its instructions.

Prior to using corrosive and abrasive materials for measurement purposes, the operator must check the level of resistance of all parts coming into contact with the materials to be measured. ABB Automation Products GmbH will gladly support you in selecting the materials, but cannot accept any liability in doing so.

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

1.4 Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this instruction, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

1.5 Plates and symbols

1.5.1 Safety/warning symbols, note symbols

DANGER – <Serious damage to health / risk to life>

This symbol in conjunction with the signal word "Danger" indicates an imminent danger. Failure to observe this safety information will result in death or severe injury.

DANGER – <Serious damage to health / risk to life>

This symbol in conjunction with the signal word "Danger" indicates an imminent electrical hazard. Failure to observe this safety information will result in death or severe injury.

WARNING – <Bodily injury>

This symbol in conjunction with the signal word “Warning“ indicates a possibly dangerous situation. Failure to observe this safety information may result in death or severe injury.

WARNING – <Bodily injury>

This symbol in conjunction with the signal word "Warning" indicates a potential electrical hazard. Failure to observe this safety information may result in death or severe injury.

CAUTION – <Minor injury>

This symbol in conjunction with the signal word “Caution“ indicates a possibly dangerous situation. Failure to observe this safety information may result in minor or moderate injury. This may also be used for property damage warnings.

ATTENTION – <Property damage>!

The symbol indicates a potentially damaging situation.

Failure to observe this safety information may result in damage to or destruction of the product and/or other system components.

IMPORTANT (NOTICE)

This symbol indicates operator tips, particularly useful information, or important information about the product or its further uses. It does not indicate a dangerous or damaging situation.

1.5.2 Name plate

The name plate is located on the transmitter housing.

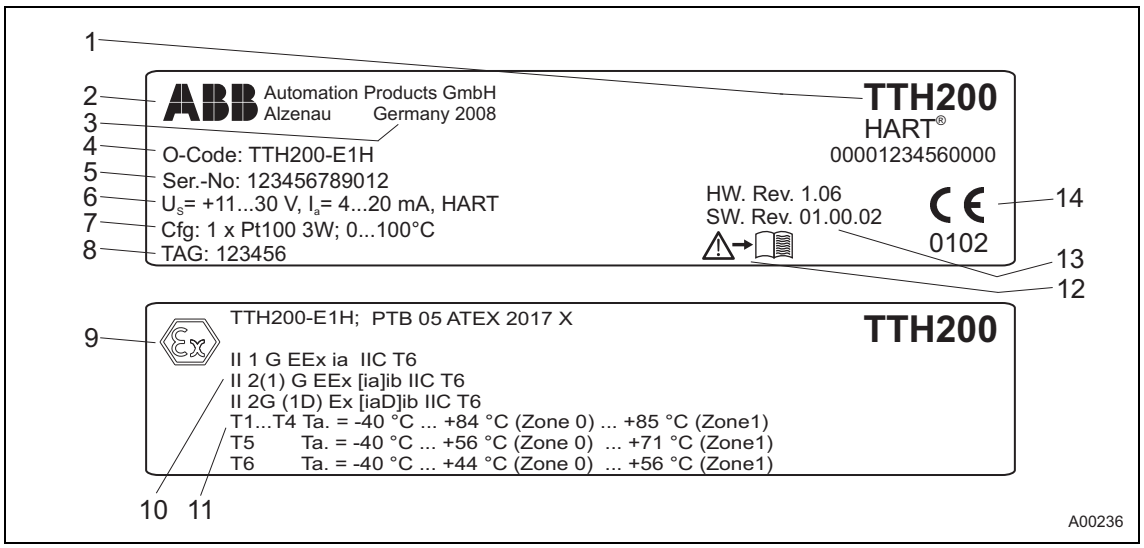


Fig. 1

1 Model name
2 Manufacturer of transmitter
3 Country and year of manufacture
4 Order code
5 Serial number
6 Technical data
7 Configuration
8 TAG number
9 Ex mark (optional)
10 Marking of explosion proof design (optional)
11 Temperature classes of explosion proof design (optional)
12 Refer to product documentation
13 Software revision number/hardware revision number
14 CE mark (EC conformity)

Important

The temperature range specified on the name plate (11) refers only to the permissible ambient temperature range for the transmitter and not to the measuring element used in the measuring inset.

1.6 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.

1.7 Safety information for electrical installation

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

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

The secure separation of contact-dangerous electrical circuits is only ensured 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.

1.8 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.

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.

1.9 Returning devices

Use the original packaging or suitably secure shipping containers if you need to return the device for repair or recalibration purposes. Fill out the return form (see the Appendix) and include this 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 shipping purposes:

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

1.10 Disposal

ABB Automation Products GmbH actively promotes environmental awareness and has an operational management system that meets the requirements of DIN EN ISO 9001:2000, EN ISO 14001:2004, and OHSAS 18001. Our products and solutions are intended to have minimum impact on the environment and persons during manufacturing, storage, transport, use, and disposal.

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

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

1.10.1 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).

The product/solution must be disposed of at a specialized recycling facility. Do not use municipal garbage collection points. According to the WEEE Directive 2002/96/EC, only products used in private applications may be disposed of at municipal garbage facilities. 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.

1.10.2 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 potentially explosive atmospheres

Special regulations must be observed in potentially explosive atmospheres for the power supply, signal inputs/outputs and ground connection. The information relating specifically to explosion protection that appears within the individual sections must be observed.

Notice - Potential damage to parts

All parts must be installed in accordance with the manufacturer's specifications, as well as relevant standards and regulations.

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

2.1 Approvals

The approvals for use of the TTH200-E1H temperature transmitter in potentially explosive atmospheres can be found in the section of the operating instructions titled "Ex relevant specifications".

2.2 Housing degree of protection

The connection parts of the TTH200-E1H temperature transmitter and the HMI type AS LCD display must be installed so that a housing degree of protection type of at least IP 20 as per IEC 60529:1989 is achieved.

2.3 Electrostatic charging

When using the transmitter in Zone 0, please ensure that impermissible electrostatic charging of the TTH200-E1H temperature transmitter and the LCD display is prevented (observe the warnings on the device).

2.4 Grounding

If, for functional reasons, the intrinsically safe circuit needs to be grounded by means of connection to the equipotential bonding, it may only be grounded at one point.

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/Part 1 (EN 60079-25/2004 and IEC 60079-25/2003). An interconnection certificate must always be provided for intrinsically safe circuits.

2.6 Configuration

The TTH200-E1H transmitter can be configured in the potentially explosive atmosphere in compliance with the interconnection certificate, both directly in the potentially explosive atmosphere using approved handheld HART terminals and by coupling an Ex modem into the circuit outside the potentially explosive atmosphere.

2.7 Ex relevant specifications

See chapter 12, "Ex relevant specifications" page 35.

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 in accordance with the HART protocol. The transmitter conforms to housing degree of protection IP 20 and is suitable for integration into DIN A and DIN B sensor heads.

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

As an option, the transmitter can be fitted with an HMI type AS LCD display.

The LCD display is used to visualize the current process data. The electrical connection between the LCD display and transmitter is provided by a 6-pin flat ribbon cable with a plug connector. The LCD display can only be used in conjunction with transmitters that have this HMI interface.

Important

The HMI type A LCD display with configuration function, used as an option with the TTH300 / TTF300, is not compatible with the TTH200.

4 Mounting

4.1 Installation options

There are three options for mounting the transmitter in the temperature sensor heads:

- in the cover of the connection head (without springs)
- directly on the measuring inset (spring mounted)
- on a top hat rail

4.1.1 Installation in the cover of the connection head

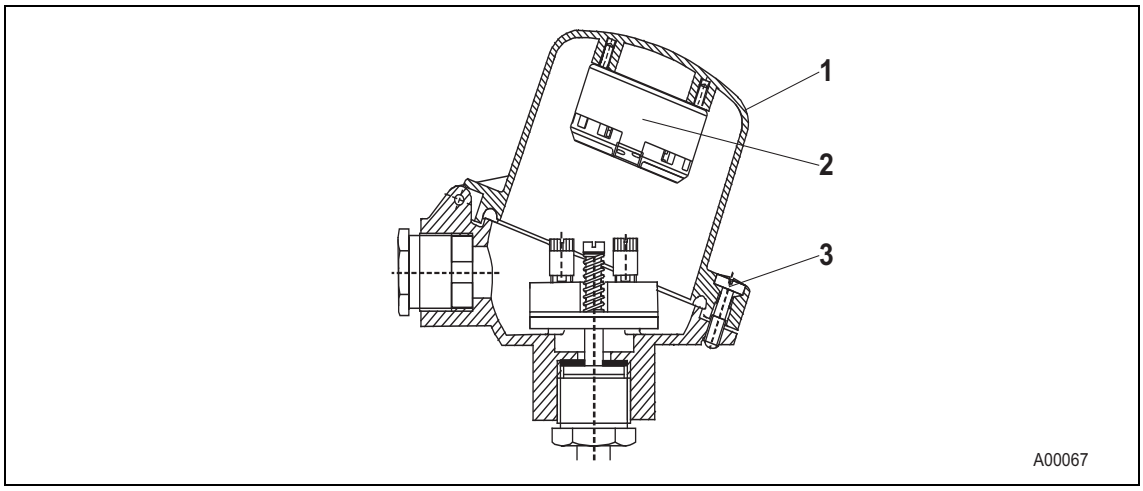


Fig. 2

1. Release the screw plug (3) for the cover of the connection head.
2. Open the cover (1).
3. Secure the transmitter (2) at the proper position on the cover, using the captive screws found in the transmitter.

4.1.2 Installation on the measuring inset

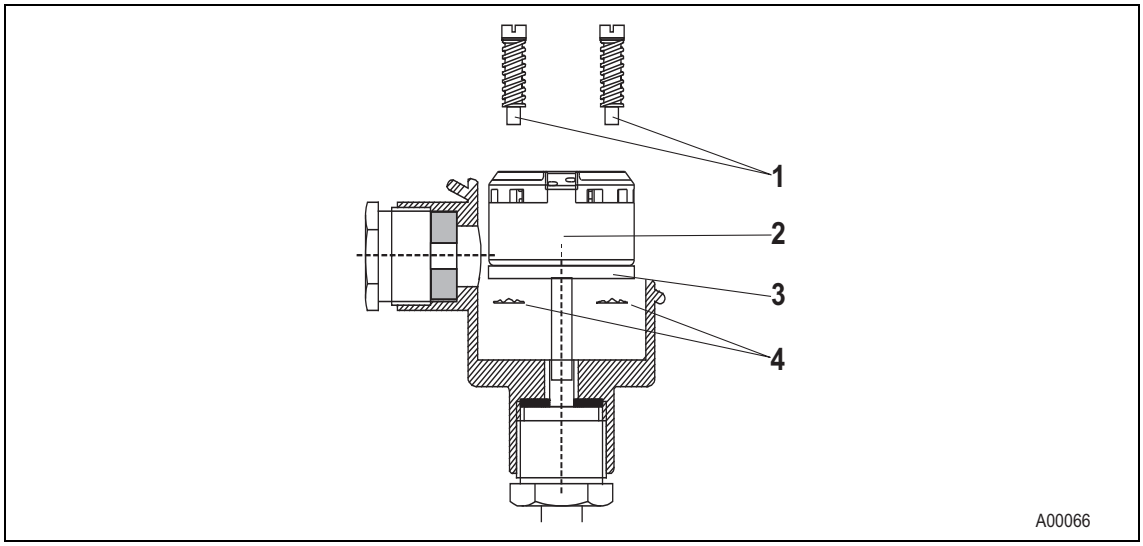


Fig. 3

Important

Before mounting the transmitter on the measuring inset, remove the ceramic block on the measuring inset and the captive screws in the transmitter.

To install the transmitter on the measuring inset, cambered toothed discs and the corresponding mounting screws are required; these must be ordered as separate accessories:

Measuring inset installation set (2 mounting screws, 2 springs, 2 toothed discs)
Order number: 215882

1. Remove the ceramic block from the measuring inset (3).
2. Remove the screws from the transmitter (2). Remove the sleeves from the screw holes and then remove the screws.
3. Insert new mounting screws (1) from above in the installation holes of the transmitter.
4. Place the cambered toothed discs (4) with curve facing upward on the downward protruding screw thread.
5. Connect the power supply cable to the transmitter according to connection diagram.
6. Place the transmitter in the housing on the measuring inset and secure it.

Important

The toothed discs between measuring inset and transmitter are straightened when the screws are tightened. This enables them to grip the mounting screws.

4.1.3 Installation on a top hat rail

When mounted on a top hat rail, the transmitter can be placed at a distance from the sensor in a housing that is suitable for the ambient conditions.

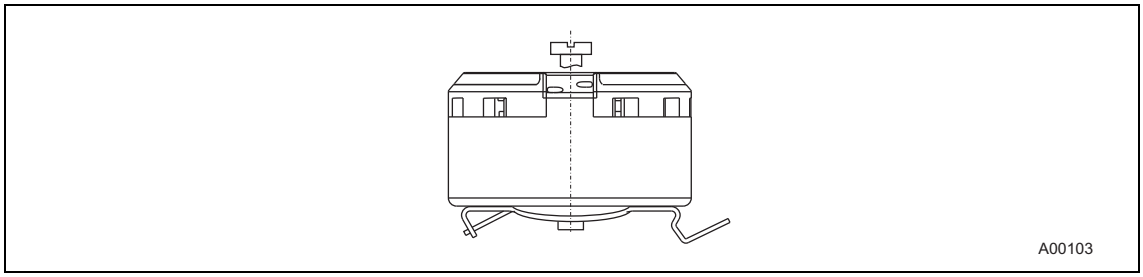


Fig. 4

4.2 Installing/Removing the optional LCD display

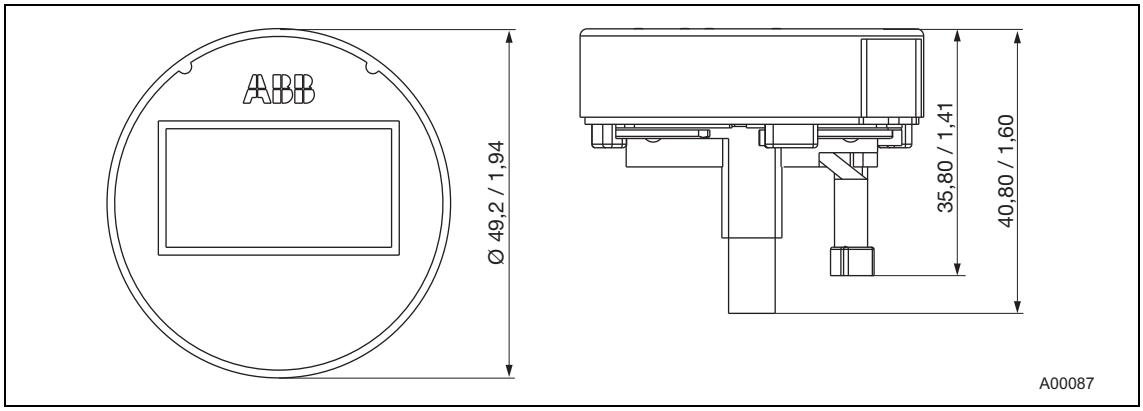


Fig. 5: HMI type AS LCD display

Thanks to the LCD display interface, the TTH200 can be operated freely with the HMI type AS LCD-display, enabling process data to be visualized.

Important

The LCD display with HMI type A configuration function, used with the TTx300 series, is not suitable for the TTH200.

The display must be removed to enable electrical connection of the sensor or the power supply:

- Carefully remove the LCD display from the transmitter inset. The LCD display is held firmly in place. You may have to use the tip of a screwdriver to pry the LCD display loose. Take care to avoid any mechanical damage.

No tools are required to insert the LCD display:

1. Carefully insert the guide pins for the LCD display in the guide holes of the transmitter inset. Make sure the black connection socket fits into the terminal on the transmitter inset.
2. Then press the LCD display in as far as it will go. Make sure that the guide pins and connection socket are fully inserted.

The position of the LCD display can be adjusted to suit the installation position of the transmitter, to ensure that the display is legible.

The LCD display has twelve positions that can be set in 30° increments.

Caution - Potential damage to parts

Make sure the flat ribbon cable does not get twisted or torn when rotating the LCD display.

1. Carefully turn the LCD display to the left to release it from its mount.
2. Use caution when positioning the LCD display.
3. Insert the LCD display back into the mount and turn it to the right until it snaps into place.

5 Electrical connection

Warning - Dangerous electrical current

The relevant guidelines must be observed during electrical installation. Connections must only be established in a dead-voltage state.

The transmitter has no switch-off elements. Therefore, overvoltage protection devices, lightning protection, or voltage disconnection options must be provided at the plant.

The power supply and signal are routed in the same line and must be implemented as a SELV or PELV circuit in accordance with the standard (standard version). For the Ex version, the guidelines stipulated by the Ex standard must to be adhered to.

A check must be carried out as to whether the existing power supply corresponds to the specifications both on the name 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 or 4 mm).

5.1 Conductor material

- Power supply cable: flexible standard conductor material
- Maximum wire cross-section: 1.5 mm^2 (16 AWG)

Notice - Potential damage to parts

Using rigid conductor material may cause line breaks.

5.2 Electrical connections configuration

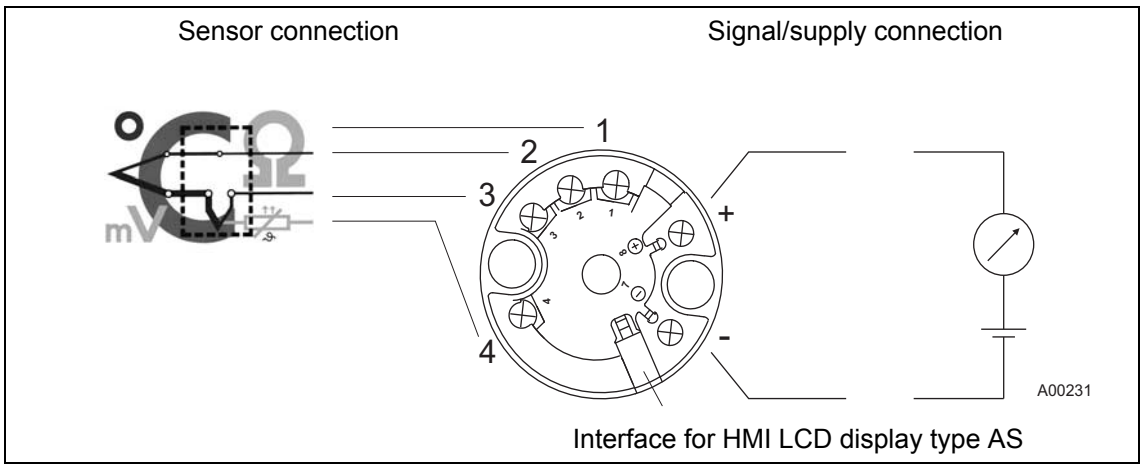


Fig. 6

5.2.1 Sensor connection

Depending on the sensor model, a variety of conductor materials can be used for sensor connections. The integrated internal reference junction makes it possible to directly connect thermal compensating cables.

For the solder terminal, a soldering tag is provided at each terminal.

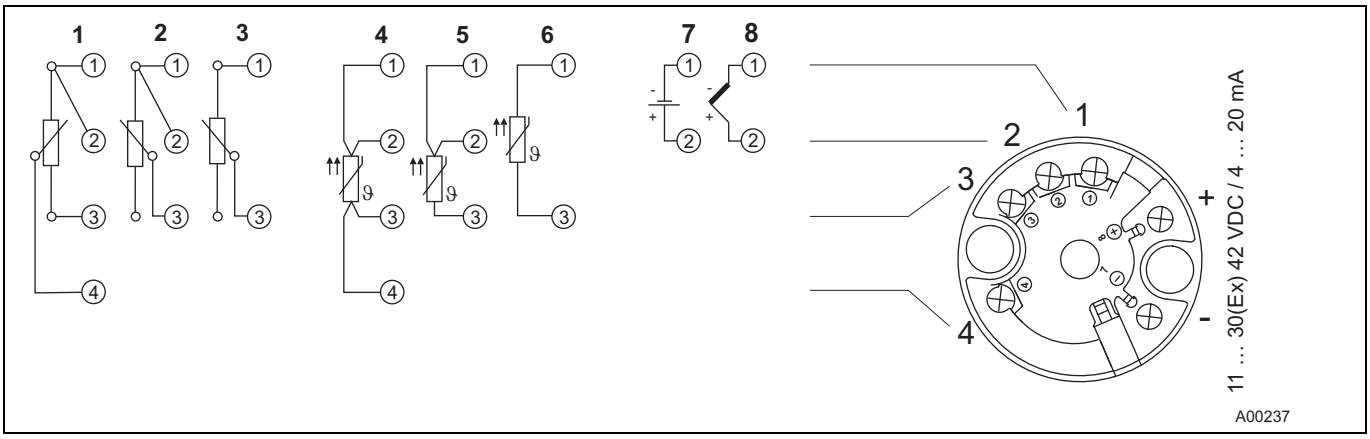


Fig. 7

1 Potentiometer, Four-wire circuit
2 Potentiometer, Three-wire circuit
3 Potentiometer, Two-wire circuit
4 RTD, Four-wire circuit
5 RTD, Three-wire circuit
6 RTD, Two-wire circuit
7 Voltage measurement
8 Thermocouple

5.3 Block diagram

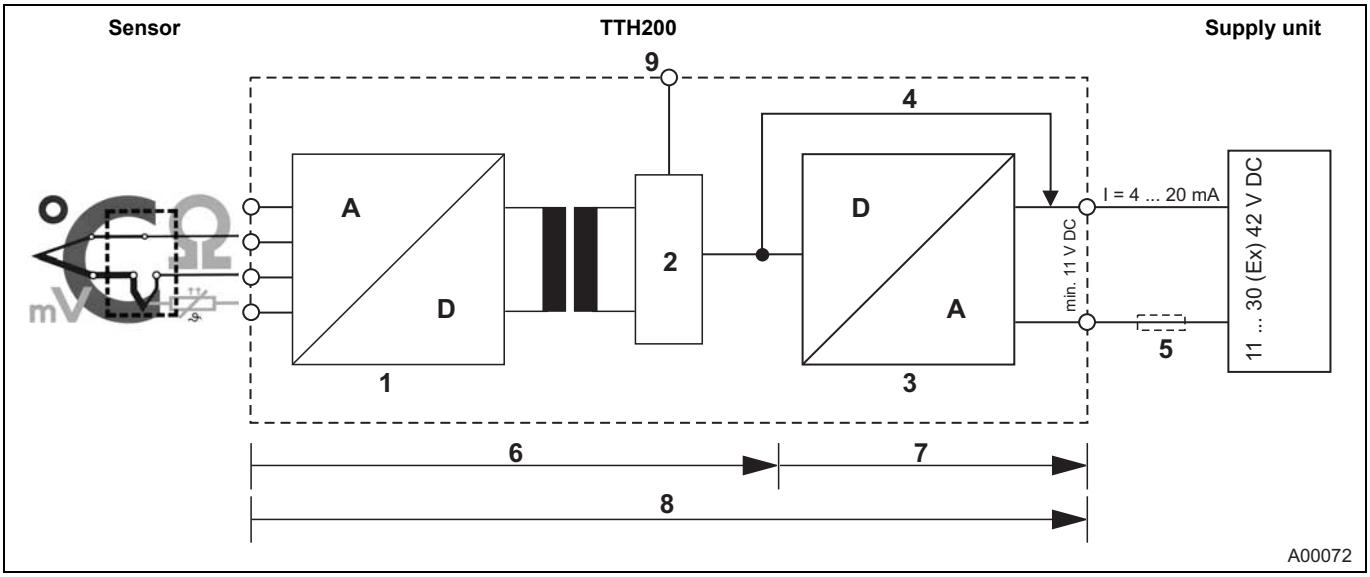


Fig. 8

1 24-bit A/D converter
2 Microcontroller
3 16-bit D/A converter
4 HART signal
5 Load (observe voltage drop, refer to Fig. 17)
6 Digital measuring accuracy
7 D/A measuring accuracy
8 Overall measuring accuracy
9 Interface for HMI LCD display type AS (not suitable for HMI LCD display type A)

5.4 Standard application

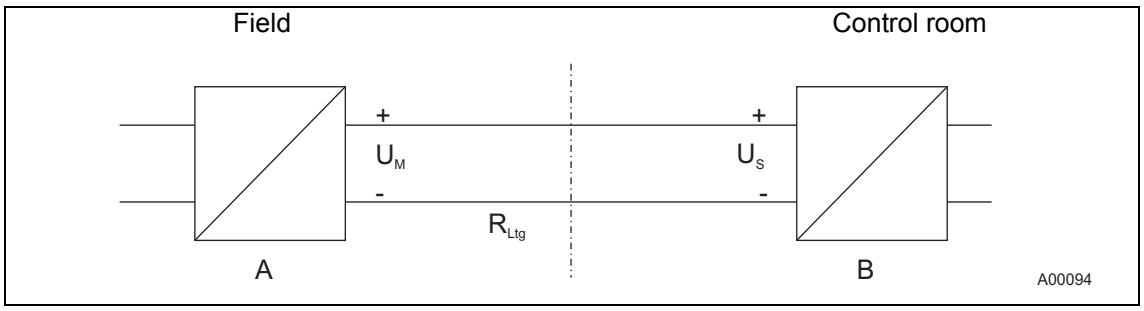


Fig. 9

A Transmitter B Supply isolator/PLC input with supply

When connecting these components, observe the following condition:

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

Where:

U_{Mmin}: Minimum operating voltage of transmitter
U_{Smin}: Minimum supply voltage of repeater supply isolater / PLC input
R_{Ltg}: Line resistance between transmitter and supply isolator

For HART functionality, use supply isolators or PLC input cards with HART mark. If this is not possible, the interconnection must have a resistance ≥ 250 Ω (< 1100 Ω).

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.

5.5 Standard application with HART functionality

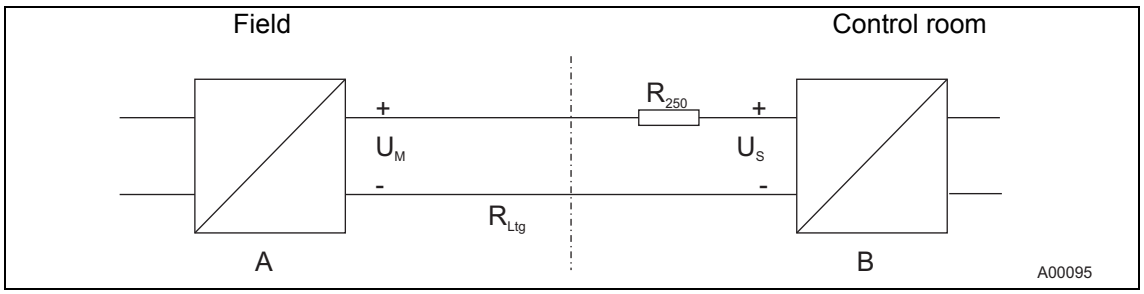


Fig. 10

A Transmitter B Supply isolator/PLC input with supply

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

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

Where:

U_{Mmin}: Minimum operating voltage of transmitter
U_{Smin}: Minimum supply voltage of repeater supply isolator / PLC input
R_{Ltg}: Line resistance between transmitter and supply isolator
R_{250}: Resistance for HART functionality

5.6 Electrical interconnection in explosion hazardous areas

Depending on the safety requirements, special interconnections are required for use in explosion hazardous areas.

Important

Refer to section "Ex relevant specifications".

Intrinsic safety

The supply isolators/PLC inputs must feature intrinsically safe input protection circuits in order to eliminate hazards (spark formation). The interconnection must be inspected. In order to provide proof of intrinsic safety, the electrical limit values must be used as the basis for the EC type-examination test certificates of the equipment (devices); this includes the capacitance and inductance values of the cables. Proof of intrinsic safety is said to have been provided if the following conditions are fulfilled when a comparison is carried out in relation to the limit values of the equipment:

Transmitter (intrinsically safe equipment)		Supply isolator/PLC input (related equipment)
U_i	≥	U_o
I_i	≥	I_o
P_i	≥	P_o
$L_i + L_c$ (cable)	≤	L_o
$C_i + C_c$ (cable)	≤	C_o

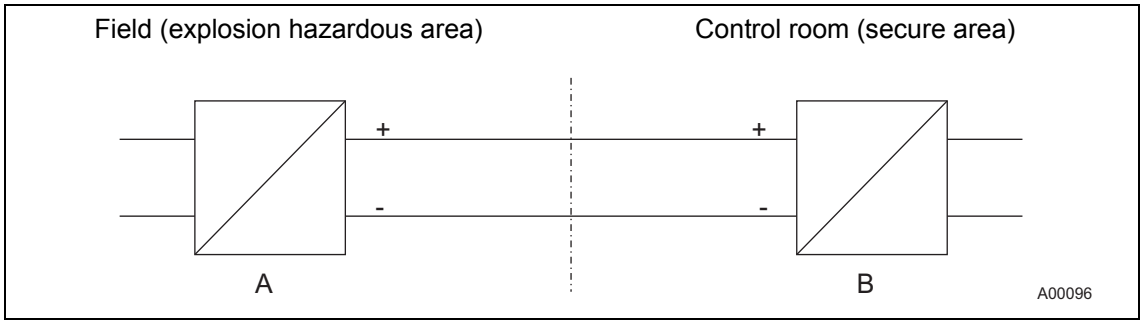


Fig. 11

A Transmitter

B Supply isolator/PLC input with supply

5.6.1 Installation in explosion hazardous areas

Transmitters can be installed in all kinds of industrial sectors. Explosion hazardous areas are divided into zones, meaning that a wide range of different instruments are also required. The Ex relevant specifications are stipulated in the section titled "Ex relevant specifications".

5.6.2 Zone 0

Transmitter design: II 1 G Ex ia IIC T6

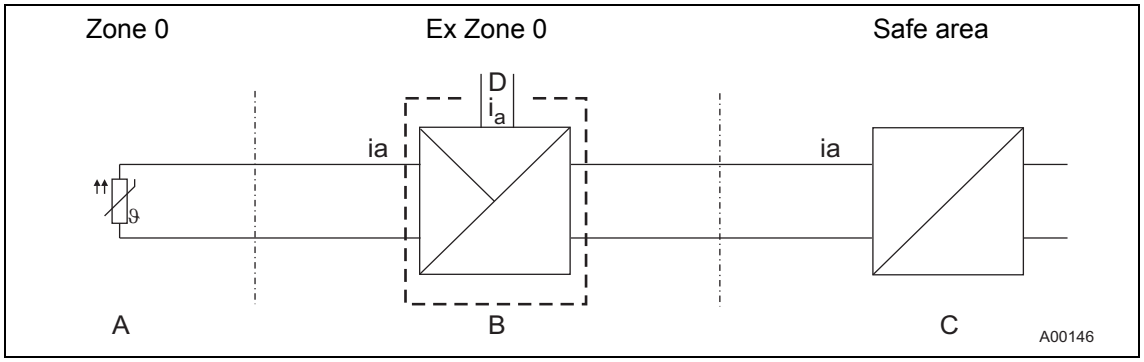


Fig. 12

A Sensor
B Transmitter in housing with IP 20 degree of protection
C Supply isolator [Ex ia]
D Interface for HMI LCD Display type AS

For instruments in Zone 0, the transmitter must be installed in a suitable housing with IP 20 degree of protection. The input for the supply isolator must have an [Ex ia] design.

When using the transmitter in Zone 0, you must ensure that impermissible electrostatic charging of the temperature transmitter is prevented (observe the warnings on the device).

The user must ensure that sensor instrumentation meets the requirements of applicable Ex standards.

5.6.3 Zone 1 (0)

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

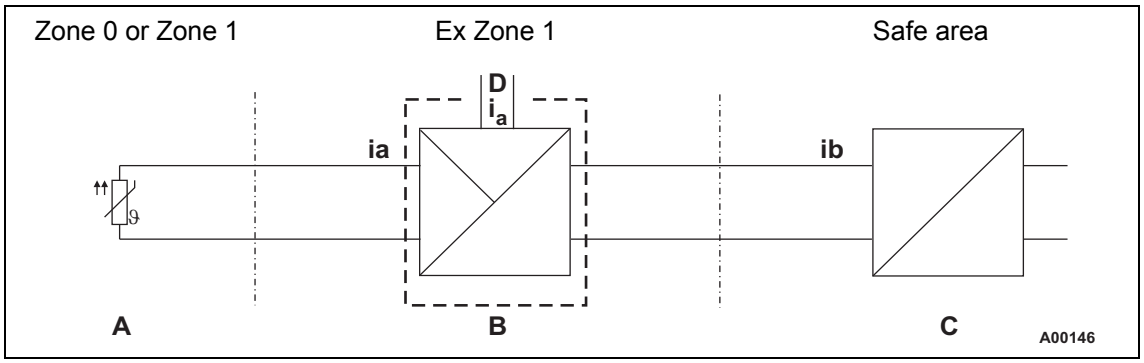


Fig. 13

A Sensor
B Transmitter in housing with IP 20 degree of protection
C Supply isolator [Ex ib]
D Interface for HMI LCD Display type AS

For instruments in Zone 1, the transmitter must be installed in a suitable housing with IP 20 degree of protection. The input for the supply isolator must have an [Ex ib] design.

The user must ensure that sensor instrumentation meets the requirements of applicable Ex standards. It can be installed in Zone 1 or Zone 0.

5.6.4 Zone 1 (20)

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

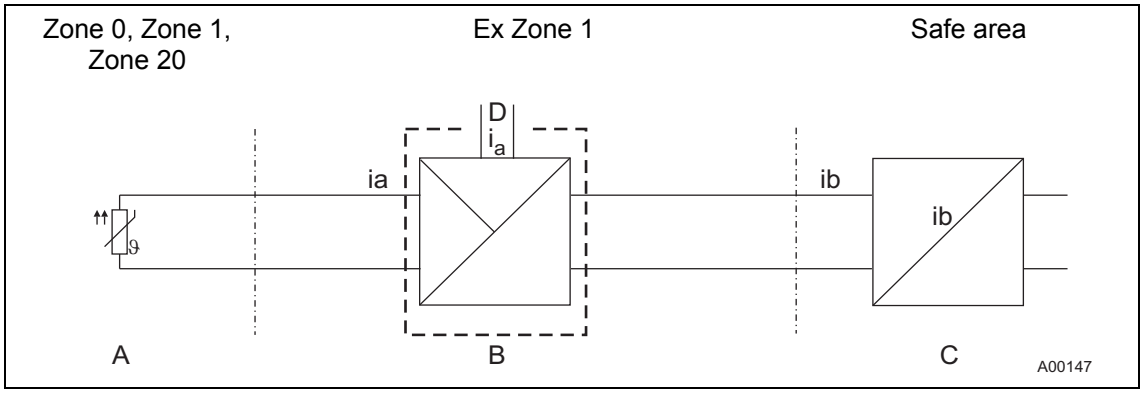


Fig. 14

A Sensor
B Transmitter in housing with IP 20 degree of protection
C Supply isolator [Ex ib]
D Interface for HMI LCD Display type AS

For instruments in Zone 1, the transmitter must be installed in a suitable housing with IP 20 degree of protection. The input for the supply isolator must have an [Ex ib] design.

The user must ensure that sensor instrumentation meets the requirements of applicable Ex standards. It can be installed in Zone 0, Zone 1, or Zone 20.

5.6.5 Zone 2

Transmitter design: II 3 G Ex nA II T6

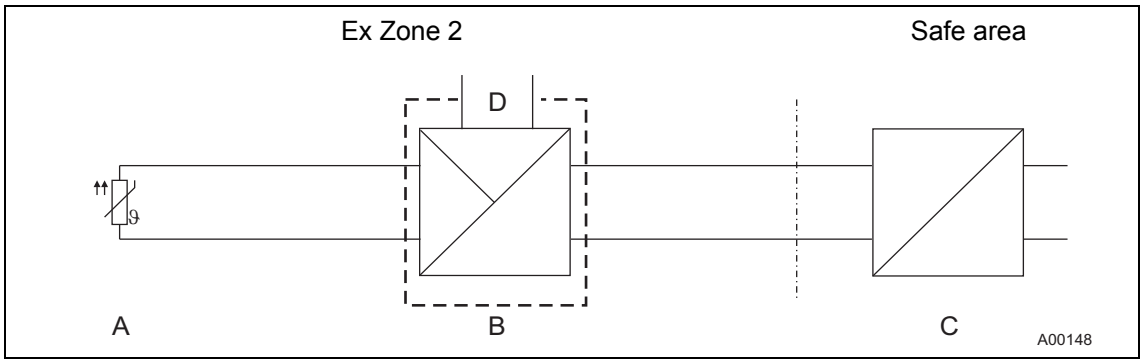


Fig. 15

A Sensor
B Transmitter in housing with IP 54 degree of protection
C Supply isolator
D Interface for HMI LCD Display type AS

For instruments in Zone 2, the transmitter must be installed in a suitable housing with a degree of protection of at least IP 54.

In the event of a disturbance, it must be ensured that the supply voltage cannot exceed the normal voltage by more than 40 %.

6 Commissioning

Important

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

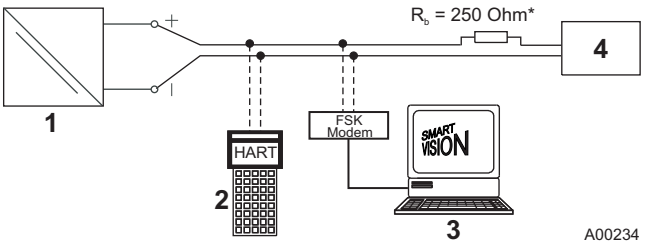
The connected lines must be checked for firm seating. Only firmly seated lines ensure full functionality.

7 Communication and configuration

7.1 Configuration types

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 frame applications
- Via fieldbus (PROFIBUS), provided that the higher-level remote I/O system is HART-enabled



* if necessary

Fig. 16

1 Temperature transmitter
2 Handheld-Terminal
3 FDT/DTM technology
4 Power supply unit (process interface)

7.1.1 HART communication

Communication with the transmitter takes place using the HART protocol. The communication signal is modulated onto both wires of the signal line in accordance with the HART FSK "Physical Layer" specification, version 8.1 (08/1999). The electrical connection is provided either at the (+) and (–) connection terminals of the transmitter or by the power supply cable that is installed at the industrial plant. The advantage of this is that remote configuration is possible with power supply units that are part of the industrial plant.

7.1.2 Configuration with the handheld terminal

Configuration with the handheld terminal normally takes place at the factory before the transmitter is installed in an industrial plant.

1. Open the housing of the sensor head measuring inset.
2. Carefully clamp both test tips of the separate operating control onto the contacts in the slots in front of the (+) and (–) connection terminals.
3. Make sure that the test terminals are securely attached.
4. Carry out installation as shown in Fig. 16.

Important

The test tips are connected without observing polarity. Clamp the test tips to the (+) and (-) terminals. The transmitter can also be configured via the HART protocol during 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 any compatible EDD frame application such as Siemens Simatic.

7.2 Sensor error adjustment (TTH200 DTM Adjust function)

Sensor error adjustment can be performed in the TTH200 DTM by navigating to <Device> <Calibration> <Sensor Adjustment> <Trim low> or <Trim high>.

For sensor error adjustment, the sensor connected to the transmitter must be brought to the lower range limit value temperature/Trim low using a 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 it.

Based on the comparison of the adjustment temperature entered (setpoints) with 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.

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

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

A pure sensor offset error must be corrected using the "Trim low" calibration function. By contrast, if the error is not a pure sensor offset error, it can only be corrected using two-point adjustment or two-point calibration.

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

Output compensation is used to compensate for errors in the current input of the higher-level system.

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

Error compensation for the higher-level system is possible at the lower range limit value with 4 mA and/or 20 mA (single-point error correction: offset; two-point error correction: offset + linear gradient).

D/A analog output compensation can be accessed in the TTH200 DTM via the path <Device> <Calibration> <Output Compensation>.

Prior to analog compensation, it is necessary to determine the loop current values based on iterative entry of current values in simulation mode; the higher-level I/O system displays exactly 4.000 mA or the lower range limit temperature, and 20.000 mA or the upper range limit temperature. The current loop values must be measured using an ammeter and recorded.

The lower range limit value or 4.000 mA +/- 16 µA must then be simulated in D/A analog output compensation mode using sensor simulation. Following this, the iteratively calculated current value at which the higher-level system displays exactly 4.000 mA or the lower range limit value must be entered as a compensation value. Proceed in a similar manner for the upper range limit value or 20.000 mA.

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

7.4 Output signal simulation

When the output signal simulation mode is activated in the TTH200 DTM via the path <Device> <Simulation> <Simulation>, an output signal in the 3.5 ... 23.6 mA range can be simulated, regardless of the sensor value.

7.5 Device reset

In the DTM, a device restart can be triggered via the path <Device> <Tools> <Device Reset>. The type of reset that follows is comparable with switching the supply voltage off and on again.

7.6 Factory reset

Via the DTM path <Device> <Tools> <Reset to Factory Setting>, the TTH200 configuration data can be reset to the factory settings Pt100 (RTD), Three-wire circuit, 0 ... 100 °C, damping off, and overdrive.

Important

The adjustment data (Trim high/low) and D/A compensation values are also reset to their factory settings.

7.7 HART variables

The TTH200 provides 3 HART variables.

The HART variables are assigned the following values:

- Primary HART variable: Process value

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

- Secondary HART variable: Electronic unit temperature
- Tertiary HART variable: Electrical input

7.8 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.

7.9 Description of parameters

Device parameter	Description	DTM parameter	Valid range
Write protection	Activates write protection for the entire device	<Device> <Tools> <Write protection> (Software write protection)	Yes: Locked No: Unlocked Enter password: 0110
Sensor Type	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) Thermocouple type U (DIN43710) Voltage –125 … 125 mV Voltage –125 … 1,100 mV Resistance 0…500 Ω Resistance 0…5,000 Ω Pt10 (IEC751) Pt50 (IEC751) Pt200 (IEC751) Pt500 (IEC751) Pt10 (JIS1604) Pt50 (JIS1604) Pt100 (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)
Type of connection	Sensor connection type relevant for all Pt, Ni, Cu resistance sensor types	<Device> <Configuration> <Sensor / Connection>	Two-wire circuit Three-wire circuit Four-wire circuit
Line resist-stance	Sensor line resistance relevant for all Pt, Ni, Cu resistance sensor types in Two-wire circuit sensor transmitter connection type	<Device> <Configuration> <Sensor / Line Resistance>	0 … max. 100 Ω

Device parameter	Description	DTM parameter	Valid range
Reference junction	When the transmitter reference junction is being used: Internally relevant for all thermocouples except type B, if a thermal/compensating line is clamped to the transmitter. When the transmitter reference junction is not being used: With the exception of type B, externally fixed transfer of thermal/compensating line via copper material at constant thermostat temperature	<Device> <Configuration> <Sensor / Reference junction>	Internal None External - fixed
Reference junction external	Relevant for external reference junction, specification of constant external reference junction temperature	<Device> <Configuration> <Sensor / Reference junction Temp.>	-50 ... 100 °C
Unit	Selects the unit of measure for the sensor	<Device> < Parametrize > <Measuring Range of PV / Unit>	°C, °F, °R, K, mV, Ω
Measurement start	Defines the lower range limit value for the sensor	<Device> <Parametrize> <Measuring Range>	Depends on sensor type
Measurement end	Defines the upper range limit value for the sensor	<Device> <Parametrize> <Measuring Range>	Depends on sensor type
Damping	Configurable condensation 63 % process variable damping value	<Device> <Parametrize> <Damping>	0 ... 100 s
Override	Generates a high alarm signal when sensor or device errors occur; can be configured from 20 … 23.6 mA. Default: 22 mA.	<Device> <Parametrize> <Current Output / Output with Fault>	Overdrive
Undedrive	Generates a low alarm signal when sensor or device errors occur; can be configured from 3.5 … 4 mA.	<Device> <Parametrize> <Current Output / Output with Fault>	Underdrive
HART tag	Defines HART tag name	<Device> <Tools> <Poll Address / Tag> (with SMART VISION frame application only) <Identification> <Instrument identification> (with all frame applications)	8 characters, alphanumeric
Address (Multidrop)	Specifies the communication type	<Device> <Tools> <Poll-Adress / Tag> (with SMART VISION frame application only)	Address = 0 corresponds to HART operating mode: point-to-point communication, 4 ... 20 mA output signal; address = 1 ... 15 corresponds to HART multidrop operating mode: output signal 3.6 mA; only the digital HART readings are available

7.9.1 Factory settings

The transmitter is configured at the factory. The table below contains the values for the individual parameters.

Menu	Description	Parameter	Factory setting
Config device	Write protection	-	No
	Input	Sensor model	Pt100 (IEC751)
		Type of connection	Three-wire circuit
		Lower range limit value	0
		Upper range limit value	100
		Unit	Degrees C
		Damping	Off
Process alarm		Error signaling	Overdrive 22 mA

8 DTM diagnostic information

8.1 HART/DTM diagnostic information

Configuration has been changed

Important

The transmitter indicates that the parameters or configuration data have changed (HART: Configuration changed flag). Following automatic or desired reconfiguration, the message can be acknowledged in the DTM using the <Reset> button.

9 Error messages

The following list contains the error messages that appear on the LCD display.

	Device Status	DIAG. NO.	Source of error	Remedy
Device	F	1	Device defective	Replace the device
Device	S	2	Ambient temperature exceeded/undershot	Check environment, reposition measuring point if required
Device	F	3	EEPROM defective	Replace the device
Device	M	4	Electronics overload	Reset to factory settings, notify Service of error message
Device	F	5	Memory error	Reset to factory settings, notify Service of error message
Device	I	7	HMI LCD display inserted	Status info; not an error
Device	I	8	Device write-protected	Status info; not an error
Device	I	9	EEPROM busy	Status info; not an error
Device	F	12	Sensor input defective (communication)	Replace the device
Device	F	13	Sensor input defective (error)	Replace the device
Device	F	14	Sensor input defective (ADC error)	Replace the device
Communication	C	32	Diagnostics simulation mode	Not an error; diagnostic info; measurement OK
Sensor	F	34	Measuring error	Check sensor connection
Sensor	F	35	Sensor short circuit	Check sensor connection
Sensor	F	36	Line break	Check sensor connection
Sensor	F	37	Sensor range exceeded	Check measuring limits
Sensor	F	38	Sensor range undershot	Check measuring limits
Sensor	I	41	Single-point adjustment active	Status info; not an error
Sensor	I	42	Two-point adjustment active	Status info; not an error
Application	F	65	Configuration defective	Check configuration: A) Wrong device B) Span is too small C) Incorrect configuration data
Application	C	71	Reconfiguration is running	Status info; not an error
Application	F	72	Incorrect application	Check configuration, connections; reset to factory settings; notify Service
Application	I	74	Analog output compensation active	Status info; not an error
Application	C	75	Analog output in simulation	Status info; not an error
Application	S	76	Values exceeded	Check parameters: A) Sensor limits exceeded B) Span is too small

Explanations in accordance with NE 107

Description	Description
I	OK or Information
C	Check Function
S	Off Specification
M	Maintenance Required
F	Failure

10 Maintenance / Repair

10.1 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.

10.2 Cleaning

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

11 Specifications

11.1 Input

11.1.1 Resistance

RTD resistance thermometer
Pt100 in accordance with DIN IEC 60751, JIS, MIL,
Ni in accordance with DIN 43760, Cu

Resistance measurement
0 … 500 Ω
0 … 5000 Ω

Sensor connection type
Two-, Three-, Four-wire circuit

Connecting cable
Max. sensor line resistance (R_W) for each line 50 Ω according to NE 89 (March 2003)
Three-wire circuit:
symmetrical sensor line resistance
Two-wire circuit:
compensation up to 100 Ω total line resistance

Measurement current
< 300 µA

Sensor short circuit
< 5 Ω (for RTD)

Sensor wire break

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 measurement	> 50 Ω
4-wire resistance measurement	> 50 Ω

Sensor error signaling

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

11.1.2 Thermocouples / Voltages

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

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

Connecting cable
Maximum sensor line resistance (R_W) for each wire: 1.5 kΩ, total: 3 kΩ

Sensor wire break monitoring in accordance with NAMUR NE 89
Pulsed with 1 µA outside measurement interval

Thermocouple measurement	5.3 ... 10 kΩ
Voltage measurement	5.3 ... 10 kΩ

Input resistance
> 10 MΩ

Internal reference point
Pt1000, DIN IEC 60751 Cl. B
(no additional jumpers necessary)

Sensor error adjustment options (sensor matching)
Via single-point adjustment (offset adjustment)
Via two-point adjustment

Sensor error signaling

Thermocouple:	Wire break
Linear voltage measurement:	Wire break

11.2 Output

Transmission characteristics
Temperature linear
Resistance linear
Voltage linear

Output signal
Configurable 4 ... 20 mA (standard)
Configurable 20 ... 4 mA
(NE 43 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)

11.3 Power supply (polarity safe)

Two-wire circuit; power lines = signal lines

Supply voltage
Non-hazardous area with or without LCD display:
U_S = 11 ... 42 V DC
hazardous area applications with or without LCD display:
U_S = 11 ... 30 V DC

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

Undervoltage detection
$U_{Terminal-Mu}$ < 10 V results in I_a = 3.6 mA

Maximum load
R_{Load} = (supply voltage – 11 V) / 0.022 A

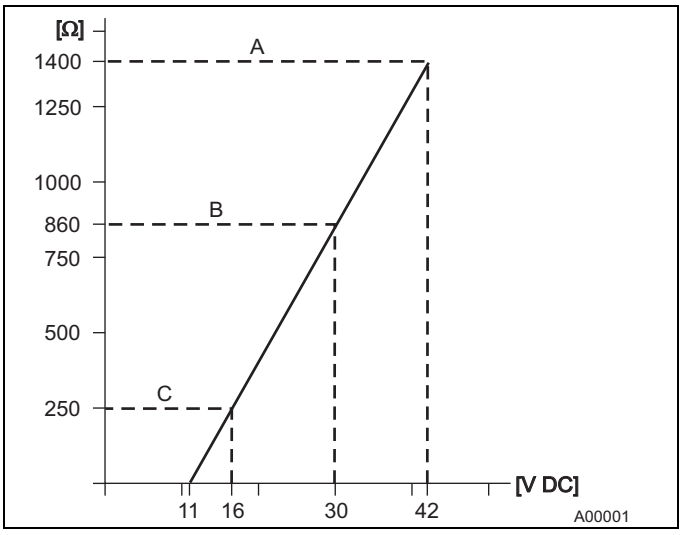


Fig. 17: Max. load depending on supply voltage
A TTH200
B TTH200 in Ex ia design
C HART communication resistance

Maximum power consumption
P = U_s x 0.022 A
e.g., U_s = 24 V → P_{max} = 0.528 W

11.4 General information

CE mark
The TTH200 meets all requirements for the CE mark in accordance with IEC 61326 (2006)

Electrical isolation
3.5 kV DC (approx. 2.5 KV AC) 60 s, input to output

MTBF time
28 years at 60 °C (140 °F) ambient temperature

Input filter
50/60 Hz

Switch-on delay
< 10 s (I_a ≤ 3.6 mA during starting cycle)

Warm-up time
5 minutes

Ramp-up time t90
400 … 1000 ms

Rate updated
10/s, independent of sensor type and sensor circuit

Output filter
Digital filter 1st order: 0 ... 100 s

11.5 Ambient conditions

Ambient temperature
Standard: -40 … 85 °C (-40 … 185 °F)
Optional: -50 … 85 °C (-58 … 185 °F)
Restricted range during operation with HMI LCD display and with explosion proof design

Transport/storage temperature
-40 … 85 °C (-40 … 185 °F)

Climate class
Cx -40 … 85 °C (-40 … 185 °F) at
5 … 95 % relative humidity, DIN EN 60654-1

Max. permissible humidity
100 % relative humidity, IEC 60068-2-30

Vibration resistance
10 … 2000 Hz at 5 g in acc. with IEC 60068-2-6, during operation and transport

Shock
gn = 30 in acc. with IEC 68-2-27, during operation and transport

Ingress protection
IP 20, or IP class of separate housing

11.6 Electromagnetic compatibility

Emitted interference in accordance with IEC 61326 (2006) and Namur NE 21 (02/2004)

11.7 EMI/RFI shielding

Interference immune in accordance with IEC 61326 (2006) and Namur NE 21 (02/2004)
Pt100: Measuring range 0 ... 100 °C (32 ... 212 °F), span 100 K

Type of test	Testing accuracy	Influence
Burst to signal/data lines	2 kV	< 0.5 %
Static discharge • Contact plate (indirect) • Supply terminals [1)] • Sensor terminals [1)]	 8 kV 6 kV 4 kV	 no no 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 Line to earth	 0.5 kV 1 kV	 No malfunction No malfunction

1) Air discharge (at 1 mm (0.04 inch) distance)

12 Ex relevant specifications

12.1 TTH200-E1, Intrinsic Safety ATEX

Explosion protection

The TTH200 complies with the requirements of ATEX directive 94/9/EC
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])

EC type-examination certificate PTB 05 ATEX 2017 X

12.2 TTH200-H1, Intrinsic Safety IECEx

Explosion protection

Approved for use in Zone 0.

Designation

Ex ia IIC T6 (Zone 0)
Ex [ia] ib IIC T6 (Zone 1 [0])
Ex [iaD] ib IIC T6 (Zone 1 [20])

For further information, see certificate

12.3 Safety specifications for Intrinsic Safety ATEX / IECEx

Temperature table

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	-50 … 44 °C (-58 ... 111.2 °F)	-50 … 56 °C (-58 ... 132.8 °F)
T5	-50 … 56 °C (-58 ... 132.8 °F)	-50 … 71 °C (-58 ... 159.8 °F)
T4, T3, T2, T1	-50 … 60 °C (-58 ... 140.0 °F)	-50 … 85 °C (-58 ... 185.0 °F)

Protection type Intrinsic Safety Ex ia IIC (Part 1)

	Supply circuit	Measurement current circuit / passive transducer (RTD)
Max. voltage	U_i = 30 V	U_o = 6.5 V
Short circuit current	I_i = 130 mA	I_o = 25 mA
Max. power	P_i = 0.8 W	P_o = 38 mW
Internal inductance	L_i = 0.5 mH	L_i = 0 mH
Internal capacitance	C_i = 5 nF	C_i = 49 nF
Maximum permissible external inductance		L_o= 5 mH
Maximum permissible external capacitance		C_o= 1.55 µF

Protection type Intrinsic Safety Ex ia IIC (Part 2)

	Measurement current circuit / active transducer (TC)	Display interface
Max. voltage	U_o = 1,2 V	U_o = 6,2 V
Short circuit current	I_o = 50 mA	I_o = 65.2 mA
Max. power	P_o = 60 mW	P_o = 101 mW
Internal inductance	L_i = 0 mH	L_i = 0 mH
Internal capacitance	C_i = 49 nF	C_i = 0 nF
Maximum permissible external inductance	L_o = 5 mH	L_o= 5 mH
Maximum permissible external capacitance	C_o= 1.05 µF	C_o= 1.4 µF

12.4 TTH200-E2, Non-Sparking ATEX

Explosion protection

The TTH200 complies with the requirements of ATEX directive 94/9/EC
Approved for use in Zone 2.

Designation

II 3G EEx nA II T6

ABB manufacturer's declaration in accordance with ATEX directive

Temperature table

Temperature class	Device category 2 use
T6	-50 … 56 °C (-58 ... 132.8 °F)
T5	-50 … 71 °C (-58 ... 159.8 °F)
T4	-50 … 85 °C (-58 ... 185.0 °F)

12.5 TTH200-L1, Intrinsically Safe FM

Class I, Div. 1 + 2, Groups A, B, C, D
Class I, Zone 0, AEx ia IIC T6
Control drawing: TTH200-L1H

12.6 TTH200-L2, Non-Incendive FM

Class I, Div. 2, Groups A, B, C, D
Control drawing: TTH200-L2H

12.7 TTH200-R1, Intrinsically Safe CSA

Class I, Div. 1 + 2, Groups A, B, C, D
Class I, Zone 0, Ex ia Group IIC T6
Control drawing: TTH200-R1H

12.8 TTH200-R2, Non-Incendive CSA

Class I, Div. 2, Groups A, B, C, D
Control drawing: TTH200-R2H (1)
Control drawing: TTH200-R2H (2) (no conduit)

13 HMI LCD display type AS

Can only be ordered in conjunction with temperature sensors

CE mark

The HMI type AS LCD display meets all requirements for the CE mark in accordance with IEC 61326 (2006)

13.1 Features

Transmitter-controlled graphic LCD display without key functions

Sign, 4 digits, 2 decimal places
Rotatable in 12 increments of 30°

Display

Process data of sensor

Bar graph display

Output %

Display diagnostic informations related to transmitter and sensor status

13.2 Specifications

Temperature range

-20 … 70 °C (-4 … 158 °F)
Restricted display function in range:
-50 … -20 °C (-58 … -4 °F) 1)
or
70 … 85 °C (158 … 185 °F)

Humidity

0 … 100 %, condensation permitted

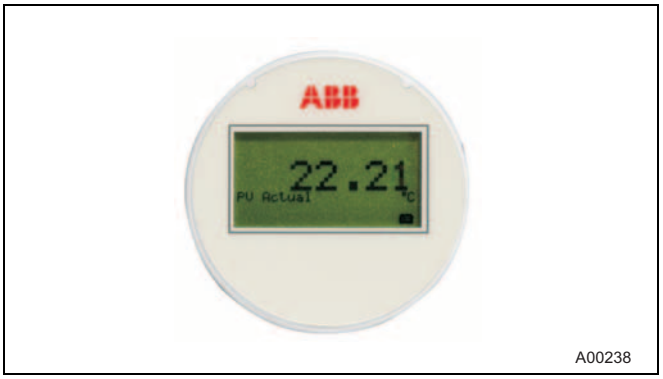


Fig. 18

1) Additional mechanical protection is required for this range

13.3 Ex relevant specifications

13.3.1 Intrinsic Safety ATEX

Explosion protection

Approved for use in Zone 0.

Designation

II 1G Ex ia IIC T6

EC type-examination certificate PTB 05 ATEX 2079 X

13.3.2 Intrinsic Safety IECEx

Explosion protection

Approved for use in Zone 0.

Designation

Ex ia IIC T6

For further information, see certificate

13.3.3 Safety specifications for Intrinsic Safety ATEX / IECEx

Temperature table

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	-40 … 44 °C (-40 … 111.2 °F)	-40 … 56 °C (-40 … 132.8 °F)
T5	-40 … 56 °C (-40 … 132.8 °F)	-40 … 71 °C (-40 … 159.8 °F)
T4	-40 … 60 °C (-40 … 140 °F)	-40 … 85 °C (-40 … 185 °F)

Protection type intrinsic safety Ex ia IIC

	Supply circuit
Max. voltage	U_i = 9 V
Short circuit current	I_i = 65.2 mA
Max. power	P_i = 101 W
Internal inductance	L_i = 0 mH
Internal capacitance	C_i = 0 nF

13.3.4 Intrinsically Safe FM

I.S. Class I Div 1 and Div 2, Group: A, B, C, D or
I.S. Class I Zone 0 AEx ia IIC T*
Temp. Ident: T6 T_{amb} 56 °C, T4 T_{amb} 85 °C
U_i / V_{max} = 9V, I_i / I_{max} < 65,2 mA, P_i = 101 mW
C_i = 0,4 µF; L_i = 0
Control Drawing: SAP_214 748

13.3.5 Non-Incendive FM

N.I. Class I Div 2, Group: A, B, C, D or
Ex nL IIC T*, Class I Zone 2
Temp. Ident: T6 T_{amb} 60 °C, T4 T_{amb} 85 °C
U_i / V_{max} = 9V, I_i / I_{max} < 65,2 mA, P_i = 101 mW
C_i = 0,4 µF; L_i = 0
Control Drawing: SAP_214 751

13.3.6 Intrinsically Safe CSA

I.S. Class I Div 1 and Div 2; Group: A, B, C, D or
I.S Zone 0 Ex ia IIC T*
*Temp. Ident T6 T_{amb} 56 C, T4 T_{amb} 85 °C
U_i / V_{max} = 9V, I_i / I_{max} < 65,2 mA; P_i = 101 mW
C_i < 0,4 F_μ, L_i = 0
Control Drawing: SAP_214 799

13.3.7 Non-Incendive CSA

N.I. Class I Div 2, Group: A, B, C, D or
Ex nL IIC T*, Class I Zone 2
*Temp. Ident T6, T_{amb} 60 °C, T4 T_{amb} 85 °C
U_i / V_{max} = 9V, I_i / I_{max} < 65,2 mA, P_i = 101 mW
C_i < 0,4 µF, L_i = 0
Control Drawing: SAP_214 750

14 Appendix

14.1 Additional documents

- Commissioning Instruction (CI/TTH200)
- Data Sheet (DS/TTH200)

14.2 Approvals and certifications

CE mark	CE	The version of the meter in your possession meets the requirements of the following European directives: - EMC directive 89/336/EEC - ATEX directive 94/9/EC
Explosion Protection	Ex IECEx FM APPROVED CSA	Identification for intended use in potentially explosive atmospheres according to: - ATEX directive - IEC standards - FM Approvals (US) - CSA International (Canada)

Important

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

www.abb.com/temperature

EG-Konformitätserklärung
EC-Certificate of Compliance

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

Erklärt, dass die Produkte der Geräteart: *Declare that the products of device type:*	**Temperatur Messumformer** **Temperature Transmitter**
Modell- / Typebezeichnung: *Model- / type name:*	**TTH200**
Produktnummer: *Product number:*	**TTH200-.H**
Konform zu EG-Richtlinien: *Conform to EC-directives:*	**94/9/EG (ATEX)** **89/336/EWG (EMV/EMC)**
EG-Baumusterprüfbescheinigung: *EC-Type examination certificate:*	**PTB 05 ATEX 2017 X**
Relevante Normen: *Related Standards:*	**EN61326-1: 2006** **EN 60079-0: 2004, EN60079-11:2006** **EN 60079-26: 2007, EN 60079-15: 2003**
Qualitätssicherung Produktion Anerkennung: *Production Quality notification:*	**PTB 99 ATEX –Q004-...**

entspricht.
complies.

Alzenau, 08 December 2008

i.V. Reiner Laurinat
Leiter Qualitätsmanagement
Quality Manager

i.A. Harald Müller
Leiter Hardwareentwicklung
R&D Manager Hardware

ABB Automation Products GmbH

Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.

Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by 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 in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

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

Biological	☐	Corrosive/irritating	☐	Combustible (highly/extremely combustible)	☐
Toxic	☐	Explosive	☐	Other toxic substances	☐
Radioactive	☐				

Which substances have come into contact with the device?

1.
2.
3.

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date	Signature and company stamp

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ABB has Sales & Customer Support expertise in over 100 countries worldwide.

www.abb.com/temperature

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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OI/TTH200-EN

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