

TTF300, TTH300

Temperature transmitter



HART protocol

Measurement made easy

TTX300-HART

Additional Information

Additional documentation on TTF300, TTH300 is available for download free of charge at www.abb.com/temperature. Alternatively simply scan this code:



TTF300



TTH300

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1 Introduction

These instructions describe the communication-specific properties of the TTX300-HART® transmitter.

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 the transmitter is ordered with standard configuration and only configured according to the requirements before commissioning, there are various possibilities for setting the parameters, see **Configuration types** on page 4.

From SW-Rev. 1.03, the transmitter supports HART protocol rev. 7 as well as HART protocol rev. 5. The exact HART protocol revision and its setting depends on the SW revision of the device.

From SW-Rev. 3.00

HART 5.9 and HART 7.6, can be switched via

- HMI LCD indicator with configuration function (option)
- Tools
- HART commands

Standard, unless ordered differently: HART 7.6

SW-Rev 1.03

HART 5.1 and HART 7, can be switched via DIP switch.

Standard, unless ordered differently: HART 5.1

SW-Rev 1.01.08: HART 5.1, previously HART 5.

For general information concerning operation, sensor configuration, connection or explosion protection, please refer to the operating or commissioning instructions.

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.

2 Communication / HART® TAG / device addressing

For ease of identification, each HART® device features a configurable 8-digit HART TAG.

When storing HART TAG measuring point tags with more than 8 digits in the device, use the 'Message' parameter, which supports up to 32 characters.

HART-Rev. 7 also has a 32-digit HART LONG TAG for improved device identification in large installations.

In addition to the HART TAG, each device has a HART address. This address is set to zero by default, which means that the device operates in HART standard communication mode (point-to-point mode).

The following applies for devices in HART 5 mode:

When an address in the range 1 to 15 is used, the device switches to HART multidrop mode with constant current output. This operating mode enables users to connect up to 15 devices in parallel to a power supply.

The following applies for devices in HART 7 mode:

HART 7 mode supports an address range from 0 to 63. The address can be selected independently of the activated current loop mode (loop current 4 to 20 mA) or constant output current. The current loop mode is activated / deactivated and the address is selected via the Tools. The operating mode with constant output current enables the connection of up to 64 devices to a power supply unit in parallel.

In HART multidrop mode (HART 5) as well as with constant output current (current loop mode deactivated, HART 7), there is no analog output signal available with a value corresponding to the process temperature. The output signal then remains constant at 4.0 mA (from SW-Rev. 3.00, previously 3.6 mA) and is used exclusively for power supply purposes. The sensor or process data information is available only as a HART signal.

3 Configuration

Configuration types

Transmitters can be configured as follows:

Independently of device drivers/tools:

- HMI LCD indicator with configuration function (optional)

Depending on device drivers/tools:

- Device management / Asset management tools
- Configuration via field bus (PROFIBUS®), if the higher-level remote I/O system is HART-enabled (e.g. ABB S800 / S900)
- 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)

You can download the TTX300 device drivers and tools from www.abb.com. The way in which individual parameters are displayed, arranged and referred to may vary between different device drivers and tools.

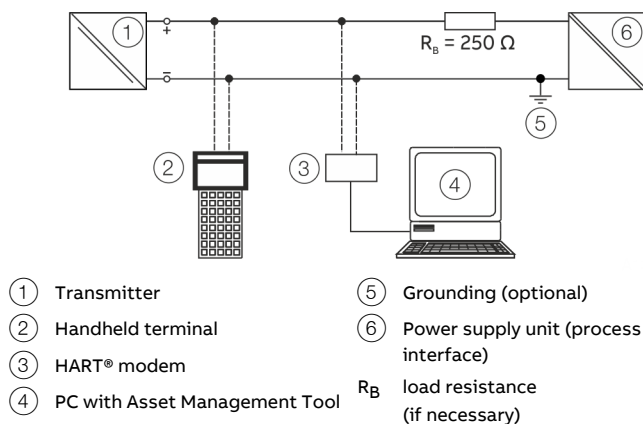


Figure 1: Example for HART® connection

HART® Communication

Note

The HART® protocol is an unsecured protocol (in the sense of IT or cyber security), as such the intended application should be assessed before implementation to make sure that this protocol is suited.

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.

Configuration via the handheld terminal

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

1. Open the housing of the sensor head measuring inset.
2. Carefully clamp both test tips of the separate operating control on the contacts in the slots in front of the + and – terminals.
3. Ensure that the test terminals are firmly seated.
4. Complete the installation in accordance with **Figure 1** on page 4.

Note

The test tips are connected without observing polarity. Clamp the test tips to the (+) and (-) terminals. The transmitter can also be configured via the HART® protocol during normal operation.

Configuration with Device Type Manager (DTM)

Configuration can be performed within an FDT frame application that is approved for use with the DTM. The bus can be connected via FSK modem as well as HART + USB, PROFIBUS + remote I/O, or HART Multiplexer.

Configuration via FDI technology with the Field Information Manager (FIM)

Configuration is made via the appropriate TTX300 package (HART 5 or HART 7). The following EDD drivers can be used as an option.

Configuration via EDD

Configuration can also be performed within an EDD frame application that is approved for use with the EDD.

Note

Depending on the HART protocol and the version of device to be configured, a variety of drivers are used. Make sure that the appropriate driver is used.

Configuration via the LCD indicator with the operating buttons (optional)

Configuration can be performed with an LCD indicator using the four operating buttons on the front. Various submenus are available that allow you to change the configuration. For details of how to use the LCD indicator, please refer to the description in the operating instructions.

Note

In contrast to configuration using Tools, the functionality of the transmitter can only be changed to a limited extent with the LCD indicator and operating buttons.

... 3 Configuration

HART® variables

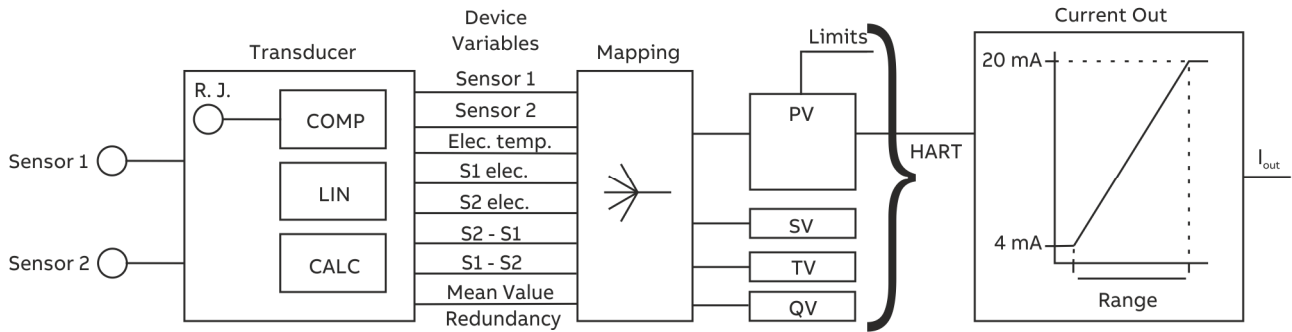


Figure 2: Data processing

This figure illustrates how the measurement value is processed from the sensor input right through to the transmitter's current output.

As well as providing access to parameters and diagnostic data, a HART® device has up to 4 dynamic variables, which can be read out by means of a command. Depending on the configuration, the following measurement values are available internally on the TTX300:

- Sensor 1 (temperature, resistance, voltage)
- Sensor 2 (temperature, resistance, voltage)
- Difference Sensor 1 – Sensor 2 (temperature, resistance, voltage)
- Difference Sensor 2 – Sensor 1 (temperature, resistance, voltage)
- Redundancy Sensor 1 and Sensor 2 (temperature, resistance, voltage)
- Average value Sensor 1 and Sensor 2 (temperature, resistance, voltage)
- Electric measured value Sensor 1 (resistance, voltage)
- Electric measured value Sensor 2 (resistance, voltage)
- Electronic unit temperature (temperature)

The configuration function in Tools allows you to select up to 4 variables and assign them to the dynamic HART® variables:

- Primary Variable, PV
- Secondary Variable, SV
- Tertiary Variable, TV
- Quarternary Variable, QV

Only the PV is mapped onto the current output, which means that it has an additional parameter in the form of the mapping range.

From HART-Rev. 7 it is also possible to access the status information on each of the aforementioned dynamic variables. See also **Extensions from HART® Protocol Rev. 7** on page 11.

Note

If the configuration is changed (by assigning variables), you will need to check how the measurement value is subsequently processed in the higher-level control system and make any necessary adjustments.

With conventional 4 to 20 mA operation, the PV is available indirectly via the current output. Modern remote I/O systems (such as the ABB S800 / S900) also allow cyclic access to all the subsidiary variables (SV, TV and QV). This enables support for more complex applications for which a measuring point has to provide more information (e.g. absolute and differential temperatures), or cost-effective processing of two sensor signals with a single transmitter.

4 Parameter descriptions

Note

The Safety check is performed in accordance with the Instructions in the SIL-Safety Manual.

Identify

Parameter [DE]	Parameter [EN]	Description	Safety instructions
Messstellenkennzeichen / Name	TAG	Measuring point tagging, 8 characters. The name that is selected should be unique within the system.	
Schreibschutz	Write Protection	<p>Up to SW-Rev. 1.03</p> <p>To unlock, enter the input combination 0110. Input combinations ≠ 0110 will lock the device.</p> <p>From SW-Rev. 3.00</p> <ol style="list-style-type: none"> 1. Confirm "Device Setup" via operating button (Select/Process./OK) and select the subitem 'Write Protection'. Displays the current write protection setting. 2. Process the current write protection configuration (off/on) and confirm with the right operating button. 3. The current write protection setting is displayed. <p>The operating button functions are described in the operating instruction.</p>	Must be locked to ensure safety function.
Softwareversion	Software Revision	Transmitter's firmware version in accordance with NAMUR recommendation, in the format XX.YY.ZZ. The information is provided on the name plate of transmitter	Check that the version is correct on the basis of the data sheet or certificate.
Hardwareversion	Hardware Revision	Hardware version of the transmitter in accordance with NAMUR recommendation, in the format XX.YY.ZZ (as of SW-Rev. 3.00, previously XX.YY). This information can also be found on the transmitter's name plate.	Check that the version is correct on the basis of the data sheet or certificate.
Hersteller	Manufacturer	Device manufacturer (ABB)	
Gerätetyp	Type	Device type (TTX300 series)	
Seriennummer	Serial Number	7-digit or 8-digit serial number of the device electronic unit. This information can also be found on the transmitter's name plate.	
Beschreibung	Description	A user-defined text (optional) that is stored in the device. E.g. additional information about the measuring point.	
Nachricht	Message	A user-defined text (optional) that is stored in the device. E.g. information for maintenance personnel.	

Temperature measurement

Parameter [DE]	Parameter [EN]	Description	Safety instructions
Messart	Measurement Mode	<p>PV measurement mode. Selection depends on selected sensor types 1 / 2:</p> <ul style="list-style-type: none"> • Sensor 1 • Sensor 2 • Difference Sensor 1 – Sensor 2 • Difference Sensor 2 – Sensor 1 • Average Sensor 1 and Sensor 2 • Redundancy Sensor 1 and Sensor 2 • Electr. Sensor 1 (sensor input signal in Ω or mV) • Electr. Sensor 2 (sensor input signal in Ω or mV) • Electronic unit temperature <p>The choice of setting determines which measured variable affects the current output (HART® = 'Primary variable', PV).</p>	Check safety function

... 4 Parameter descriptions

... Temperature measurement

Parameter [DE]	Parameter [EN]	Description	Safety instructions
Sensor 1 / 2: Sensortyp	Sensor 1 / 2: Sensor Type	Sensor type setting for sensor 1 / 2 All sensors are supported in accordance with the data sheet or handbook.	Check safety function
Sensor 1 / 2: Messbereich	Sensor 1 / 2: Range	Physical measuring range for sensor 1 / 2, depending on type of sensor selected.	
Sensor 1 / 2: Anschluss	Sensor 1 / 2: Connection	Type of sensor connection (two-wire, three-wire, or four-wire circuit).	Check safety function
Sensor 1 / 2: Vergleichsstelle	Sensor 1 / 2: Cold junction Compensation	Type of reference junction: No reference No compensation (not used) Internal (internal) Internal (measured inside transmitter) External (external) Stabilized externally using a thermostat Sensor 1 Measured using a resistance thermometer on Channel 1 (only configurable on Channel 2)	Check safety function
Sensor 1 / 2: Temperatur feste Vergleichsstelle	Sensor 1 / 2: Temperature fixed CJ	The temperature of an externally stabilized reference junction is entered here in °C.	Check safety function
Sensor 1 / 2: Leitungswiderstand	Sensor 1 / 2: Line resistance	Line resistance for sensor 1 / 2 if a resistance thermometer is being used or if the sensor type selected is linear resistance measurement with a two-wire circuit.	Check safety function
CvD Datensatz 1 bis 5	CvD data set 1 to 5	Callendar-Van Dusen data set 1 / 2. Coefficients R0, A, B, C	Check safety function
Anwenderspezifische Kennlinie 1 bis 5 Fixed point 1 to 5		User-specific characteristic involving 32 pairs of reference points (X1..32, Y1..32), strictly monotonic increasing or decreasing.	Check safety function
Firmware version 01.01.03 and higher			
Driftüberwachung: aktiv	Drift Monitoring active	Activates sensor drift monitoring.	Check safety function
Driftüberwachung: max. Sensordifferenz	Max Sensor Difference	Value at which sensor drift is signaled if overshoot lasts longer than the limit time period.	Check safety function
Driftüberwachung: Sensordrift Limit-Zeitspanne	Limit / Inhibit Time	Time period during which the max. sensor difference is exceeded before sensor drift is signaled.	Check safety function

Current output / mapping of measuring range

Parameter [DE]	Parameter [EN]	Description	Safety instructions
Einheit	Unit	For selecting the unit of measurement to be used for the PV measurement value (°C, °F, °R, K, mV and Ω). As of SW-Rev 3.00 additionally V and kΩ.	Check safety function
Messbereichsanfang	Range Start	Determine the sensor lower range value (corresponds to 4 mA).	Check safety function
Messbereichsende	Range End	Determine the sensor upper range value (equivalent to 20 mA).	Check safety function
Dämpfung	Damping	Damping of the primary variable using a first-order filter element.	Check safety function
HI_HI Grenze (oberer Grenzwert PV Alarm)	HI_HI Limit (Upper alarm limit PV)	Diagnostics are triggered if the value of the primary variable (PV) exceeds this limit value.	
HI Grenze (oberer Grenzwert PV Warnung)	HI_HI Limit (Upper limit warning PV)	Diagnostics are triggered if the value of the primary variable (PV) exceeds this limit value. The bit set within the diagnostics data remains set even if the HI_HI limit is overshot.	
LO Grenze (unterer Grenzwert PV Warnung)	LO Limit (Lower warning limit PV)	Diagnostics are triggered if the value of the primary variable (PV) drops below this limit value. The bit set within the diagnostics data remains set even if the LO_LO limit is undershot.	
LO_LO Grenze (unterer Grenzwert PV Alarm)	LO_LO Limit (Lower alarm limit PV)	Diagnostics are triggered if the value of the primary variable (PV) drops below this limit value.	
Verhalten bei Fehler	Reaction on Error	Overrange / High Generates a high alarm signal in the event of a sensor or device error; can be configured from 20.0 to 23.6 mA. Underrange / Low alarm Generates a low alarm signal in the event of a sensor or device error; can be configured from 3.5 to 4.0 mA.	Check safety function

Notes

- Regardless of the setting of the alarm, a high alarm or a low alarm is always generated for some device-internal errors (e.g. hardware errors). Detailed information in this regard can be found in the SIL Safety Manual.
- As of SW-Rev. 3.00, the behavior of the alarm current can also be influenced by the NAMUR status configuration for diagnosis notices.

Verhalten bei Wartungsbedarf	Reaction on Maintenance required	Analog alarm pulse signaling with configurable pulse width when sensor maintenance is required (e.g. failure of a sensor in redundancy mode or overshooting of max. sensor drift difference). SW-Rev. 1.01.03 to SW-Rev. 1.03 <ul style="list-style-type: none"> • Off • Pulse width: > 0 to 59.5 s • Pulse period 60 s (not variable) • Continuous From SW-Rev. 3.00 <ul style="list-style-type: none"> • Off • Pulse width: 1 to 127 s • Pulse period: 60 to 86400 s (1 day) • Continuous 	Check safety function
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... 4 Parameter descriptions

... Current output / mapping of measuring range

The primary variable (PV) is mapped onto the current output linearly and within the range of 4 to 20 mA. The mapping limits should be selected in accordance with the application concerned and do not have to lie completely within the sensor's physical measuring range. It is also possible to assign warning and alarm limits to the PV. These are relevant from the point of diagnostics, but will not affect the current output in any way.

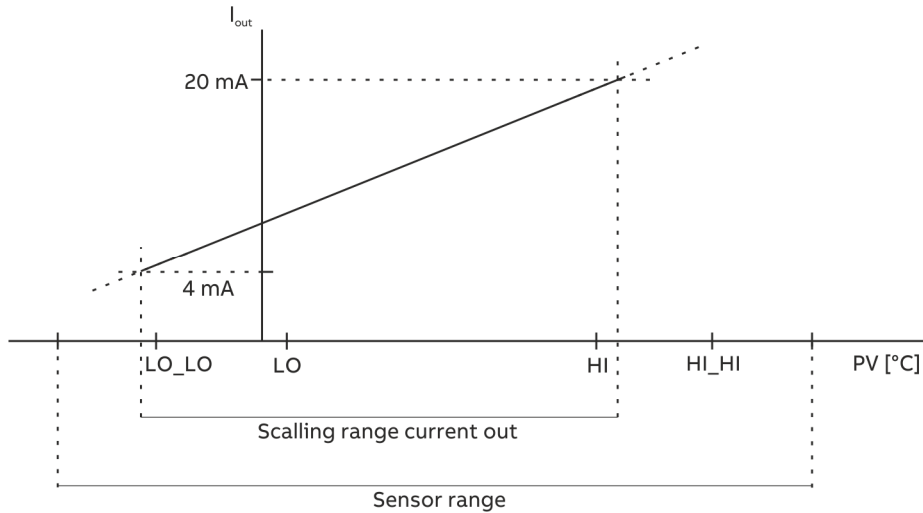


Figure 3: Measuring range

Communication / HART® Protocol Rev. 5

Parameter [DE]	Parameter [EN]	Description	Safety instructions
HART® TAG	HART® TAG	Determine the HART® TAG name. 8 characters, alphanumeric	
Adresse (Multidrop)	Address (Multidrop)	Specifies the communication type: Address = 0 corresponds to HART "Point-to-point communication" operating mode, output signal 4 to 20 mA. Address = 1 to 15 corresponds to HART operating mode 'Multidrop', constant output signal 4.0 mA (as of SW-Rev. 3.00, previously 3.6 mA). Only the digital HART measured values are available.	Check safety function

Miscellaneous

Parameter [DE]	Parameter [EN]	Description	Safety instructions
Werksreset	Factory Reset	Configuration data is reset to the factory setting: Pt100 three-wire circuit, 0 to 100 °C, damping off, overrange. Calibration data (Trim high/low) and DAC adjustment values are also reset to their factory settings.	Safety function for potential risk. All configuration and calibration data is reset to the factory setting. The currently set HART version remains unchanged.
Ab SW-Rev. 3.00 Reset auf Bestellung	From SW-Rev. 3.00 Reset to order	Configuration data is reset to the configuration ordered by the customer (standard or customer-specific configurations). A reset is performed to the trim and calibration values that have been factory set, if applicable.	Safety function for potential risk. All configuration data is reset to the values in accordance with the customer order. The factory set trim and calibration values, if applicable, are once again valid. The currently set HART version remains unchanged.
Gerätereset	Reset / Warm Start	The device performs a restart (warm start). Parameters and configuration data remain unchanged.	

Extensions from HART® Protocol Rev. 7

The following additional functions are supported in HART® protocol rev. 7 and above:

- Reading of dynamic variables with additional status information.
- Reading and writing of the LONG TAG (32 bytes) for unambiguous device identification, even in large installations.
- Easier location of a device in the installation. The message "Squawk" is shown on the display of the device you are searching for.
- Locking of changes to a device via the 'Lock Device' HART® command.
- As of SW-Rev 3.00: device search via 'Find' HART function, HART command #73.

5 Double sensor input functionality / dual sensor mode

Dual HART® measure value signal

As explained in the 'Electrical connections' section of the operating instruction, equivalent resistance sensors or thermocouple sensors (or a combination of the two) can be connected to the transmitter inputs.

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

The 4 to 20 mA analog output maps one sensor value only. Users can choose to map Sensor value 1 or Sensor value 2, the difference between the two, the average or the electronic unit temperature. The value to be mapped is specified during configuration of the transmitter, e.g. via LCD indicator in the "Device setup" menu / "In-output Assignment" submenu. In addition, from SW-Rev. 3.00, this can also be specified via the menu item "In-output Assignment" in the "Easy Setup" menu.

Redundancy / sensor backup

To increase system uptime, TTH300 transmitters have 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) as well as for the thermocouples, or for a mixture of the two. With a mixture of the two, the resistance sensor should be connected to Channel 1 and the thermocouple to Channel 2. Failure of a sensor can be signaled using a configurable alarm pulse.

Up to SW-Rev. 1.03

Sensor redundancy / sensor backup for increased availability

With sensor redundancy (sensor backup), the temperature is always measured between both sensors, and the mean value is derived from that when using identical sensors. This value is provided at the output of the transmitter. If the sensors are different, the measured value from Channel 1 (resistance thermometer) is output.

Should a sensor fail, the temperature measurement for the sensor that remains in operation is smoothly provided at the output of the transmitter.

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

From SW-Rev. 3.00

Extended configuration options are available for redundant operation.

Redundancy behavior can be configured for:

- increased availability (standard factory setting with redundancy),
- increased safety and
- increased accuracy (output of the mean value).

Redundancy behavior	Output behavior (current output behavior)	Assignment of the current output to be set (tools: 'HART mapping')	Redundancy configuration to be set (Tools: 'Parameterization')	Diagnosis notice in accordance with NAMUR NE 107
Increased availability (switchover if sensor defective)	<p>Standard operation: output signal follows Sensor 1</p> <p>Sensor 1 defective: smooth switchover (with soft transition) to Sensor 2. Output signal remains valid.</p> <p>Sensor 1 and Sensor 2 defective: output of the set alarm current</p>	'Redundancy'	'Availability'	<p>Redundancy, S1 not available: 'Maintenance required'</p> <p>Redundancy, S2 not available: 'Maintenance required'</p> <p>Sensor drift detected: 'Maintenance required'</p>
Increased safety (use of drift detection)	<p>Standard operation: output signal follows Sensor 1</p> <p>Sensor 1 or Sensor 2 defective: output of the set alarm current</p> <p>Sensor drift detected: output of the set alarm current</p>	'Redundancy'	'Safety'	<p>Redundancy, S1 not available: 'Failure'</p> <p>Redundancy, S2 not available: 'Failure'</p> <p>Sensor drift detected: 'Failure'</p>
Increased accuracy (through averaging)	<p>Output signal follows the arithmetic average of Sensor 1 and Sensor 2</p> <p>Sensor 1 or Sensor 2 defective: output of the set alarm current</p>	'Mean value'	without relevance	<p>Redundancy, S1 not available: 'Failure'</p> <p>Redundancy, S2 not available: 'Failure'</p> <p>Sensor drift detected: 'Maintenance required'</p>

Relevant diagnosis notices are available via DTM, EDD, the FDI package (FIM) or on the LCD indicator. The meaning of the diagnostic messages in accordance with NAMUR 107 as well as the error messages and options for troubleshooting are described in the operating instruction of the device.

Note

Only the behavior of the current output and the redundancy configuration can be set for the three redundancy behaviors via the HMI LCD indicator with configuration function. The diagnosis notices according to NAMUR NE 107 can only be changed in the tools and remain in the standard factory settings ('Maintenance Required')

... 5 Double sensor input functionality / dual sensor mode

... Redundancy / sensor backup

Sensor or device failure fault signaling at the analog output signal as required by NAMUR NE43 / NE107 guarantees that the transmitter is capable of signaling 'Maintenance required' diagnostic information via both a HART signal and an analog signal, using a high alarm (22 mA) or low alarm (3.5 mA).

'Maintenance required' diagnosis information can be signaled in accordance with NE107 during standard operation with a 4 to 20 mA analog output by superimposing pulses.

Depending on the fault signaling, positive 22 mA pulses are superimposed on the 4 to 20 mA signal in the case of a 22 mA high alarm configuration and negative 3.5 mA pulses are imposed in the case of a 3.5 mA low alarm configuration. The following values can be configured via pulse width parameters:

Up to SW-Rev. 1.03

A pulse width of 0.5 s to 59.5 s (increment 0.5 s) The pulse period is 60 seconds (constant value, non-variable). A permanent signal can be set and pulse output suppression can be implemented.

From SW-Rev. 3.00

- A pulse width of 0 to 127 s, increment 1 s
- Pulse period of 60 to 86400 s (1 day)

The pulse width 0 implements suppression of a pulse (the measured value is constantly indicated). If the pulse width is larger or equal to the period, constant alarm signaling takes place.

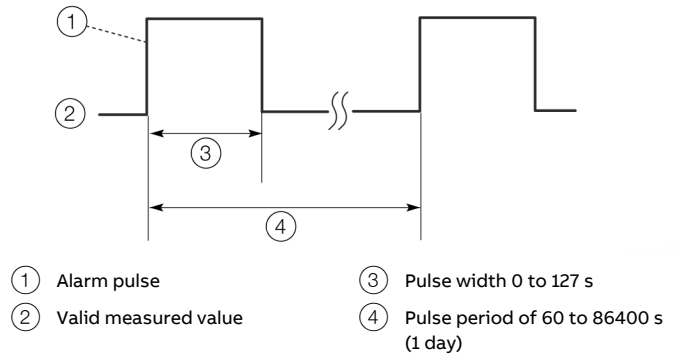
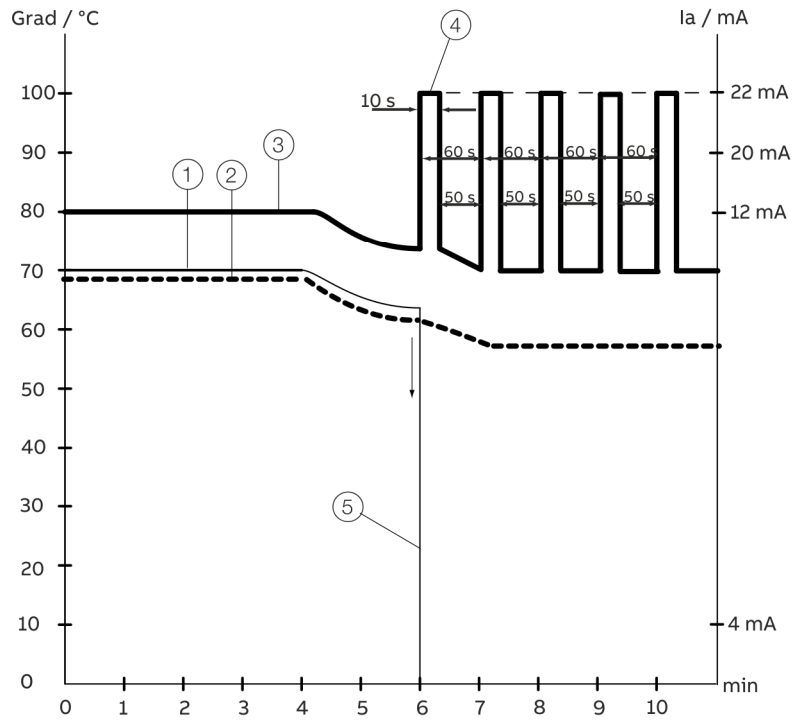


Figure 4: Setting the alarm pulse, from SW-Rev. 3.00

Example:

If a pulse width of 10 seconds and a pulse period of 60 seconds is configured, after a 10-second pulse diagnosis alarm signal of for example 22 mA, the standard temperature signal of 4 to 20 mA is active at the output again for 50 seconds. The next cycle begins with a 10 second diagnosis alarm signal and the standard 4 to 20 mA temperature signal is then displayed at the output again for 50 seconds.



- ① Temperature progression, sensor 1 -----
- ② Temperature progression, sensor 2 —————
- ③ 4 to 20 mA output signal
- ④ Alarm, pulse *
- ⑤ Break, temperature progression 2

* Pulse alarm: off, on → configurable pulse width, continuous pulse

Figure 5: Alarm pulse signaling in redundancy mode for failure of the temperature progression for sensor 2

... 5 Double sensor input functionality / dual sensor mode

Sensor drift monitoring

When two sensors are connected, an optional sensor drift monitoring function can be activated in redundancy mode, in Dual HART® measurement signal mode and during averaging. Sensor drift monitoring and analog diagnosis notice (described in the previous chapter) can only be activated and configured using the Tools.

Sensor drift monitoring can be activated with the following combinations:

- 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, such as 2 minutes, during which the sensor deviation has to constantly exceed the maximum set.

Sensor drift monitoring up to SW-Rev. 1.03

If the transmitter records a larger sensor deviation during the defined time period, a 'Maintenance required' diagnosis information is generated in accordance with NE 107 (Tools and LCD indicator). The 'Maintenance required' diagnosis information is signaled by the device status 'M' and the error-dependent diagnosis code displayed below the measured value on the LCD indicator.

The 'Maintenance required' diagnosis information concerning sensor drift monitoring can also be superimposed on the 4 to 20 mA signal as a pulse alarm signal and signaled in the same way as if a sensor failure had occurred in redundancy mode. In this regard, see also **Redundancy / sensor backup** on page 12.

If drift monitoring is used for the same sensor types (2 × resistance thermometer or 2 × thermocouple), the average 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 resistance thermometer drift monitoring, the resistance thermometer must be connected to Channel 1 and the thermocouple to Channel 2. The measured value from channel 1 (resistance thermometer) is mapped at the transmitter output as a process variable.

Sensor drift monitoring from SW-Rev. 3.00

If the transmitter records a larger sensor deviation during the defined time period, a diagnosis information is generated in accordance with NE 107 (Tools and LCD indicator). A detailed diagnosis with status symbols in accordance with NAMUR NE 107 can be requested via the LCD indicator. By default, a 'Maintenance required' information is preset for this case. The 'Maintenance required' diagnosis information concerning sensor drift monitoring can also be superimposed on the 4 to 20 mA signal as a pulse alarm signal and signaled in the same way as if a sensor failure had occurred in redundancy mode. In this regard, see also **Redundancy / sensor backup** on page 12.

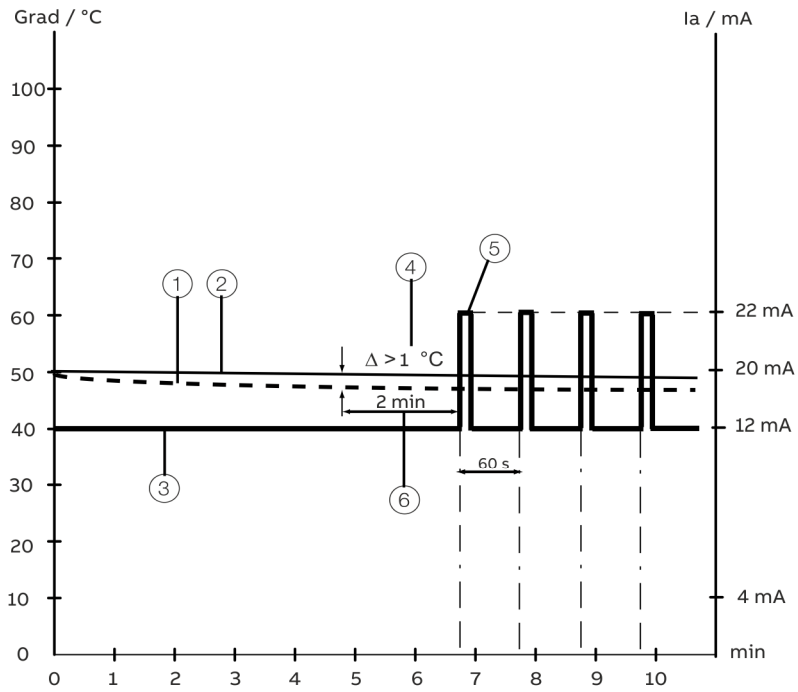
The diagnosis information can be configured through the tools.

If a thermocouple is used for resistance thermometer drift monitoring, the resistance thermometer must be connected to Channel 1 and the thermocouple to Channel 2.

The output signal of the transmitter always corresponds to the configured redundancy behavior, see **Redundancy / sensor backup** on page 12.

Note

Before configuring the maximum permissible sensor deviation for drift detection, it is advisable to balance sensor Channel 2 with the value of sensor Channel 1.



- ① Temperature progression, sensor 1 -----
- ② Temperature progression, sensor 2 _____
- ③ 4 to 20 mA output signal
- ④ Max. sensor drift difference (e.g. $\Delta > 1 \text{ } ^\circ\text{C}$)
- ⑤ Alarm, pulse *
- ⑥ Sensor drift monitoring time period (e.g. 2 min.)

* Pulse alarm: off, on □ configurable pulse width, continuous pulse

Figure 6: Alarm pulse signaling for sensor drift overshoot

6 Sensor error adjustment

For sensor error adjustment, the sensor connected to the transmitter must be brought to the lower range limit value temperature / Trim low using a water quench or oven. It is important to make sure the temperature is balanced and stable.

The sensor error adjustment can be performed in the Tools via the menu path Device settings / Detailed setup / Calibration. Before the adjustment is done, the corresponding adjustment temperature of the sensor should be entered there.

Based on the comparison of the adjustment temperature entered (setpoints) with the digital temperature measured by the transmitter, the transmitter calculates the temperature deviation resulting from the sensor error.

During single-point adjustment, this calculated temperature deviation results in an offset shift of the linear characteristic output by the linearization module.

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

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

Alternatively, the sensor error adjustment can also be performed via the LCD indicator using the operating buttons in the 'Calibrate' menu item (option).

7 D/A analog output adjustment (4 mA and 20 mA Trim)

D/A analog output adjustment is used to compensate for errors in the current input of the higher-level system.

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

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

The D / A sensor error adjustment can be performed in the Tools via the menu path Device settings / Detailed setup / Calibration. Prior to analog compensation, it is necessary to determine the loop current values based on iterative entry of current values in simulation mode; the higher-level I/O system displays exactly 4.000 mA or the lower range limit temperature, and 20.000 mA or the upper range limit temperature. The current loop values must be measured using an ammeter and recorded.

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

After this correction, the AD converter error of the higher-level system is corrected by the DA converter of the transmitter. For the higher-level system, the values of the analog 4 to 20 mA output signal and the digital HART® signal now match.

The adjustment should be repeated when connecting the transmitter to another input of a higher-level system. Alternatively, the D / A analog output adjustment can also be performed via the LCD indicator using the operating buttons in the 'Calibrate' menu item (option).

8 Special functions

The following functions can be executed via the Tools as well as through the optional HMI LCD indicator with configuration function (operating buttons). The exact designations in the various tools can differ from the following description.

Output signal simulation

When activating the output signal - simulation mode in the Tools in menu item 'Loop test' in the menu path 'Device settings / Easy setup', an output signal can be simulated in the range from 3.5 to 23.6 mA (indicator with operating buttons: 'Diagnosis' menu) independent of the sensor value.

Resetting the device

The device can be reset to various settings in the Tools via the menu path 'Device settings / detailed setup / extras' and via the indicator with operating buttons in the 'Service' menu. For additional information on reset data see **Miscellaneous** on page 11.

- **Factory reset**
Configuration data is reset to the factory setting. The currently set HART version remains unchanged.
- **Reset to order (from SW-Rev. 3.00)**
Configuration data are reset to the values in accordance with the customer order. The currently set HART version remains unchanged.
- **Restart device**
The device is restarted without any configuration changes. The restart that follows is comparable with power-down and power-up of the supply voltage.

SIL Check

(From SW-Rev. 3.00 only when device with SIL2 conformity is ordered.

The SIL Check function supports the operator in checking important functional safety parameters for the intended device utilization. It therefore facilitates the implementation of the required described in the SIL Safety Manual.

A check of the current configuration and set device parameters for SIL conformity is performed. The areas checked include the following:

- correct configuration in accordance with NAMUR
- correct operation with
 - HART 5: deactivated HART Multidrop mode
 - HART 7: activated Current Loop mode (loop current 4 to 20 mA)
- correct setting of the alarm current and allocation of HART variables
- correct temperature configuration
- correct setting of redundancy behavior
- The simulation mode must be switched off

The SIL Check function can be executed via the HMI LCD indicator with configuration function and in detail via the Tools or HART commands. Tools: menu path 'Device settings / Detailed setup / Extras'. Indicator with operating buttons: 'Diagnosis' menu. When using the LCD indicator, you obtain a 'passed' or 'not passed'. In the case of a 'not passed' result, a detailed check using a tool is recommended.

Switching the HART version

As of SW-Rev. 3.00 and HW-Rev. 2.00, the HART version is switched in the menus (previously using the DIP switch on the device).

Tools: menu path 'Device settings / Detailed setup / Extras'. Indicator with operating buttons: 'Communication' menu.

Switch the device from HART 5 to HART 7 and the other way around. A device restart is recommended after changing the HART version.

Note

Different drivers (DTMs, EDDs, FDI packages) will be required in the Tools for HART 5 and HART 7!

... 8 Special functions

Configurable diagnosis categorization in accordance with NAMUR NE 107

Configuration of all diagnoses in accordance with NE 107 can be made via Tools as of SW-Rev. 3.00. The following categories can be assigned:

- Failure
- Maintenance Required
- Check Function
- Out of Specification

Active diagnosis of the 'Failure' category results in a configured alarm current (high alarm, low alarm).

Active diagnosis of the 'Maintenance' category results in an alarm pulse signalization, if such signalization is set.

The 'Failure' category has top priority and always results in a configured alarm current.

9 Follow-up / Monitoring

As of SW-Rev. 3.00, the TTX300-HART® transmitter supports the logging of critical events and follow-up of changes in device configuration. Both these monitors can be accessed via Tools:

- Event monitor for the logging of critical events
- Configuration monitor for the logging of configuration changes

The time of the event / change is recorded in all log entries (shown in operating hours of the device, two decimal points).

Event monitor

When the device is reset (reset, restart) or the supply voltage is powered-down and powered-up, the event monitor is emptied and is then available for storing 48 entries. New entries are cyclically written over the oldest entries.

The Event monitor stores the following events:

Setting and resetting of the signalization of:

- Upper limit value PV Alarm (Limit HIGH HIGH), the process temperature is higher than the set alarm value.
- Lower limit value PV Alarm (Limit LOW LOW), the process temperature is lower than the set alarm value.
- Upper limit value PV Warning (Limit HIGH), the process temperature is higher than the set warning value.
- Lower limit value PV Warning (Limit LOW), the process temperature is lower than the set warning value.
- Electronics temperature outside the specified range
- Electronics temperature too high (above the specified value).
- Electronics temperature too low (below the specified value).

Configuration monitor

Changes to the configuration of the device are saved in non-volatile memory. This information is therefore once again available after device reset (reset, restart) or when the supply voltage is powered-down and powered-up. 50 entries can be saved. New entries are cyclically written over the oldest entries. In addition, the value of the current HART Configuration Change Counters is entered.

The following configuration changes can be recorded:

- Sensor configuration change
- Change of the set sensor measuring range
- Change of the NAMUR configuration
- Change of the PV alarm and warning limit values (such as Limit HIGH HIGH)
- Change of the assignment of HART variables (PV, SV, TV and QV)

By default, the listed configuration changes are NOT logged. They can however be released for logging individually in the Tools

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PROFINET International (PI)

Notes

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/temperature

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