Operating Instruction
OI/TTF300-EN

Field mounted Temperature Transmitter TTF300

HART COMMUNICATION PROTOCOL

ABB

Field mounted Temperature Transmitter
TTF300

Operating Instruction

OI/TTF300-EN

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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.

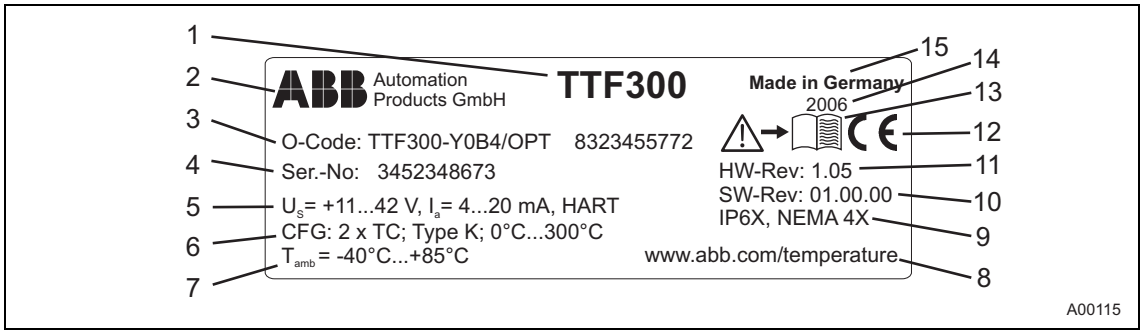


Fig. 1

1 Transmitter model
2 Manufacturer of transmitter
3 Order code with SAP no.
4 Serial number
5 Approved power supply, current communications protocol
6 Configured parameters
7 Permissible ambient temperature
8 Internet address of manufacturer
9 Level of protection
10 Software version
11 Hardware version
12 CE mark (EC conformity)
13 Refer to product documentation
14 Year
15 Country

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 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.).

Please contact Customer Center Service acc. to page 2 for nearest service location.

1.10 Disposal

ABB Automation Products GmbH actively promotes environmental awareness and has an operational management system that meets the requirements of ISO 9001:2008, ISO 14001:2004, and BS OHSAS18001:2008. 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 specialist 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 into 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 certain amounts 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 at the right time, in the future 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 areas 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 TTF300 temperature transmitter in potentially explosive atmospheres can be found in the section of the operating instructions titled "Ex relevant specifications".

2.2 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.

2.3 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.

2.4 Configuration

The TTF300 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.

2.5 Ex relevant specifications

See chapter 12, "Ex relevant specifications" page 64.

3 Design and function

TTF300 digital transmitters are communication-ready field 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 graphic user interface (DTM) can be used to configure, poll and test transmitters on a PC-specific basis. Handheld terminals also support communication.

The transmitter is equipped with an LCD-display. The LCD-display is used to visualize the current process data. The four control buttons can be used to perform a local configuration. The electrical connection between LCD-display and transmitter is provided by a 6-pole flat ribbon cable with plug connectors.

For explosion-proof designs, the explosion-proof design is described on a separate plate.

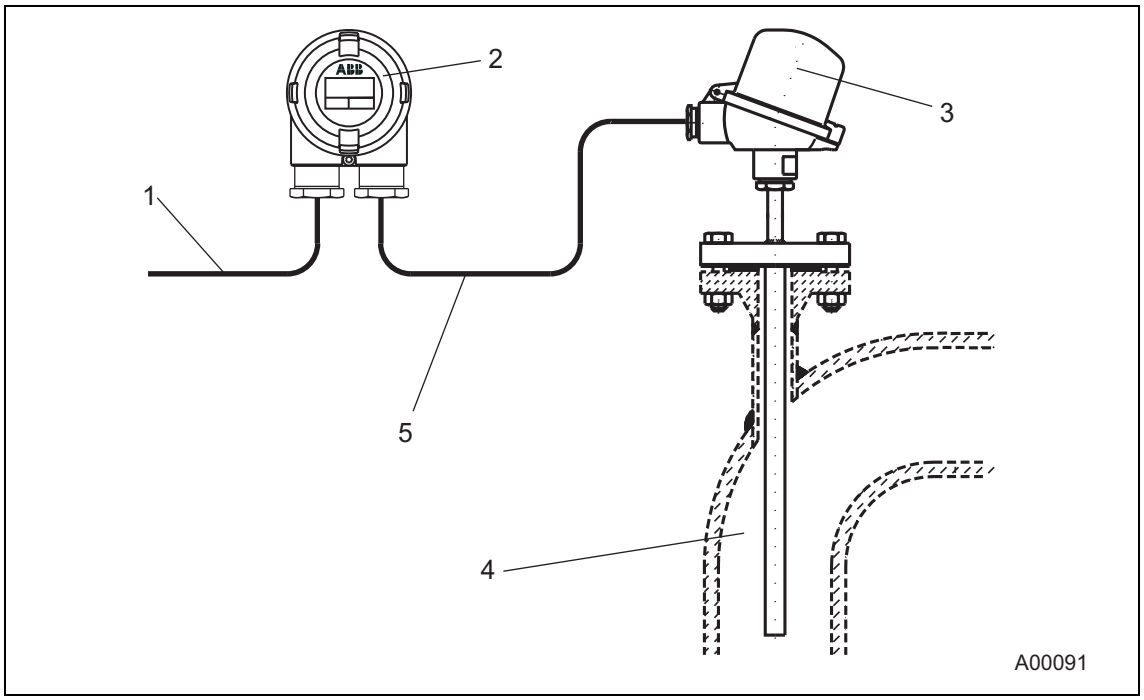


Fig. 2

1 Signal / power supply cable
2 TTF300 transmitter
3 Temperature sensor head
4 Processing pipe
5 Sensor connection cable

4 Mounting

4.1 Installation options

There are two ways to install transmitters:

- Wall installation
- Pipe installation

Important

The transmitter is available with an LC display as an option.

4.1.1 Wall installation

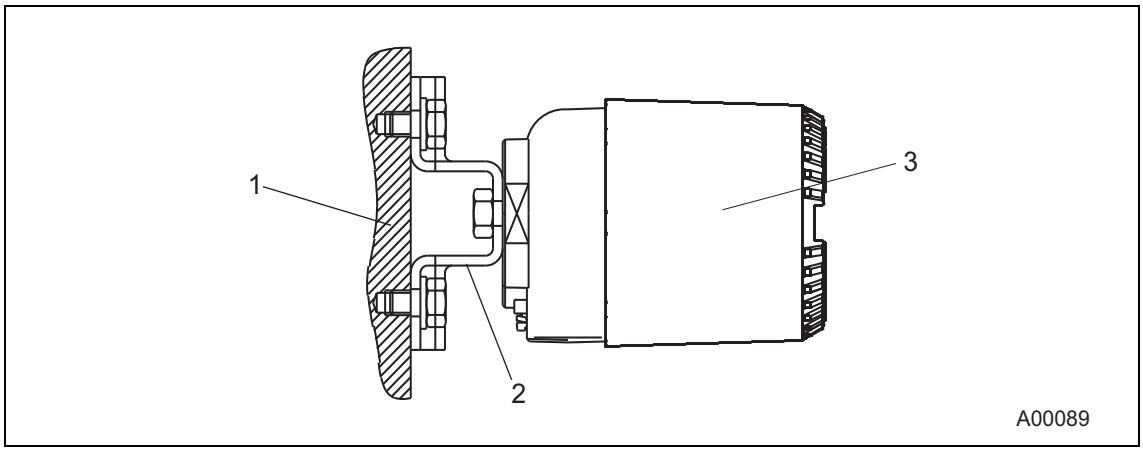


Fig. 3

1 Wall
2 Wall mount
3 TTF300 transmitter

1. Locate an installation site close to the temperature sensor head.

Warning - General risks!

The transmitter can fall and be damaged if not firmly attached. There is also a risk that persons can be injured.

Install the wall mount on a sufficiently stable wall only.

2. Screw the transmitter to the wall mount.
3. Attach the wall mount securely with 4 screws (∅ 10 mm).

4.1.2 Pipe installation

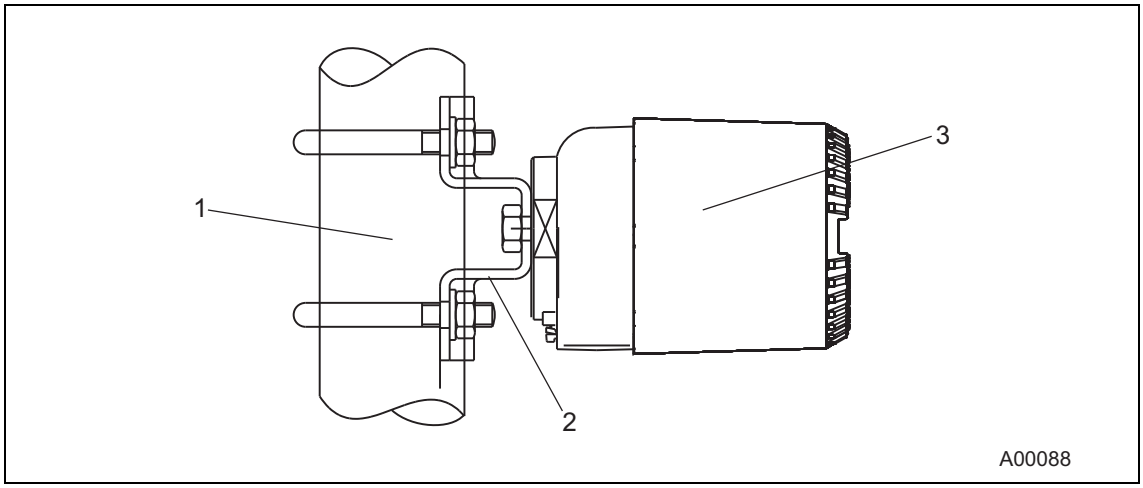


Fig. 4

1 Pipe
2 Pipe mount TTF300
3 Transmitter

1. Locate an installation site on a pipe close to the temperature sensor head.

Important
The pipe mount can be attached to a pipe with a maximum diameter of 2.5 inch.

2. Screw the transmitter to the pipe mount.
3 Attach the pipe mount securely to the pipe with 2 pipe clamps (∅ 10 mm).

4.2 Installing the optional LCD display with control buttons

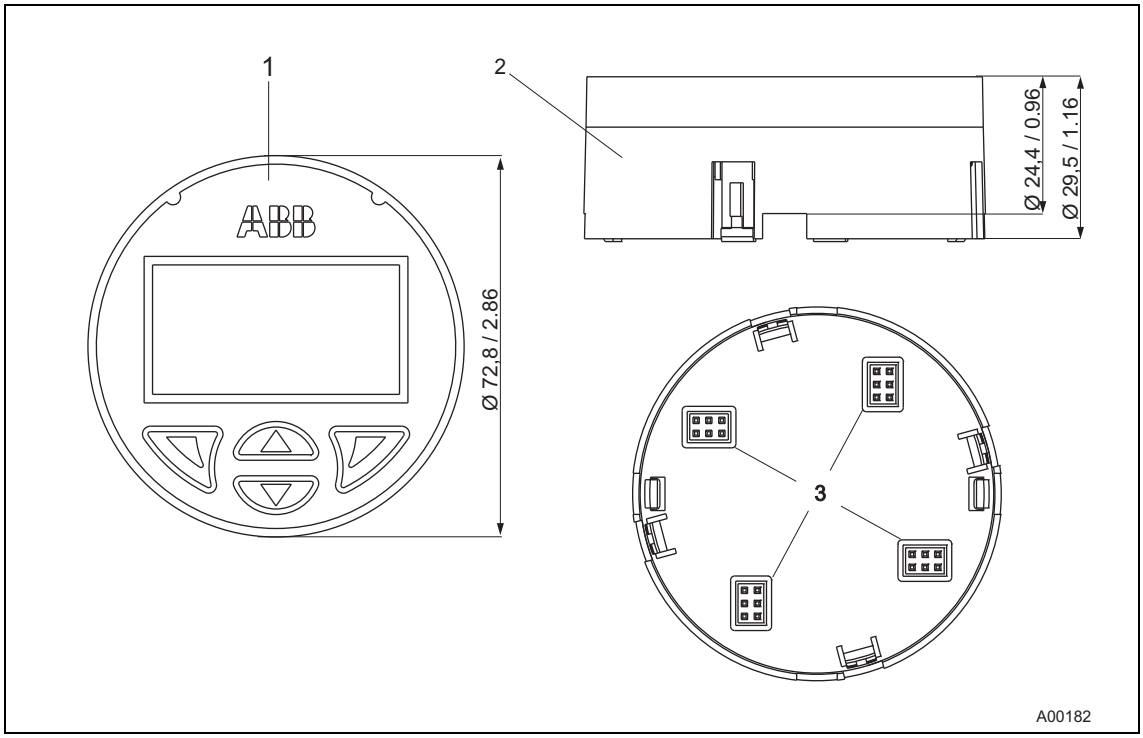


Fig. 5

1 Front view
2 Side view
3 Rear view of LCD display / plug positions

The LCD display is attached to the housing of the TTF300 transmitter. Power cables must be disconnected during installation.

Warning - General risks!
The connection head can be become very hot as a result of the process. There is a danger of burns.
The atmosphere at the transmitter can be explosive. Risk of explosion!
Before replacing the LCD display, make sure there is sufficient ventilation with fresh air.

1 Unscrew the housing cover for the transmitter.
2. Carefully remove the LCD display from the inset for the transmitter. 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.
3 Following this, the position of the LC display can be adjusted to suit the installation position of the transmitter, to ensure that the display is legible. The LC display has four positions that can be set in 90° increments.
4. No tools are required to insert the LCD display. Ensure that the adapter connector is properly seated and that the black connection socket selected on the underside of the LC display is suitable. Press the LC display onto the transmitter firmly as far as it will go, until the four clips snap into place.
5. Screw on the housing cover for the transmitter.

5 Electrical connections

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 name plate and the technical specifications (see “Technical Specifications" chapter and/or data sheet).

Important

The electrical connection is carried out with the transmitter in the installed state.

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

The cross-head screws of the connection terminals are tightened with a size 1 screwdriver (3.5 mm or 4 mm).

5.1 Conductor material

- Standard conductor material must be used for the power supply cable.
- The maximum peripheral wire cross section is 2.5 mm^2.

Notice! Potential damage to parts!

A rigid conductor material can result in wire breaks.

The connecting cable must be flexible.

Line length

From the lower edge of the housing (no cable gland) to the hole in the clamping area, an additional 100 mm of line is needed. An overall line length (without cable gland) of approx. 200 mm is required (approx. 100 mm bared).

5.2 Connection for power supply cable

Caution - Potential damage to parts

Connecting the power supply cable with power switched on may result in a short circuit and potential damage to the transmitter.

The power must be switched off to connect the power supply cable.

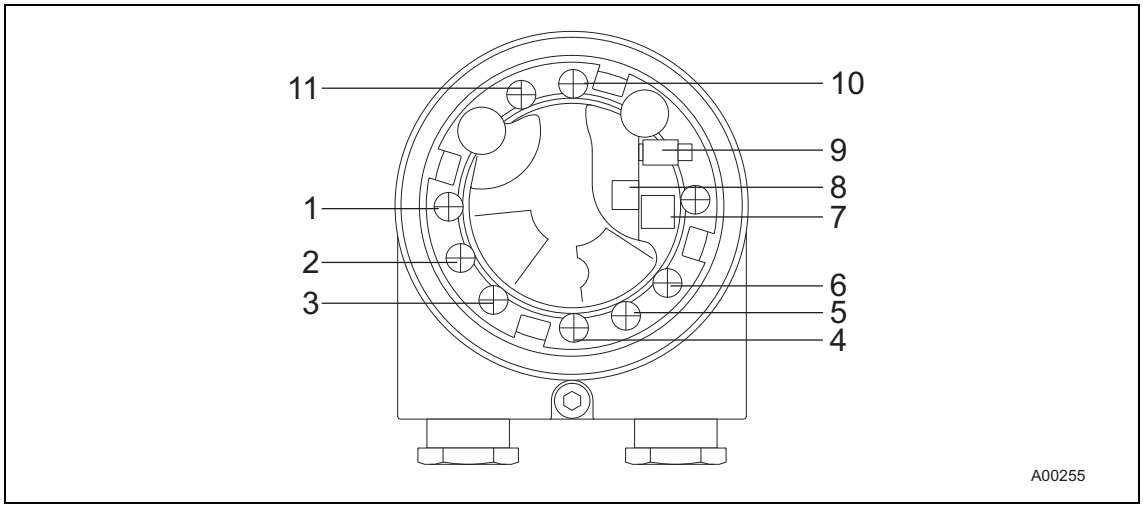


Fig. 6: Terminal for transmitter (without LC display)

1 … 6 Sensor connection
7 Ground connection
8 DIP switch 1: on, hardware write protection is enabled
DIP switch 2: no function
9 Interface for LC display
10 … 11 Signal-/ power supply connection
11 ... 42 VDC / 4 … 20 mA
11 ... 30 VDC / 4 … 20 mA (Ex)

1. Route the power supply cable through the cable gland into the housing of the transmitter. Then tighten the cable gland.
2. Strip the wires and attach wire end sleeves.
3. Release the clamping screws for the (+) and (-) terminals with the proper screwdriver. Make sure that the screws do not fall out.
4. Connect the (+) wire to the (+) terminal on the transmitter.
5. Connect the (-) wire to the (-) terminal on the transmitter.

The connection of the line shield is optional.

5.3 Connection for measuring element

Important

The measuring element is connected via sensor connecting cable. The sensor connecting cable is not delivered with the transmitter. It must be ordered as a separate accessory.

The model of the sensor connecting cable must correspond to the sensor model and configuration of the transmitter.

When connecting the transmitter and measuring inset (sensor) make sure for thermocouple sensors that the material of the sensor connecting cable corresponds to the thermocouple model.

1. Look for the connection type for the selected measuring element in the electrical connections for measuring elements.
2. Release the clamping screws for terminals 1 to 6 using the proper screwdriver. Make sure that the screws do not fall out.
3. Insert the wires for the measuring element and sensor cable connection under the open terminals and carefully tighten the clamping screws for the connections.

5.4 Cable glands

5.4.1 TTF300 without cable gland

The cable diameter for the cable gland used must comply with requirements for IP / Nema 4x protection class. This must be checked during installation.

For delivery without cable gland (threads M20 x 1.5 or NPT 1/2"), the following points must be observed:

- Use cable glands acc. to version M20 x 1.5 or NPT 1/2".
- Observe information in data sheet / operating instructions for cable gland used.
- Check the working temperature for the cable gland used.
- Check the IP protection class IP 66 / 67 or NEMA 4X of the cable gland used.
- Check the ex relevant specifications for the cable gland used acc. to manufacturer's data sheet or Ex certificate.
- The cable gland used must be approved for the cable diameter (IP protection class).
- For tightening torque, observe information in data sheet / operating instructions for cable gland used.

5.4.2 TTF300 EEx d models without cable gland

For delivery of the product variants TTF300-E3... (ATEX EEx d / flameproof enclosure) and TTF300-E4....(ATEX EEx d and EEx ia or flameproof enclosure and intrinsic safety) without cable gland an approved ATEX EEx d cable gland must be used according to EN 50018.

The ex relevant specifications for the cable glands used (M20*1.5 6H or 1/2" NPT, clamping range, temperature range, etc.) must comply with the requirements for PTB 99 ATEX 1144 approval in order to ensure protection type "EEx d" for the TTF300.

For information on the cable gland used, refer to the data sheet and operating instructions.

5.4.3 TTF300 EEX d models with standard cable gland

General information

Type Capri ADE 1F	ISO threads	Outer diameter of cable	Material
816674 No. 4	M20 x 1,5	Ø 6 ... 8.5 mm	Nickel-plated brass or stainless steel
818674 No. 4	1/2“ NPT	Ø 6 ... 8.5 mm	Nickel-plated brass or stainless steel
816694 No. 5	M20 x 1,5	Ø 9 ... 12 mm	Nickel-plated brass or stainless steel
818694 No. 5	1/2“ NPT	Ø 9 ... 12 mm	Nickel-plated brass or stainless steel

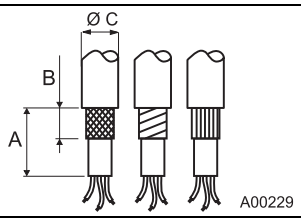
Intended use

- Ex Group II Category 2, Zones 1 and 2 for gas, Zones 21 and 22 for dust, EExell, EExtD, EExdIIC ≤ 2,000 cm³
- Ingress protection IP 66 / 67, 10 bar
- LCIE 97 ATEX 6008 X certification
- Permanent operating temperature range: -40 ... 100 °C with neoprene gasket
- Only for fixed installations and non-reinforced cables with round and smooth plastic sleeves and suitable outer diameters
- All applicable requirements as stipulated by EN 60079-14 must be observed

Installation instructions

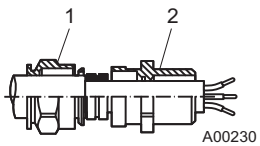
The rings will harden at low temperatures. To make them soft, keep them at a temperature of 20 °C for 24 hours prior to installation. Before fixing them onto the cable gland, bend the rings to ensure they are soft and flexible.

1. Check that a suitable cable is being used (i.e., check the mechanical resilience, temperature range, creep resistance, resistance to chemicals, outer diameter, etc.).
2. Strip the cable in accordance with the table information.



Stripping for ADE 1F N° [4] / [5]	
Position	**[mm]**
Ø C	8,5 / 12
A	40
B	12

3. Check the outer sleeve for damage and soiling.
4. Insert the cable in the cable gland.
5. Tighten the cable gland until the cable is firmly enclosed by the sealing ring. Do not tighten the cable gland any more than 1.5 times the specified torques!



Minimum tightening torques for ADE N° [4], [5] in Nm		
Position	**[4]**	**[5]**
1	7,5	12,5
2	3	3

Important

Ingress protection IP 66 / 67 is only achieved by installing the black neoprene gasket between the cable gland and the housing and by observing the tightening torque for the cable gland of 3 Nm (Position 2).

Cables must be protected against extreme mechanical loads (caused by tension, torsion, crushing, etc.). Even under operating conditions, it must be ensured that the cable entry remains hermetically sealed. The customer must provide a strain relief device for the cable.

Maintenance

Check the glands during each maintenance session. If the cable is slack, retighten the cap(s) of the glands. If it is not possible to retighten them, the gland will need to be replaced.

5.5 Electrical connections

Resistance thermometers (RTD) / resistors (potentiometers)

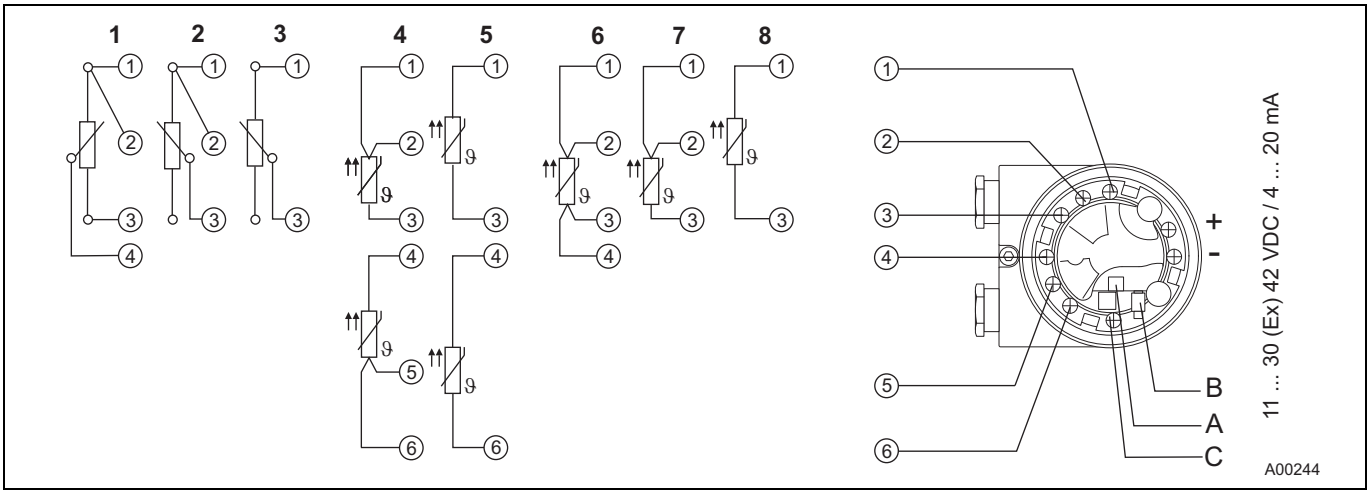


Fig. 7

A DIP switch 1: on, hardware write protection is enabled
DIP switch 2: no function
B Interface for LC display
C Ground terminal for sensor and supply- / signal-cable shield connection

1 Potentiometer, four-wire circuit
2 Potentiometer, three-wire circuit
3 Potentiometer, two-wire circuit
4 2 x RTD, three-wire circuit [1)]

5 2 x RTD, two-wire circuit [1)]
6 RTD, four-wire circuit
7 RTD, three-wire circuit
8 RTD, two-wire circuit

1) Sensor backup/redundancy, sensor drift monitoring, mean measurement or differential measurement

Thermocouple / voltage and resistance thermometer (RTD) / thermocouple combinations

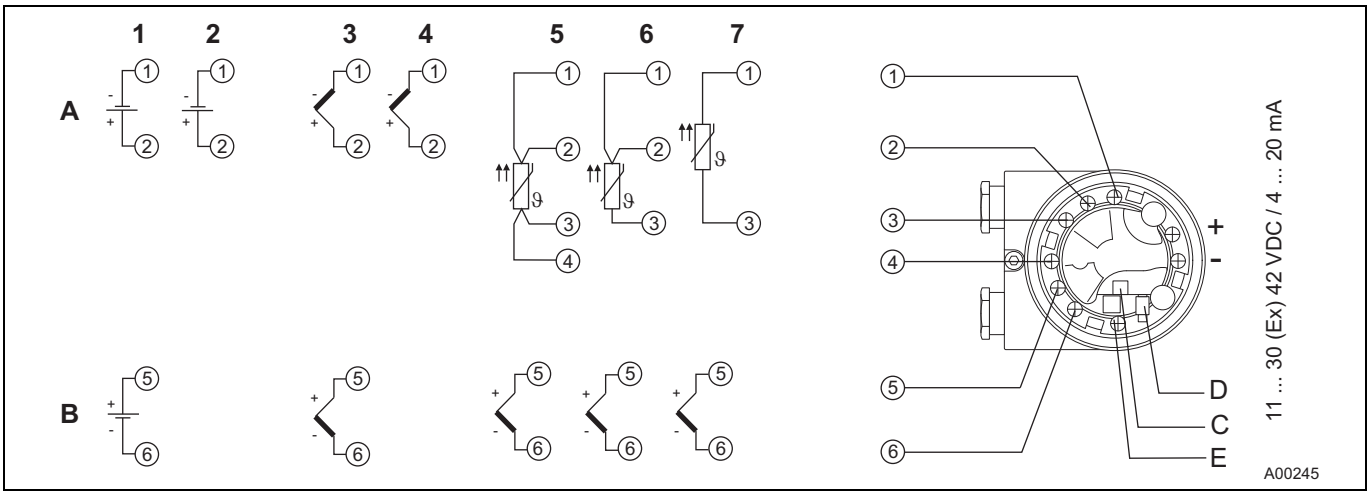


Fig. 8

A Sensor 1
B Sensor 2
C DIP switch 1: on, hardware write protection is enabled
DIP switch 2: no function
D Interface for LC display
E Ground terminal for sensor and supply- / signal-cable shield connection

1 2 x voltage measurement [1)]
2 1 x voltage measurement
3 2 x thermocouple [1)]
4 1 x thermocouple

5 1 x RTD, four-wire circuit, and thermocouple [1)]
6 1 x RTD, three-wire circuit, and thermocouple [1)]
7 1 x RTD, two-wire circuit, and thermocouple [1)]

1) Sensor backup/redundancy, sensor drift monitoring, mean measurement or differential temperature measurement

5.5.1 Standard application

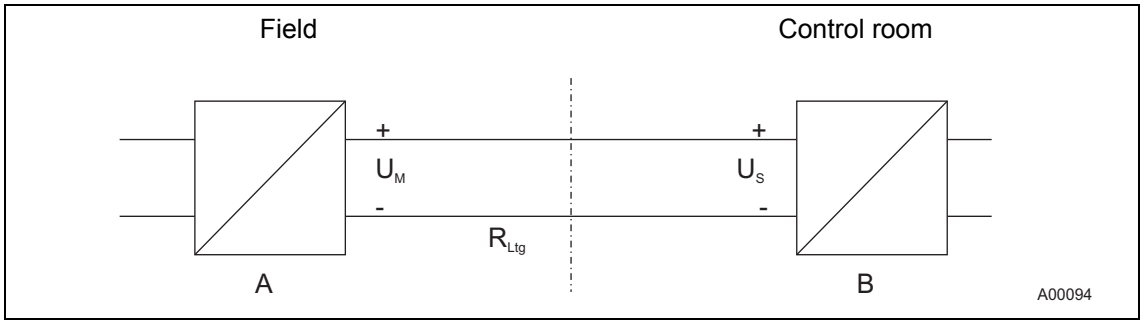


Fig. 9

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 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 ≥ 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.

5.5.1.1 Standard application with HART functionality

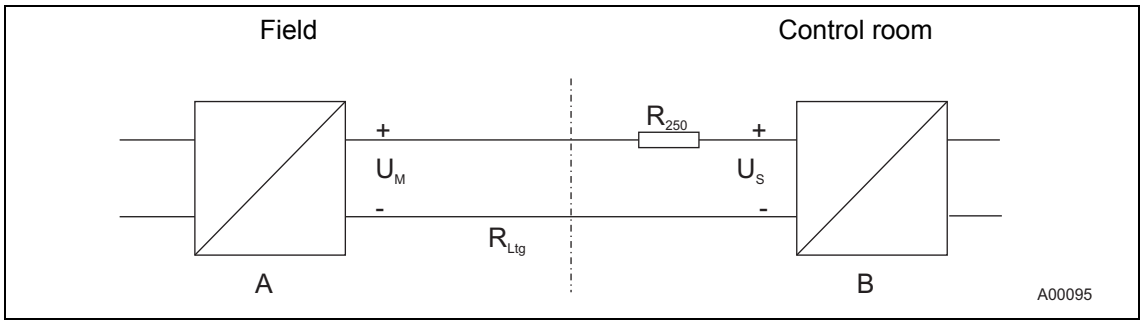


Fig. 10

A Transmitter B Power supply / SPS input with supply

Adding resistance R250 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 power supply / SPS input

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

R_{250}:Resistance for HART functionality

5.5.1.2 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	≥	U_o
I_i	≥	I_o
P_i	≥	P_o
$L_i + L_c$ (cable)	≤	L_o
$C_i + C_c$ (cable)	≤	C_o

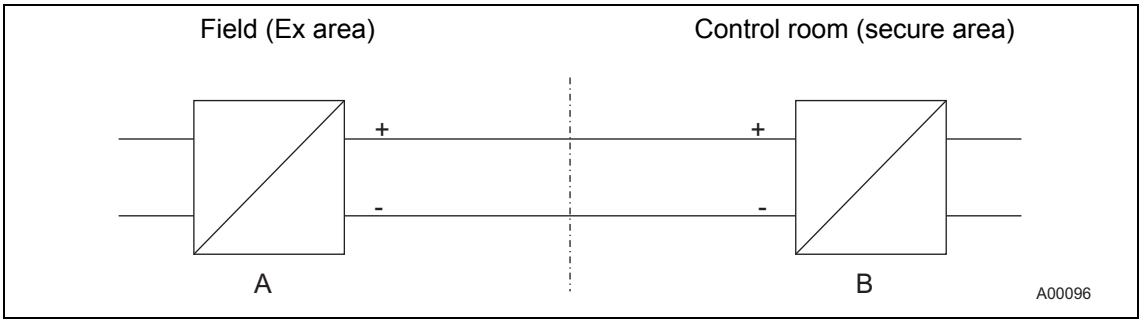


Fig. 11

A Transmitter B Power supply SPS input

Important

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

5.5.2 Installation in explosion risk area

Transmitters can be installed in all kinds of industrial sectors. Ex systems are divided into zones, meaning that a wide range of different instruments are also required. For additional information, refer to the section “Ex relevant specifications” or the data sheet.

5.5.2.1 Zone 0

Transmitter design: II 1 G EEx ia IIC T6

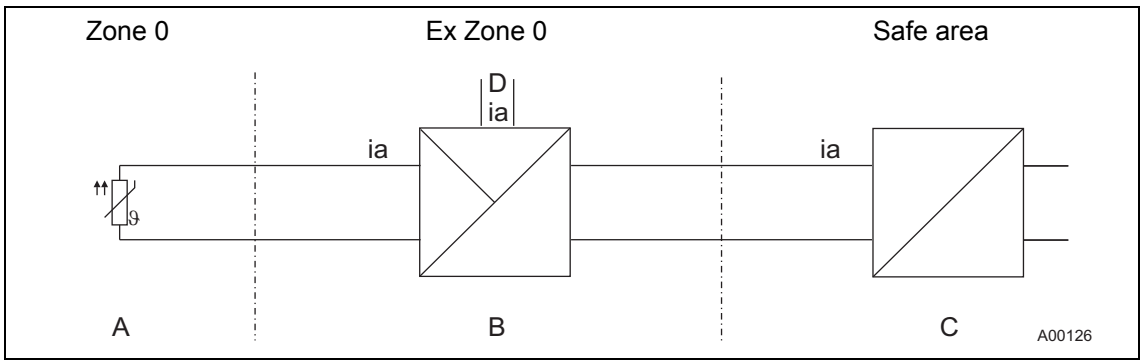


Fig. 12

A Sensor
B Transmitter TTF300
C Power supply [EEx ia]
D Interface for LC display

The input for the repeater power supply must be designed to "EEx ia".

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.

5.5.3 Zone 1 (0)

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

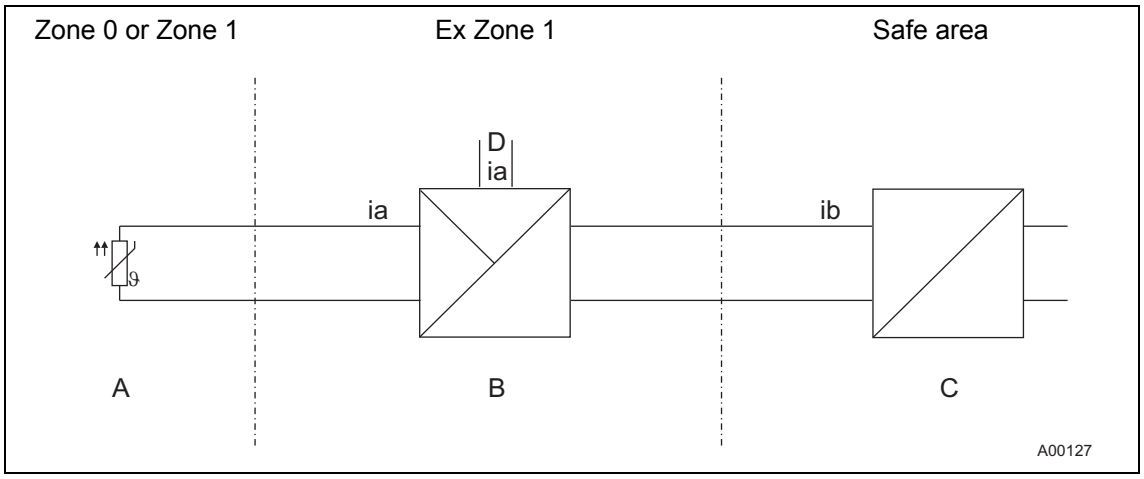


Fig. 13

A Sensor
B Transmitter TTF300
C Power supply [EEx ib]
D Interface for LC display

The input for the repeater power supply must be designed to "EEx ib" as a minimum.

The user must ensure that sensor instrumentation meets the requirements of applicable Ex standards. It can be installed in Zone 1 or Zone 0. For zone 0, the circuit must be designed to "ia".

5.5.4 Zone 1 (20)

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

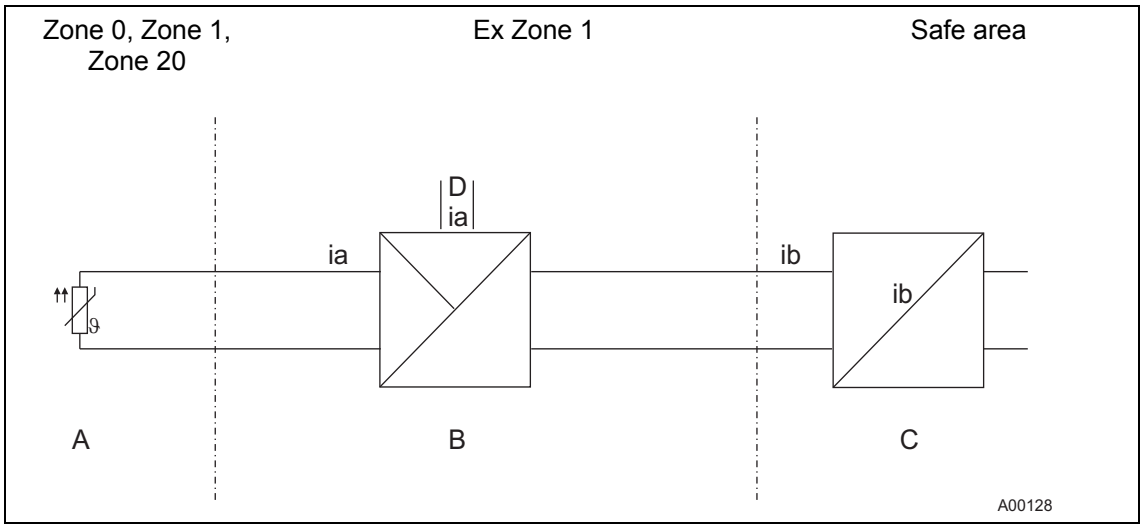


Fig. 14

A Sensor
B Transmitter TTF300
C Power supply [EEx ib]
D Interface for LC display

The input for the repeater power supply must be designed to "EEx ib" as a minimum.

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. For Zone 0 and Zone 20, the circuit must be designed to "ia".

5.5.5 Zone 2

Transmitter design: II 3G EEx nA II T6

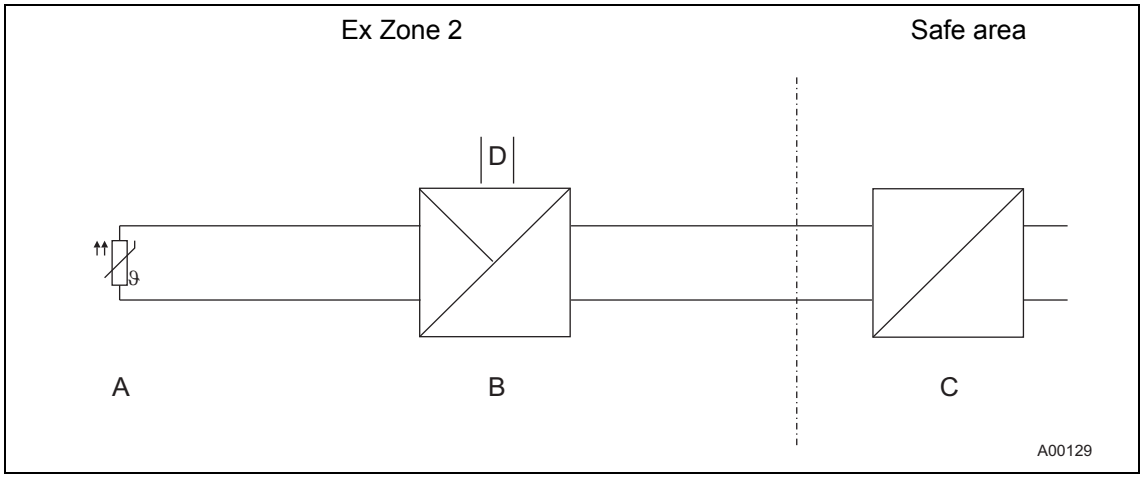


Fig. 15

A Sensor
B Transmitter TTF300
C Supply isolator
D Interface for LC display

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

5.5.6 Dust-explosion protection Zone 20

Transmitter design: ATEX II 1D IP 65 T135 °C

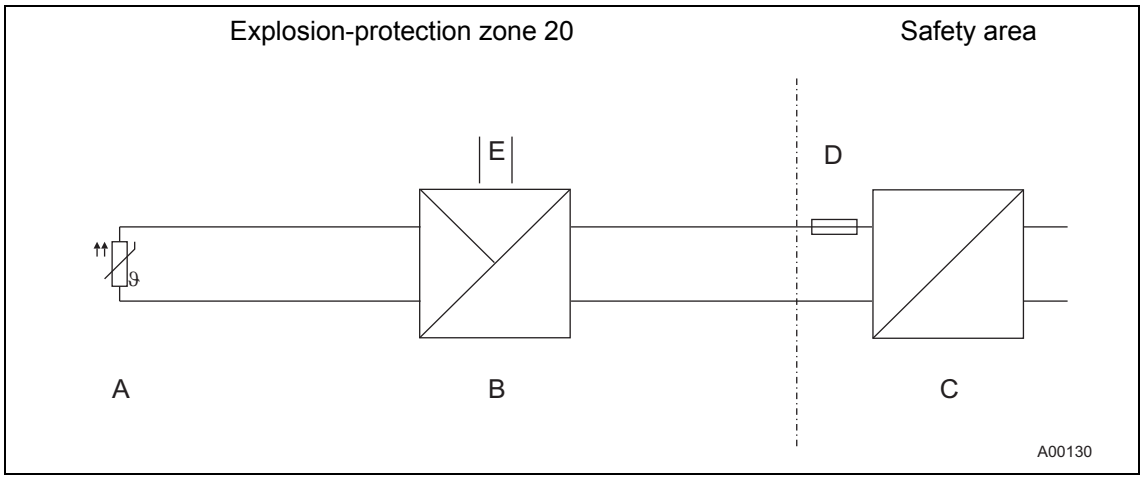


Fig. 16

A Sensor
B Transmitter TTF300
C Power supply
D Fuse, 32 mA
E Interface for LC display

The electric circuit of the transmitter must be limited by an upstream fuse per IEC 127 with a fuse current rating of 32 mA. This is not required if the power supply is in intrinsically safe "ia" design.

5.5.7 Dust-explosion protection Zone 0/20

Housing design: ATEX II 1D IP 65 T135 °C
Transmitter design: ATEX II 1G EEx ia IIC T6

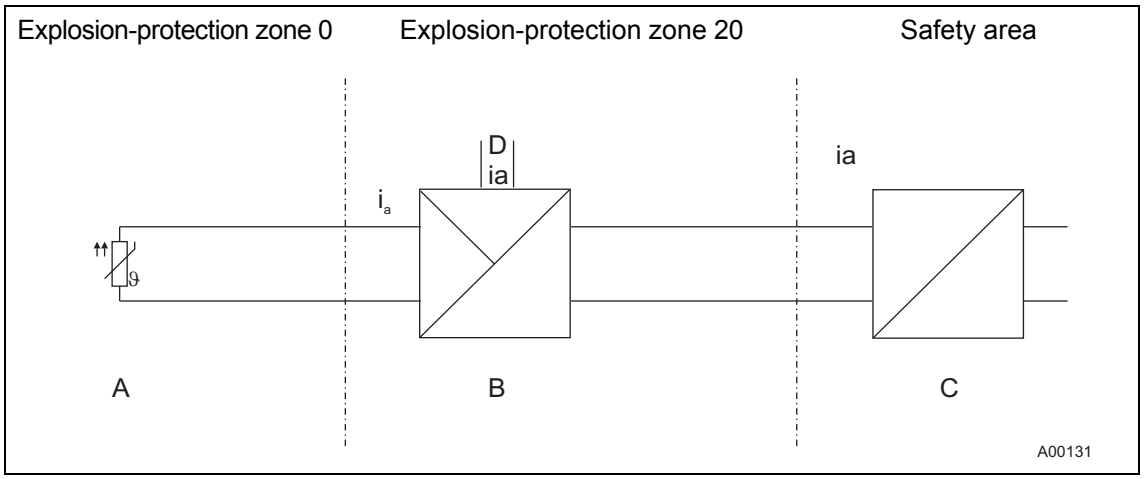


Fig. 17

A Sensor
B Transmitter TTF300
C Power supply
D Interface for LC display

When using the sensor in zone 0, the transmitter must be in EEx ia (category 1G) design.

If the transmitter is designed with intrinsic safety, the power supply must provide an intrinsically safe circuit.

5.5.8 Flameproof protection Zone 1

Housing design: ATEX II 2G EEx d IIC T6
Transmitter design: No ignition protection

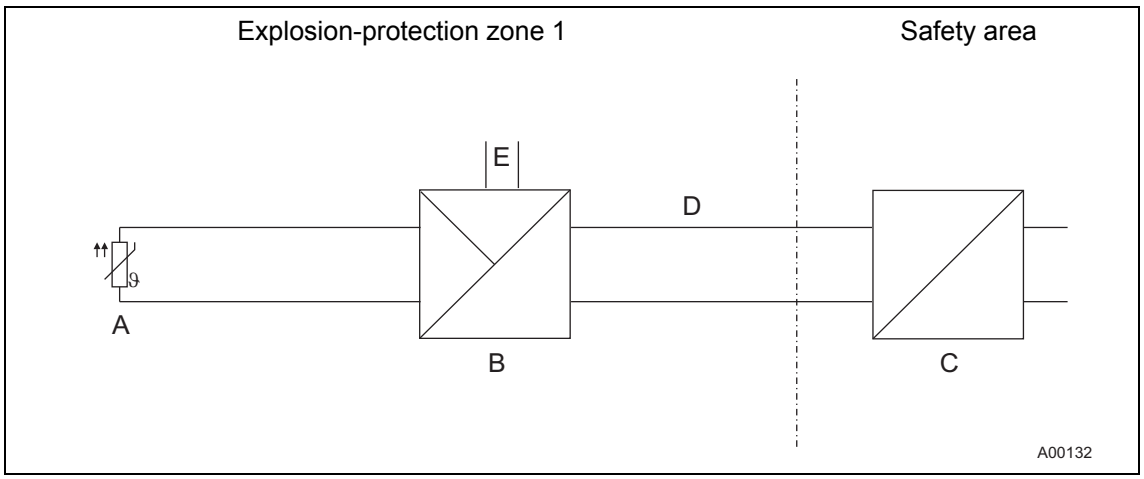


Fig. 18

A Sensor
B TTF300 transmitter in Ex d housing
C Power supply
D Fuse, 32 mA
E Interface for LC display

To achieve the flameproof protection, proper mounting of a specially certified cable gland that complies with the standards and relevant Ex designation on the cover sheet of the PTB 99 ATEX 1144 certificate is required

5.5.9 Flameproof protection Zone 0

Housing design: ATEX II 2G EEx d IIC T6

Transmitter design: ATEX II 1G EEx ia IIC T6

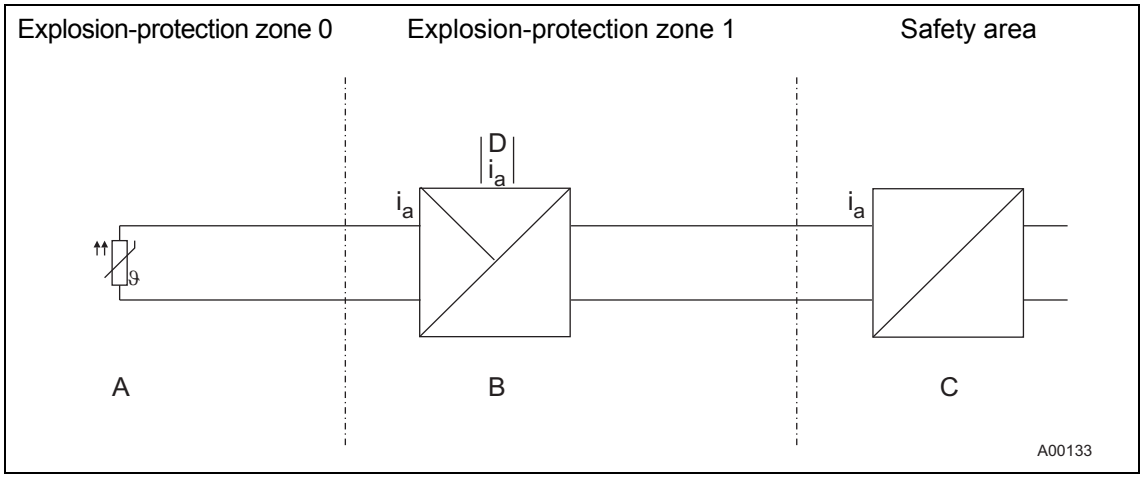


Fig. 19

A Sensor
B TTF300 transmitter in Ex d housing
C Power supply
D Interface for LC display

To achieve the flameproof protection, proper mounting of a specially certified cable gland that complies with the standards and relevant Ex designation on the cover sheet of the PTB 99 ATEX 1144 certificate is required

The input for the power supply must be in EEx ia 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. For zone 0, the circuit must be in "ia" design.

6 Commissioning

Important

The LC display is ready for operation as soon as the temperature sensor has been mounted and the connections have been installed.

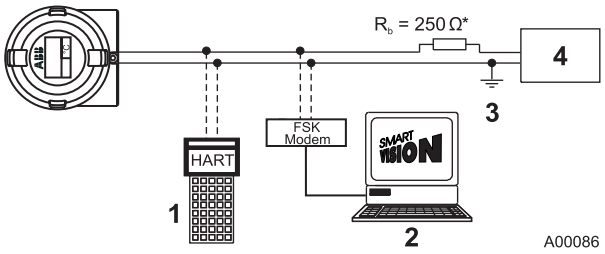
The connected wires must be checked for firm seating. Only firmly seated wires ensure full functionality.

7 Configuration

7.1 Configuration types

There are a variety of configuration options for the transmitter.

- via optional, plug-on LCD display with control buttons.
- 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.
- Configuration via fieldbus (PROFIBUS), if the superordinate remote I/O system is HART-enabled (e.g., ABB S800 or S900).



* If necessary

Fig. 20

1 Handheld terminal
2 FDT / DTM technology
3 Ground connection (optional)
4 Power unit (process interface)

7.1.1 HART communication

Communication with the transmitter takes place using the HART protocol. The communication signal is modulated on both wires for the power supply line and decoded by the transmitter. 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 of this is that remote configuration is possible with supply units that are part of the industrial plant.

7.1.1.1 Configuration via the LCD display with the control buttons

During operation, the name of the measuring location of the flowmeter sensor and the rate are shown on the LC display.

7.1.1.2 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.

1. Open the housing of the head-mounted measuring inset.
2. Carefully clamp both test tips of the separate operating control on the contacts in the slotting in front of the + and – connection terminals.
3. Be sure the test terminals are firmly seated.
4. The installation is to be realized according to the figure in the “Configuration types” paragraph.

Important

The connection of the test tips is performed without polarity. Thus, it does not make a difference which test tip is clamped to which + or – connection terminal.

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

7.1.1.3 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.

7.1.1.4 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.

7.1.2 Configuration via the LC display with control buttons

The configuration of the transmitter is done using the control buttons below the LC display on the front side of the housing. The control buttons and the LC display are in a protected location under the housing cover with inspection glass. The housing cover must be unscrewed before the transmitter is configured.

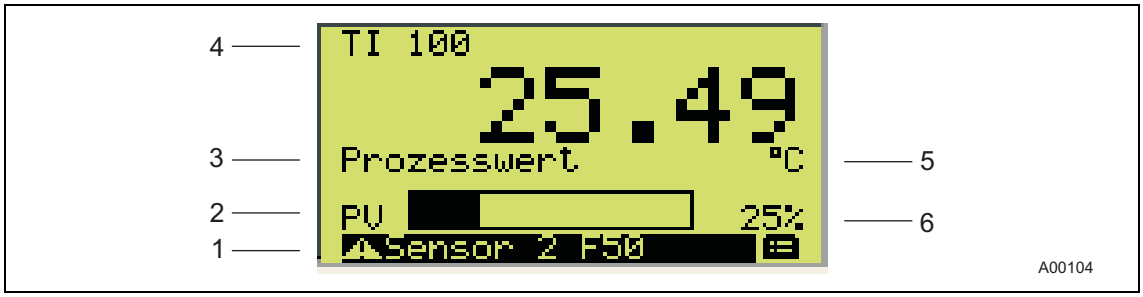


Fig. 21

1 Diagnostics
2 Bar graph
3 Value
4 HART tag
5 Unit
6 Optional: bar graph in % of configured measuring range

7.1.3 Menu navigation

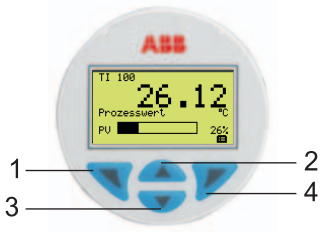


Fig. 22

- The ◂ (1), ▸ (4), ▴ (2), and ▾ (3) control buttons are available for the menu-controlled configuration.
- The menu/submenu name is displayed above in the LCD display.
- The number/line of the currently selected menu item is displayed in the upper right of the LCD display.
- A scroll bar is located on the right edge of the LCD display which shows the relative position of the currently selected menu item within the menu.
- Both of the ◂ and ▸ control buttons can have various functions assigned to them. The meanings of these control buttons are displayed at the bottom of the LC display, above the respective control button. The following functions are possible.

Functions of control button ◂	Meaning
Exit	Exit menu.
Back	Back one submenu.
Cancel	Exit without saving the selected parameter value.
Next	Select next digit for entering numerical values.

Functions of control button ▸	Meaning
Select	Select submenu/parameter.
Edit	Edit parameter.
OK	Save selected parameter and display stored parameter value.

- You can browse through the menu or select a number within a parameter value using the ▴ or ▾ control button. The ▸ control button selects the desired menu item.
- You can exit a parameter, a submenu, or the main menu at any time using the ◂ control button.

7.1.3.1 Calling up the menu

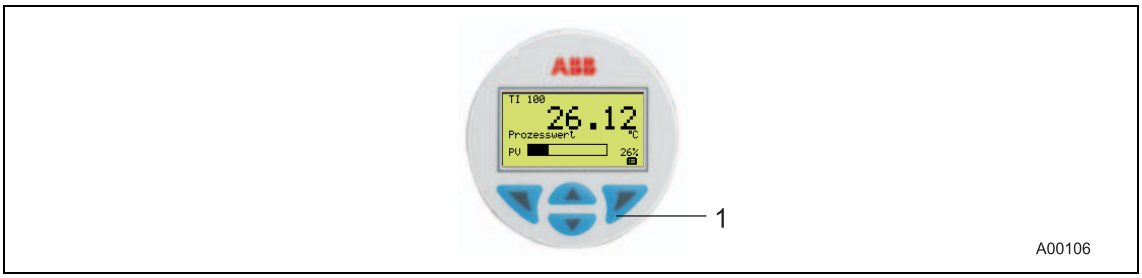


Fig. 23

1 Entering the menu

1. First, the transmitter voltage supply must be switched on. The “ABB connecting …“ display appears after a few seconds. The “Primary VAL“ value is subsequently displayed.
2. A symbol for calling up the menu is located on the LC display above the ▸ control button. By pressing the ▸ control button, the configuration menu is called up. The “Config Device” main menu is displayed.

7.1.3.2 Selecting a menu item / parameter

- The desired submenu must be selected if the menu contains submenus.
- You can only then select a parameter when the corresponding submenu contains configurable parameters, e.g., “Sensor Type”.

7.1.3.3 Configuring a parameter value

1. If a parameter in a submenu is selected, the current configurable parameter value is displayed.
2. By pressing the ▸ "Edit" control button, either all configurable parameter values or a numerical value to be set are displayed. The currently configured parameter value is highlighted.

   Using the “HART tag“ example, alphanumeric operation is also possible. The character position of the tag no. is determined with the ◂ control button. The corresponding character can be selected from the standard character set with the ▴ and ▾ control buttons.

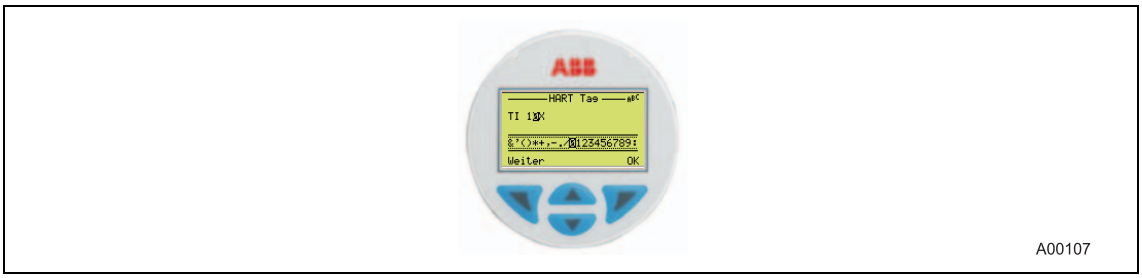


Fig. 24

7.1.4 Example of configuration changes

Output configuration (standard)

Input sensor 1 / sensor type:	PT100 IEC751
Measuring range:	0 … 100 °C
Connection type:	3-wire connection
Fault signaling:	Override / 22 mA
Damping:	Off / 0s
Write Protection:	disabled

Configuration to be set:

Input sensor 1 / sensor type:	Thermocouple type K
Measuring range:	0 ... 1000 °C
Reference point:	internal
Fault signaling:	Override / 22 mA
Damping:	Off / 0s
Write Protection:	activated

Procedure:

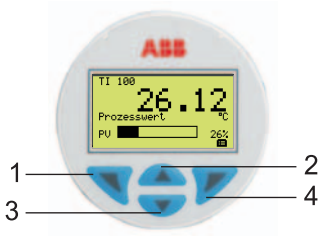


Fig. 25

1. Press the ▸ (4) control button to call up the main menu.
2. Use the ▲ (2) and ▼ (3) control buttons to mark "Config Device" and confirm via ▸ (4).
3. Select "Input Sensor 1" and confirm via ▸ (4).
4. In the submenu “Input Sensor 1” select the sensor type.
5. Use the ▲ (2) or ▼ (3) control button to select and confirm “TC Type K (IEC 584)”.
6. “Back” via the ◂ (1) control button in the submenu “Input Sensor 1” and menu item “Reference Point”.

Since “internal” is set at the factory, no change is required here.

7. Exit “Reference Point” and return to the menu item “Config. Device” via the ◂ (1) control button.
8. Select the subitem “Measuring Range”.
9. In the subitem “Measuring Range”, select the function “Upper Range Value”.

The currently configured URL (100 °C) is displayed.

10. The ▸ (4) “Edit” control button can be used to edit the URL. Use the ◂ (1) control button to select the individual numbers of the URL and edit these via the ▲ (2) or ▼ (3) control button.

Important

When changing the LRL or URL, use the ◂ (1) control buttonto select the digit position with the current decimal point. The digit position can be changed so that no decimal point appears at this position before the decimal point is set at another position.

If no decimal point is set at another digital position, it can be selected after selecting the digit position by using the ◂ (1) control button with the control button ▲ (2) or ▼ (3) before or after the configurable digits 0 to 9.

7.2 Activating write protection

1. Confirm “Config Device” via control button ▸ (4) and select “Write Protection”. Displays the current write protection setting.
2. Use the ▸ (4) “Edit” control button to edit the current write protection configuration.
3. Use the control buttons ▲ (2) or ▼ (3) to select up to 4 alphanumeric characters and confirm via the ▸ (4) control button.

Important

Spaces and the number combination 0110 cannot be entered.

4. Write protection “YES” is displayed.

Click the ◂ (1) control button three times to exit the configuration mode and display "Reading Display Mode".

7.3 Deactivating write protection

Access the write protection edit mode according to the example.

In the write protection edit mode, an alphanumeric character chain is displayed.

1. Enter master password “0110”.
2. Use the ▸ (4) "OK" control button to confirm.

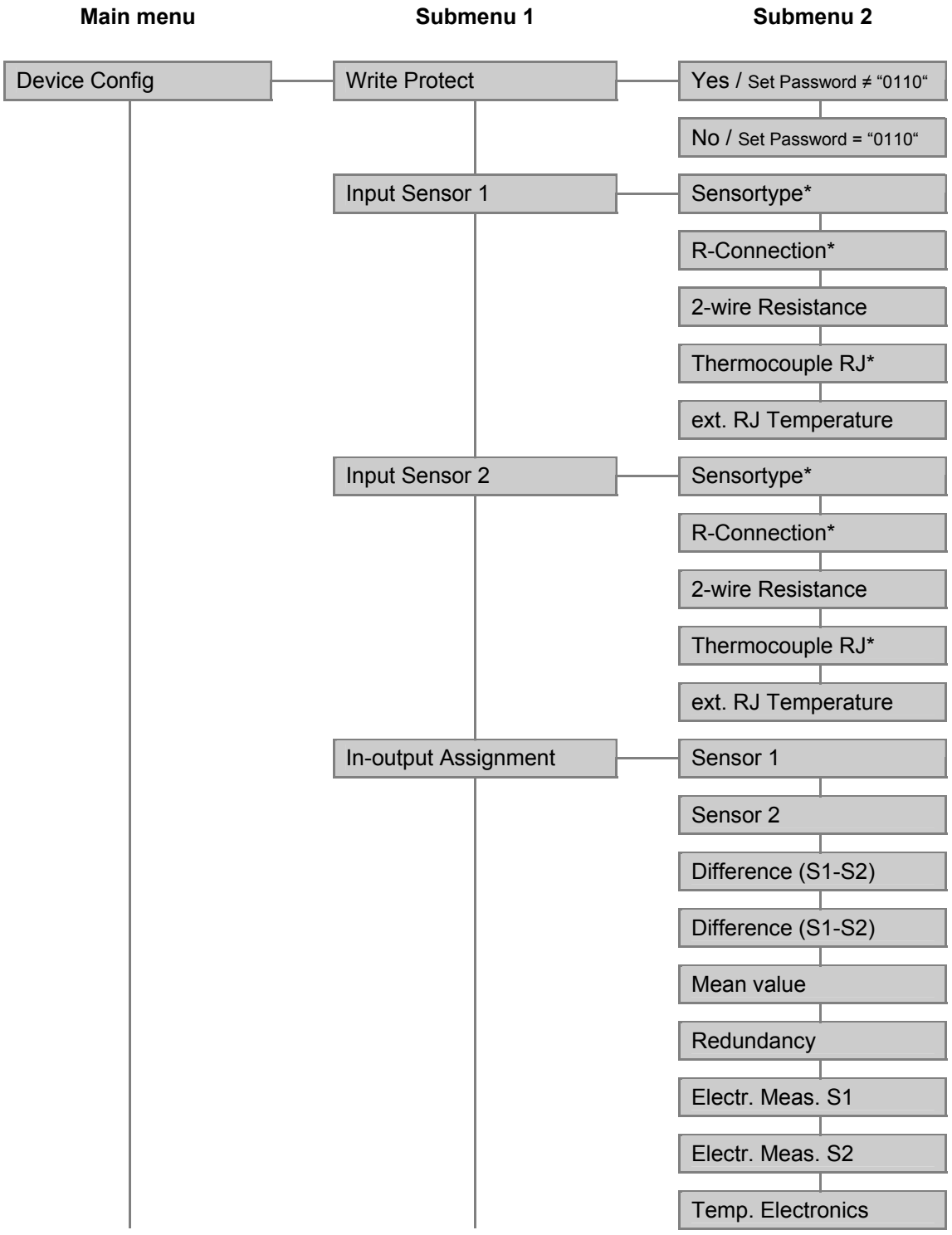
The information “Write protection NO” is displayed.

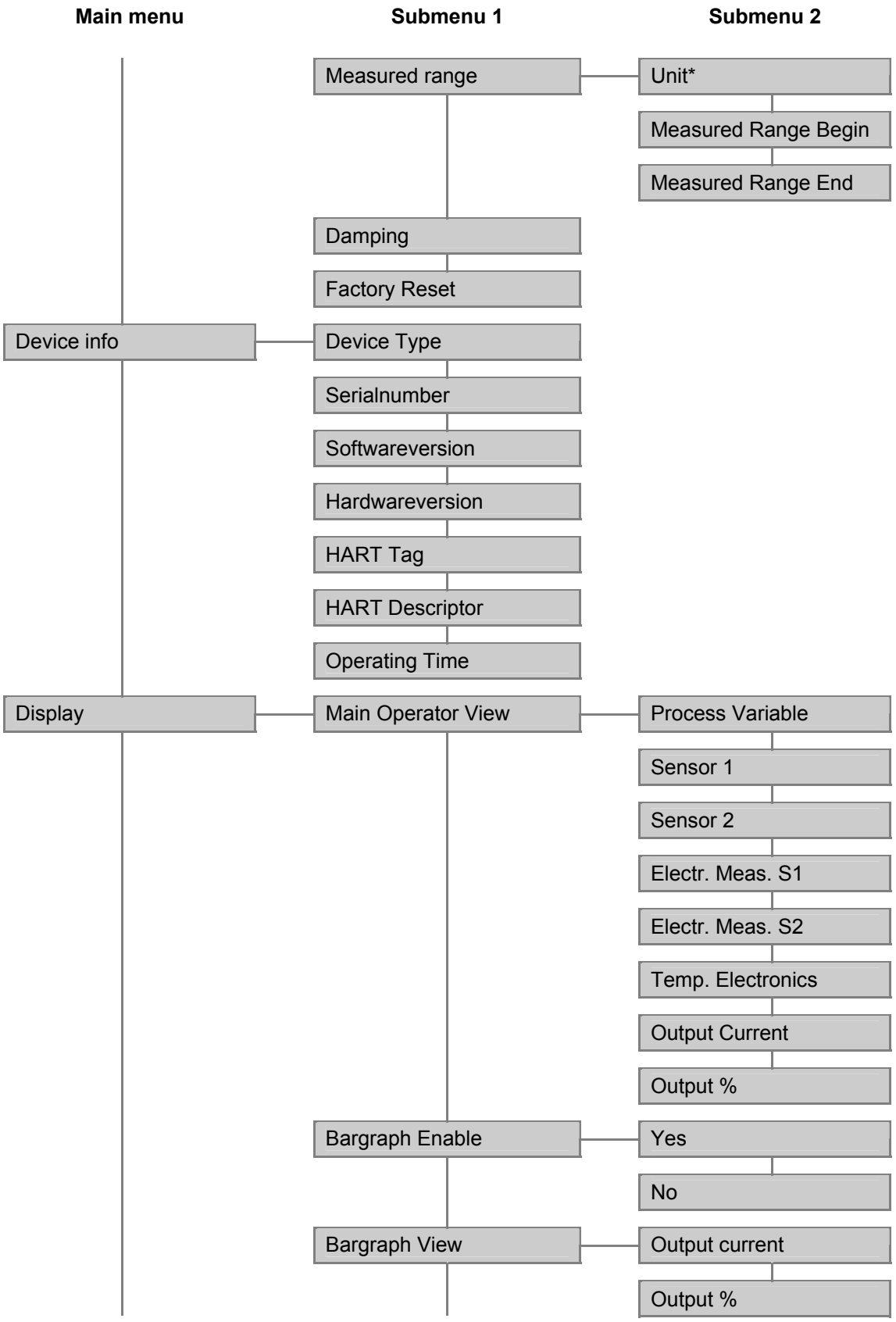
Important

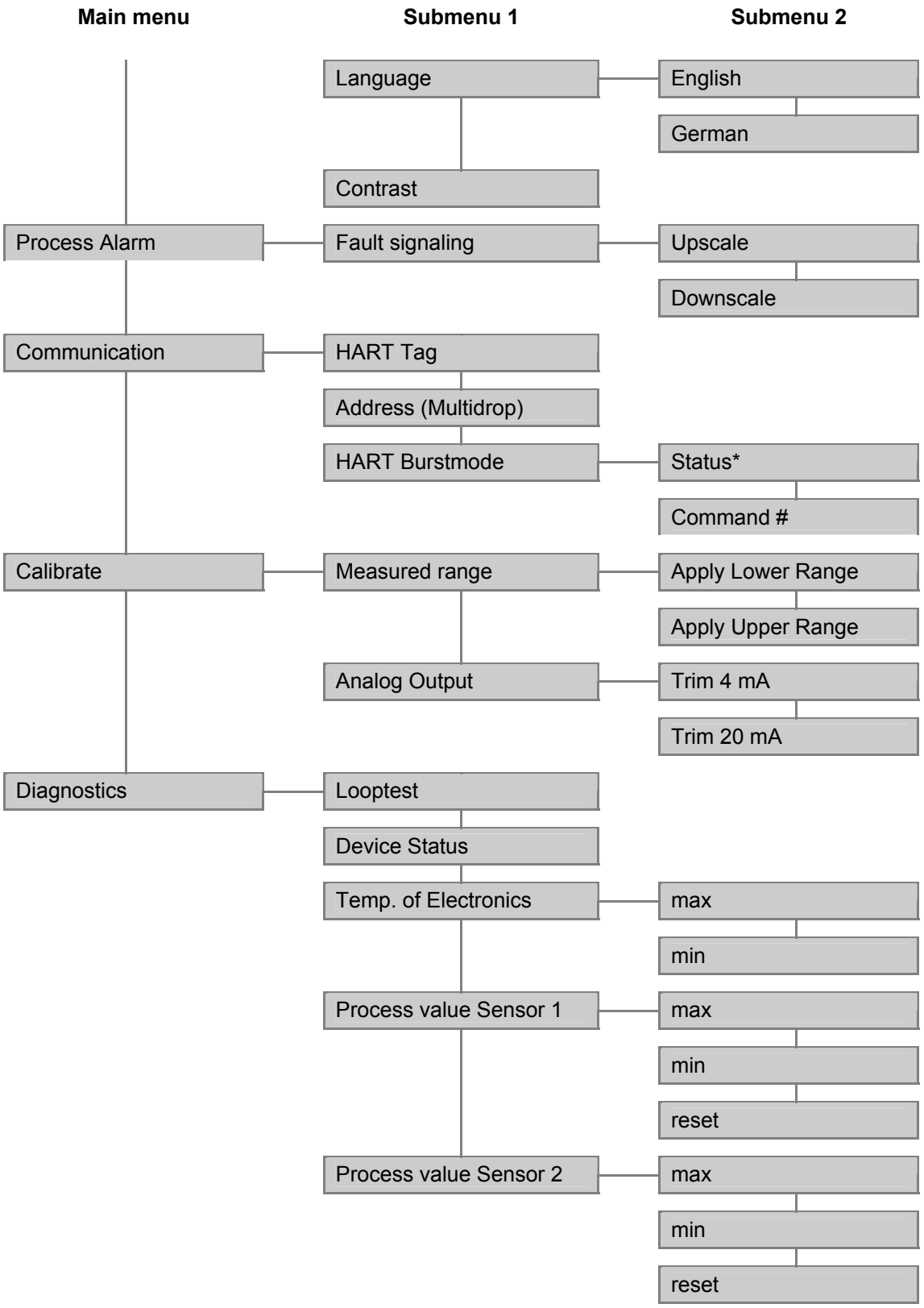
The master password for deactivating write protection cannot be changed.

7.3.1.1 Menu structure

The parameters are structured as a menu. The menu consists of a maximum of three levels. Menu items with the * have additional parameters that are called up in the next section.




Main menu
Submenu 1
Submenu 2
Measured range
Unit*
Measured Range Begin
Measured Range End
Damping
Factory Reset
Device info
Device Type
Serialnumber
Softwareversion
Hardwareversion
HART Tag
HART Descriptor
Operating Time
Display
Main Operator View
Process Variable
Sensor 1
Sensor 2
Electr. Meas. S1
Electr. Meas. S2
Temp. Electronics
Output Current
Output %
Bargraph Enable
Yes
No
Bargraph View
Output current
Output %


Main menu
Submenu 1
Submenu 2
Language
English
German
Contrast
Process Alarm
Fault signaling
Upscale
Downscale
Communication
HART Tag
Address (Multidrop)
HART Burstmode
Status*
Command #
Calibrate
Measured range
Apply Lower Range
Apply Upper Range
Analog Output
Trim 4 mA
Trim 20 mA
Diagnostics
Looptest
Device Status
Temp. of Electronics
max
min
Process value Sensor 1
max
min
reset
Process value Sensor 2
max
min
reset

8 2-sensor input functionality / Dual sensor mode

8.1 2-HART measurement signals

According to the “Electrical connections” section, equivalent RTD or thermocouple sensors or combinations of both can be attached to the transmitter inputs.

Remote I/O systems such as ABB S900 read out these HART variables on a cyclic basis and provide them to the control system in the form of cyclic process data.

The 4 … 20 mA analog output maps only one sensor value. Users can choose to map sensor value 1 or sensor value 2, the differential based on both, or the average. The value mapped is specified during transmitter configuration, e.g., LC display in the menu “Config. Device” / submenu “Input/Output Assignment”.

8.2 Sensor redundancy / Sensor backup

Use two sensors and sensor redundancy mode to increase system uptime.

If sensor 1 fails, the output signal switches bumplessly within the cyclic refresh rate to sensor 2.

In addition, a HART diagnostic message is generated in accordance with Namur NE 107 “Maintenance required / Sensor wire break”.

If redundant sensor 2 fails, a HART signal diagnostic notification is generated.

To minimize the effect on the output signal and increase accuracy in case of a sensor wire break, the average of both sensors is mapped to the analog output in redundancy mode as long as both sensors are available.

Sensor or device failure fault signaling at the analog output signal as required per Namur NE 43 / NE 107 ensures that the transmitter is capable of signaling "Maintenance required” diagnostic information via HART signal as well as analog signal, using overranging (22 mA) and underranging (3.6 mA).

The signaling of “Maintenance required” diagnostic information according to NE 107 when operating with normal 4 … 20 mA analog output is provided by superimposing pulses.

Depending on fault signaling, for 22 mA overload configuration the 4 … 20 mA signal is superimposed on positive 22 mA pulses or with 3.6 mA underload configuration, negative 3.6 mA pulses.

The following values can be configured via pulse width parameters:

- A pulse width of 0.5 … 59.5 s (increment 0.5 s)
- Continuous pulse
- No diagnostic signaling per pulse on the analog output

The specified pulse width refresh rate is 60 seconds.

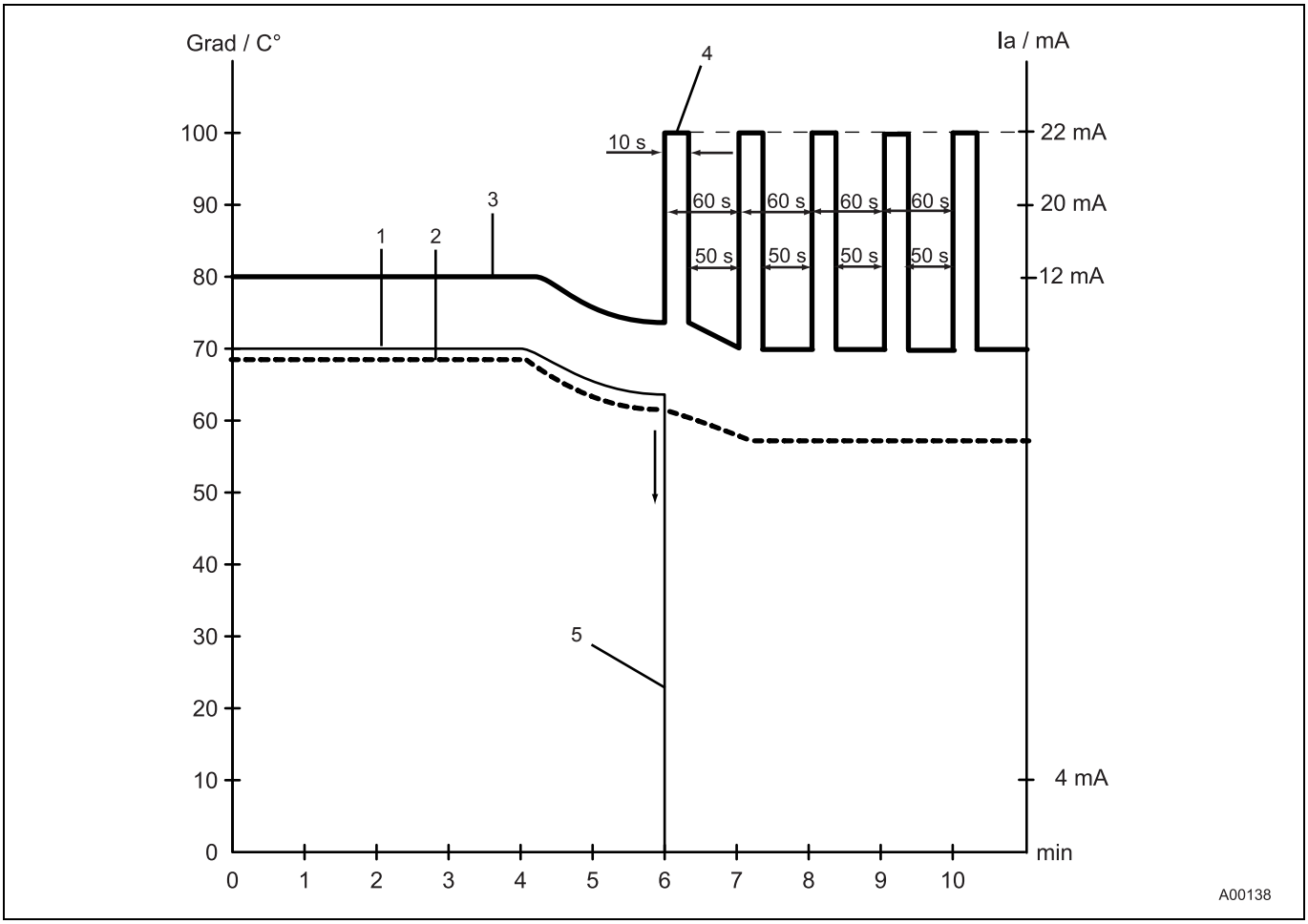


Fig. 26: Alarm pulse signaling in redundancy mode for failure of the temperature characteristic for sensor 2

1 Temperature characteristic for sensor 1 -------
2 Temperature characteristic for sensor 2 ——
3 4 ... 20 mA output signal
4 Alarm pulse:
-Off
-On -> Configurable pulse width
-Continuous pulse
5 Wire break temperature characteristic 2

Example:

If a pulse width of 10 seconds is set, the normal temperature signal of 4 … 20 mA is found at the output due to the pulse width refresh rate of 60 seconds after a 10-second pulse diagnostic alarm signal, e.g., of 22 mA for 50 seconds.

The next cycle begins with a 10-second diagnostic alarm signal and subsequently starts again with a 50-second pulse width refresh rate with the normal 4 ... 20 mA temperature signal.

8.3 Sensor drift detection

When two sensors are connected, an optional sensor drift detection can be activated in redundancy mode, 2-HART measurement signal mode, and during averaging.

Activation or configuration of sensor drift detection and analog diagnostic signaling (described in the previous section) can only be performed using TTF300 DTM configuration or EDD-based tools.

Sensor drift detection can be activated for the following two sensor types (see "electrical connections"):

- 2 x RTD two-wire circuit
- 2 x RTD three-wire circuit
- 2 x resistance measurement / potentiometer two-wire circuit
- 2 x resistance measurement / potentiometer three-wire circuit
- 2 x thermocouple
- 2 x voltage measurement
- 1 x Pt100 two-wire circuit and thermocouple
- 1 x Pt100 three-wire circuit and thermocouple
- 1 x Pt100 four-wire circuit and thermocouple

To activate sensor drift detection, the transmitter must first be configured for the abovementioned sensor types. Then the maximum permissible sensor deviation must be configured, e.g., max. 1 °C (33.8 °F).

Based on possible marginally different sensor response times, a limit must subsequently be set during which time the sensor deviation must be continuously larger than the maximum sensor drift differential value defined at 1 °C (33.8 °F), for example.

If the transmitter records a larger sensor deviation during the defined time period, a HART, EDD, and DTM diagnostic notification “Maintenance required” is generated according to NE 107. In addition, diagnostic information is shown on the LC display.

If drift monitoring is used for equivalent sensors (2 x Pt100 or 2 x TC), the average from both sensors is basically mapped to the transmitter's output signal as a process variable in redundancy mode.

If a thermocouple sensor is used for Pt100 drift monitoring, the Pt100 sensor (see section 9 "Error messages") must be connected to channel 1 and the thermocouple sensor to channel 2.

The measurement value from channel 1 (Pt100) is basically mapped at the transmitter output as a process variable.

Note

Before configuring the maximum permissible sensor deviation for drift detection, sensor channel 2 must be aligned with the value for sensor channel 1, with the help of the TTH300 DTM.

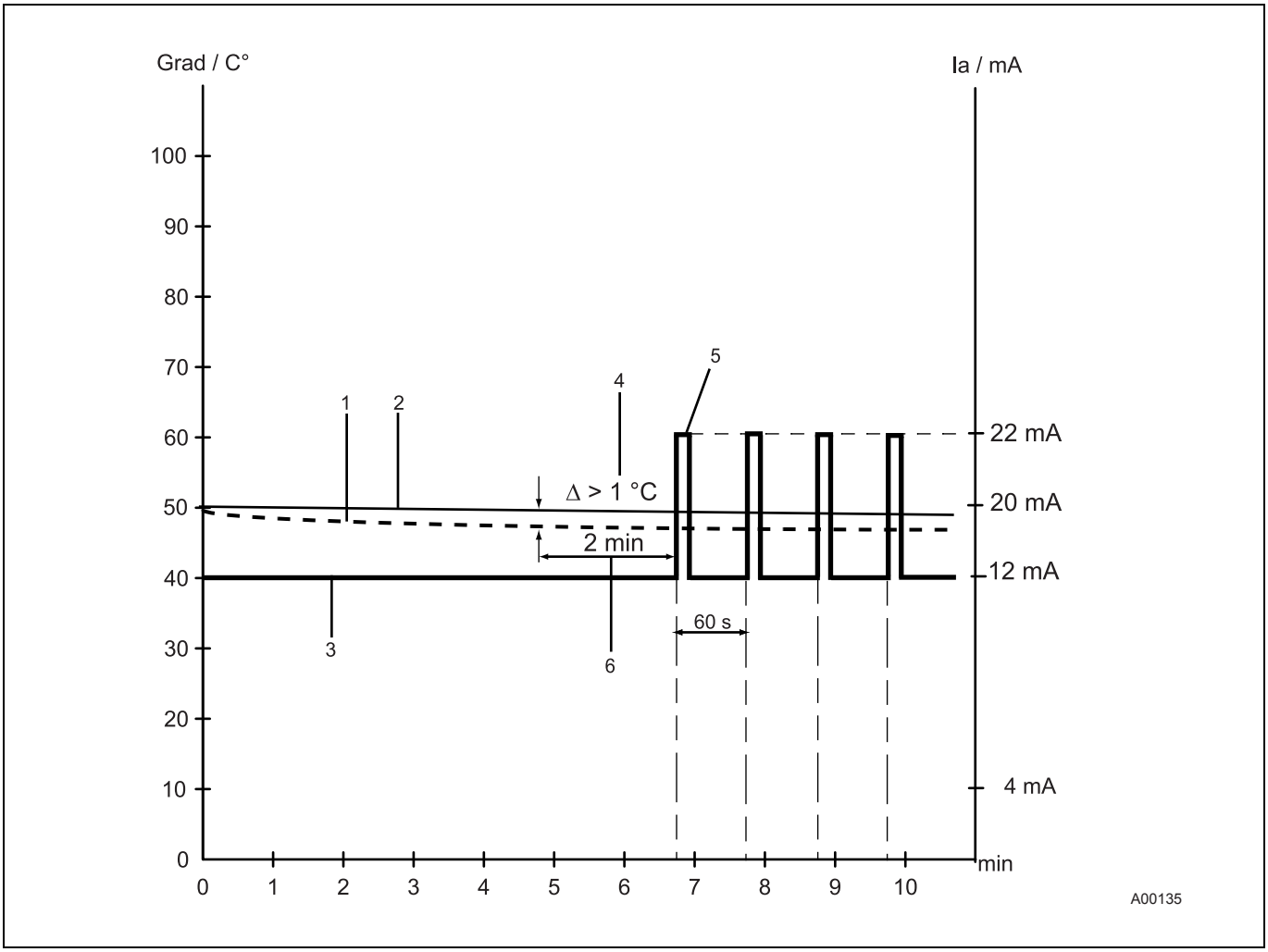


Fig. 27: Alarm pulse signaling during sensor drift overshoot

1 Temperature characteristic for sensor 1 ------
2 Temperature characteristic for sensor 2 ——
3 4 ... 20 mA output signal
4 Maximum sensor drift differential (e.g., Δ > 1 °C)
5 Alarm pulse:
-Off
-On -> Configurable pulse width
-Continuous pulse
6. Sensor drift detection time period (e.g., 2 minutes)

8.4 Sensor error adjustment (TTF300 DTM: Adjust function / HMI LC display: Calibrate function)

Sensor error adjustment can be performed in the TTF300 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 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 or LCD configuration software, 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.

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 can be corrected via the calibration function “Set Measurement Start” or the “Trim low” adjustment 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.

If you enter the temperature value for sensor 1 when adjusting for sensor error on channel 2, then channel 2 is adjusted to the temperature value of sensor 1.

This can occur at a single point (one-point adjustment – sensor – offset – underpressure) as well as at two points (two-point adjustment – sensor – offset and gradient correction).

8.5 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)

D/A analog output compensation can be accessed in the HMI LCD display via the menu path Calibrate / Analog Output / Trim 4/20mA or via TTF300 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 to measured via amperemeter and to record .

Simulate the LRL or 4,000 mA +/- 16µA 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. As a result, the HART value displayed is slightly different from the output signal current.

8.6 HART variable assignment

Because every HART devices can basically transmit four variables, the measurement value to be transmitted via HART signal can be specified in the menu Device / Configuration when using the TTF300 DTM or EDD for device setup.

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

The following values can be assigned to variables:

- Elec. input 1
- Elec. input 2
- Sensor 1 process data
- Sensor 2 process data
- Differential sensor 1 – sensor 2
- Differential sensor 2 – sensor 1
- Average of sensor 1 + sensor 2
- Redundancy
- Electronic unit temperature

8.7 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 “Message” parameter, which supports up to 30 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, basically, a constant 4 mA and is used exclusively for the power supply.

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

In addition to point-to-point and multidrop modes, the third type of HART communication is burst mode. When burst mode is activated, the device continuously transmits a HART telegram containing reading information approx. every 500 ms without prompting by HART command.

In burst mode as with point-to-point mode, the analog output signal is available and matches the primary variable defined during setup.

8.8 Description of parameters

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Write protection	Activates write protection for the entire device.	<Basic Parameters> <General> <Write Protection>	<Device Setup> <Write Protection> <Password>	HMI Yes: Password: locked ≠ 0110 No: unlocked Enter password: 0110	Must be locked to ensure safety function.
Sensor 1: Sensor model	Select sensor type:	<Device> <Configuration> <Sensor 1 / Sensor Type>	<Device Setup> <Input sensor 1> <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…1100 mV 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) Fixpoint-Tabl. 1 Fixpoint-Tabl. 2 Fixpoint-Tabl. 3 Fixpoint-Tabl. 4 Fixpoint-Tabl. 5 Combisensor Cal. Van Dusen 1 Cal. Van Dusen 2 Cal. Van Dusen 3 Cal. Van Dusen 4 Cal. Van Dusen 5	Check safety function
Sensor 1: Type of connection	Sensor connection type relevant for all Pt, Ni, Cu resistance sensor types	<Device> <Configuration> <Sensor 1 / Connection>	<Device Setup> <Input sensor 1> <Connection Type>	2-wire 3-wire 4-wire	Check safety function

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Sensor 1: Line resistance	Sensor resistance relevant for all Pt, Ni, Cu resistance sensor types in 2-wire sensor transmitter connection type	<Device> <Configuration> <Sensor 1 / Line Resistance>	<Device Device> <Input Sensor 1> <Line Resistance>	0 … max. 100 Ω	Check safety function
Sensor 1: Reference point	When using the transmitter reference point: internally relevant for all thermocouples except type B, if thermo / equalizing conductor is clamped to the transmitter without using the transmitter reference point: without type B, externally fixed transfer of thermo / equalizing conductor via copper material at constant thermostat temperature	<Device> <Configuration> <Sensor 1 / Reference Point>	<Device Device> <Input Sensor 1> <Reference Point>	internal without externally - fixed	Check safety function
Sensor 1: Reference point ext.	Relevant for external reference point, information on constant external reference point temperature	<Device> <Configuration> <Sensor 1 / Reference Point Temp.>	<Device Device> <Input Sensor 1> <Reference Point Ext.>	-50 ...100 °C	Check safety function
Sensor 2: Sensor model	Select sensor type:	<Device> <Configuration> <Sensor 2 / Sensor Type>	<Device Setup> <Input Sensor 2> <Sensor Type>	Like sensor 1	Safety function relevant and requires check of following input / output assignments: Sensor 2 Differential (S1-S2) Differential (S1-S2) Mean Redundancy Elec. reading 2
Sensor 2: Type of connection	Sensor connection type relevant for all Pt, Ni, Cu resistance sensor types	<Device> <Configuration> <Sensor 2 / Connection>	<Device Setup> <Input Sensor 2> <Connection Type>	Like sensor 1	Safety function relevant and requires check of following input / output assignments: Sensor 2 Differential (S1-S2) Differential (S2-S1) Mean Redundancy Elec. reading 2

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Sensor 2: Line resistance	Sensor resistance relevant for all Pt, Ni, Cu resistance sensor types in 2-wire sensor transmitter connection type	<Device> <Configuration> <Sensor 1 / Line Resistance>	<Device Setup> <Input Sensor 2> <Line Resistance>	Like sensor 1	Safety function relevant and requires check of following input / output assignments: Sensor 2 differential (S1-S2) differential (S2-S1) mean redundancy elec. reading 2
Sensor 2: Reference point	When using the transmitter reference point: internally relevant for all thermocouples except type B, if thermo / equalizing conductor is clamped to the transmitter without using the transmitter reference point: without type B, externally fixed transfer of thermo/equalizing conductor via copper material at constant thermostat temperature	<Device> <Configuration> <Sensor 1 / Reference Point>	<Device Setup> <Input Sensor 2> <Reference Point>	Like sensor 1	Safety function relevant and requires check of following input / output assignments: Sensor 2 differential (S1-S2) differential (S2-S1) average redundancy elec. reading 2
Sensor 2: Reference point ext.	Relevant for externally fixed reference point, information on constant external reference point temperature	<Device> <Configuration> <Sensor 1 / Reference Point Temperature>	<Device Setup> <Input Sensor 2> <Reference Point Ext.>	Like sensor 1	Safety function relevant and requires check of following input/output assignments: Sensor 2 Difference (S1-S2) Differential (S2-S1) mean redundancy elec. reading 2
Sensor 1	Parametrized measuring range of sensor 1 is mapped to the 4 … 20 mA analog output	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Sensor 1	Check safety function
Sensor 2	Parametrized measuring range of sensor 2 is mapped to the 4 … 20 mA analog output	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Sensor 2	Check safety function

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Differential (S1-S2)	The differential temperature from sensor 1 minus sensor 2 is mapped to the 4 … 20 mA analog output according to the parametrized measuring range (0 °C … max. differential temperature)	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Difference (S1-S2)	Check safety function
Differential (S2-S1)	The differential temperature from sensor 2 minus sensor 1 is mapped to the 4 … 20 mA analog output according to the parametrized measuring range (0 °C … max. differential temperature)	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output Assignment>	Difference (S1-S2)	Check safety function
Mean	The average of two independent sensors 1 and 2 is mapped to the 4 … 20 mA analog output according to the parametrized measuring range	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Mean	Check safety function
Redundancy	With two functioning sensors for a measuring inset, the average is mapped to the 4 … 20 mA analog output for the parametrized measuring range. When on sensor fails, the temp signal for the functioning sensor switches bumplessly and is mapped to the 4 … 20 mA output.	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Redundancy	Check safety function
Elec. reading S1	The 4 … 20 mA output signal matches the Ω or mV signal of sensor 1	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Elec. reading S1	Check safety function
Elec. reading S2	The 4 … 20 mA output signal matches the Ω or mV signal of sensor 2	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Elec. reading S2	Check safety function

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Temp. electronics	The 4 ... 20 mA output signal matches the electronic unit temperature	<Device> <Configuration> <Measurement Type / Primary Variable (PV)>	<Device Setup> <Input / output assignment>	Temp. electronics	Check safety function
Unit	Select the unit of measure for the sensor	<Device> <Parametrize> <Measuring Range of PV / Unit>	<Device Setup> <Measuring Range> <Unit>	°C, °F, °R, K, user, mV, Ω, mA	Depending on sensor type
Measurement start	Defines the sensor measurement start	<Device> <Parametrize> <Measuring Range of PV / Lower Range Value>	<Device Setup> <Measuring Range> <Lower Range Value>	Depending on sensor type	Depending on sensor type
Measurement end	Defines the sensor measurement end	<Device> <Parametrize> <Measuring Range of PV / Upper Range Value>	<Device Setup> <Measuring Range> <Upper Range Value>	Depending on sensor type	Depending on sensor type
Damping	Configurable condensation 63 % output signal damping value	<Device > <Parametrize> <Voltage Output / Damping>	<Device Setup> <Damping>	0 ... 100 s	Depending on sensor type
Factory reset	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>	<Device Setup> <Factory Setting>	Yes / OK	Safety function for potential risk all configuration and adjustment data are reset to the factory default
Device reset	Configuration data is reset to factory setting for Pt100 3-wire, 0 … 100°C damping off, override	<Device> <Maintenance> <Device Reset>			Safety function for potential risk configuration data is reset to the factory default
Override	Generates a 22 mA high alarm signal for sensor or device errors	<Device> <Parametrize> <Current Output / Output with Fault>	<Process Alarm> <Fault Signaling>	Override	Check safety function
Underdrive	Generates a 3.6 mA low alarm signal for sensor or device errors	<Device> <Parametrize> <Current Output / Output with Fault>	<Process Alarm> <Fault Signaling>	Underdrive	Check safety function
HART tag	Defines HART tag name	<Device> <Maintenance> <Poll Address / Tag>	<Communication> <HART Tag>	8 characters, alphanumeric	Check safety function

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
Address (Multidrop)	Defines communication type	<Device> <Maintenance> <Poll Address / Tag>	<Communication> <Address (Multidrop)>	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 const. 4 mA only the digital HART readings are available	Check safety function
HART burst mode			<Communication> <HART Burst Mode> <Status> <Communication> <HART Burst Mode> <Command>	on off Primary Var. Current + % Range Current + Dyn. Var.	Check safety function
Set measurement start	Temperature correction for specified / simulated sensor LRL value to desired LRL temperature value	<Device> <Maintenance> <Adjust>	<Calibrate> <Measuring Range>	Trim low or Set Lower Range Value> ok	Check safety function
Set measurement end	Temperature correction for specified / simul. Sensor measurement value at desired URL temperature value	<Device> <Maintenance> <Adjust>	<Calibrate> <Measuring Range>	Trim high or Set Upper Range Value> ok	Check safety function
Trim 4 mA	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>	<Calibrate> <Analog Output>	Analog current measurement value input min. 3.5 ... max. 4.5 mA	Check safety function
Trim 20 mA	Output signal correction for specified / simul. Sensor URL at 20,000 mA setpoint	<Device> <Maintenance > <Adjust / DAC compensation fixed for amplification at 20 mA>	<Calibrate>- <Analog Output>	Analog current measurement value input min. 19.5 ... max. 20.5 mA	Check safety function
Simulation	Output signal simulation corresponding to the value specified	<Device> <Simulation>	<Diagnostic> <Loop Test>	3.5 ... 23.6 mA	Check safety function

Device parameters	Description	DTM parameters	HMI LCD display parameters	Effective range	Safety information
For software version SW 01.01.03 or higher:					
Drift detection: enabled	activated Sensor drift detection	<Device > <Parametrize> <enabled>		on off	Check safety function
Drift detection: max. sensor differential	Value at which sensor drift signaling occurs, if overshoot is longer than the limit time period is present	<Device > <Parametrize> <Max. Sensor Differential>		... Degrees C; ...°F, ...mV, ... Ohm	Check safety function
Drift detection: Sensor drift Limit time period	Time period during which the max. sensor differential must be overshot, before sensor drift signaling occurs	<Device > <Parametrize> <Limit time period>		.....minutes	Check safety function
Analog alarm pulse maintenance demand signaling: Response for maintenance need	Analog alarm pulse signaling with configurable pulse width for sensor maintenance needs (e.g., failure of a sensor in redundancy mode or overshoot of max. sensor drift differential)	<Device > <Parametrize> <Output current / Response for Maintenance Needs>		Off Pulse width: >0....59.5 s continuous	Check safety function

* Safety check is performed acc. to SIL safety information based on the document SM/TTX3X/SIL-EN

8.8.1 Factory settings

The transmitter is preconfigured at the factory. The following tables contain the values of the individual parameters.

Menu	Designation	Parameter	Factory setting
Device Config	Write Protect	-	No
	Input Sensor 1	Sensortype	Pt100 (IEC751)
		R-Connection	3-wires
		Measured Range Begin	0
		Measured Range End	100
		Unit	°C
		Damping	Off
Process Alarm		Fault signaling	Override 22 mA
	Input Sensor 2	Sensortype	Off
	In-output Assignment	-	Sensor 1
	HART Tag	-	-
	HART Descriptor	-	TIXXX
Display	Main Operator View	-	Process Variable
	Bargraph Enable	-	Yes
	Bargraph View	-	Output %
	Language	-	English
	Contrast	-	50 %
Communication	HART Burstmode	Status	Off

9 Error messages

The following list contains the error messages for the LCD display.

	Device Status	DIAG. NO.	Source of Error	Error correction
Device	F	1	Device defective.	Replacing the device.
Device	S	2	Above/below ambient temperature.	Check environment, possibly reposition measuring point.
Device	F	3	EEPROM defective.	Replacing 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 inserted.	Status info, no error.
Device	I	8	Device write-protected.	Status info, no error.
Device	I	9	EEPROM busy.	Status info, no error.
Device	F	12	Sensor input defective (communication).	Replacing the device.
Device	F	13	Sensor input defective (error).	Replacing the device.
Device	F	14	Sensor input defective (ADC error).	Replacing the device.
Communication	C	32	Diagnostic simulation mode	No error, diagnostic info, measurement OK.
				Sensor
Sensor 1	F	34	Measuring error.	Check sensor connection.
Sensor 1	F	35	Sensor short-circuit.	Check sensor connection.
Sensor 1	F	36	Wire break.	Check sensor connection.
Sensor 1	F	37	Above sensor range.	Check measuring limits.

	Device Status	DIAG. NO.	Source of Error	Error correction
Sensor 1	F	38	Below sensor range.	Check measuring limits.
Sensor 1	I	41	Single point calibration active.	Status info, no error.
Sensor 1	I	42	Two point calibration active.	Status info, no error.
				Sensor
Sensor 2	F	50	Measuring error.	Check sensor connection.
Sensor 2	F	51	Sensor short-circuit.	Check sensor connection.
Sensor 2	F	52	Wire break.	Check sensor connection.
Sensor 2	F	53	Above sensor range.	Check measuring limits.
Sensor 2	F	54	Below sensor range.	Check measuring limits.
Sensor 2	I	57	Status info.	Status info, no error.
Sensor 2	I	58	Status info.	Status info, no error.
Application	F	65	Configuration defective.	Check configuration: A) Incorrect device. B) Measuring span is too small. Incorrect configuration data.
Application	M	66	No sensor detected at sensor 1 in redundancy configuration.	Check connection.
Application	M	67	No sensor detected at sensor 2 in redundancy configuration.	Check connection.
Application	M	68	Sensors exceeded specified drift window	Calibrate sensors
Application	C	71	Reconfiguration is running.	Status info, no error.
Application	F	72	Incorrect application.	Check configuration, connections; reset to factory settings; notify service.
Application	I	74	Calibration of analog output active.	Status info, no error.

	Device Status	DIAG. NO.	Source of Error	Error correction
Application	C	75	Analog output in simulation.	Status info, no error.
Application	S	76	Above range.	Check parameters: A) Above sensor range. Measuring span is too small.
Application	S	77	Limit HIGH HIGH.	Upper limit value: Alarm.
Application	S	78	Limit LOW LOW.	Lower limit value: Alarm
Application	S	79	Limit HIGH.	Upper limit value: Warning.
Application	S	80	Limit LOW.	Lower limit value: Warning.

Explanations per NE 107

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

10 Additional TTF300 DTM diagnostic information

Configuration has been changed

Important

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

10.1 Long-term monitoring

The transmitter saves the highest and lowest values for the electronic unit temperature as well as readings from sensor 1 and sensor 2 in a failsafe memory (“Drag Indicator”).

Supply voltage	Current supply voltage measured at the clamps of the transmitter in volts (± 5 %).
Maximum electronic unit temperature	Highest detected internal temperature in °C that the transmitter was subjected to. This value cannot be reset.
Minimum electronic unit temperature	Lowest detected internal temperature in °C that the transmitter was subjected to. This value cannot be reset.
Maximum value sensor 1, 2	Highest reading at sensor 1 or 2. When changing the sensor type (e.g., Pt100 to thermocouple type K), the value is reset automatically.
Minimum value sensor 1, 2	Lowest reading at sensor 1 or 2. When changing the sensor type, the value is reset automatically.
Reset	The drag indicators for the sensor readings are reset to the current measurement value.

10.2 Operating hour statistics

Operating hours	Total hours since commissioning that power has been switched on for transmitter.
Operating hours per electronic unit temperature	The operating hours are categorized according to the measured internal temperature of the transmitter. Due to rounding and frequently switching the device on and off, the total of the individual values may differ slightly from the value displayed by the counter for operating hours. Values in the fields on the far left and right display operation of the transmitter outside the specified range. In this event, acknowledged properties of the transmitter might be limited, in particular, with respect to accuracy and service life.

11 Maintenance / Repair

11.1 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.

11.2 Cleaning

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

12 Ex relevant specifications

12.1 TTF300-E1XX, intrinsic safety ATEX

Explosion protection

The TTF300 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 2G(1D) Ex [iaD] ib IIC T6 (Zone 1 [20])

EC type-examination test certificate PTB 05 ATEX 2017 X

12.2 TTF300-H1XX, intrinsic safety IECEx

Designation

Ex ia IIC T6
Ex [ia] ib IIC T6
Ex [iaD] ib IIC T6

TTF300-H1XX :
IECEx Certificate of Conformity IECEx PTB 09.0014X

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 TTF300-E5XX, non-sparking ATEX + dust explosion protection

Explosion protection
The TTF300 complies with the requirements of ATEX directive 94/9/EC
Approved for use in Zone 2/22
Designation
II 3G EEx nA II T6
II 3 D IP 65 T 135 °C

ABB manufacturer's declaration in accordance with ATEX directive

Temperature table

Temperature class	Device category 3 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 TTF300-D1XX, dust explosion protection

Explosion protection
Approved for use in dust/Zone 20.
Designation
II 1 D IP 65 T 135°C

EC prototype test certificate BVS 06 ATEX E 029

12.6 TTF300-D2XX, dust explosion protection + intrinsic safety

Explosion protection
Approved for use in dust/Zone 20 and gas/Zone 0.
Designation
II 1 D IP 65 135°C
II 1G EEx ia IIC T6

EC prototype test certificate BVS 06 ATEX E 029
EC prototype test certificate PTB 05 ATEX 2017 X

12.7 TTF300-E3XX, flameproof enclosure

Explosion protection
Approved for use in Zone 1.
Designation
II 2G EEx d IIC T6

EC prototype test certificate PTB 99 ATEX 1144

12.8 TTF300-E4XX, flameproof enclosure + intrinsic safety

Explosion protection
Approved for use in Zone 1.
Designation
II 2G EEx d IIC T6
II 1G EEx ia IIC T6

EC prototype test certificate PTB 99 ATEX 1144
EC prototype test certificate PTB 05 ATEX 2017 X

12.9 TTF300-L1XX, intrinsically safe FM

Class I, Div. 1 + 2, Groups A, B, C, D T6
Class II, Groups E, F, G; Class III
Class I, Zone 0, AEx ia IIC T6
Product variant: TTF300-L1
Control drawing: 214832

12.10 TTF300-L2XX, non-incendive FM

Class I, Div. 2, Groups A, B, C, D
Class II, Groups E, F, G; Class III
Control drawing: 214830

12.11 TTF300-L3XX, explosion proof FM

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed
Control drawing: 214866

12.12 TTF300-L7XX, explosion proof + Intrinsically Safe FM

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed
Control-Drawing: 214866
Class I, Div. 1 + 2, Groups A, B, C, D T6
Class II, Groups E, F, G; Class III
Class I, Zone 0, AEx ia IIC T6
Control drawing: 214832

12.13 TTF300-R1XX, intrinsically safe CSA

Class I, Div. 1 + 2, Groups A, B, C, D
Class II, Groups E, F, G; Class III
Control drawing: 214825

12.14 TTF300-R2XX, non-incendive CSA

Class I, Div. 2, Groups A,B,C,D
Class II, Groups E, F, G; Class III
Control-Drawing: 214827

12.15 TTF300-R3XX, explosion proof CSA

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed
Control drawing: 214866

12.16 TTF300-R7XX, explosion proof + Intrinsically Safe CSA

XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed
Control-Drawing: 214866
Class I, Div. 1 + 2, Groups A, B, C, D
Class II, Groups E, F, G; Class III
Control-Drawing: 214825

13 Specifications

13.1 Input

13.1.1 Resistance thermometers / Resistors

Resistance thermometers
Pt100 in accordance with IEC 60751, JIS C1604-81, MIL-T-24388,
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
Maximum sensor line resistance (R_W) for each line 50 Ω according to NE 89 (January 2009)
Three-wire circuit:
symmetrical sensor line resistances
Two-wire circuit:
compensation up to 100 Ω total line resistance

Measurement current
< 300 µA

Sensor short circuit
< 5 Ω (for resistance thermometer)

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 NE 89

Three-wire resistance measurement	> 50 Ω
Four-wire resistance measurement	> 50 Ω

Sensor error signaling

Resistance thermometers:	Short circuit and wire break
Linear resistance measurement:	Wire break

13.1.2 Thermocouples / Voltages

Types
B, E, J, K, N, R, S, T in accordance with IEC 60584
U, L in accordance with DIN 43710
C, D in accordance with ASTM E-988

Voltages
-125 ... 125 mV
-125 ... 1,100 mV

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

Sensor wire-break monitoring in accordance with 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, IEC 60751 Cl. B
(no additional jumpers necessary)

Sensor error signaling

Thermocouple:	Wire break
Linear voltage measurement:	Wire break

13.1.3 Functionality

Freestyle characteristics and 32-point sampling table
Resistance measurement up to maximum 5 kΩ
Voltages up to maximum 1.1 V

Sensor error adjustment
Via Callendar van Dusen coefficients
Via table of 32 sampling points
Via single-point adjustment (offset adjustment)
Via two-point adjustment

Input functionality
1 sensor
2 sensors:
mean measurement,
differential measurement,
sensor redundancy,
sensor drift monitoring

13.2 Output

Transmission characteristics
Temperature linear
Resistance linear
Voltage linear

Output signal
Configurable 4 ... 20 mA (standard)
Configurable 20 ... 4 mA
(dynamic range: 3.8 ... 20.5 mA in accordance with NE 43)

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)

13.3 Power supply (polarity safe)

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

Supply voltage

Non ignition-proof application with or without LCD-display:
U_S = 11 ... 42 V DC
Ignition-proof applications with or without LCD-display:
U_S = 11 ... 30 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

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

Max. load

R_{load} = (supply voltage: 11 V)/0.022 A

Max. load (W) depending on supply voltage (V DC)

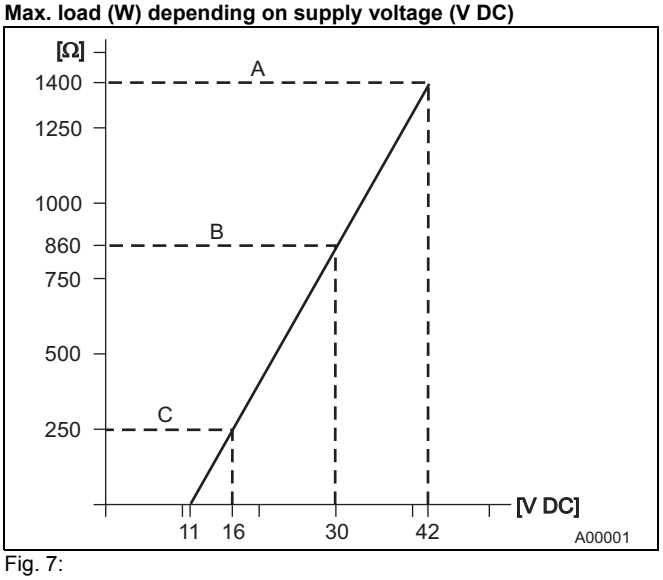


Fig. 7:

A TTF300,
B TTF300 in EEx ia design
C HART communication resistance

Max. power consumption

P = U_S x 0.022 mA
e.g., U_s = 24 V $\rightarrow$ P_{max} = 0.528 W

14 General information

CE Marking
The TTF300 meets all requirements as regards the CE Marking in accordance with Directive 2004 / 108 / EC

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

MTBF time
28 years at 60 °C ambient temperature

Input filter
50 / 60 Hz

Switch-on delay
HART: < 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 with 1 sensor, 5/s with 2 sensors, depending on sensor type and sensor circuit

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

14.1 Ambient conditions

Ambient temperature
Standard: -40 … 85 °C (-40 … 185 °F)
Restricted range during operation with LCD or with hazardous area 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 … 2,000 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 the bay

14.2 Electromagnetic compatibility

Emitted interference in accordance with IEC EN 61326 (2006) and Namur NE 21 (February 2004)

14.3 EMI / RFI shielding

Interference immune in accordance with IEC 61326 (2006) and Namur NE 21 (08/2007)
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)

14.4 Measuring accuracy

Includes linearity deviation, reproducibility/hysteresis at 23 °C (73.4 °F) ± 5 K and 20 V supply voltage

Information on measuring accuracy corresponds to 3 σ (Gaussian distribution)

Input element		Measuring range limits	Minimum span	Digital measuring accuracy (24-bit A/D converter)	D/A measuring accuracy [1] (16-bit DA)
Standard	**Sensor**				
Resistance thermometer / resistor					
IEC 60751	Pt10 (a=0.003850)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.80 °C (± 1.44 °F)	± 0.05 %
	Pt50 (a=0.003850)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.16 °C (± 0.29 °F)	± 0.05 %
	Pt100 (a=0.003850) [2]	**-200 ... 850 °C (-328 ... 1562 °F)**	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Pt200 (a=0.003850)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.24 °C (± 0.43 °F)	± 0.05 %
	Pt500 (a=0.003850)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.16 °C (± 0.29 °F)	± 0.05 %
	Pt1000 (a=0.003850)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
JIS C1604-81	Pt10 (a=0.003916)	-200 ... 645 °C (-328 ... 1193 °F)	10 °C (18 °F)	± 0.80 °C (± 1.44 °F)	± 0.05 %
	Pt50 (a=0.003916)	-200 ... 645 °C (-328 ... 1193 °F)	10 °C (18 °F)	± 0.16 °C (± 0.29 °F)	± 0.05 %
	Pt100 (a=0.003916)	-200 ... 645 °C (-328 ... 1193 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
MIL-T-24388	Pt10 (a=0.003920)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.80 °C (± 1.44 °F)	± 0.05 %
	Pt50 (a=0.003920)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.16 °C (± 0.29 °F)	± 0.05 %
	Pt100 (a=0.003920)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Pt200 (a=0.003920)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.24 °C (± 0.43 °F)	± 0.05 %
	Pt1000 (a=0.003920)	-200 ... 850 °C (-328 ... 1562 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
DIN 43760	Ni50 (a=0.006180)	-60 ... 250 °C (-76 ... 482 °F)	10 °C (18 °F)	± 0.16 °C (± 0.29 °F)	± 0.05 %
	Ni100 (a=0.006180)	-60 ... 250 °C (-76 ... 482 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Ni120 (a=0.006180)	-60 ... 250 °C (-76 ... 482 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Ni1000 (a=0.006180)	-60 ... 250 °C (-76 ... 482 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Cu10 (a=0.004270)	-50 ... 200 °C (-58 ... 392 °F)	10 °C (18 °F)	± 0.80 °C (± 1.44 °F)	± 0.05 %
	Cu100 (a=0.004270)	-50 ... 200 °C (-58 ... 392 °F)	10 °C (18 °F)	± 0.08 °C (± 0.14 °F)	± 0.05 %
	Resistance measurement	0 ... 500 Ω	4 Ω	± 32 mΩ	± 0.05 %
	Resistance measurement	0 ... 5000 Ω	40 Ω	± 320 mΩ	± 0.05 %
Thermocouples [3] / voltages					
IEC 60584	Type K (Ni10Cr-Ni5)	-270 ... 1372 °C (-454 ... 2502 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type J (Fe-Cu45Ni)	-210 ... 1200 °C (-346 ... 2192 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type N (Ni14CrSi-NiSi)	-270 ... 1300 °C (-454 ... 2372 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type T (Cu-Cu45Ni)	-270 ... 400 °C (-454 ... 752 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type E (Ni10Cr-Cu45Ni)	-270 ... 1000 °C (-454 ... 1832 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type R (Pt13Rh-Pt)	-50 ... 1768 °C (-58 ... 3215 °F)	100 °C (180 °F)	± 0.95 °C (± 1.71 °F)	± 0.05 %
	Type S (Pt10Rh-Pt)	-50 ... 1768 °C (-58 ... 3215 °F)	100 °C (180 °F)	± 0.95 °C (± 1.71 °F)	± 0.05 %
	Type B (Pt30Rh-Pt6Rh)	-0 ... 1820 °C (32 ... 3308 °F)	100 °C (180 °F)	± 0.95 °C (± 1.71 °F)	± 0.05 %
DIN 43710	Type L (Fe-CuNi)	-200 ... 900 °C (-328 ... 1652 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
	Type U (Cu-CuNi)	-200 ... 600 °C (-328 ... 1112 °F)	50 °C (90 °F)	± 0.35 °C (± 0.63 °F)	± 0.05 %
ASTM E-988	Type C	-0 ... 2315 °C (32 ... 4200 °F)	100 °C (180 °F)	± 1.35 °C (± 2.43 °F)	± 0.05 %
	Type D	-0 ... 2315 °C (32 ... 4200 °F)	100 °C (180 °F)	± 1.35 °C (± 2.43 °F)	± 0.05 %
	Voltage measurement	-125 ... 125 mV	2 mV	± 12 µV	± 0.05 %
	Voltage measurement	-125 ... 1100 mV	20 mV	± 120 µV	± 0.05 %

Long-term drift

± 0.05 °C (± 0.09 °F) or ± 0.05 % [1] per year. the larger value applies.

1) Percentages refer to the configured measuring span. omitted for PROFIBUS and FOUNDATION Fieldbus
2) Standard model
3) Include the internal reference point error for digital measuring accuracy: Pt1000. IEC 60751 Cl. B
4) Without reference point error

14.5 Operating influences

The percentages refer to the configured measuring span.

Supply voltage influence / load influence: within the specified limits for the voltage / load. the total influence is less than 0.001 % per volt

Common-mode interference: No influence up to 100 V_{eff} (50 Hz) or 50 VDC

Ambient temperature influence: based on 23 °C (73.4 °F) for ambient temperature range -40 ... 85 °C (-40 ... 185 °F) [4)]

Sensor	**Ambient temperature influence for 1 °C (1.8 °F) deviation to 23 °C (73.4 °F) for digital measurement**	**Ambient temperature influence [1) 2)] for 1 °C (1.8 °F) deviation to 23 °C (73.4 °F) for D/A converter**
Resistance thermometers for two-. three-. four-wire circuits		
Pt10 IEC. JIS. MIL	± 0.04 °C (± 0.072 °F)	± 0.003 %
Pt50 IEC. JIS. MIL	± 0.008 °C (± 0.014 °F)	± 0.003 %
Pt100 IEC. JIS. MIL	± 0.004 °C (± 0.007 °F)	± 0.003 %
Pt200 IEC. MIL	± 0.02 °C (± 0.036 °F)	± 0.003 %
Pt1000 IEC. MIL	± 0.004 °C (± 0.007 °F)	± 0.003 %
Ni50 DIN 43760	± 0.008 °C (± 0.014 °F)	± 0.003 %
Ni100 DIN 43760	± 0.004 °C (± 0.007 °F)	± 0.003 %
Ni120 DIN 43760	± 0.003 °C (± 0.005 °F)	± 0.003 %
Ni1000 DIN 43760	± 0.004 °C (± 0.007 °F)	± 0.003 %
Resistance measurement		
0 ... 500 Ω	± 0.002 Ω	± 0.003 %
0 ... 5000 Ω	± 0.02 Ω	± 0.003 %
Thermocouple. for all defined types	± [(0.001 % x (ME[mV] / MS[mv]) + (100 % x (0.009 °C / MS [°C])] 3)	± 0.003 %
Voltage measurement		
-125 ... 125 mV	± 1.5 µV	± 0.003 %
-125 ... 1100 mV	± 15 µV	± 0.003 %

1) percentages refer to the configured measuring span of the analog output signal
2) effect on DA converter
3) ME = measuring end. MS = measuring span
4) In the case of the option to expand the ambient temperature range up to -50 °C (-58 °F), the causal variables are doubled in the range between -50 ... -40 °C (-58 ... -40 °F)

When calculating the influence of the ambient temperature. ME and MS correspond to the measuring ranges of the sensor. as defined by the relevant standard.

15 Type B LCD HMI

Type B LCD with configuration function using keys.

CE Marking

The HMI type B LCD meets all requirements as regards the CE Marking in accordance with IEC 61326 (2006).

15.1 Features

Transmitter-controlled graphic (alphanumeric) LCD display

Character height, mode-dependent
Sign, 4 digits, 2 decimal places
Bar graph display
Rotatable in 4 increments of 90°

Displayoption

Sensor 1 process data
Sensor 2 process data
Sensor 1 electrical (ohm / mV)
Sensor 2 electrical (ohm / mV)
Electronics/ambient temperature
Output value
Output %

Display diagnostic information related to transmitter and sensor status

15.2 Specifications

Temperature range

-20 … 70 °C (-4 … 158 °F)
Restricted display function (contrast, reaction time) in the temperature ranges:
-50 … -20 °C (-58 … -4 °F) [1)]
or
70 … 85 °C (158 … 185 °F)

Humidity

0 … 100%, condensation permitted

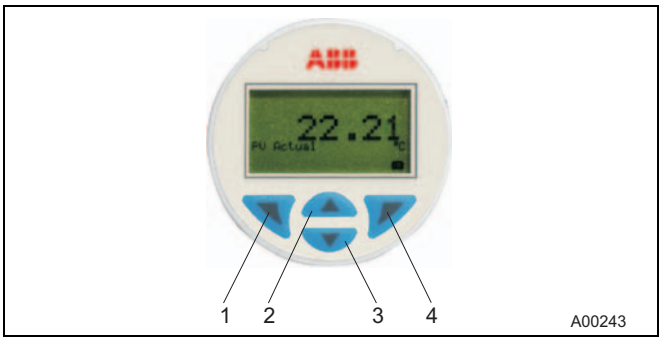


Fig. 28: Type B LCD

1 Exit / Cancel
2 Scroll back
3 Scroll forward
4 Select

1) Additional mechanical protection is required for this range

15.3 Type B LCD configuration function

All parameters configurable

(sensor type, sensor circuit, measuring range, behavior in the event of a fault, etc.)
except: table-based sensor and freestyle characteristics, Callendar van Dusen coefficients, warning and alarm limits

Software write protection for TTF300 configuration

15.4 Ex relevant specifications

15.4.1 Intrinsic Safety ATEX / IECEx

Explosion protection

Approved for use in Zone 0.

Designation

II 1G EEx ia IIC T6

EC type-examination test certificate PTB 05 ATEX 2079 X
IECEx Certificate of Conformity IECEx PTB 09.0014X

15.4.2 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

15.4.3 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

15.4.4 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

15.4.5 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_214 749

15.4.6 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

16 Appendix

16.1 Additional documents

- Commissioning Instruction (CI/TTF300)
- Data Sheet (DS/TTF300)
- SIL-Safety Instructions (SM/TTX3X0_SIL)
- Interface Description HART (COM/TTX300/HART)

16.2 Approvals and certifications

CE mark	CE	The version of the meter in your possession meets the requirements of the following European directives: - EMC directive 2004/108/EC - ATEX directive 94/9/EC
Explosion Protection	Ex IECEx FM APPROVED CSA	Identification for intended use in potentially explosive atmospheres according to: - ATEX directive (marking in addition to CE marking) - 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 Feldgehäuse Temperature Transmitter Fieldhousing**
Modell- / Typebezeichnung: *Model- / type name:*	**TTF300**
Produktnummer: *Product number:*	**TTF300-...**
Konform zu EG-Richtlinien: *Conform to EC-directives:*	**94/9/EG (ATEX)** **2004/108/EG(EMV/EMC)**
EG-Baumusterprüfbescheinigung: *EC-Type examination certificate:*	**PTB 05 ATEX 2017 X** **PTB 05 ATEX 2079 X** **PTB 99 ATEX 1144** **BVS 06 ATEX E 029**
Relevante Normen: *Related Standards:*	**EN 61326-1:2006** **EN 60079-0:2006, EN 60079-11:2007** **EN 61241-0:2006, EN 61241-1:2004** **EN 60079-26:2006**
Qualitätssicherung Produktion Anerkennung: *Production Quality notification:*	**PTB 99 ATEX –Q004-...**

entspricht.
complies.

Alzenau 24 April 2009

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

17 Index

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OI/TTF300-EN Rev. B

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