ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

# TTF300

## Field-mount temperature transmitter


Temperature transmitter for all communications protocols. Redundancy thanks to two inputs.

**Measurement made easy**



## Introduction

The TTF300 is available with the HART, PROFIBUS PA and FOUNDATION Fieldbus communication protocols.

The TTF300 has global approvals for explosion protection up to Zone 0.

Safety-relevant applications up to SIL 3 (redundant) are supported in accordance with IEC 61508.

The TTF300 is approved for custody transfer measurements by MID certificate in accordance with the Measuring Instruments Directive 2014/32/EU.

## Additional Information

Additional documentation on TTF300 is available for download free of charge at www.abb.com/temperature.
Alternatively simply scan this code:

# Table of contents

# 1 Safety

## General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.
The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.
Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed. These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

## Warnings

The warnings in these instructions are structured as follows:

**⚠ DANGER**

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

**⚠ WARNING**

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

**⚠ CAUTION**

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

***NOTICE***

The signal word ***'NOTICE'*** indicates possible material damage.

**Note**
'**Note**' indicates useful or important information about the product.

## Intended use

This device is intended for the following uses:

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

The device has been designed for use exclusively within the technical limit values indicated on the name plate and in the data sheets.

- The maximum ambient temperature must not be exceeded.
- The IP rating of the housing must be observed during operation.
- For use in potentially explosive atmospheres, follow the associated guidelines.
- When using as a SIL-device in safety-relevant applications, the SIL Safety Manual should be observed.

## Improper use

The following are considered to be instances of especially improper use of the device:

- For use as a climbing aid, for example for mounting purposes.
- For use as a bracket for external loads, for example as a support for piping, etc.
- Material application, for example by painting over the housing, name plate or welding/soldering on parts.
- Material removal, for example by spot drilling the housing.

## Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, 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.

## Notes on data safety

This product is designed to be connected to and to communicate information and data via a network interface.
It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).
Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and / or theft of data or information.
ABB Automation Products GmbH and its affiliates are not liable for damages and / or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and / or theft of data or information.

## Manufacturer's address

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# 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## Ex marking

**Note**

- Further information on the approval of devices for use in potentially explosive atmospheres can be found in the explosion protection test certificates (at www.abb.com/temperature).
- Depending on the design, a specific marking in accordance with ATEX or IECEx applies.
- In devices with combined types of protection, for example TTF300-E4, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

### Transmitter

#### ATEX intrinsic safety

The device fulfills the requirements of Directive 2014/34/EU in case of corresponding purchase orders and is approved for use in Zone 0, 1 and 2.

| **Model TTF300-E1H** | |
|---|---|
| Type Examination Test Certificate | PTB 05 ATEX 2017 X |
| II 1 G | Ex ia IIC T6 Ga |
| II 2 (1) G | Ex [ia IIC Ga] ib IIC T6 Gb |
| II 2 G (1D) | Ex [ia IIIC Da] ib IIC T6 Gb |
| **Model TTF300-E1P and TTF300-E1F** | |
| Type Examination Test Certificate | PTB 09 ATEX 2016 X |
| II 1 G | Ex ia IIC T6 Ga |
| II 2 (1) G | Ex [ia IIC Ga] ib IIC T6 Gb |
| II 2 G (1D) | Ex [ia IIIC Da] ib IIC T6 Gb |

#### ATEX non-sparking and dust explosion protection

Approved for use in Zone 2 and 22.

| **Model TTF300-E5** | |
|---|---|
| Declaration of conformity | |
| II 3 G | Ex nA IIC T1-T6 Gc |
| II 3 D | Ex tc IIIB T135°C Dc |

#### ATEX dust explosion protection

Approved for use in Zone 21 and 22.

| **Model TTF300-D5H** | |
|---|---|
| Type Examination Test Certificate | BVS 06 ATEX E 029 |
| II 2D | Ex tb IIIC T135°C Db |
| II 3D | Ex tc IIIC T135°C Dc |

#### ATEX dust explosion protection and intrinsic safety

Approved for zone 21, 22 and Zone 0, 1 and 2.

The 'D6H' coding combines the following types of protection: 'Intrinsic safety' (TTF300-E1H) and 'Dust explosion protection' (TTF300-D5H).
Devices with combined types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

| **Model TTF300-D6H** | |
|---|---|
| Type Examination Test Certificate | BVS 06 ATEX E 029<br>PTB 05 ATEX 2017 X |
| II 2D | Ex tb IIIC T135°C Db |
| II 1G | Ex ia IIC T6 Ga |

#### ATEX flameproof (enclosure)

Approved for use in Zone 1 and 2.

| **Model TTF300-E3** | |
|---|---|
| Type Examination Test Certificate | PTB 99 ATEX 1144 X |
| II 2G | Ex db IIC T6/T4 Gb |

#### ATEX flameproof (enclosure) and intrinsic safety

Approved for use in Zone 0 (intrinsic safety only), 1 and 2.

The 'E4' coding combines the following types of protection: 'Intrinsic safety' (TTF300-E1) and 'Flameproof (enclosure)' (TTF300-E3). Devices with combined types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

| **Model TTF300-E4** | |
|---|---|
| Type Examination Test Certificate | PTB 99 ATEX 1144 X<br>PTB 05 ATEX 2017 X<br>PTB 05 ATEX 2016 X |
| II 2G | Ex db IIC T6/T4 Gb |
| II 1G | Ex ia IIC T6 Ga |

### IECEx intrinsic safety

Approved for use in Zone 0, 1, and 2.

| **Model TTF300-H1H** | |
|---|---|
| IECEx certificate of conformity | IECEx PTB 09.0014X |
| **Model TTF300-H1P and TTF300-H1F** | |
| IECEx certificate of conformity | IECEx PTB 11.0108X |
| Ex ia IIC T6...T1 Ga | |
| Ex [ia IIC Ga] ib IIC T6...T1 Gb | |
| Ex [ia IIIC Da] ib IIC T6...T1 Gb | |

### IECEx dust explosion protection

Approved for use in Zone 21 and 22.

| **Model TTF300-J5H** | |
|---|---|
| IECEx certificate of conformity | IECEx BVS 17.0065X |
| Ex tb IIIC T135°C Db | |
| Ex tc IIIC T135°C Dc | |

### IECEx flameproof (enclosure)

Approved for use in Zone 1 and 2.

| **Model TTF300-H5** | |
|---|---|
| IECEx certificate of conformity | IECEx PTB 12.0039 X |
| Ex db IIC T6/T4 Gb | |

### LCD indicator

### ATEX intrinsic safety

The device fulfills the requirements of Directive 2014/34/EU in case of corresponding purchase orders and is approved for use in Zone 0, 1 and 2.

| Type Examination Test Certificate | PTB 05 ATEX 2079 X |
|---|---|
| II 1G Ex ia IIC T6 Ga | |

### Non-sparking ATEX

The device fulfills the requirements of Directive 2014/34/EU in case of corresponding purchase orders and is approved for use in Zone 2.

| Declaration of conformity |
|---|
| II 3 G Ex nA IIC T1-T6 Gc |

### IECEx intrinsic safety

Approved for use in Zone 0, 1, and 2.

| IECEx certificate of conformity | IECEx PTB 12.0028X |
|---|---|
| Ex ia IIC T6 | |

# … 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## Temperature data

### Transmitter

**ATEX / IECEx intrinsic safety, ATEX non-sparking**

| Temperature class | Permissible ambient temperature range | |
|---|---|---|
| | Device category 1 use | Device category 2 / 3 use |
| T6 | −50 to 44 °C (−58 to 111.2 °F) | −50 to 56 °C (−58 to 132.8 °F) |
| T4 to T1 | −50 to 60 °C (−58 to 140.0 °F) | −50 to 85 °C (−58 to 185.0 °F) |

**ATEX / IECEx Flameproof (Enclosure)**

| Temperature class | Permissible ambient temperature range on the connection head |
|---|---|
| T6 | −40 to 67 °C (−40 to 152 °F) |
| T4 to T1 | −40 to 85 °C (−40 to 185 °F) |

### LCD indicator

**ATEX / IECEx intrinsic safety, ATEX non-sparking**

| Temperature class | Permissible ambient temperature range | |
|---|---|---|
| | Device category 1 use | Device category 2 / 3 use |
| T6 | −40 to 44 °C (−40 to 111.2 °F) | −40 to 56 °C (−40 to 132.8 °F) |
| T4 to T1 | −40 to 60 °C (−40 to 140 °F) | −40 to 85 °C (−40 to 185 °F) |

## Electrical data

### Transmitter

**Intrinsic safety type of protection Ex ia IIC (Part 1)**

| Supply circuit | | | |
|---|---|---|---|
| | TTF300-E1H TTF300-H1H | TTF300-E1P / -H1P TTF300-E1F / -H1F | |
| | | FISCO* | ENTITY |
| Max. voltage | $U_i$ = 30 V | $U_i$ ≤ 17.5 V | $U_i$ ≤ 24.0 V |
| Short-circuit current | $I_i$ = 130 mA | $I_i$ ≤ 183 mA** | $I_i$ ≤ 250 mA |
| Max. power | $P_i$ = 0.8 W | $P_i$ ≤ 2.56 W** | $P_i$ ≤ 1.2 W |
| Internal inductance | $L_i$ = 0.5 mH | $L_i$ ≤ 10 µH | $L_i$ ≤ 10 µH |
| Internal capacitance | $C_i$ = 0.57 nF*** | $C_i$ ≤ 5 nF | $C_i$ ≤ 5 nF |

* FISCO in accordance with 60079-27

** II B FISCO: $I_i$ ≤ 380 mA, $P_i$ ≤ 5.32 W

*** Only applies for HART variants. From HW Rev. 1.07, previously 5 nF

**Intrinsic safety type of protection Ex ia IIC (Part 2)**

| Measurement current circuit | | |
|---|---|---|
| | Resistance thermometers, resistors | Thermocouples, voltages |
| Max. voltage | $U_o$ = 6.5 V | $U_o$ = 1.2 V |
| Short-circuit current | $I_o$ = 25 mA | $I_o$ = 50 mA |
| Max. power | $P_o$ = 38 mW | $P_o$ = 60 mW |
| Internal inductance | $L_i$ = 0 mH | $L_i$ = 0 mH |
| Internal capacitance | $C_i$ = 49 nF | $C_i$ = 49 nF |
| Maximum permissible external inductance | $L_o$ = 5 mH | $L_o$ = 5 mH |
| Maximum permissible external capacitance | $C_o$ = 1.55 µF | $C_o$ = 1.05 µF |

**Intrinsic safety type of protection Ex ia IIC (Part 3)**

| LCD indicator interface | |
|---|---|
| Max. voltage | $U_o$ = 6.2 V |
| Short-circuit current | $I_o$ = 65.2 mA |
| Max. power | $P_o$ = 101 mW |
| Internal inductance | $L_i$ = 0 mH |
| Internal capacitance | $C_i$ = 0 nF |
| Maximum permissible external inductance | $L_o$ = 5 mH |
| Maximum permissible external capacitance | $C_o$ = 1.4 µF |

### Type of protection flameproof (enclosure) Ex db IIC

| **Supply circuit** | |
|---|---|
| Maximum voltage | $U_S$ = 30 V |
| Maximum current | $I_s$ = 32 mA, limited by the upstream fuse (rated fuse current 32 mA) |

| **Measurement current circuit** | |
|---|---|
| Maximum voltage | $U_O$ = 6.5 V |
| Maximum current | $I_O$ = 17.8 mA |
| Maximum power | $P_O$ = 39 mW |

### Dust explosion protection type of protection Ex tb IIIC T135°C Db, Ex tc IIIC T135°C Dc

#### Non-intrinsically safe power supply

| **Supply circuit** | |
|---|---|
| Maximum voltage | $U_S$ = 30 V |
| Maximum current | $I_s$ = 32 mA, limited by the upstream fuse (rated fuse current 32 mA) |

| **Measurement current circuit** | |
|---|---|
| Maximum permissible power dissipation in the measuring inset (sensor) | $P_i$ = 0.5 W |

#### Intrinsically safe power supply

If in the dust explosion protection type of protection, the transmitter is supplied with power from a power supply unit which is designed as intrinsically safe in the ‘Ex ia’ or ‘Ex ib’ type of protection, a limitation of the power supply circuit by an upstream fuse is not required.

In this case, the electric data of the transmitter for the intrinsic safety type of protection Ex ia IIC (Part 1) for TTF300-E1H and TTF300-H1H, Ex ia IIC (Part 2) as well Ex ia IIC (Part 3) should be complied with.
Refer to **Transmitter** on page 8.

### LCD indicator
### Intrinsic safety type of protection Ex ia IIC

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

# … 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## Installation instructions

**ATEX / IECEx**

The installation, commissioning, maintenance and repair of devices in potentially explosive atmospheres must only be carried out by appropriately trained personnel. Works may be carried out only by persons, whose training has included instructions on different types of protection and installation techniques, concerned rules and regulations as well as general principles of zoning. The person must possess the appropriate competences for the type of work to be conducted.
When operating with combustible dusts, comply with EN 60079-31.
The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas).
Comply with the applicable regulations for the protection of employees to ensure safe operation.

**Cable entries**

**Devices with type of protection 'Ex d' without supplied cable glands**

For devices with the 'Ex d – flameproof (enclosure)' type of protection which are supplied without cable glands, observe the instructions in **Flameproof (enclosure) – Zone 1** on page 15.
For information on the cable gland used, refer to the relevant data sheet and operating instructions.

**Devices with type of protection 'Ex d' with cable glands**

If devices in 'Ex d – flameproof (enclosure)' type of protection with cable gland are ordered, an Ex d certified cable gland is factory-installed.

**Cable gland data**

- Thread: 2 × M20 × 1.5 or 2 × ½ in NPT
- Temperature range: −50 to 85 °C (−58 to 185 °F)
- Cable outside diameter: 3.2 to 8.7 mm (0.13 to 0.34 in)
- Material: nickel-plated brass

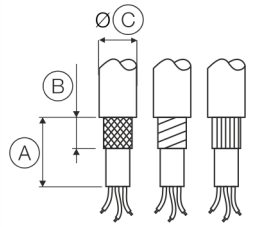
The cable entry is only suitable for fixed installations and non-reinforced cables with round and smooth plastic sleeves and suitable outside diameter. The cables must be attached appropriately in order to prevent them being pulled out or twisted.

The operating instruction and approvals supplied with the cable glands, as well as any applicable requirements in accordance with EN 60079-14 must be taken into account accordingly.

**Installation instructions for cable glands**

The sealing rings of the cable glands harden at low temperatures. Before installation, bring the sealing rings to a temperature of at least 20 °C for 24 hours. Before inserting the sealing rings and fixing them onto the cable gland, knead the rings to ensure they are soft and flexible.

IP rating IP66 / 67 is only achieved by installing the black neoprene sealing ring between the cable gland and the housing and by observing the tightening torque of 3.6 Nm (Figure 2, item (2)).
Cables must be protected against extreme mechanical loads (caused by tension, torsion, crushing, and so on). 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.




(A) 40 mm
(B) 12 mm
(C) Ø 8.5 / 12 mm

**Figure 1: Stripping the connection cable**

1. Check that cable used is suitable (i.e., check the mechanical resilience, temperature range, creep resistance, resistance to chemicals, outside diameter, and so on).
2. Strip the cable in accordance with Figure 1.
3. Check the outer sleeve for damage and soiling.
4. Insert the cable in the cable gland.

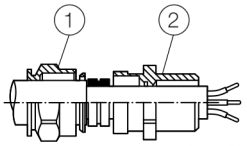



**Figure 2: Tighten cable glands**

5. Tighten the cable gland until the cable is firmly enclosed by the sealing ring (Figure 2, item (1)). Do not tighten more than 1.5--times of the specified torque on the housing (see assembly instructions for cable gland)!

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

**M20 × 1.5 plastic cable gland for various types of protection**
The optionally supplied M20 × 1.5 plastic cable gland has a limited temperature range. The permissible ambient temperature range of the cable gland is −20 to 80 °C (−4 to 176 °F). When using the cable gland, make sure that the ambient temperature is within this range.

The cable gland must be installed in the housing with a tightening torque of 3.8 Nm. On the cable side, when installing the connection of the cable gland and cable, check for integrity to ensure that the required IP rating is met.

## Electrical connections

### Grounding
If, for functional reasons, the intrinsically safe circuit needs to be grounded by means of a connection to the potential equalization, it may only be grounded at one point.

**Intrinsic safety installation check**
If transmitters are operated in an intrinsically safe circuit, proof that the interconnection is intrinsically safe must be provided in accordance with IEC/EN 60079-14 as well as IEC/EN 60079-25. The supply isolators / DCS inputs must feature intrinsically safe input protection circuits in order to eliminate hazards (spark formation).
In order to provide proof of intrinsic safety, the electrical limit value must be used as the basis for the EC-type examination certificates for the equipment (devices); this includes the capacitance and inductance values of the cables.
Proof of intrinsic safety is said to have been provided if the following conditions are fulfilled when a comparison is carried out in relation to the limit values of the equipment:

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

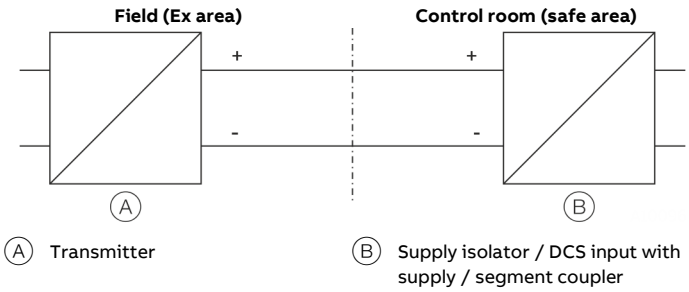



**Figure 3: Intrinsic safety installation check**

**Installation in a potentially explosive atmosphere**
Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

**Note**
Ex relevant specifications must be taken from the EC-type examination certificates and other relevant certificates that apply in each case.

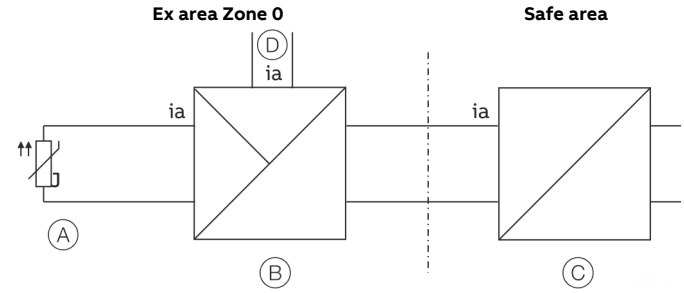
With transmitters for PROFIBUS PA and FOUNDATION Fieldbus H1 applications, FISCO interconnection methods can be used.

# … 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## … Installation instructions

### ATEX – Zone 0

**Designation: II 1 G Ex ia IIC T6 Ga**




Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Supply isolator [Ex ia]
Ⓓ Interface for LCD indicator

**Figure 4: Hookup in ATEX – Zone 0**

The input for the supply isolator must be designed with 'Ex ia' type of protection.
When using the transmitter in Zone 0, make sure that impermissible electrostatic charging of the transmitter is avoided (observe the warnings on the device).
As the user, it is your responsibility to ensure that the sensor instrumentation meets the requirements of applicable explosion protection standards.

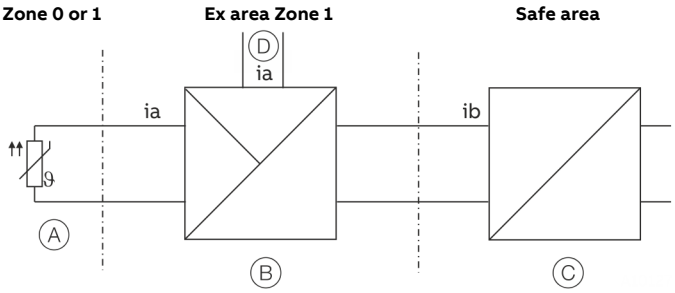
**⚠ WARNING**

**Risk of explosion!**
When using the device in areas which require the 'Ga' equipment protection level - EPL (Zone 0), the TTF300 types should be installed with aluminum housings to protect against mechanical impact loads or friction.

**Note**
When operating the transmitter in Zone 0 (EPL 'Ga'), the compatibility of the device materials with the surrounding atmosphere must be ensured.
Encapsulation material used for the transmitter:
Polyurethane (PUR), WEVO PU-417

### ATEX – Zone 1 (0)

**Marking: II 2 (1) G Ex [ia IIC Ga] ib IIC T6 Gb**




Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Supply isolator [Ex ib]
Ⓓ Interface for LCD indicator

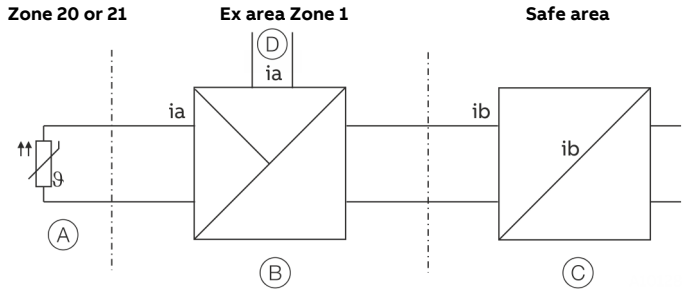
**Figure 5: Hookup in ATEX - Zone 1 (0)**

The input for the supply isolator must be designed with 'Ex ib' type of protection.
As the user, it is your responsibility to ensure that the sensor instrumentation meets the requirements of applicable explosion protection standards. The sensor can be installed in Zone 1 or Zone 0.

When using the transmitter in Zone 1, you must ensure that impermissible electrostatic charging of the temperature transmitter is prevented (observe the warnings on the device).

### ATEX – Zone 1 (20)

**Marking: II 2 G (1D) Ex [ia IIIC Da] ib IIC T6 Gb**




Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Supply isolator [Ex ib]
Ⓓ Interface for LCD indicator

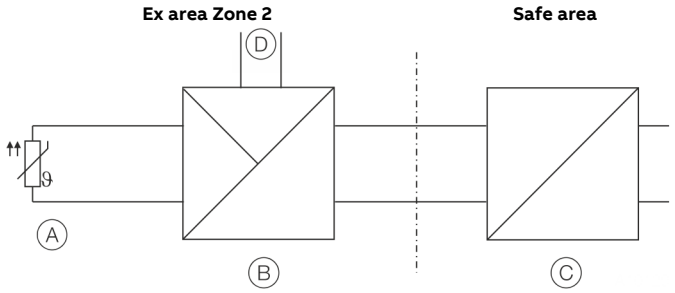
**Figure 6: Hookup in ATEX - Zone 1 (20)**

The input for the supply isolator must be designed with 'Ex ib' type of protection.
As the user, it is your responsibility to ensure that the sensor instrumentation meets the requirements of applicable explosion protection standards. The sensor can be installed in Zone 20 or Zone 21.

When using the transmitter in Zone 1, make sure that impermissible electrostatic charging of the temperature transmitter is avoided (observe the warnings on the device).

### ATEX – Zone 2

**Designation: II 3 G Ex nA IIC T1-T6 Gc**




Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Supply isolator
Ⓓ Interface for LCD indicator

**Figure 7: Hookup in ATEX - Zone 2**

When using the transmitter in Zone 2, observe the following:

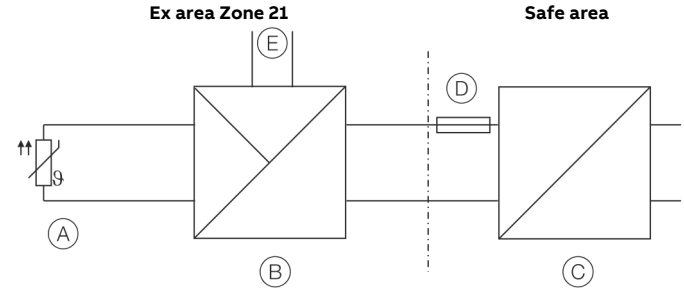
- The temperature transmitter must be installed in accordance with IP rating IP 54 (in accordance with EN 60529). Suitable cable glands must be used for this purpose.
- External measures must be made for the power supply circuit in order to prevent the rated voltage from being up-scaled by more than 40 % in the event of transient disturbances.
- The electrical connections must only be opened or closed when there is no hazardous atmosphere.
- The temperature transmitter must be integrated into the potential equalization of the system.

# … 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## … Installation instructions

**Dust explosion protection – Zone 21**

**Marking:**
**II 2D Ex tb IIIC T135°C Db**
**II 3D Ex tc IIIC T135°C Dc**



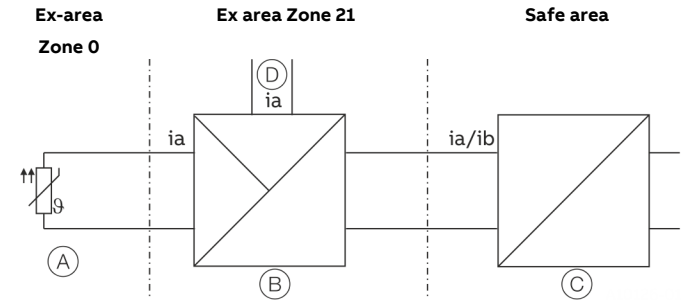

Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Supply isolator with voltage limit (30 V)
Ⓓ Fuse, 32 mA
Ⓔ Interface for LCD indicator

**Figure 8: Hookup in Zone 21 (dust explosion protection)**

The power supply circuit of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA. This is not required if the power supply unit is designed as intrinsically safe with a 'Ex ia / Ex ib' type of protection.
Maximum input terminal voltage of the transmitter: 30 V DC
The maximum permissible power dissipation in the measuring inset (sensor) is $P_i$ = 0.5 W.

**Dust explosion protection – Zone 0/21**

**Housing design: ATEX II 2D Ex tb IIIC T135°C Db**
**Transmitter design: ATEX II 1G Ex ia IIC T6 Ga**



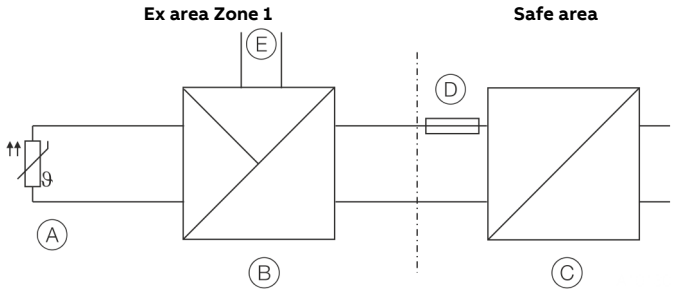

Ⓐ Sensor
Ⓑ TTF300 transmitter
Ⓒ Intrinsically safe supply isolator in 'Ex ia' or 'Ex ib' type of protection
Ⓓ Interface for LCD indicator

**Figure 9: Hookup in Zone 0/21 (dust explosion protection)**

When using the sensor in Zone 0 and the transmitter in Zone 21, the transmitter must comply with Category 2D, while the sensor circuit must be designed in the 'Ex ia' type of protection and the supply circuit and power supply unit in the 'Ex ia' or 'Ex ib' type of protection.

**Flameproof (enclosure) – Zone 1**

**Housing design: ATEX II 2G Ex db IIC T6/T4 Gb**




(A) Sensor
(B) Transmitter in Ex d-housing
(C) Supply isolator with voltage limit (30 V)
(D) Fuse, 32 mA
(E) Interface for LCD indicator

**Figure 10: Hookup in Zone 1 'flameproof (enclosure)' type of protection**

The power supply circuit of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
Maximum input terminal voltage of the transmitter: 30 V DC
The 'flameproof enclosure' type of protection is only achieved by correctly installing a specially certified cable gland with the Ex d type of protection with the corresponding marking.
The sensor instrumentation must be provided by the user in accordance with the valid Ex-standards.
As far as the installation and mounting of components is concerned (explosion-proof cable entries, connection parts), only those components are approved which at the least technically comply with the current version of the PTB 99 ATEX 1144 X type examination certificate and for which a separate examination certificate exists. At the same time, it is imperative that the operating conditions listed in the respective component certificates are complied with.

The transmitter must be connected using suitable cable and cable entries or pipeline systems that satisfy the requirements of EN 60079-1 and for which a separate examination certificate exists. If the transmitter is connected to pipeline systems, the relevant sealing device must be affixed directly to the housing.
Cable entries (PG glands) and sealing plugs of simple design must not be used.
Close unused cable entry in accordance with EN 60079.-1.
The connection lead must be routed securely and in such a way as to ensure adequate protection against damage.
If the temperature on the entry parts is over 70° C, connection leads with sufficient temperature resistance must be used.
The transmitter must be integrated into the local potential equalization of the potentially explosive area.

# … 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

## Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

## Operating instructions

**⚠ DANGER**

**Risk of explosion due to hot parts**

Hot parts inside the device pose an explosion hazard.

- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

**⚠ DANGER**

**Explosion hazard when opening the device**

Explosion hazard when opening the device with activated power supply.

- Before opening the device, switch off the power supply.

**Damage to the 'Flameproof (enclosure)– Ex d' type of protection**

The cover thread is used as a flameproof joint for the 'Flameproof (enclosure) – Ex d' type of protection.

- During assembly / disassembly of the device, make sure that the cover thread does not get damaged.
- Devices with damaged threads must no longer be used in potentially explosive atmospheres.

**Protection against electrostatic discharges**

The painted surface of the housing and the plastic parts inside the device can store electrostatic charges.

**⚠ WARNING**

**Risk of explosion!**

The device must not be used in areas in which process-related electrostatic charging of the housing may occur.

- The device must be maintained and cleaned so that any dangerous electrostatic charge is avoided.

## Repair

**⚠ DANGER**

**Explosion hazard**

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

# 3 Use in potentially explosive atmospheres in accordance with FM and CSA

**Note**

- Further information on the approval of devices for use in potentially explosive atmospheres can be found in the explosion protection test certificates (at www.abb.com/temperature).
- Depending on the design, a specific marking in accordance with FM or CSA applies.

## Ex marking

### Transmitter

#### FM Intrinsically Safe

| | |
|---|---|
| **Model TTF300-L1H** | |
| Control Drawing | SAP_214832 |
| **Model TTF300-L1P** | |
| Control Drawing | TTF300-L1..P (IS) |
| **Model TTF300-L1F** | |
| Control Drawing | TTF300-L1..F (IS) |
| Class I, Div. 1 + 2, Groups A, B, C, D | |
| Class I, Zone 0, AEx ia IIC | |

#### FM Non-Incendive

| | |
|---|---|
| **Model TTF300-L2H** | |
| Control Drawing | SAP_214830 (NI_PS) |
| | SAP_214828 (NI_AA) |
| **Model TTF300-L2P** | |
| Control Drawing | TTF300-L2..P (NI_PS) |
| | TTF300-L2..P (NI_AA) |
| **Model TTF300-L2F** | |
| Control Drawing | TTF300-L2..F (NI_PS) |
| | TTF300-L2..F (NI_AA) |
| Class I, Div. 2, Groups A, B, C, D | |
| Class I Zone 2 Group IIC T6 | |

#### FM Explosion proof

| |
|---|
| **Model TTF300-L3** |
| XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed |

#### CSA Intrinsically Safe

| | |
|---|---|
| **Model TTF300-R1H** | |
| Control Drawing | SAP_214825 |
| **Model TTF300-R1P** | |
| Control Drawing | TTF300-R1..P (IS) |
| **Model TTF300-R1F** | |
| Control Drawing | TTF300-R1..F (IS) |
| Class I, Div. 1 + 2, Groups A, B, C, D | |
| Class I, Zone 0, Ex ia IIC | |

#### CSA Non-Incendive

| | |
|---|---|
| **Model TTF300-R2H** | |
| Control Drawing | SAP_214827 (NI_PS) |
| | SAP_214895 (NI_AA) |
| **Model TTF300-R2P** | |
| Control Drawing | TTF300-R2..P (NI_PS) |
| | TTF300-R2..P (NI_AA) |
| **Model TTF300-R2F** | |
| Control Drawing | TTF300-R2..F (NI_PS) |
| | TTF300-R2..F (NI_AA) |
| Class I, Div. 2, Groups A, B, C, D | |

#### CSA Explosion proof

| |
|---|
| **Model TTF300-R3** |
| XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed |

#### CSA Explosion Proof and Intrinsically Safe

| | |
|---|---|
| **Model TTF300-R7H (R1H + R3H)** | |
| Control Drawing | SAP_214825 |
| **Model TTF300-R7P (R1P + R3P)** | |
| Control Drawing | TTF300-R1..P (IS) |
| **Model TTF300-R7F (R1F + R3F)** | |
| Control Drawing | TTF300-R1..F (IS) |
| XP,NI, DIP Class I, II, III, Div. 1 + 2, Groups A-G, factory sealed | |
| Class I, Div. 1 + 2, Groups A, B, C, D | |
| Class I, Zone 0, Ex ia Group IIC T6 | |

# … 3 Use in potentially explosive atmospheres in accordance with FM and CSA

## … Ex marking

### LCD indicator

**FM Intrinsically Safe**

| Control Drawing | SAP_214 748 |
|---|---|
| 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* | |
| $U_i$ / $V_{max}$ = 9 V, $I_i$ / $I_{max}$ < 65.2 mA, $P_i$ = 101 mW, $C_i$ = 0.4 µF, $L_i$ = 0 | |

**FM Non-Incendive**

| Control Drawing | SAP_214 751 |
|---|---|
| N.I. Class I Div 2, Group: A, B, C, D oder Ex nL IIC T**, Class I Zone 2 | |
| $U_i$ / $V_{max}$ = 9 V, $I_i$ / $I_{max}$ < 65.2 mA, $P_i$ = 101 mW, $C_i$ = 0.4 µF, $L_i$ = 0 | |

**CSA Intrinsically Safe**

| Control Drawing | SAP_214 749 |
|---|---|
| I.S. Class I Div 1 and Div 2; Group: A, B, C, D or | |
| I.S Zone 0 Ex ia IIC T* | |
| $U_i$ / $V_{max}$ = 9 V, $I_i$ / $I_{max}$ < 65.2 mA, $P_i$ = 101 mW, $C_i$ < 0.4 µF, $L_i$ = 0 | |

**CSA Non-Incendive**

| Control Drawing | SAP_214 750 |
|---|---|
| N.I. Class I Div 2, Group: A, B, C, D oder Ex nL IIC T**, Class I Zone 2 | |
| $U_i$ / $V_{max}$ = 9 V, $I_i$ / $I_{max}$ < 65.2 mA, $P_i$ = 101 mW, $C_i$ < 0.4 µF, $L_i$ = 0 | |

* Temp. Ident: T6 $T_{amb}$ 56 °C, T4 $T_{amb}$ 85 °C

** Temp. Ident: T6 $T_{amb}$ 60 °C, T4 $T_{amb}$ 85 °C

## Installation instructions

### FM / CSA

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.
The operator must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices. (e. g. NEC, CEC).

**M20 × 1.5 plastic cable gland for various types of protection**

The optionally supplied M20 × 1.5 plastic cable gland has a limited temperature range. The permissible ambient temperature range of the cable gland is −20 to 80 °C (−4 to 176 °F). When using the cable gland, make sure that the ambient temperature is within this range.

The cable gland must be installed in the housing with a tightening torque of 3.8 Nm. On the cable side, when installing the connection of the cable gland and cable, check for integrity to ensure that the required IP rating is met.

### Electrical connections

**Grounding**

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

**Intrinsic safety installation check**

If transmitters are operated in an intrinsically safe circuit, proof that the interconnection is intrinsically safe must be provided in accordance with IEC/EN 60079-14 as well as IEC/EN 60079-25. The supply isolators / DCS inputs must feature intrinsically safe input protection circuits in order to eliminate hazards (spark formation).
In order to provide proof of intrinsic safety, the electrical limit value must be used as the basis for the EC-type examination certificates for the equipment (devices); this includes the capacitance and inductance values of the cables.

**Note**

When operating the transmitter in Zone 0, the compatibility of the device materials with the surrounding atmosphere must be guaranteed.
Encapsulation material used for the transmitter:
Polyurethane (PUR), WEVO PU-417

Proof of intrinsic safety is said to have been provided if the following conditions are fulfilled when a comparison is carried out in relation to the limit values of the equipment:

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

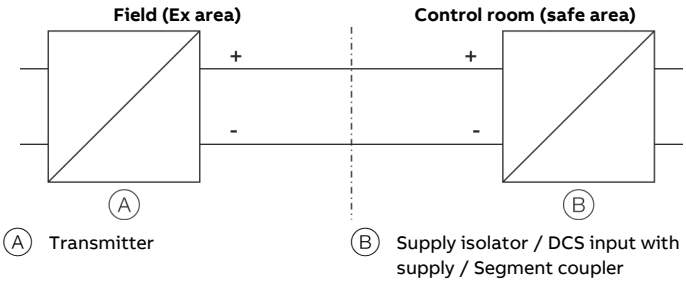



**Figure 11: Intrinsic safety installation check**

**Installation in a potentially explosive atmosphere**
Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

**Note**
Ex relevant specifications must be taken from the EC-type examination certificates and other relevant certificates that apply in each case.

With transmitters for PROFIBUS PA and FOUNDATION Fieldbus H1 applications, FISCO interconnection methods can be used.

## Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

## Operating instructions

**⚠ DANGER**

**Risk of explosion due to hot parts**
Hot parts inside the device pose an explosion hazard.
- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

**⚠ DANGER**

**Explosion hazard when opening the device**
Explosion hazard when opening the device with activated power supply.
- Before opening the device, switch off the power supply.

**Adverse effect on the 'Explosionproof – XP' type of protection**
The cover thread is used as a flameproof joint for the 'Explosionproof – XP' type of protection.
- During assembly / disassembly of the device, make sure that the cover thread does not get damaged.
- Devices with damaged threads must no longer be used in potentially explosive atmospheres.

**Protection against electrostatic discharges**
The painted surface of the housing and the plastic parts inside the device can store electrostatic charges.

**⚠ WARNING**

**Risk of explosion!**
The device must not be used in areas in which process-related electrostatic charging of the housing may occur.
- The device must be maintained and cleaned so that any dangerous electrostatic charge is avoided.

# … 3 Use in potentially explosive atmospheres in accordance with FM and CSA

## Repair

**⚠ DANGER**

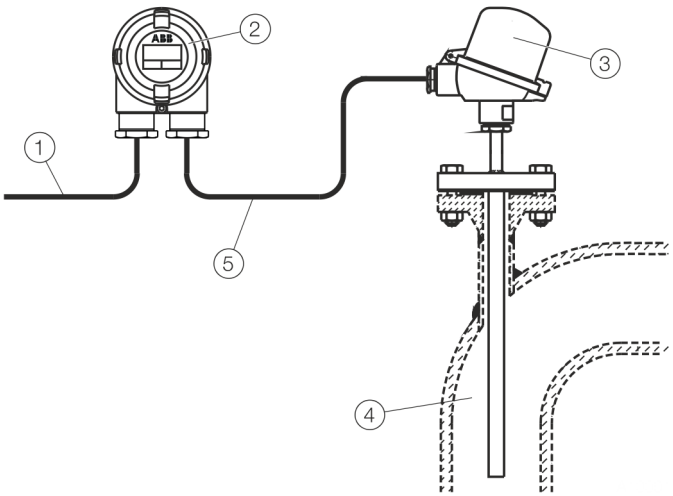
**Explosion hazard**

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

# 4 Design and function

TTF300 digital transmitters are communication-ready devices with microprocessor-controlled electronics.
In the HART® transmitter, an FSK signal is superimposed on the 4 to 20 mA output signal in accordance with the HART standard to facilitate bidirectional communication.
In the PROFIBUS PA transmitter, communication takes place in accordance with PROFIBUS – MBP (IEC 61158-2), PROFIBUS PA Profile 3.01.
With FF transmitters, communication takes place in accordance with FOUNDATION Fieldbus H1 (IEC 61158-2), ITK Version 5.x.
The transmitters can be configured, queried and tested using a DTM, an EDD, the Field Information Manager (FIM) or the optional Type A LCD indicator.




1. Supply voltage cable
2. TTF300 transmitter
3. Temperature sensor
4. Process pipe
5. Sensor connection cable

**Figure 12: Setup**

## Input functionality

**Sensor Redundancy**
To enhance system availability, the TTF300 has two sensor inputs.
The second sensor input can be used redundantly for both resistance thermometers (2 x three-wire circuit or 2 x two-wire circuit) and thermocouples, or for a mixture of the two.

Sensor redundancy (or sensor backup) always involves measuring the temperature of the two sensors and calculating the mean value on the basis of this.
This value is provided at the output of the transmitter. Should a sensor fail, the temperature measurement for the sensor that remains in operation is provided at the output of the transmitter.

A relevant diagnosis notice is available via DTM, EDD, FDI Package (FIM) or on the LCD indicator. The measured value remains available and maintenance measures can be taken at the same time.

**Sensor drift monitoring**
When two sensors are connected, sensor drift monitoring can be activated via the DTM, EDD or FDI Package (FIM) .

The sensor drift monitoring can be activated for the following sensor types:

- 2 × resistance thermometer (RTD), two-wire circuit
- 2 × resistance thermometer (RTD), three-wire circuit
- 2 × resistors (potentiometer), two-wire circuit
- 2 × resistors (potentiometer), three-wire circuit
- 2 × thermocouple
- 2 × voltages
- 1 × resistance thermometer (RTD), two-wire circuit, and 1 × thermocouple
- 1 × resistance thermometer (RTD), three-wire circuit, and 1 × thermocouple
- 1 × resistance thermometer (RTD), four-wire circuit, and 1 × thermocouple

To activate sensor drift monitoring, the transmitter must first be configured for the sensor types referred to above. Following this, the maximum permissible sensor deviation must be configured, e.g., 1 K.

Since sensor response times may differ slightly, it is then necessary to configure a limit time period during which the sensor deviation has to constantly exceed the maximum set.
If the transmitter records a larger sensor deviation during the defined time period, a ‘Maintenance required’ diagnosis information is generated through HART, EDD and DTM in accordance with NE 107. At the same time, diagnostic information is shown on the LCD indicator.

# … 4 Design and function

## … Input functionality

If drift monitoring is used for the same types of sensor (2 × Pt100 or 2 × thermocouple), the mean value calculated from the two sensors is mapped to the transmitter output signal as a process variable in redundancy mode.
If a thermocouple is used for Pt100 drift monitoring, the Pt100 sensor (see **Electrical connections** on page 27) should be connected to channel 1 and the thermocouple to channel 2.
The measured value from channel 1 (Pt100) is mapped to the transmitter output as a process variable.

**Note**
Before configuring the maximum permissible sensor deviation for drift monitoring, sensor adjustment with respect to the sensor channel 1 value must be carried out with the help of, for example. the TTF300 DTM.

**Sensor error adjustment in accordance with Callendar-Van Dusen**
Under normal circumstances, the standard Pt100 characteristic curve is used for resistance thermometer measurement. However, recent advances in technology now mean that maximum measuring accuracy can be achieved where necessary by carrying out individual sensor error adjustment.

Sensor characteristic curves are optimized by using a Pt100 polynomial in accordance with IST-90 / IEC 751, and EN 60150, and by applying A ,B, C, or Callendar-Van Dusen coefficients.

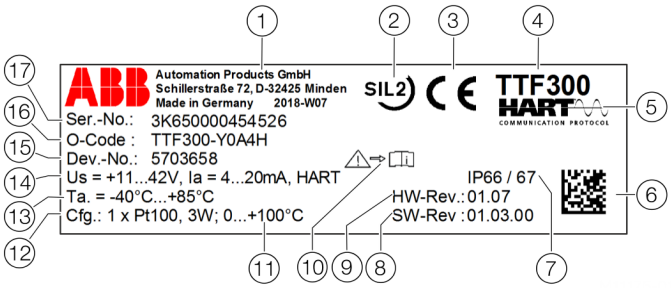
With the help of the DTM, EDD or FDI package (FIM), these sensor coefficients (Callendar-Van Dusen) can be adjusted and stored in the transmitter as a CVDcharacteristic curve. Up to five different CVDcharacteristic curves can be stored for HART and PROFIBUS PA, while up to two CVDcharacteristic curves can be stored for FOUNDATION Fieldbus.

# 5 Product identification

## Name plate

**Note**
The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

**Note**
The ambient temperature range specified on the name plate refers only to the transmitter itself and not to the measuring element used in the measuring inset.
For devices with PROFIBUS PA® or FOUNDATION Fieldbus®, the device IDs are additionally specified.




(1) Manufacturer, manufacturer address, country of manufacture, manufacturing year - week
(2) Safety integrity level, SIL logo (optional)
(3) CE mark (EU conformity), if not on additional plate
(4) Type designation / model
(5) Communication protocol of the transmitter (HART®, FF, PB)
(6) 2D barcode for serial number in accordance with order
(7) IP rating of housing
(8) Software revision
(9) Hardware version
(10) 'Follow product documentation' symbol
**(11) and (12): HART® transmitter customer configuration:**
  (11) Set measuring range of the transmitter
  (12) Set sensor type and circuit type
**(11) and (12): PROFIBUS PA® or FOUNDATION Fieldbus® transmitter customer configuration:**
  Ident_Number or DEVICE_ID
(13) Ambient temperature range, on additional plate for Ex versions
(14) Specification of the transmitter (supply voltage range, output current range, communication protocol)
(15) 7-digit serial number of the device electronic unit
(16) Device type: Coding of type of protection, housing/indicator, cable entry and communication protocol
(complies with the ordering information of the device).
(17) Serial number of the device (serial number in accordance with order)

**Figure 13: HART® name plate (example)**

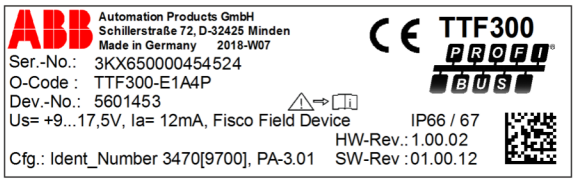



**Figure 14: PROFIBUS PA® name plate (example)**

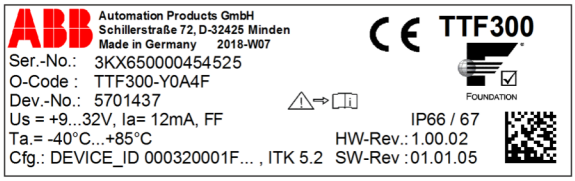


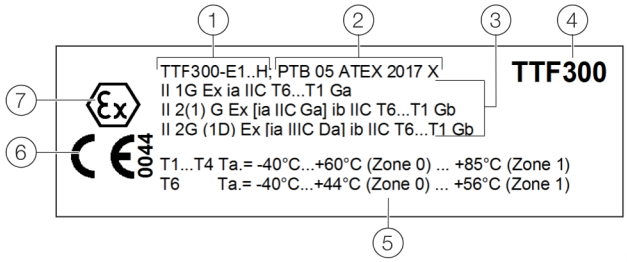

**Figure 15: FOUNDATION Fieldbus® name plate (example)**

## Explosion protection marking for devices with one type of protection

Devices with an explosion-proof design are marked with the following additional plates.

### Note

- Further information on the approval of devices for use in potentially explosive atmospheres can be found in the explosion protection test certificates (at www.abb.com/temperature).
- Depending on the design, a specific marking in accordance with ATEX or IECEx applies.




1. Type designation in accordance with approval
2. Approval number
3. Protection class of the explosion-proof design (explosion protection marking)
4. Type designation
5. Temperature class of the explosion-proof design
6. CE mark (EU conformity) and notified body for quality assurance
7. Ex marking

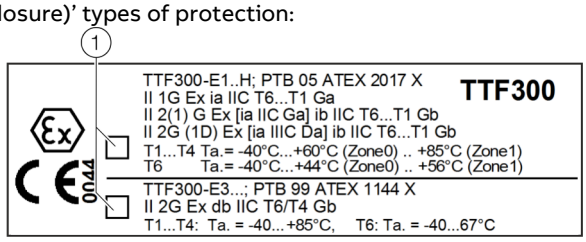
**Figure 16: Additional plate for explosion-protected apparatus (example)**

## Explosion protection marking for devices with a combination of explosion protection types

Coding of the type of protection of the device in accordance with order information can also refer to a combination of different explosion approvals for various types of protection.

The 'intrinsic safety', 'flameproof (enclosure)' and 'dust explosion protection' types of protection can be combined with each other.

The following example shows the explosion protection marking for the combination of the 'intrinsic safety' and 'flameproof (enclosure)' types of protection:




1. Checkboxes for marking type of protection

**Figure 17: Combination of 'Intrinsic safety' and 'Flameproof (enclosure)' types of protection, coding of type of protection: E4.**

## Measures required before the use of devices with combined types of protection

### NOTICE

**Note for temperature transmitters with combined approval**

Before the transmitter is installed, the selected type of protection must be indelibly marked on the explosion protection certification plate.

The transmitter can then only be operated with this degree of protection throughout its entire service life.

- If two protection types are indelibly marked on the explosion protection certification plate, the transmitter must not be used in areas categorized as hazardous.

# … 5 Product identification

## … Name plate

Devices with combined types of protection may only be operated in one of the possible types of protection.
Before commissioning, users must decide on one of these types of protection and their corresponding approval.

- The ‘E4’ coding combines the following types of protection: ‘Intrinsic safety’, type ‘TTF300-E1’ and ‘Flameproof (enclosure)’, type ’TTF300-E3’.
- The ‘D6’ coding combines the following types of protection: ‘Intrinsic safety’, type ‘TTF300-E1’ and ‘Dust explosion protection’, type ’TTF300-D5’.

Additional combinations are generally possible.

Use in explosive hybrid mixtures (where explosive dusts and gases are present simultaneously) is not currently permitted in accordance with EN 60079-0 and EN 61241-0.

The additional plate has two checkboxes (see Figure 17) for marking.
It is absolutely necessary to mark one of the checkboxes on the left side indelibly in accordance with the selected type of protection of the application. This has to be done before the TTF300 is commissioned in the application.

The marking must be applied in a permanent and indelible manner, for example by using a caustic or acidic pencil or by stamping the marking on a metallic plate.

Unmarked devices must **NOT** be commissioned.

# 6 Transport and storage

## Inspection

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

## Transporting the device

Observe the following instructions:

- Do not expose the device to humidity during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, for example, by using air-cushioned packing.

## Storing the device

Bear the following points in mind when storing devices:

- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

**Ambient conditions**
The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.
Adhere to the device data sheet!

## Returning devices

For the return of devices, follow the instructions in **Repair** on page 69.

# 7 Installation

**Note**
When using the device in potentially explosive atmospheres, note the additional data in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 and **Use in potentially explosive atmospheres in accordance with FM and CSA** on page 17!

## Ambient conditions

**Ambient temperature**
- Standard: −40 to 85 °C (−40 to 185 °F)
- Optional: −50 to 85 °C (−58 to 185 °F)
- Limited temperature range during operation with LCD indicator: −20 to 70 °C (−4 to 158 °F)
- Limited temperature range with explosion-proof design: see corresponding certificate
- Limited temperature range with MID certification: see corresponding certificate

**Transport / Storage temperature**
−50 to 85 °C (−58 to 185 °F)

**Climate class in accordance with DIN EN 60654-1**
Cx −40 to 85 °C (−40 to 185 °F) at 5 to 95 % relative air humidity

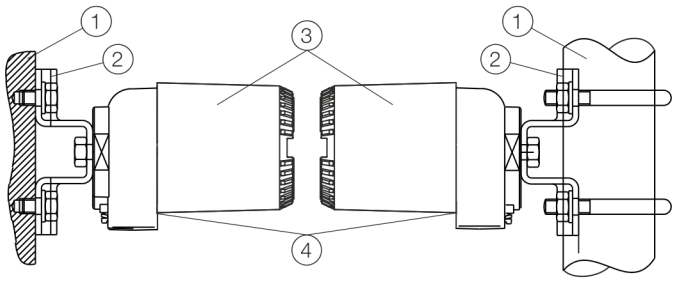
**Max. permissible humidity in accordance with IEC 60068-2-30**
100 % relative air humidity

**Vibration resistance in accordance with IEC 60068-2-6**
10 to 2000 Hz at 5 g, during operation and transport

**Shock resistance in accordance with IEC 68-2-27**
gn = 30, during operation and transport

**IP rating**
IP 66 and IP 67, NEMA 4X, ENCL 4X

## Mounting




1 Wall / Pipe
2 Bracket
3 Transmitter
4 Locking screw

**Figure 18: Installation variants**

**⚠ CAUTION**

**Risk of injury!**
There is a risk of injury if the transmitter falls out due to improper mounting.
- Make sure that transmitter is securely fastened.

**Wall mounting:**
Fasten the wall bracket to the wall using 4 screws (Ø 10 mm)

**Pipe mounting:**
Attach the pipe mount to the pipe using 2 pipe clamps (Ø 10 mm). The pipe mount can be fastened to a pipe with a maximum diameter of 63.5 mm (2.5 in)

# … 7 Installation

## Opening and closing the housing

**⚠ DANGER**

**Danger of explosion if the device is operated with the transmitter housing or terminal box open!**

While using the device in potentially explosive atmospheres before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that no flammable or hazardous atmospheres are present.

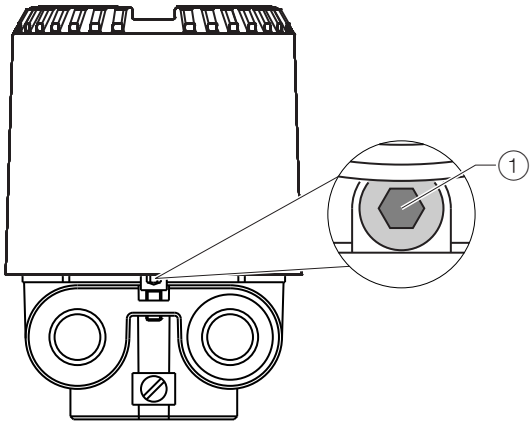



**Figure 19: Cover lock (example)**

To open the housing, release the cover lock by screwing in the Allen screw (1).

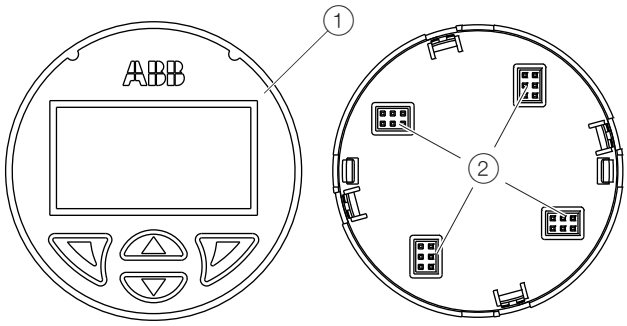
After closing the housing, lock the housing cover by unscrewing the Allen screw (1).

**NOTICE**

**Potential adverse effect on the IP rating**

- Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.
- Check that the O-ring gasket is properly seated when closing the housing cover.

## Rotating the LCD indicator




(1) Front view

(2) Rear view of LCD indicator / plug positions

**Figure 20: Rotating the LCD indicator**

The position of the LCD indicator can be adjusted to suit the mounting position of the transmitter, to ensure that the display is as clearly legible as possible. There are 4 positions at increments of 90°-.

To adjust the position, proceed as follows:

1. Tighten the lock screw under the housing cover.
2. Release the housing cover by turning it counterclockwise.
3. Carefully pull the LCD indicator to release it from its bracket.
4. Carefully insert the LCD indicator in the required position.
5. Screw the housing cover back on.
6. Loosen the lock screw until the housing cover is firmly in place.

**NOTICE**

**Potential adverse effect on the IP rating**

- Check the O-ring gasket for damage and replace it if necessary before closing the housing cover.
- Check that the O-ring gasket is properly seated when closing the housing cover.

# 8 Electrical connections

## Safety instructions

**⚠ DANGER**

**Improper installation and commissioning of the device carries a risk of explosion.**
For use in potentially explosive atmospheres, observe the information in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 and **Use in potentially explosive atmospheres in accordance with FM and CSA** on page 17

Observe the following instructions:

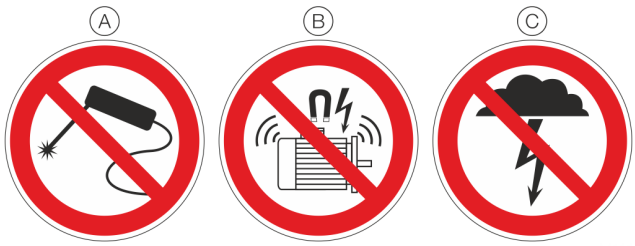
- The electrical connection may only be established by authorized specialist personnel and in accordance with the connection diagrams.
- The relevant regulations must be observed during electric installation.
- The electrical connection information in the instruction must be observed; otherwise, the electric IP rating may be adversely affected.
- Safe isolation of electric circuits which are dangerous if touched is ensured only if the connected devices satisfy the requirements of DIN EN 61140 (VDE 0140 Part 1) (basic requirements for safe isolation).
- To ensure safe isolation, install connection leads separate from electric circuits which are dangerous if touched, or implement additional insulation measures.
- Connections must only be established in a dead-voltage state!
- The transmitter has no switch-off elements. Therefore, overcurrent protective devices, lightning protection, or voltage disconnection options must be provided with the installation.
- The power supply and signal are routed in the same conductor and should be implemented as a SELV or PELV circuit in accordance with the relevant standard (standard version). For the explosion-proof design, the guidelines in accordance with the Ex standard must be adhered to.
- You need to check that the available power supply corresponds to the information on the name plate.

**Note**
The signal cable wires must be provided with wire end sleeves. The slotted screws of the connection terminals are tightened with a size 1 screwdriver (3.5 or 4 mm).

**Protection of the transmitter from damage caused by highly energetic electrical interferences**
The transmitter has no switch-off elements. Therefore, overcurrent protective devices, lightning protection, or voltage disconnection options must be provided at the plant.
For the shielding and grounding of the device and the connection cable, observe **Examples of shielding / grounding** on page 29.

***NOTICE***

**Temperature transmitter damage!**
Overvoltage, overcurrent and high-frequency interference signals on the supply connection as well as sensor connection side of the device can damage the temperature transmitter.




Ⓐ Do not weld
Ⓑ No high-frequency interference signals / switching operations of large consumers
Ⓒ No overvoltage due to lightning

**Figure 21: Warning signs**

Overcurrent and overvoltage can occur through for example welding operations, switching operations of large electric consumers, or lightning in the vicinity of the transmitter, sensor, as well as connector cables.
Temperature transmitters are sensitive devices on the sensor side as well. Long connector cables to the sensor can encourage damaging interference. This can already happen if temperature sensors are connected to the transmitter during installation, but are not yet integrated into the system (no connection to the supply isolator / DCS)!

# … 8 Electrical connections

## … Safety instructions

**Suited protective measures**
The following items should be observed to protect the transmitter from sensor-side damage:

- In the vicinity of the transmitter, sensor and sensor connector cable in case of a connected sensor, high-energy overvoltage, overcurrent and high-frequency interference signals due to welding operations, lightning, circuit breakers or large consumers of electricity among others should be absolutely avoided.
- The connection cable of the sensor on the transmitter should be disconnected when performing welding work in the vicinity of the installed transmitter, sensor, as well as supply lines from the sensor to the transmitter.
- This correspondingly also applies to the supply side, if there is a connection there.

## Conductor material

**Power supply cable**
Maximum cable outer diameter:
12 mm (0.47 in)

Maximum wire cross section:
2.5 $mm^2$ (AWG 16)

## Cable glands

The cable diameter must be appropriate for the cable gland used so that IP rating IP 66 /IP 67 or NEMA 4X can be maintained. This must be checked during installation.
For delivery without cable gland (thread M20 × 1.5 or NPT ½ in), the following points must be observed:

- Use cable glands in accordance with version M20 × 1.5 or NPT ½ in.
- Observe information in the data sheet for the cable gland used.
- Check the working temperature for the cable gland used.
- Check the IP rating IP 66 / IP 67 or NEMA 4X of the cable gland used.
- Check the Ex relevant specifications for the cable gland used in accordance with the manufacturer data sheet or the Ex declaration.
- The cable gland used must be approved for the cable diameter (IP rating).
- Observe tightening torque in accordance with information in data sheet / operating instructions for the cable gland used.

## Shielding of the sensor connecting cable

To ensure the system benefits from optimum electromagnetic interference immunity, the individual system components, and the connection cables in particular, need to be shielded.
The shield must be connected to the ground reference plane.

**Note**
National regulations and directives must be observed when grounding system components.

***NOTICE***

**Damage to components!**
In systems without potential equalization or with potential differences between the individual grounding points, multiple instances of shield grounding can result in transient currents at mains frequency.
These can damage the shielding, influence the measurements and have a significant impact on signal transmission, of bus signals in particular.

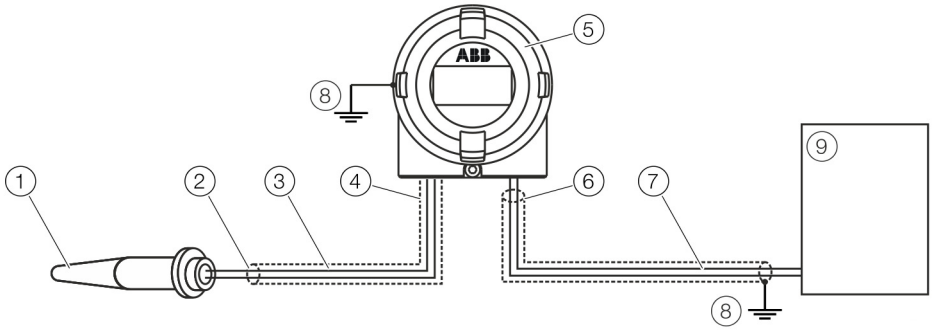
### Examples of shielding / grounding

**Insulated sensor measuring inset (thermocouple, mV, RTD, ohms), transmitter housing grounded**

The shielding of the sensor connection cable is grounded via the grounded transmitter housing. This shielding is insulated from the sensor.

The shielding of the power supply cable is grounded at the supply isolator / DCS input directly This shielding is insulated from the transmitter housing.

The shielding of the power supply cable and the shielding of sensor connection cable must not be connected to one another. Make sure that the shielding is not connected to ground anywhere else.




1. Temperature sensor
2. Shielding insulated from sensor
3. Sensor connection cable
4. Shielding grounded via transmitter housing
5. Transmitter housing, grounded
6. Shielding insulated from transmitter housing
7. Supply voltage cable
8. Grounding point
9. Supply isolator / DCS input

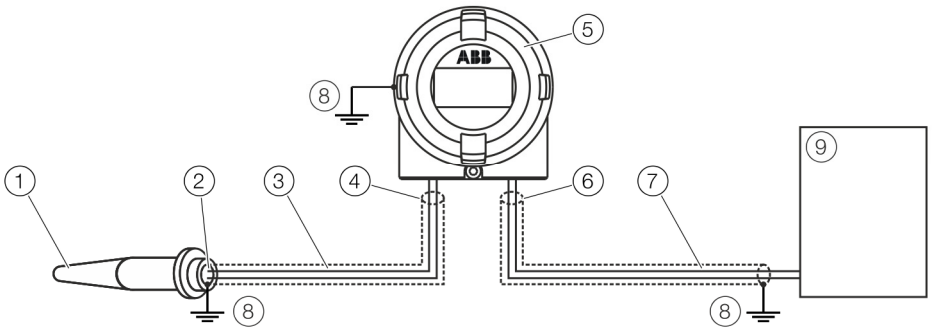
**Figure 22: The shieldings of the sensor connection cable and the supply voltage cable are separate and each grounded at one end**

**Insulated sensor measuring inset (thermocouple, mV, RTD, ohms), transmitter housing grounded**

The shielding of the sensor connection cable is grounded via the grounded sensor housing. This shielding of the power supply cable is insulated from the transmitter housing.

The shielding of the power supply cable is grounded at the supply isolator / DCS input directly This shielding is insulated from the transmitter housing.

The shielding of the power supply cable and the shielding of sensor connection cable must not be connected to one another. Make sure that the shielding is not connected to ground anywhere else.




1. Temperature sensor
2. Shielding grounded via sensor
3. Sensor connection cable
4. Shielding insulated from transmitter housing
5. Transmitter housing, grounded
6. Shielding insulated from transmitter housing
7. Supply voltage cable
8. Grounding point
9. Supply isolator / DCS input

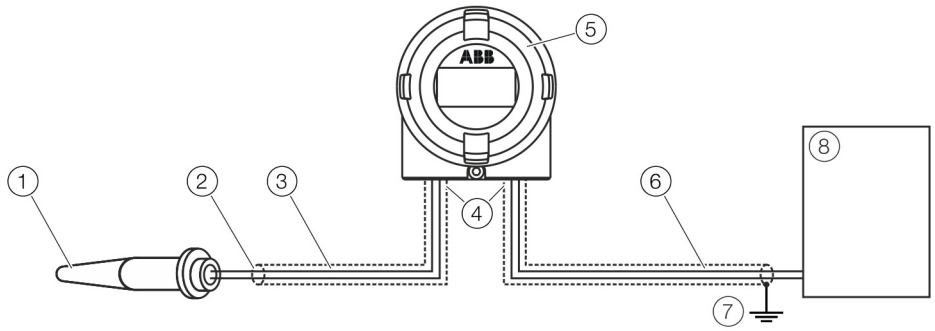
**Figure 23: The shieldings of the sensor connection cable and the supply voltage cable are separate and each grounded at one end**

# … 8 Electrical connections

## … Shielding of the sensor connecting cable

**Insulated sensor measuring inset (thermocouple, mV, RTD, ohms), transmitter housing not grounded**

The shielding of the power supply cable and the shielding of the sensor connection cable are connected to one another via the transmitter housing. The shielding is grounded at one end of the power supply cable, directly at the supply isolator / DCS input. Make sure that the shielding is not connected to ground anywhere else.



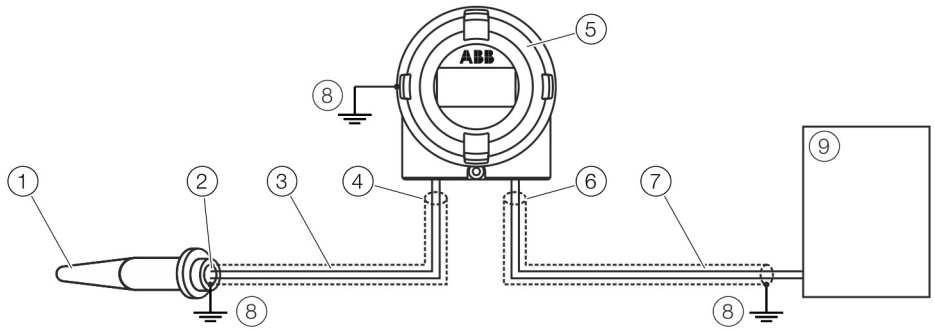

1. Temperature sensor
2. Shielding insulated from sensor
3. Sensor connection cable
4. Shielding connected electrically via transmitter housing
5. Transmitter housing, not grounded
6. Supply voltage cable
7. Grounding point
8. Supply isolator / DCS-input

**Figure 24: The shieldings of the sensor connection cable and the supply voltage cable are connected electrically via the transmitter housing and grounded at one end**

**Non-insulated sensor measuring inset (thermocouple), transmitter housing grounded**

The shielding of the sensor connection cable is grounded via the grounded pressure sensor housing. This shielding of the power supply cable is insulated from the transmitter housing.

The shielding of the power supply cable is grounded at the supply isolator / DCS input directly This shielding is insulated from the transmitter housing. The shielding of the power supply cable and the shielding of the sensor connection cable must not be connected to one another. Make sure that the shielding is not connected to ground anywhere else.

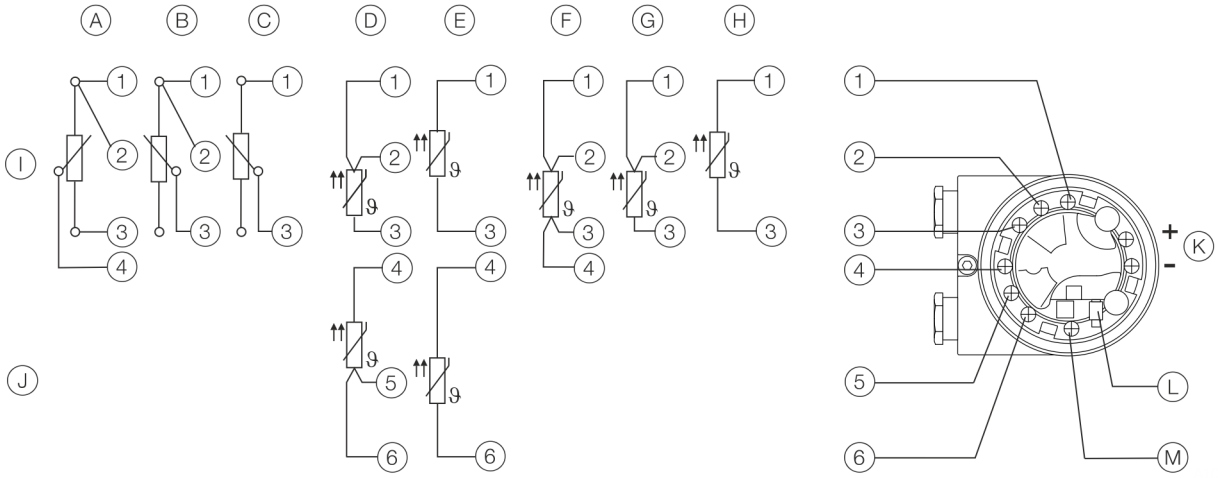



1. Temperature sensor
2. Shielding grounded via sensor
3. Sensor connection cable
4. Shielding insulated from transmitter housing
5. Transmitter housing, grounded
6. Shielding insulated from transmitter housing
7. Supply voltage cable
8. Grounding point
9. Supply isolator / DCS input

**Figure 25: The shieldings of the sensor connection cable and the supply voltage cable are separate and each grounded at one end**

# Pin assignment

### Resistance thermometers (RTD) / resistors (potentiometer)




- (A) Potentiometer, four-wire circuit
- (B) Potentiometer, three-wire circuit
- (C) Potentiometer, two-wire circuit
- (D) 2 x RTD, three-wire circuit*
- (E) 2 x RTD, two-wire circuit*
- (F) RTD, four-wire circuit
- (G) RTD, three-wire circuit
- (H) RTD, two-wire circuit

- (I) Sensor 1
- (J) Sensor 2*
- (K) 4 to 20 mA HART®, PROFIBUS PA®, FOUNDATION Fieldbus®
- (L) Interface for LCD indicator and service
- (M) Ground terminals for shield support for sensors and supply / signal lines
- (1) – (6) Sensor connection (of measuring inset)

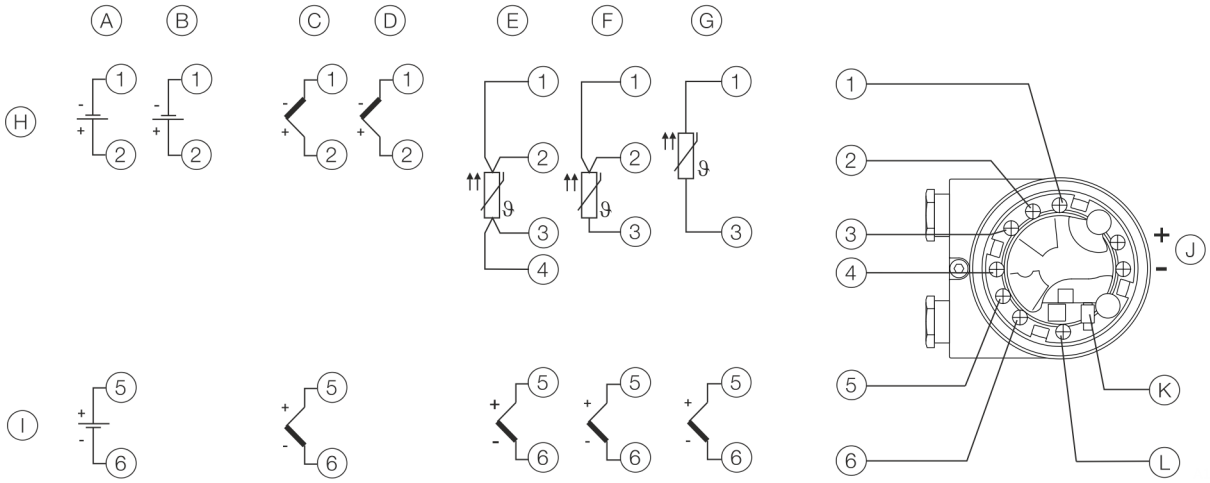
* Sensor backup / sensor redundancy, sensor drift monitoring, mean measurement, or differential measurement

**Figure 26: Terminal assignment resistance thermometer (RTD) / resistors (potentiometer)**

# … 8 Electrical connections

## … Pin assignment

### Thermocouples / voltages and resistance thermometer (RTD) / thermocouple combinations




Ⓐ 2 x voltage measurement*
Ⓑ 1 x voltage measurement
Ⓒ 2 x thermocouple*
Ⓓ 1 x thermocouple
Ⓔ 1 x RTD, four-wire circuit and thermocouple*
Ⓕ 1 x RTD, three-wire circuit and thermocouple*
Ⓖ 1 x RTD, two-wire circuit and thermocouple*

Ⓗ Sensor 1
Ⓘ Sensor 2*
Ⓙ 4 to 20 mA HART®, PROFIBUS PA®, FOUNDATION Fieldbus®
Ⓚ Interface for LCD indicator and service
Ⓛ Ground terminals for shield support for sensors and supply / signal lines
① – ⑥ Sensor connection (of measuring inset)

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

**Figure 27: Terminal assignment thermocouples / voltages and resistance thermometer (RTD) / thermocouple combinations**

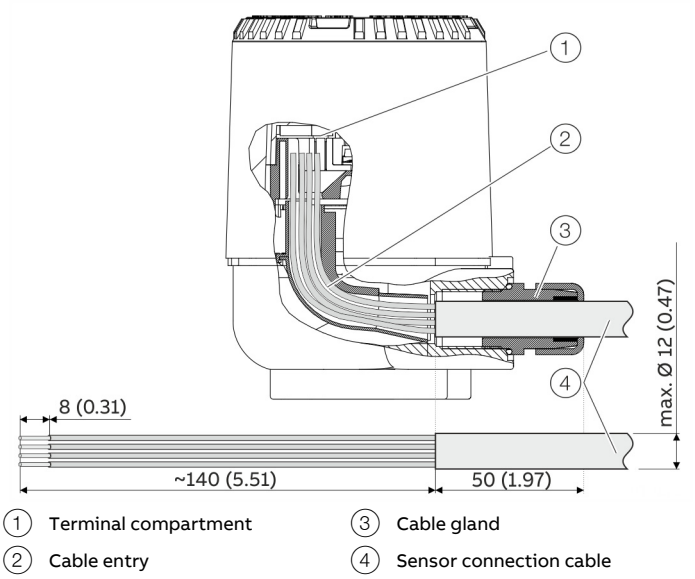
## Terminal for sensor connection cable

**⚠ DANGER**

**Danger of explosion if the device is operated with the transmitter housing or terminal box open!**

While using the device in potentially explosive atmospheres before opening the transmitter housing or the terminal box, note the following points:

- A valid fire permit must be present.
- Make sure that no flammable or hazardous atmospheres are present.




① Terminal compartment
② Cable entry
③ Cable gland
④ Sensor connection cable

**Figure 28: Connection to the transmitter, dimensions in mm (in.)**

1. Tighten the lock screw under the housing cover.
2. Unscrew the housing cover.
3. If available, pull out the LCD indicator carefully
4. Strip the sensor connection cable as shown and attach wire end sleeves.
   A line length of 190 mm should be ensured between the cable gland entry and the terminals. 140 mm should be stripped from the cable jacket along this length.
5. Guide the sensor connection cable through the cable glands and into the housing. Then tighten the cable glands.
6. Connect the wires as per the connection diagram.
7. If there is one, carefully insert the LCD indicator in the previous / required position.
8. Screw the housing cover back on.
9. Loosen the lock screw until the housing cover is firmly in place.

## Electrical data for inputs and outputs

### Input - resistance thermometer / resistances

**Resistance thermometer**

- Pt100 in accordance with IEC 60751, JIS C1604, MIL-T-24388
- Ni in accordance with DIN 43760
- Cu in accordance with recommendation OIML R 84

**Resistance measurement**

- 0 to 500 Ω
- 0 to 5000 Ω

**Sensor connection type**

Two-, three-, four-wire circuit

**Connection lead**

- Maximum sensor line resistance per line 50 Ω in accordance with NE 89
- Three-wire circuit: Symmetrical sensor line resistances
- Two-wire circuit: Compensation up to 100 Ω total lead resistance

**Measurement current**

< 300 µA

**Sensor short circuit**

< 5 Ω (for resistance thermometer)

**Sensor wire break**

- Measuring range: 0 to 500 Ω > 0.6 to 10 kΩ
- Measuring range: 0 to 5 Ω > 5.3 to 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 thermometer: Sensor short circuit and sensor wire break
- Linear resistance measurement: Sensor wire break

# … 8 Electrical connections

## … Electrical data for inputs and outputs

**Input - 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 to 125 mV
- −125 to 1100 mV

**Connection lead**

- Maximum sensor line resistance:
  per 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 to 10 kΩ
- Voltage measurement 5.3 to 10 kΩ

**Input resistance**

> 10 MΩ

**Internal reference junction Pt1000, IEC 60751 Cl. B**

(no additional jumpers necessary)

**Sensor error signaling**

- Thermocouple:
  Sensor wire break
- Linear voltage measurement:
  Sensor wire break

**Functionality input**

**Freestyle characteristic / 32-points-sampling point table**

- Resistance measurement up to a maximum of 5 kΩ
- Voltages up to maximum 1.1 V

**Sensor error adjustment**

- Through Callendar-Van Dusen coefficients
- Through value table, 32 support points
- Through single-point adjustment (offset adjustment)
- Through two-point adjustment

**Input functionality**

- 1 Sensor
- 2 Sensors:
  mean measurement,
  differential measurement,
  sensor redundancy,
  Sensor drift monitoring

**Output – HART®**

**Note**

The HART® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

**Transmission characteristics**

- Temperature linear
- Resistance linear
- Voltage linear

**Output signal**

- Configurable 4 to 20 mA (standard)
- Configurable 20 to 4 mA
  (Dynamic range: 3.8 to 20.5 mA in accordance with NE 43)

**Simulation mode**

3.5 to 23.6 mA

**Induced current consumption**

< 3.5 mA

**Maximum output current**

23.6 mA

**Configurable error current signal**

- Overrange 22 mA (20.0 to 23.6 mA)
- Underrange 3.6 mA (3.5 to 4.0 mA)

### Output – PROFIBUS PA®

**Note**
The PROFIBUS PA® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

**Output signal**
- PROFIBUS – MBP (IEC 61158-2)
- Baud rate 31.25 kBit/s
- PA-Profile 3.01
- FISCO compliant (IEC 60079-27)
- ID-Number: 0x3470 [0x9700]

**Error current signal**
- FDE (Fault Disconnection Electronic)

**Block structure**
- Physical Block
- Transducer Block 1 – Temperature
- Transducer Block 2 – HMI (LCD indicator)
- Transducer Block 3 – enhanced diagnosis
- Analog Input 1 – Primary Value (Calculated Value*)
- Analog Input 2 – SECONDARY VALUE_1 (Sensor 1)
- Analog Input 3 – SECONDARY VALUE_2 (Sensor 2)
- Analog Input 4 – SECONDARY VALUE_3 (reference junction temperature)
- Analog Output – optional HMI display (Transducer Block 2)
- Discrete Input 1 – extended diagnosis 1 (Transducer Block 3)
- Discrete Input 2 – extended diagnosis 2 (Transducer Block 3)

* Sensor 1, Sensor 2 or difference or mean

### Output – FOUNDATION Fieldbus®

**Note**
The FOUNDATION Fieldbus® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

**Output signal**
- FOUNDATION Fieldbus H1 (IEC 611582-2)
- Baud rate 31.25 kBit/s, ITK 5.x
- FISCO compliant (IEC 60079-27)
- Device ID: 000320001F...

**Error current signal**
- FDE (Fault Disconnection Electronic)

**Block structure***
- Resource Block
- Transducer Block 1 – Temperature
- Transducer Block 2 – HMI (LCD indicator)
- Transducer Block 3 – enhanced diagnosis
- Analog Input 1 – PRIMARY_VALUE_1 (Sensor 1)
- Analog Input 2 – PRIMARY_VALUE_2 (Sensor 2)
- Analog Input 3 – PRIMARY_VALUE_3 (Calculated Value**)
- Analog Input 4 – SECONDARY_VALUE (reference junction temperature)
- Analog Output – optional HMI display (Transducer Block 2)
- Discrete Input 1 – extended diagnosis 1 (Transducer Block 3)
- Discrete Input 2 – extended diagnosis 2 (Transducer Block 3)
- PID – PID controller

LAS (Link Active Scheduler) link master functionality

* For the block description, block index, execution times, and block class, refer to the interface description

** Sensor 1, Sensor 2 or difference or mean

# … 8 Electrical connections

## … Electrical data for inputs and outputs

**Power supply**
Two-wire technology, polarity safe; power supply lines = signal lines

**Note**
Following calculations apply for standard applications. This should be taken into consideration when working with a higher maximum current.

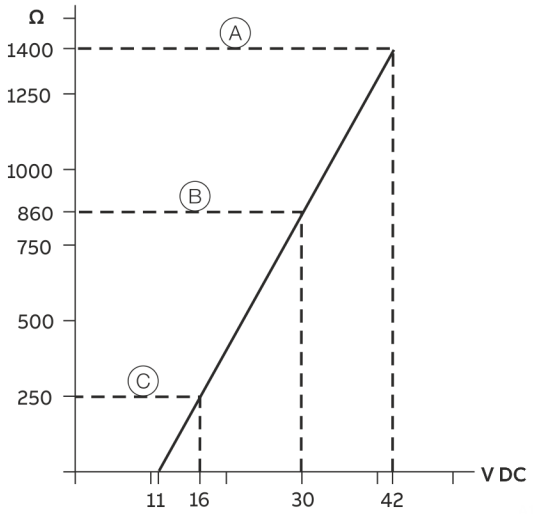
**Power supply – HART®**

**Input terminal voltage**
Non-Ex application:
$U_S$ = 11 to 42 V DC
Ex applications:
$U_S$ = 11 to 30 V DC

**Maximum permissible residual ripple for input terminal voltage**
During communication this is in accordance with the HART FSK 'Physical Layer' specification.

**Undervoltage detection on the transmitter**
If the terminal voltage on the transmitter down-scales a value of 10 V, this may lead to an output current of $I_a \leq 3.6$ mA.

**Maximum load**
$R_B$ = (supply voltage−11 V) / 0.022 A

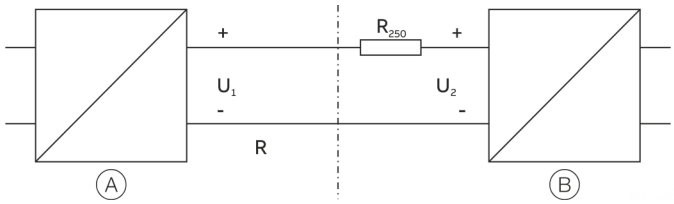



Ⓐ **TTF300**
Ⓑ **TTF300** in Ex-applications
Ⓒ HART communication resistance

**Figure 29: Maximum load depending on input terminal voltage**

**Maximum power**
P = $U_s$ x 0.022 A
E.G. $U_s$ = 24 V → $P_{max}$ = 0.528 W

**Voltage drop on the signal line**
When connecting the devices, note the voltage drop on the signal line. The minimum supply voltage on the transmitter must not be undershot.




Ⓐ Transmitter
Ⓑ Supply isolator / DCS input with supply / segment coupler

**Figure 30: HART load resistance**

$U_{1min}$: Minimum supply voltage on the transmitter
$U_{2min}$: Minimum supply voltage of the supply isolator / DCS input
R: Line resistance between transmitter and supply isolator
$R_{250}$: Resistance (250 Ω) for HART functionality

**Standard application with 4 to 20 mA functionality**
When connecting these components, observe the following condition:
$U_{1min} \leq U_{2min}$ - 22 mA x R

**Standard application with HART functionality**
Adding resistance $R_{250}$ increases the minimum supply voltage $U_{2min}$: $U_{1min} \leq U_{2min}$ - 22 mA × (R + $R_{250}$)

For HART functionality, use supply isolators or DCS input cards with a HART mark. If this is not possible, a resistance of ≥ 250 Ω (< 1100 Ω) must be added to the interconnection.
The signal line can be operated with / without grounding. When establishing a ground connection (minus side), make sure that only one side of the terminal is connected to the equipotential bonding.
Unless the profile HART protocol Rev. 7 is specifically selected during the ordering process, the device normally supports the profile HART protocol Rev. 5 in the delivery status. The user can later change at any time to the HART Protocol Rev. 7 profile via a miniature switch. For additional information, see **Hardware settings** on page 42.

## Power supply – PROFIBUS / FOUNDATION Fieldbus

**Input terminal voltage**
Non-Ex application:
$U_S$ = 9 to 32 V DC
Ex-applications with:
$U_S$ = 9 to 17 V DC (FISCO)
$U_S$ = 9 to 24 V DC (Fieldbus Entity model I.S.)
Current consumption:
≤ 12 mA

**Standard application with PROFIBUS PA and FOUNDATION Fieldbus H1 functionality**
During hookup, the following condition should be complied with:
$U_{1min} \leq U_{2min} - 12\ mA \times R$

# 9 MID Certification

## TTF300 with MID certification

The temperature transmitter TTF300 is certified by an MID Parts Certificate in accordance with the Measuring Instruments Directive 2014/32/EU (MID) and the standard WELMEC 7.2. The device with the appropriate configuration is therefore approved for 'Custody Transfer' measurements (fiscal metering).
The MID certification emphasizes the high accuracy, reliability and durability of the TTF300.

**Note**
This chapter provides basic information on the MID-certified transmitter TTF300. Before commissioning the device, full information should be consulted in the supplied MID documents (Parts Certificate and associated 'Description'). Any generally applicable statements on the transmitter TTF300, especially pertaining to explosion protection and device safety, remain unaffected.

**General**
Devices with MID certification have their own EU declaration of conformity. In addition to the declaration, the 'Parts Certificate' and the associated 'Description' are enclosed with the device.
It is compulsory and imperative that the described areas of application, requirements and restrictions are complied with for the intended use of the device!

The requirements of explosion protection and functional safety (SIL) remain unaffected by the MID certification.

The number of the partial certificate (TC10833) of the notified body NMi Certin B.V. and the checksum (0x46c9) of the certified SW revision 01.03.00 are printed on the name plate of the device.

**Areas of application, conditions and requirements**
The temperature transmitter TTF300 with MID certification for custody transfer measurements is especially suited for measurement and control systems in the oil and gas industry. In addition to gas, any liquids except for water are permitted for measurement.

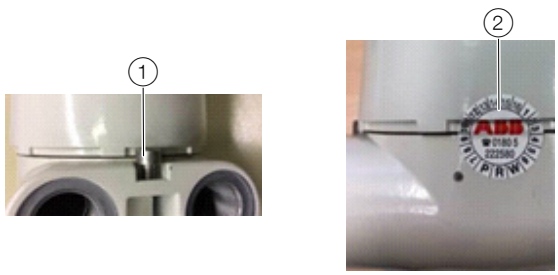
The MID certification refers to a special configuration of the transmitter. This must not be modified! An extract of the conditions and requirements stated in the certificate follows below:

- Communication protocol: HART 5, HART 7
- HW revision: 1.07
- SW revision: 01.03.00 with checksum 0x46c9
- The checksum of the software (firmware) is printed on the name plate of the device
- On sensor Pt100 in a four-wire circuit
- Permissible measuring range: −50 to 150 °C (−58 to 302 °F)
- Ambient temperature range with and without LCD indicator: −10 to 70 °C (14 to 158 °F)

**Note**
The MID certification can generally be combined with all certifications of explosion protection.
The ambient temperature and measuring range named in the corresponding explosion protection certificate, however, limit the ranges permitted in the MID certificate.

**Installation and Operation**
The following should be observed in particular during installation and operation of the device:

- Protection against overwrite:
  Local write protection (DIP switch 1) should be activated after installation and configuration.
- After closing the housing, lock the housing cover by unscrewing the appropriate Allen screw. Afterwards, seal the housing of the device by applying the supplied seal over the gap between the housing cover and housing base.




① Allen screw ② Seal sticker

**Figure 31: TTF300 allen screw and seal (example)**

# 10 Commissioning

## General

In case of corresponding order the transmitter is ready for operation after mounting and installation of the connections. The parameters are set at the factory.

If not exclusively selected while ordering the profile HART 7, the transmitter is delivered present with the profile HART 5. The profile can be always switched to HART 7 via a miniature switch, see **Hardware settings** on page 42.

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

## Checks prior to commissioning

The following points must be checked before commissioning the device:

- Correct wiring in accordance with **Electrical connections** on page 27.
- The ambient conditions must correspond to the information given on the name plate and in the data sheet.

## Communication

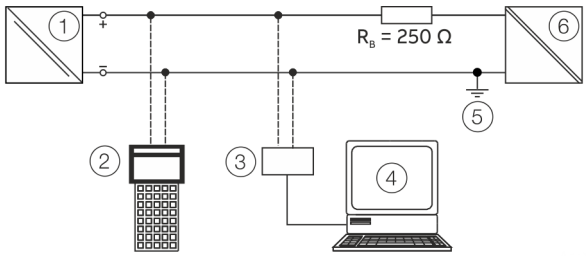
### HART® Communication

**Note**

The HART® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

Communication with the transmitter takes place using the HART protocol. The communication signal is modulated onto both wires of the signal line in accordance with the HART FSK 'Physical Layer' specification.
The HART modem is connected at the signal line of the current output via which power is also supplied via the power supply unit.

The device is listed with the FieldComm Group.




1. Transmitter
2. Handheld terminal
3. HART® modem
4. PC with Asset Management Tool
5. Grounding (optional)
6. Power supply unit (process interface)

$R_B$ load resistance (if necessary)

**Figure 32: Example for HART® connection**

| | |
|---|---|
| Manufacturer ID | 0x1A |
| Device ID | HART 5: 0x000B,<br>HART 7: 0x1A0B |
| Profile | HART 5.1 (can be switched to HART 7) |
| Configuration | On device using LCD indicator<br>DTM, EDD, FDI (FIM) |
| Transmission signal | BELL Standard 202 |

#### Operating modes

- Point-to-point communication mode – standard (general address 0)
- Multidrop mode (addressing 1 to 15)
- Burst Mode

#### Configuration options / tools

Driver-independent:

- HMI LCD indicator with configuration function

Driver-dependent:

- Device management / Asset management tools
- FDT technology – via TTX300-DTM driver (Asset Vision Basic / DAT200)
- EDD – via TTX300 EDD driver (Handheld terminal, Field Information Manager / FIM)
- FDI technology – via TTX300 package (Field Information Manager / FIM)

#### Diagnosis notice

- Overrange- / underrange in accordance with NE 43
- HART diagnosis

# … 10 Commissioning

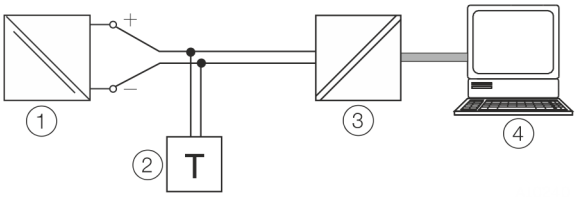
## … Communication

### PROFIBUS® Communication

**Note**

The PROFIBUS PA® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.

The interface complies with Profile 3.01
(Standard PROFIBUS®, EN 50170, DIN 1924 [PRO91]).




① Transmitter
② Bus termination
③ Segment coupler
④ PC / DCS

**Figure 33: Example for PROFIBUS PA® connection**

| | |
|---|---|
| Manufacturer ID | 0x1A |
| ID number | 0x3470 [0x9700] |
| Profile | PA 3.01 |
| Configuration | On device using LCD indicator |
| | DTM |
| | EDD |
| | GSD |
| Transmission signal | IEC 61158-2 |

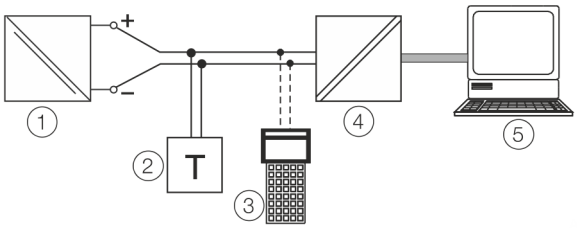
#### Voltage / current consumption

- Mean current consumption: 12 mA.
  In the event of an error, the FDE function (= Fault Disconnection Electronic) integrated in the device makes sure that the current consumption cannot exceed a maximum of 20 mA.

### FOUNDATION Fieldbus® Communication

**Note**

The FOUNDATION Fieldbus® protocol is an unsecured protocol, as such the intended application should be assessed to ensure that these protocols are suitable before implementation.




① Transmitter
② Bus termination
③ Handheld terminal
④ Linking Device
⑤ PC / DCS

**Figure 34: Example for FOUNDATION Fieldbus® connection**

| | |
|---|---|
| Device ID | 000320001F… |
| ITK | 5.x |
| Configuration | On device using LCD indicator |
| | EDD |
| Transmission signal | IEC 61158-2 |

#### Voltage / current consumption

- Mean current consumption: 12 mA.
  In the event of an error, the FDE function (= Fault Disconnection Electronic) integrated in the device makes sure that the current consumption cannot exceed a maximum of 20 mA.

## Basic Setup

**Note**
Transmitter communication and configuration via HART, PROFIBUS PA, and FOUNDATION Fieldbus H1 are described in separate documentation ('Interface description').

The following configuration types are available for the transmitter:

- With DTM:
  Configuration can be performed within an FDT frame application that is approved for use with the DTM.
- With EDD:
  Configuration can be performed within an EDD frame application that is approved for use with the EDD.
- With FDI-Package (FIM):
  Configuration is possible within an FDI frame applications (Field Information Manager / FIM) for which the FDI packages are released.
- With LCD indicator Type A with operating buttons
  Commissioning via the LCD indicator does not require any tools to be connected to the device and is therefore the simplest way of configuring the TTF300.
  The general operation and menus of the LCD indicator are described in **Menu navigation** on page 42.

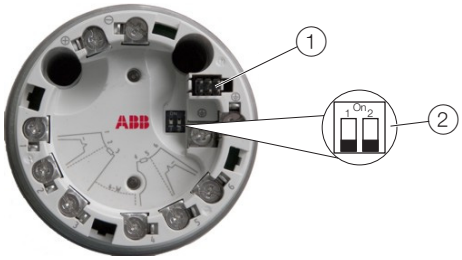
**Note**
Unlike configuration using the DTM, EDD or FDI-Package (FIM) the functionality of the transmitter can only be changed to a limited extent with the LCD indicator.

# 11 Operation

## Safety instructions

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

## Hardware settings




① LCD indicator interface ② DIP switch

**Figure 35: DIP switch on the transmitter**

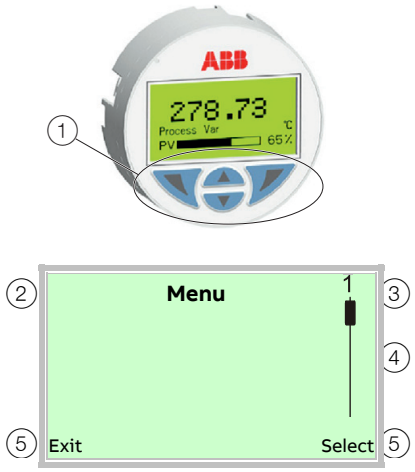
Located on the top of the transmitter next to the LCD indicator interface ① are two DIP switches ②.
Switch 1 activates the hardware write protection.
Switch 2 supports the request of the FOUNDATION Fieldbus for a hardware release for simulation in accordance with ITK.
For transmitters that support HART 7, switch 2 allows the desired HART version to be set (HART 5 or HART 7).

| DIP switch | | Function |
|---|---|---|
| 1 | Local write protection | Off: Local write protection deactivated |
| | | On: Local write protection activated |
| 2 | Release of the simulation | Off: Simulation deactivated |
| | (FOUNDATION Fieldbus only) | On: Simulation activated |
| 2 | HART version | Off: HART 5 |
| | | On: HART 7 |

**Note**

- Factory setting: both switches set to ‘OFF’. Local write protection deactivated and HART 5, unless explicitly ordered HART 7 (HART version) or simulation locked (FOUNDATION Fieldbus).
- In PROFIBUS PA devices, Switch 2 must always be set to the ‘OFF’ position.

## Menu navigation




① Operating buttons for menu navigation
② Indication of menu designation
③ Indication of menu number
④ Marking to indicate relative position within the menu
⑤ Indication of the current function assigned to the operating buttons and

**Figure 36: LCD indicator (example)**

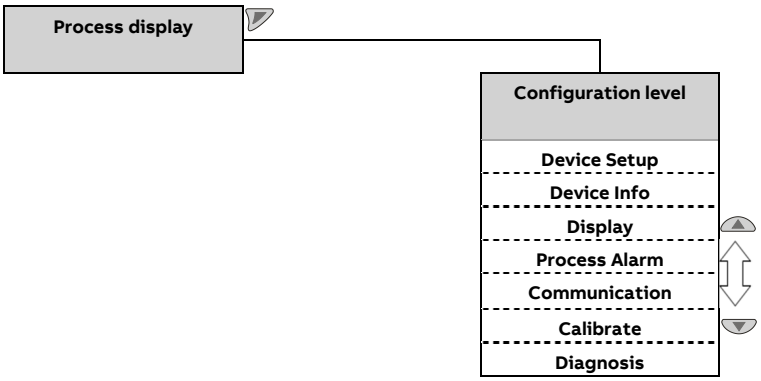
You can use the or operating buttons to browse through the menu or select a number or character within a parameter value.
Different functions can be assigned to the and operating buttons. The function ⑤ that is currently assigned to them is shown on the LCD display.

### Control button functions

| | Meaning |
|---|---|
| Exit | Exit menu |
| Back | Go back one submenu |
| Cancel | Cancel a parameter entry |
| Next | Select the next position for entering numerical and alphanumeric values |

| | Meaning |
|---|---|
| Select | Select submenu / parameter |
| Edit | Edit parameter |
| OK | Save parameter entered |

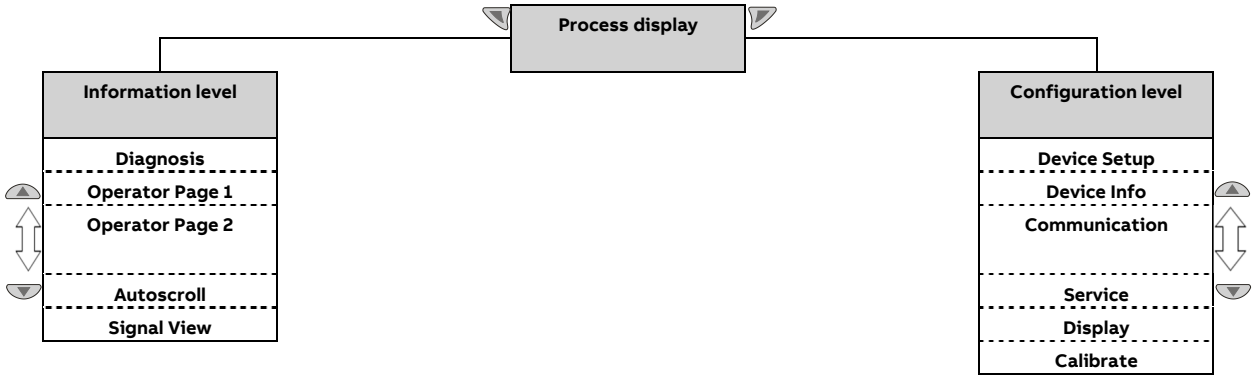
### HART® menu levels




**Process display**
The process display shows the current process values.

**Configuration level**
The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level.

### PROFIBUS PA® and FOUNDATION Fieldbus® H1 menu levels



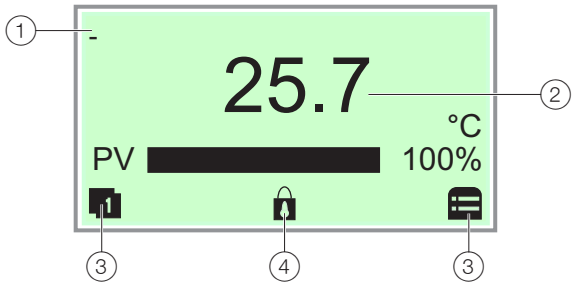

**Process display**
The process display shows the current process values.

**Information level**
The information level contains the parameters and information that are relevant for the operator.
The device configuration cannot be changed on this level.

**Configuration level**
The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level.

# … 11 Operation

## Process display




1. Measuring point tagging (Device TAG)
2. Current process values
3. 'Button function' symbol
4. 'Parameterization protected' symbol

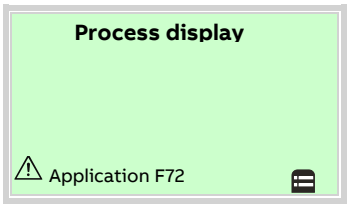
**Figure 37: Process display (example)**

The process display appears on the LCD display when the device is powered on. It shows information about the device and current process values.
The way in which the current process values are shown can be adjusted on the configuration level.
The symbols at the bottom of the process display are used to indicate the functions of the operating buttons and , in addition to other information.

| Symbol | Description |
|---|---|
| | Call up information level. |
| | Call up configuration level. |
| | The device is protected against changes in the parametrization. |

### Error messages on the HART® LCD display

If the event of an error, a message consisting of a symbol or letter (device status) and a number (DIAG NO.) will appear at the bottom of the process display.




The diagnostic messages are divided into the following groups in accordance with the NAMUR classification scheme:

| Symbol - Letter | Description | |
|---|---|---|
| I | OK or Information | Device is functioning or information is available |
| C | Check Function | Device is undergoing maintenance (for example simulation) |
| S | Off Specification | Device or measuring point is being operated outside of the specifications |
| M | Maintenance Required | Request service to prevent the measuring point from failing |
| F | Failure | Error; measuring point has failed |

The error can then be read in plain-text format on the 'Diagnosis' information level.

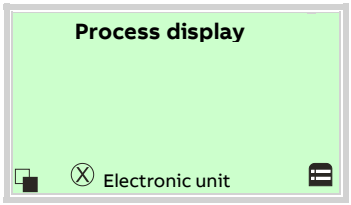
Additionally, the diagnostic messages are divided into the following areas:

| Range | Description |
|---|---|
| Electronics | Diagnosis for device hardware. |
| Sensor | Diagnosis for sensor elements and connection lines. |
| Installation / Configuration | Diagnosis for communication interface and parameterization / configuration |
| Operating conditions | Diagnosis for ambient and process conditions. |

**Note**
For a detailed description of the errors and notices on troubleshooting, see **Possible error messages – HART®** on page 66.

### Error messages on the PROFIBUS PA® and FOUNDATION Fieldbus® LCD display

In the event of an error, a message consisting of a symbol and text appears at the bottom of the process screen (e. g. electronics) The text displayed provides information about the area in which the error has occurred.




The error messages are divided into four groups in accordance with the NAMUR classification scheme. The group assignment can only be changed using a DTM or EDD:

| Symbol | Description |
|---|---|
|  | Error / failure |
|  | Function check |
|  | Outside of the specification |
|  | Maintenance required |

The error can then be read in plain-text format on the ‘Diagnosis’ information level.

The error messages are also divided into the following areas:

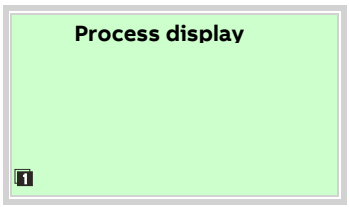
| Range | Description |
|---|---|
| Electronics | Diagnosis for device hardware. |
| Sensor | Diagnosis for sensor elements and connection lines. |
| Installation / Configuration | Diagnosis for communication interface and parameterization / configuration |
| Operating conditions | Diagnosis for ambient and process conditions. |

**Note**

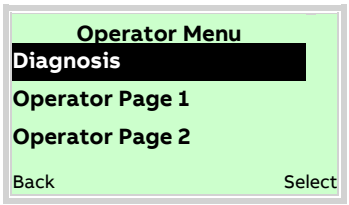
For a detailed description of the errors and notices on troubleshooting, see **Possible error messages – PROFIBUS PA® and FOUNDATION Fieldbus®** on page 68.

## Switching to the information level

(PROFIBUS PA and FOUNDATION Fieldbus only)
On the information level, the operator menu can be used to display diagnostic information and choose which operator pages to display.




1. Open the using Operator Menu.



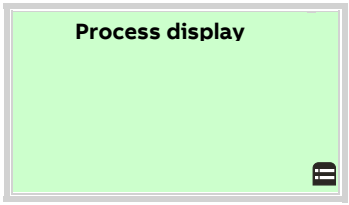

2. Select the desired submenu using / .
3. Confirm the selection with .

| Menu | Description |
|---|---|
| **... / Operator Menu** | |
| Diagnosis | Selection of sub-menu ‘Diagnosis’; see also **Error messages on the HART® LCD display** on page 44. |
| Operator Page 1 | Selection of operator page to be displayed. |
| Operator Page 2 | |
| Autoscroll | When ‘Multiplex mode‘ is activated, automatic switching of the operator pages is initiated on the process screen. |
| **Signal View** | Selects the ‘Signal View’ submenu, in which all dynamic measured values are displayed. |

# … 11 Operation

## Switching to the configuration level (parameterization)

The device parameters can be displayed and changed on the configuration level.




1. Switch to the configuration level using .

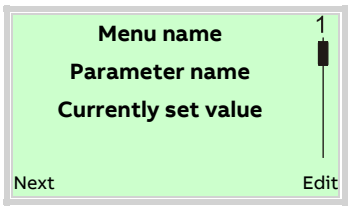
The LCD display now indicates the first menu item on the configuration level.

2. Select a menu using / .
3. Confirm the selection with .

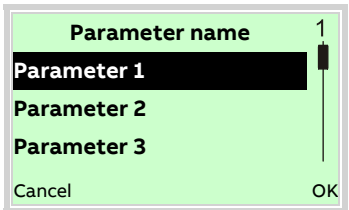
## Selecting and changing parameters

**Entry from table**

When an entry is made from a table, a value is selected from a list of parameter values.




1. Select the parameters you want to set in the menu.
2. Use to call up the list of available parameter values. The parameter value that is currently set is highlighted.

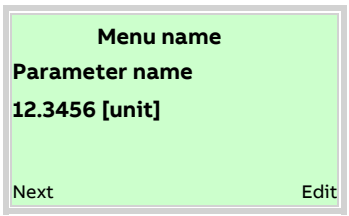



3. Select the desired value using / .
4. Confirm the selection with .

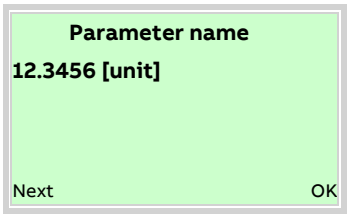
This concludes the procedure for selecting a parameter value.

**Numerical entry**

When a numerical entry is made, a value is set by entering the individual decimal positions.




1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.

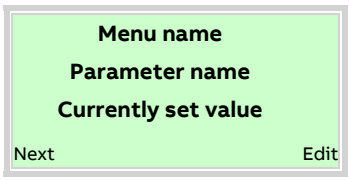



3. Use to select the decimal place to change.
4. Use / to set the desired value.
5. Use to select the next decimal place.
6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
7. Use to confirm your setting.

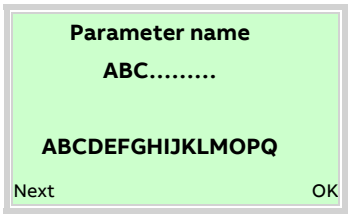
This concludes the procedure for changing a parameter value.

**Alphanumeric entry**

When an alphanumeric entry is made, a value is set by entering the individual decimal positions.




1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.




3. Use to select the decimal place to change.
4. Use / to set the desired value.
5. Use to select the next decimal place.
6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
7. Use to confirm your setting.

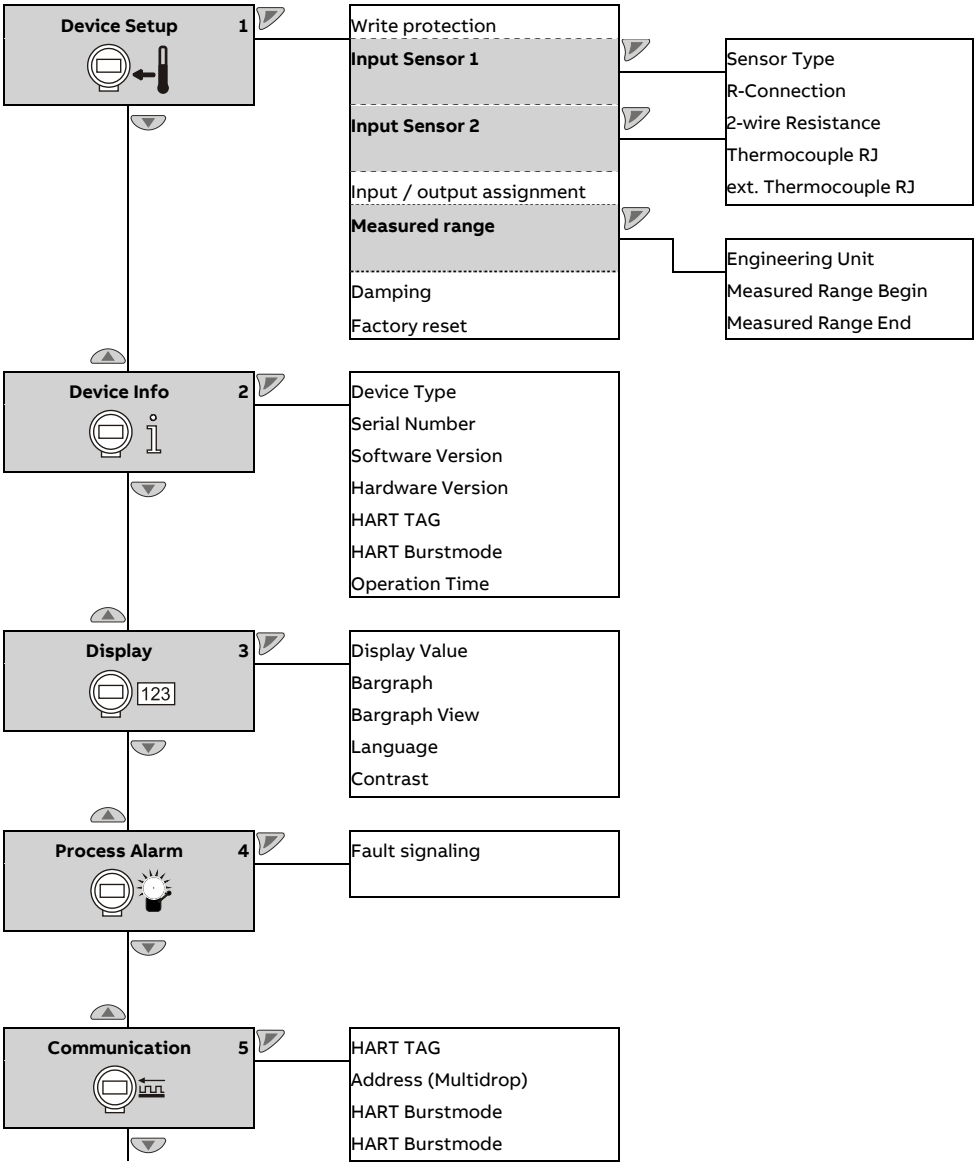
This concludes the procedure for changing a parameter value.

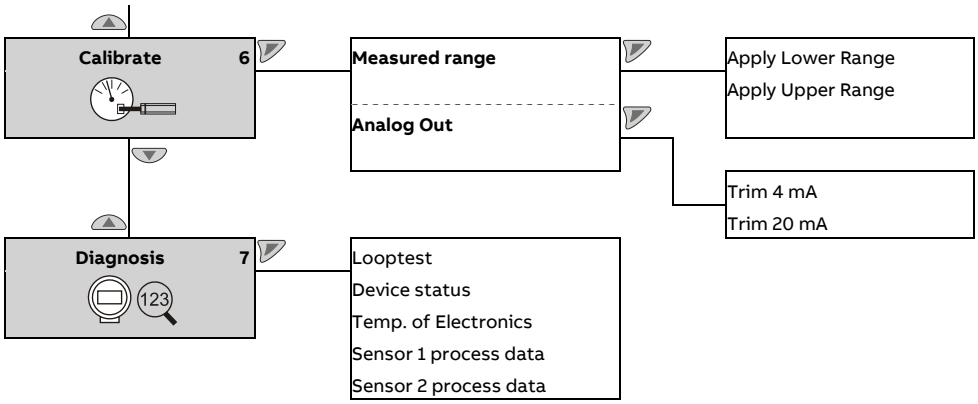
# … 11 Operation

## HART® Parameter Overview

**Note**

This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible in it.




Calibrate
6
Measured range
Analog Out
Apply Lower Range
Apply Upper Range
Trim 4 mA
Trim 20 mA
Diagnosis
7
123
Looptest
Device status
Temp. of Electronics
Sensor 1 process data
Sensor 2 process data

# … 11 Operation

## Parameter description HART®

### Menu: Device Setup

| Menu / parameter | Description |
|---|---|
| **… / Device Setup** | |
| Write protection | Activates write protection for the entire device<br>• Yes: locked<br>Entry combination: ≠ 0110<br>• No: unlocked<br>Entry combination: 0110 |
| **Input Sensor 1** | Select the 'Input Sensor 1' submenu. |
| **Input Sensor 2** | Select the 'Input Sensor 2' submenu. |
| Input / output assignment | Selects the inputs that are mapped to the current output<br>• Sensor 1<br>• Sensor 2<br>• Difference (S1-S2)<br>• Difference (S2-S1)<br>• Meanvalue<br>• Electr. Meas. S1<br>• Electr. Meas. S2<br>• Redundancy<br>• Temp. Electronics |
| **Measured range** | Select the 'Measured range' submenu. |
| Damping | Configurable τ 63% output signal damping value<br>Value range: 0 to 100 s |
| Factory reset | Resets configuration data, adjustment data trim high / low and DAC adjustment values to factory settings.<br>• Yes / OK |

| | |
|---|---|
| **… / Device Setup / Input Sensor 1**<br>**… / Device Setup / Input Sensor 2** | |
| Sensor Type | Selects sensor type:<br>• Pt100 (IEC751): Resistance thermometer Pt100 (IEC751)<br>• Pt1000 (IEC751): Resistance thermometer Pt1000 (IEC751)<br>• TC type K (IEC584): Thermocouple type K (IEC584)<br>• TC type B (IEC584): Thermocouple type B (IEC584)<br>• TC type C (ASTME988): Thermocouple type C (IEC584)<br>• TC type D (ASTME988): Thermocouple type D (ASTME988)<br>• TC type E (IEC584): Thermocouple type E (IEC584)<br>• TC type J (IEC584): Thermocouple type J (IEC584)<br>• TC type N (IEC584): Thermocouple type N (IEC584)<br>• TC type R (IEC584): Thermocouple type R (IEC584)<br>• TC type S (IEC584): Thermocouple type S (IEC584)<br>• TC type T (IEC584): Thermocouple type T (IEC584)<br>• TC type L (DIN43710): Thermocouple type L (DIN43710)<br>• TC type U (DIN43710): Thermocouple type U (DIN43710) |

| Menu / parameter | Description |
|---|---|
| **... / Device Setup / Input Sensor 1** | |
| **... / Device Setup / Input Sensor 2** | |
| Sensor Type | Selection of the sensor type (continued):<br>• –125 ... 125 mV: Linear voltage measurement -125 to 125 mV<br>• –125 ... 1100 mV: Linear voltage measurement -125 to 1100 mV<br>• 0 ... 500 Ω: Linear resistance measurement 0 to 500 Ω<br>• 0 ... 5000 Ω: Linear resistance measurement 0 to 5000 Ω<br>• Pt10 (IEC751): Resistance thermometer Pt10 (IEC751)<br>• Pt50 (IEC751): Resistance thermometer Pt50 (IEC751)<br>• Pt200 (IEC751): Resistance thermometer Pt200 (IEC751)<br>• Pt500 (IEC751): Resistance thermometer Pt500 (IEC751)<br>• Pt10 (JIS1604): Resistance thermometer Pt10 (JIS1604)<br>• Pt50 (JIS1604): Resistance thermometer Pt50 (JIS1604)<br>• Pt100 (JIS1604): Resistance thermometer Pt100 (JIS1604)<br>• Pt200 (JIS1604): Resistance thermometer Pt200 (JIS1604)<br>• Pt10 (IMIL24388): Resistance thermometer Pt10 (MIL24388)<br>• Pt50 (IMIL24388): Resistance thermometer Pt50 (MIL24388)<br>• Pt100 (MIL24388): Resistance thermometer Pt100 (MIL24388)<br>• Pt200 (MIL24388): Resistance thermometer Pt200 (MIL24388)<br>• Pt1000 (MIL24388): Resistance thermometer Pt1000 (MIL24388)<br>• Ni50 (DIN43760): Resistance thermometer Ni50 (DIN43716)<br>• Ni100 (DIN43760): Resistance thermometer Ni100 (DIN43716)<br>• Ni120 (DIN43760): Resistance thermometer Ni120 (DIN43716)<br>• Ni1000 (DIN43760): Resistance thermometer Ni1000 (DIN43716)<br>• Cu10 a=4270: Resistance thermometer Cu10 a=4270<br>• Cu100 a=4270: Resistance thermometer Cu100 a=4270<br>• Fixpoint Table 1: Customer-specific characteristic curve 1<br>• Fixpoint Table 2: Customer-specific characteristic curve 2<br>• Fixpoint Table 3: Customer-specific characteristic curve 3<br>• Fixpoint Table 4: Customer-specific characteristic curve 4<br>• Fixpoint Table 5: Customer-specific characteristic curve 5<br>• Cal. Van Dusen 1: Callendar Van Dusen coefficient set 1<br>• Cal. Van Dusen 2: Callendar Van Dusen coefficient set 2<br>• Cal. Van Dusen 3: Callendar Van Dusen coefficient set 3<br>• Cal. Van Dusen 4: Callendar Van Dusen coefficient set 4<br>• Cal. Van Dusen 5: Callendar Van Dusen coefficient set 5<br>• off: Sensor channel deactivated (sensor 2 only) |

# … 11 Operation

## … Parameter description HART®

| Menu / parameter | Description |
|---|---|
| R-Connection | Sensor connection type relevant for all Pt, Ni, Cu resistance thermometers<br>• two-wire: Sensor connection type in two-wire technology<br>• three-wire: Sensor connection type in three-wire technology<br>• four-wire: Sensor connection type in four-wire technology |
| 2-wire Resistance | Sensor line resistance relevant for all Pt, Ni, Cu resistance thermometers with a two-wire circuit<br>Value range: 0 to 100 Ω |
| Thermocouple RJ | • Internal: Use of internal reference junction of the transmitter when using thermal compensating cable.<br>• External - fixed: Use of external fixed reference junction of the transmitter when constant thermostat temperature is used (can be set with ext. Thermocouple RJ).<br>• Without: no Thermocouple RJ<br>• Sensor 1: Use of sensor 1 as reference junction for sensor 2 |
| ext. Thermocouple RJ | — Relevant for external reference junction, specification of constant external reference junction temperature<br>Value range: -50 to 100 °C |

| … / Device Setup / Measured range | |
|---|---|
| Engineering Unit | Selects the physical unit for the sensor measuring signal<br>Units: °C, °F, °R, K, user, mV, Ω, mA |
| Measured Range Begin | Defines the value for 4 mA (adjustable) |
| Measured Range End | Defines the value for 20 mA (adjustable) |

## Menu: Device Info

| Menu / parameter | Description |
|---|---|
| **... / Device Info** | |
| Device Type | Displays device type. |
| Serial Number | Displays device serial number. |
| Software Version | Displays device software version. |
| Hardware Version | Displays device hardware version. |
| HART TAG | Displays the HART Tag. |
| HART Burstmode | Displays the HART Descriptor. |
| Operation Time | Displays device operating hours. |

## Menu: Display

| Menu / parameter | Description |
|---|---|
| **... / Display** | |
| Display Value | Selects the process variable shown in the process display<br>• Process Variable: Calculated process variable (PV)<br>• Sensor 1: Measured value from Sensor 1<br>• Sensor 2: Measured value from Sensor 2<br>• Electr. Meas. S1: Measured value from Sensor 1 (in Ω or mV)<br>• Electr. Meas. S2: Measured value from Sensor 2 (in Ω or mV)<br>• Temp. Electronics: Temperature of the transmitter<br>• Output Current: Output current of 4 to 20 mA signal<br>• Output %: Output value as % of measuring range |
| Bargraph | Selects whether or not a Bargraph is shown |
| Bargraph View | • Output Current: Output current of the 4 to 20 mA signal<br>• Output %: Output value as % of measuring range |
| Language | Selects the menu language<br>• German<br>• English |
| Contrast | Sets the display contrast<br>Value range: 0 to 100 % |

# … 11 Operation

## … Parameter description HART®

### Menu: Process Alarm

| Menu / parameter | Description |
|---|---|
| **… / Process Alarm** | |
| Fault signaling | • Underrange: in the event of an error, the current, for example 3.6 mA, is output<br>• Overrange: in the event of an error, the current, for example 22 mA, is output |

### Menu: Communication

| Menu / parameter | Description |
|---|---|
| **… / Communication** | |
| HART TAG | Measuring point tagging<br>• 8 characters |
| Address (Multidrop) | Address range in multidrop mode<br>Value range: 0 to15 (0 means no multidrop mode) |
| HART Burstmode | • Status (on / off): Switches burst operating mode on or off<br>• Command # (1, 2, 3, 33): sets the HART command to be sent cyclically |
| HART Burstmode | Number of preambles to be used for sending<br>Value range: 5 to 20 |

### Menu: Calibrate

| Menu / parameter | Description |
|---|---|
| **… / Calibrate** | |
| **Measured range** | Select the ‘Measured range’ submenu. |
| **Analog Out** | Select the ‘Analog Out’ submenu. |

| … / Calibrate / Measured range | |
|---|---|
| Apply Lower Range | The current reading (PV) is used as the lower range limit (4 mA). |
| Apply Upper Range | The current reading (PV) is used as the upper range limit (20 mA). |

| … / Calibrate / Analog Out | |
|---|---|
| Trim 4 mA | Adjusts the current output with a 4 mA setpoint<br>Value range: 3.500 to 4.500 mA |
| Trim 20 mA | Adjusts the current output with a 20 mA setpoint<br>Value range: 19.500 to 20.500 mA |

### Menu: Diagnosis

| Menu / parameter | Description |
|---|---|
| **... / Diagnosis** | |
| Looptest | Simulates the current output signal<br>Value range: 0 to 23.600 mA |
| Device status | Diagnosis notice (maintenance required, error, etc.) |
| Temp. of Electronics | Drag indicator: maximum or minimum device temperature |
| Sensor 1 process data | Drag indicator: maximum or minimum sensor temperature for sensor 1<br>Reset: Resets the values |
| Sensor 2 process data | Drag indicator: maximum or minimum sensor temperature for sensor 2<br>Reset: Resets the values |

**Activating write protection**

1. Confirm 'Device Setup' with and select the sub item 'Write protection'. Displays the current write protection setting.
2. Use the 'Edit' button to edit the current write protection configuration.
3. Use the or buttons to select at least one alphanumeric character (up to 4 may be selected) and confirm via the button.

**Note**

Spaces and the number combination 0110 must not be entered.

4. Write protection 'YES' is displayed.

Click the button 3 times to exit configuration mode and display 'Reading Display Mode'.

**Deactivating write protection**

Access the write protection edit mode according to the example. In write protection edit mode, an alphanumeric string of characters is displayed.

1. Enter the entry combination '0110'.
2. Confirm with the 'OK' button.

'Write protection NO' is displayed.

**Note**

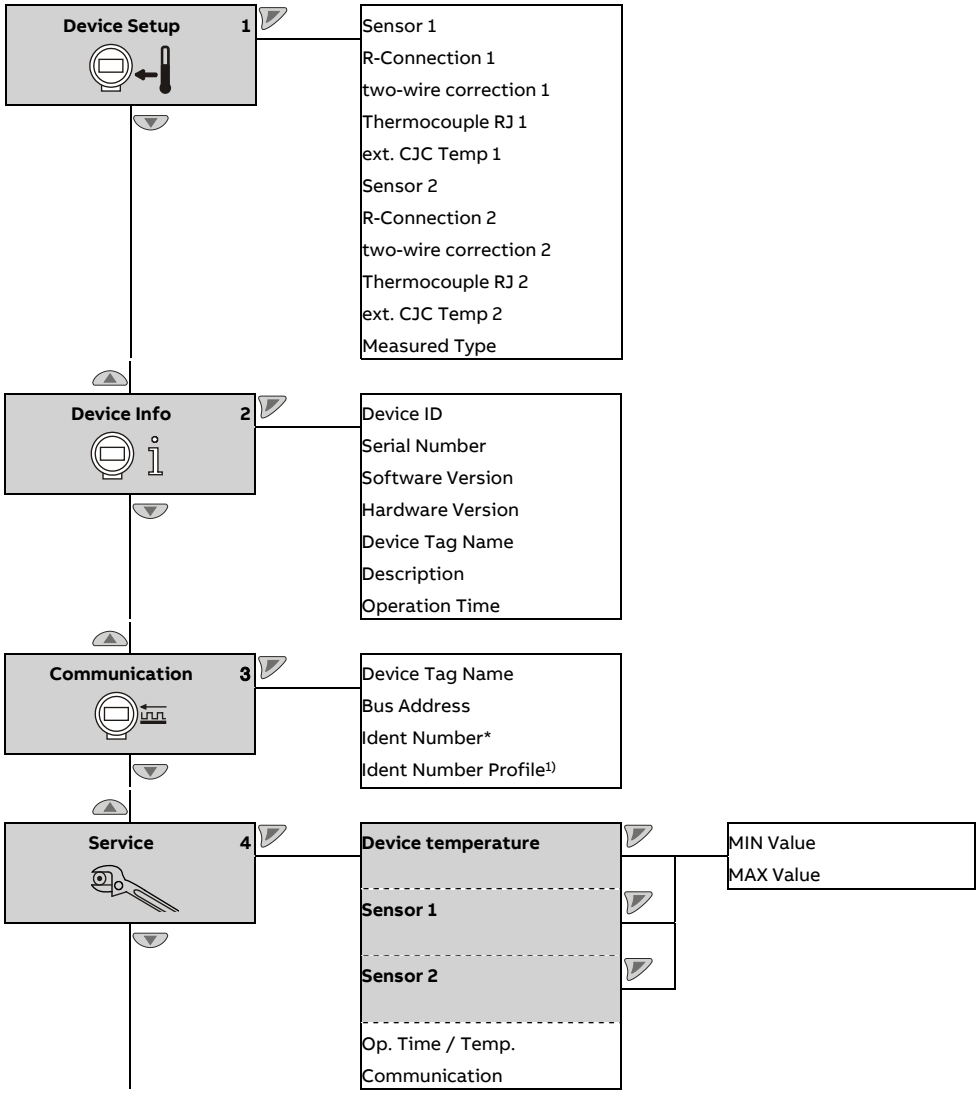
Entry combination '0110', used to deactivate write protection, cannot be changed.

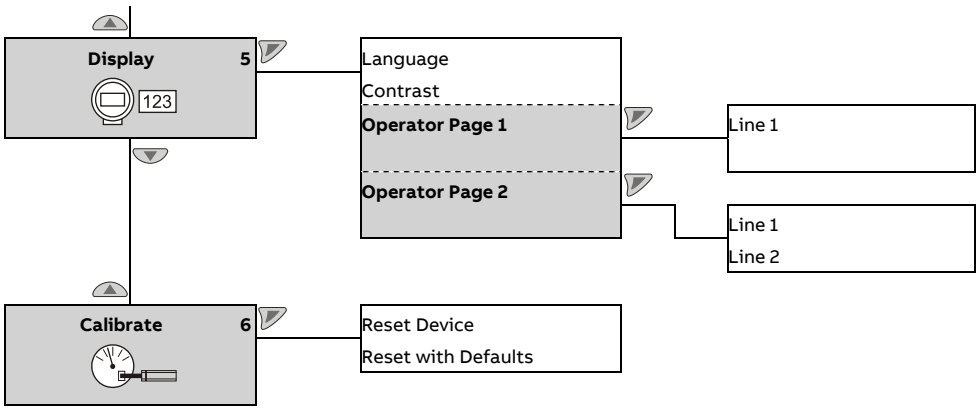
# … 11 Operation

## PROFIBUS PA® und FOUNDATION Fieldbus® Parameter overview

**Note**

This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible in it.






* PROFIBUS PA only

# … 11 Operation

## Parameter description PROFIBUS PA® and FOUNDATION Fieldbus®

### Menu: Device Setup

| Menu / parameter | Description |
|---|---|
| **… / Device Setup** | |
| Sensor 1 / Sensor 2 | Selects sensor type:<br>• Pt100 (IEC751): Resistance thermometer Pt100 (IEC751)<br>• Pt1000 (IEC751): Resistance thermometer Pt1000 (IEC751)<br>• TC type K (IEC584): Thermocouple type K (IEC584)<br>• TC type B (IEC584): Thermocouple type B (IEC584)<br>• TC type C (ASTME988): Thermocouple type C (IEC584)<br>• TC type D (ASTME988): Thermocouple type D (ASTME988)<br>• TC type E (IEC584): Thermocouple type E (IEC584)<br>• TC type J (IEC584): Thermocouple type J (IEC584)<br>• TC type N (IEC584): Thermocouple type N (IEC584)<br>• TC type R (IEC584): Thermocouple type R (IEC584)<br>• TC type S (IEC584): Thermocouple type S (IEC584)<br>• TC type T (IEC584): Thermocouple type T (IEC584)<br>• TC type L (DIN43710): Thermocouple type L (DIN43710)<br>• TC type U (DIN43710): Thermocouple type U (DIN43710)<br>• –125 … 125 mV: Linear voltage measurement -125 to 125 mV<br>• –125 … 1100 mV: Linear voltage measurement -125 to 1100 mV<br>• 0 … 500 Ω: Linear resistance measurement 0 to 500 Ω<br>• 0 … 5000 Ω: Linear resistance measurement 0 to 5000 Ω<br>• Pt10 (IEC751): Resistance thermometer Pt10 (IEC751)<br>• Pt50 (IEC751): Resistance thermometer Pt50 (IEC751)<br>• Pt200 (IEC751): Resistance thermometer Pt200 (IEC751)<br>• Pt500 (IEC751): Resistance thermometer Pt500 (IEC751)<br>• Pt10 (JIS1604): Resistance thermometer Pt10 (JIS1604)<br>• Pt50 (JIS1604): Resistance thermometer Pt50 (JIS1604)<br>• Pt100 (JIS1604): Resistance thermometer Pt100 (JIS1604)<br>• Pt200 (JIS1604): Resistance thermometer Pt200 (JIS1604)<br>• Pt10 (IMIL24388): Resistance thermometer Pt10 (MIL24388)<br>• Pt50 (IMIL24388): Resistance thermometer Pt50 (MIL24388)<br>• Pt100 (MIL24388): Resistance thermometer Pt100 (MIL24388)<br>• Pt200 (MIL24388): Resistance thermometer Pt200 (MIL24388)<br>• Pt1000 (MIL24388): Resistance thermometer Pt1000 (MIL24388) |

| Menu / parameter | Description (continuation) |
|---|---|
| Sensor 1 / Sensor 2 | Selection of the sensor type (continued):<br>• Ni50 (DIN43760): Resistance thermometer Ni50 (DIN43716)<br>• Ni100 (DIN43760): Resistance thermometer Ni100 (DIN43716)<br>• Ni120 (DIN43760): Resistance thermometer Ni120 (DIN43716)<br>• Ni1000 (DIN43760): Resistance thermometer Ni1000 (DIN43716)<br>• Cu10 a=4270: Resistance thermometer Cu10 a=4270<br>• Cu100 a=4270: Resistance thermometer Cu100 a=4270<br>• Fixpoint Table 1: Customer-specific characteristic curve 1<br>• Fixpoint Table 2: Customer-specific characteristic curve 2<br>• Fixpoint Table 3: Customer-specific characteristic curve 3<br>• Fixpoint Table 4: Customer-specific characteristic curve 4<br>• Fixpoint Table 5: Customer-specific characteristic curve 5<br>• Cal. Van Dusen 1: Callendar-Van Dusen coefficient set 1<br>• Cal. Van Dusen 2: Callendar-Van Dusen coefficient set 2<br>• Cal. Van Dusen 3: Callendar-Van Dusen coefficient set 3*<br>• Cal. Van Dusen 4: Callendar-Van Dusen coefficient set 4*<br>• Cal. Van Dusen 5: Callendar-Van Dusen coefficient set 5*<br>• off: Sensor channel deactivated (sensor 2 only) |

* only for communication protocol PROFIBUS PA

| **... / Device Setup** | |
|---|---|
| R-Connection 1 /<br>R-Connection 2 | Sensor connection type relevant for all Pt, Ni, Cu resistance thermometers<br>• two-wire: Sensor connection type in two-wire technology<br>• three-wire: Sensor connection type in three-wire technology<br>• four-wire: Sensor connection type in four-wire technology |
| two-wire correction 1 /<br>two-wire correction 2 | Resistance correction of the connection lead for the connection type two-wire<br>Value range: 0 to 100 Ω |
| Thermocouple RJ 1 /<br>Thermocouple RJ 2 | • Internal: Use of internal reference junction of the transmitter when using thermal compensating cable.<br>• External - fixed: Use of external fixed reference junction of the transmitter when constant thermostat temperature is used (can be set with ext. Thermocouple RJ).<br>• Without: no Thermocouple RJ<br>• Sensor 1: Use of Sensor 1 as reference junction for Sensor 2 |
| ext. Thermocouple RJ 1 / ext.<br>Thermocouple RJ 2 | — Relevant for external reference junction, specification of constant external reference junction temperature<br>Value range: -50 to 100 °C |

# … 11 Operation

## … Parameter description PROFIBUS PA® and FOUNDATION Fieldbus®

### Menu: Device Info

| Menu / parameter | Description |
|---|---|
| **… / Device Info** | |
| Device ID | Displays device ID |
| Serial Number | Displays serial number |
| Software Version | Displays software version |
| Hardware Version | Displays hardware version |
| TAG | Displays measuring point tagging |
| Description | Displays a user-defined text |
| Operation Time | Displays operating hours |

### Menu: Communication

| Menu / parameter | Description |
|---|---|
| **… / Communication** | |
| TAG | Measuring point tagging<br>• 16 characters |
| Bus Address | Address range during bus operation<br>Value range: 0 to 125 |
| Ident Number | PROFIBUS PA profile: selects ID numbers than can be used<br>Manufacturer-specific: (IDENT__NUMBER_SELECT) only for PROFIBUS PA |
| Ident Number Profile | ID numbers used for profile with PROFIBUS PA<br>• 1*AI (0x9700)<br>• 2*AI (0x9701)<br>• 3*AI (0x9702)<br>• 4*AI (0x9703) |

## Menu: Service Menu

| Menu / parameter | Description |
|---|---|
| **... / Service Menu** | |
| **Device temperature** | Select the 'Device temperature' submenu. |
| **Sensor 1** | Select the 'Sensor 1' submenu. |
| **Sensor 2** | Select the 'Sensor 2' submenu. |
| Op. Time / Temp. | Displays total operating hours and the operating hours within specific ranges of the device temperature.<br>• Total: Total operating hours<br>• < −40 °C: operating hours at < −40 °C<br>• −40 to −20 °C: operating hours at −40 °C to −20 °C<br>• −20 to 0 °C: operating hours at −20 °C to 0 °C<br>• 0 to 20 °C: operating hours at 0 to 20 °C<br>• 20 to 40 °C: operating hours at 20 to 40 °C<br>• 40 to 60 °C: operating hours at 40 to 60 °C<br>• 60 to 85 °C: operating hours at 60 to 85 °C<br>• > 85 °C: operating hours at > 85 °C |
| Communication | Displays the communication quality<br>• Excellent<br>• Very good<br>• Good<br>• Poor<br>• None |

| | |
|---|---|
| **... / Service Menu / Device temperature** | |
| min | Drag indicator: minimum device temperature |
| max | Drag indicator: maximum device temperature |

| | |
|---|---|
| **... / Service Menu / Sensor 1** | |
| min | Drag indicator: minimum sensor temperature, sensor 1 |
| max | Drag indicator: maximum sensor temperature, sensor 1 |

| | |
|---|---|
| **... / Service Menu / Sensor 2** | |
| min | Drag indicator: minimum sensor temperature, sensor 2 |
| max | Drag indicator: maximum sensor temperature, sensor 2 |

# … 11 Operation

## … Parameter description PROFIBUS PA® and FOUNDATION Fieldbus®

### Menu: Display

| Menu / parameter | Description |
|---|---|
| **… / Display** | |
| Language | Selects the menu language<br>• German<br>• English |
| Contrast | Sets the display contrast<br>Value range: 0 to 100 % |
| **Operator Page 1** | Select the ‘Operator Page 1’ submenu. |
| **Operator Page 2** | Select the ‘Operator Page 2’ submenu. |

| **… / Display / Operator Page 1** | |
|---|---|
| Line 1 | Selects the value displayed<br>• Calculated value<br>• Sensor 1<br>• Sensor 2<br>• Device temperature<br>• AO Block |

| **… / Display / Operator Page 2** | |
|---|---|
| Line 1 | Selects the value displayed in Line 1<br>• Calculated value<br>• Sensor 1<br>• Sensor 2<br>• Device temperature<br>• AO Block |
| Line 2 | Selects the value displayed in Line 2<br>• Calculated value<br>• Sensor 1<br>• Sensor 2<br>• Device temperature<br>• AO Block |

### Menu: Calibrate

| Menu / parameter | Description |
|---|---|
| **… / Calibrate** | |
| Reset Device | Device restarts without configuration changes |
| Reset with Defaults | Device restarts with factory settings applied |

# Factory settings

### Firmware settings

The transmitter is configured at the factory. The table below contains the relevant parameter values.

| Menu | Designation | Parameter | Factory setting |
|---|---|---|---|
| Device Setup | Write protection | – | No |
| | Input Sensor 1 | Sensor Type | Pt100 (IEC60751) |
| | | R-Connection | Three-wire |
| | | Measured Range Begin[1)] | 0 |
| | | Measured Range End[1)] | 100 |
| | | Engineering Unit | Degrees °C |
| | | Damping | Off |
| Process Alarm | | Fault signaling[1)] | Overrange 22 mA[1] |
| | Input Sensor 2 | Sensor Type | Off |
| | Input / output assignment | Measurement type | Sensor 1 |
| | TAG | – | – |
| | HART Burstmode[1] | – | TIXXX-[1] |
| Display | Display Value | – | Process Variable |
| | Bargraph[1] | – | Yes, output %[1] |
| | Language | – | German |
| | Contrast | – | 50 % |
| Communication | HART Burstmode[1] | Status[1)] | Off[1] |
| | Bus Address[2 3] | – | 126[2] / 30[3] |
| | Simulation mode[3] | – | Off[3] |
| | HART Protocol | – | HART 5[4] |

1 Only applies to HART transmitters

2 Only applies to PROFIBUS PA transmitters

3 Only applies to FOUNDATION Fieldbus transmitters

4 HART 7 provided unless specifically specified in the order.

# 12 Diagnosis / error messages

## Diagnostic information

### Monitoring of operating data

The transmitter saves the highest and lowest values for the electronic unit temperature as well as measured values from sensor 1 and sensor 2 in the non-volatile memory (‘Drag Indicator’).

| Value | Description |
|---|---|
| Supply voltage | Current supply voltage measured at the terminals of the transmitter in volts (± 5 %). |
| Max. elec. temp. | Highest detected internal temperature in °C that the transmitter was subjected to. This value cannot be reset. |
| Min. elec. temp. | Lowest detected internal temperature in °C that the transmitter was subjected to. This value cannot be reset. |
| Max. reading for sensors 1 / 2 | Largest measured value on Sensor 1 or 2. When changing the sensor type (e.g., Pt100 to thermocouple type K), the value is reset automatically. |
| Min. reading for sensors 1 / 2 | Smallest measured value on Sensor 1 or 2. When changing the sensor type the value is reset automatically. |
| Reset | The drag indicators for the sensor readings are all reset to the current measured value in each case. |

### Operating hours statistics

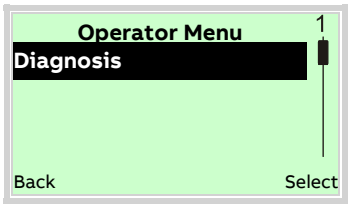
| Value | Description |
|---|---|
| Operation Time | Total hours since commissioning that the supply voltage has been switched on for the transmitter. |
| Operation Time (Depending on device temperature) | The operating hours are categorized according to the measured internal temperature of the transmitter. 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 indicate 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. |

## Calling up the error description

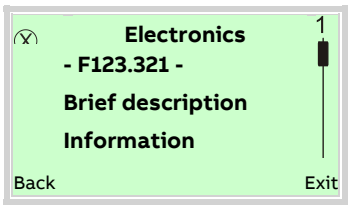
For PROFIBUS PA and FOUNDATION Fieldbus transmitters only!

Additional details about the error that has occurred can be called up on the information level.


1. Use to switch to the information level (Operator Menu).




2. Use / to select the submenu ‘Diagnosis’.
3. Confirm the selection with .




The error message is shown on the display according to priority.
The first line shows the area in which the error has occurred.
The second line shows the unique error number. It is made up of the priority (Fxxx) and the error position (.xxx)
The next lines show a brief description of the error and information on how to remedy it.
You absolutely need to scroll the display further to read the error message in more detail.

**Note**
For a detailed description of the error messages and information on troubleshooting, see the following pages.

# … 12 Diagnosis / error messages

## Possible error messages – HART®

| Range | Displays the device status | Displays the DIAG. NO. | Cause | Remedy |
|---|---|---|---|---|
| Electronics | F | 1 | Device defective | Replace the device |
| Electronics | S | 2 | Ambient temperature overshot / undershot | Check environment; reposition measuring point if required |
| Electronics | F | 3 | EEPROM defective | Replace the device |
| Electronics | M | 4 | Electronics overload | Factory reset |
| Electronics | F | 5 | Memory error | Factory reset |
| Electronics | I | 7 | LCD display connected | Remove display |
| Installation / Configuration | I | 8 | Device write-protected | Remove write protection |
| Electronics | I | 9 | EEPROM busy | Wait for status information to finish processing |
| Electronics | F | 12 | Sensor input defective (communication) | Replace the device |
| Electronics | F | 13 | Sensor input defective (error) | Replace the device |
| Electronics | F | 14 | Sensor input defective (ADC error) | Replace the device |
| Installation / Configuration | C | 32 | Simulation mode | Exit simulation mode |
| Sensor | F | 34 | Measuring error, sensor 1 | Check sensor connection |
| Sensor | F | 35 | Short-circuit, sensor 1 | Check sensor connection |
| Sensor | F | 36 | Wire break, sensor 1 | Check sensor connection |
| Sensor | F | 37 | Range exceeded, sensor 1 | Check measuring limits |
| Sensor | F | 38 | Range undershot, sensor 1 | Check measuring limits |
| Installation / Configuration | I | 41 | Single-point adjustment active, sensor 1 | Terminate single-point adjustment |
| Installation / Configuration | I | 42 | Two-point adjustment active, sensor 1 | Terminate two-point adjustment |
| Sensor | F | 50 | Measuring error, sensor 2 | Check sensor connection |
| Sensor | F | 51 | Short-circuit, sensor 2 | Check sensor connection |
| Sensor | F | 52 | Wire break, sensor 2 | Check sensor connection |
| Sensor | F | 53 | Range exceeded, sensor 2 | Check measuring limits |
| Sensor | F | 54 | Range undershot, sensor 2 | Check measuring limits |
| Installation / Configuration | F | 65 | Configuration defective | Check configuration:<br>A Wrong device<br>B Measuring span is too small<br>C Incorrect configuration data |

| Range | Displays the device status | Displays the DIAG. NO. | Cause | Remedy |
|---|---|---|---|---|
| Sensor | M | 66 | No sensor 1 detected during redundancy configuration | Check connection |
| Sensor | M | 67 | No sensor 2 detected during redundancy configuration | Check connection |
| Sensor | M | 68 | Sensors exceeded specified drift window | Calibrate sensors |
| Installation / Configuration | C | 71 | Reconfiguration is running | Terminate reconfiguration |
| Operating conditions | F | 72 | Error in the application | Check configuration, connections; reset to factory settings |
| Installation / Configuration | I | 74 | Analog output adjustment active | Terminate compensation |
| Installation / Configuration | C | 75 | Analog output in simulation | Terminate simulation |
| Operating conditions | S | 76 | Values overshot | Check parameters:<br>A) Sensor limits overshot<br>B) Span is too small |
| Operating conditions | S | 77 | Limit HIGH HIGH | Upper limit value: alarm |
| Operating conditions | S | 78 | Limit LOW LOW | Lower limit value: alarm |
| Operating conditions | S | 79 | Limit HIGH | Upper limit value: warning |
| Operating conditions | S | 80 | Limit LOW | Lower limit value: warning |

**Note**

If the remedial measures listed for the error message do not improve the status of the device, please consult ABB Service.

# … 12 Diagnosis / error messages

## Possible error messages – PROFIBUS PA® and FOUNDATION Fieldbus®

| Range | Device status message (on the display) | Cause | Remedy |
|---|---|---|---|
| Sensor | Sensordrift | Outside of the specification | Sensor adjustment |
| Sensor | S1 line resistance too high | Maintenance required | Sensor 1: Remove corrosion at the connections or reduce line length. |
| Sensor | S1 short-circuit | Errors | Sensor 1: Rectify short-circuit or replace sensor 1 |
| Sensor | S1 wire break | Errors | Sensor 1: Rectify wire break or replace sensor 1 |
| Sensor | S2 line resistance too high | Maintenance required | Sensor 2: Remove corrosion at the connections or reduce line length. |
| Sensor | S2 short-circuit | Errors | Sensor 2: Rectify short-circuit or replace sensor 2 |
| Sensor | S2 wire break | Errors | Sensor 2: Rectify wire break or replace sensor 2 |
| Operating conditions | S1 measuring range overflow | Outside of the specification | Adapt S1 measuring range to suit measuring task |
| Operating conditions | S1 measuring range underflow | Outside of the specification | Adapt S1 measuring range to suit measuring task |
| Operating conditions | S2 measuring range overflow | Outside of the specification | Adapt S2 measuring range to suit measuring task |
| Operating conditions | S2 measuring range underflow | Outside of the specification | Adapt S2 measuring range to suit measuring task |
| Operating conditions | Device temperature out of spec. | Outside of the specification | Check environment; reposition measuring point if required |
| Electronics | Device error | Errors | Replace device |
| Electronics | Device not calibrated | Outside of the specification | Calibrate device |
| Electronics | Device being simulated | Function check | Terminate simulation |
| Electronics | Configuration error | Errors | Validate configuration |
| Sensor | Sensor 1 + 2 redundancy failure | Errors | Check sensor / sensor connection |
| Sensor | Sensor 1 redundancy: short-circuit | Maintenance required | Rectify short-circuit at sensor 1 or replace sensor 1 |
| Sensor | Sensor 1 redundancy: wire break | Maintenance required | Rectify break at sensor 1 or replace sensor 1 |
| Sensor | Sensor 2 redundancy: short-circuit | Maintenance required | Rectify short-circuit at sensor 2 or replace sensor 2 |
| Sensor | Sensor 2 redundancy, wire break | Maintenance required | Rectify break at sensor 2 or replace sensor 2 |

**Note**
If the remedial measures listed for the error message do not improve the status of the device, please consult ABB Service.

# 13 Maintenance

Repair and maintenance activities may only be performed by authorized customer service personnel.
When replacing or repairing individual components, use original spare parts.

## Safety instructions

**⚠ DANGER**

**Explosion hazard**
Explosion hazard due to improper repair of the device.
- Faulty devices may not be repaired by the operator.
- The device may only be repaired by the ABB Service Department.

If transmitters are used as intended under normal operating conditions, no maintenance is required.

On-site repair of the transmitter or exchange of electronic components is not permissible.

## Cleaning

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

When using the device in potentially explosive atmospheres, observe the notice on cleaning in **Protection against electrostatic discharges** on page 16.

# 14 Repair

## Safety instructions

**⚠ DANGER**

**Explosion hazard**
Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.
- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

Repair and maintenance activities may only be performed by authorized customer service personnel.
When replacing or repairing individual components, use original spare parts.

## Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.
Fill out the return form (see **Return form** on page 71) and include this with the device.
In accordance with the EU Directive governing 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 must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Please contact Customer Center Service acc. to page 5 for nearest service location.

# 15 Recycling and disposal

**Note**

Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).
They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

# 16 Specification

**Note**

The device data sheet is available in the ABB download area at www.abb.com/temperature.

# 17 Additional documents

**Note**

Declarations of conformity of the device are available in the download area of ABB at www.abb.com/temperature. In addition, these are also included with the device in case of ATEX-certified devices.

# Trademarks

HART is a registered trademark of FieldComm Group, Austin, Texas, USA

PROFIBUS and PROFIBUS PA are registered trademarks of PROFIBUS & PROFINET International (PI)

FOUNDATION Fieldbus is a registered trademark of FieldComm Group, Austin, Texas, USA.

# 18 Appendix

## Return form

**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: | Email: |

**Device details:**

| | |
|---|---|
| Type: | Serial no.: |
| Reason for the return/description of the defect: | |

**Was this device used in conjunction with substances which pose a threat or risk to health?**

☐ Yes ☐ No

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

| | | |
|---|---|---|
| ☐ biological | ☐ corrosive / irritating | ☐ combustible (highly / extremely combustible) |
| ☐ toxic | ☐ explosive | ☐ other toxic substances |
| ☐ radioactive | | |

Which substances have come into contact with the device?

1.

2.

3.

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

| | |
|---|---|
| Town/city, date | Signature and company stamp |

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