Operating Instructions Edition 04/2007

Temperature Transmitter SITRANS TR200/TR300

7NG3032-*JN00 SITRANS TR200
7NG3033-*JN00 SITRANS TR300

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Temperature transmitter SITRANS TR200/TR300

Operating Instructions

7NG3032-*JN00 SITRANS TR200
7NG3033-*JN00 SITRANS TR300

04/2007
A5E01071992-01

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Automation and Drives
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Ordernumber: A5E01071992
℗ 07/2007

Table of contents

Introduction

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1.1 Purpose of this documentation

These instructions contain all the information you need for commissioning and using the device.

It is aimed both at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

1.2 History

The following table shows the most important changes in the documentation compared to each previous edition:

Edition	Remark	Firmware identification type plate	System integration	Installation path for PDM
01 04/2007	First edition	FW: 01.01.05	TR200: SIPROM T V1.2.0 TR300: PDM V6.0 DD Rev. 1.00	TR200: Not applicable TR300: SITRANS TR300

1.3 Further information

Information

The contents of these instructions shall not become part of or modify any prior or existing agreement, commitment or legal relationship. All obligations on the part of Siemens AG are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. Any statements contained herein do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of printing. We reserve the right to make technical changes in the course of further development.

Worldwide contact person

If you need more information or have particular problems which are not covered sufficiently by the operating instructions, get in touch with your contact person. You can find contact information for your local contact person in the Internet.

Product information on the Internet

The Programming Manual is an integral part of the companion CD, which may be ordered separately. In addition, the Programming Manual is available on the Internet on the Siemens homepage.

On the CD you will also find the technical data sheet containing the ordering data, the Device Install software for SIMATIC PDM for subsequent installation and the required software.

See also

Contacts (http://www.siemens.com/processinstrumentation/contacts)

Product information on SITRANS T in the Internet (http://www.siemens.com/sitranst)

Instructions and Manuals (http://www.siemens.com/processinstrumentation/documentation)

General safety notes

2

2.1 General information

This device left the factory free from safety problems. In order to maintain this status and to ensure safe operation of the device, please observe the safety information and warnings contained in these instructions.

2.2 Correct usage

The device may only be used for the purposes specified in these instructions.

Insofar as they are not expressly stated in these instructions, all changes to the device are the sole responsibility of the user.

2.3 Qualified Personnel

Qualified personnel are people who are familiar with the installation, mounting, commissioning, and operation of the product. These people have the following qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures and aggressive as well as hazardous media.
- For explosion-proof devices: They are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in maintenance and use of appropriate safety equipment according to the safety regulations.
- They should be trained in first aid.

2.4 Measures

For the sake of safety, the following precautions must be observed:

⚠ WARNING

"Intrinsically safe" protection type

"Intrinsically-safe" devices lose their certification as soon as they are operated on circuits which do not correspond with the test certification valid in their country. The device's protection level "ia" is reduced to "ib" when intrinsically safe electrical circuits with protection level "ib" are connected.

Protection type "limited energy" nL (zone 2)

Devices with "limited energy" may be connected and disconnected while in operation.

Protection type "non-sparking" nA (zone 2)

Devices with "non-sparking" protection may only be connected and disconnected when off circuit.

⚠ CAUTION

Electrostatic Sensitive Devices (ESD)

This device contains electrostatic sensitive devices. Electrostatic sensitive devices may be destroyed by voltages that are undetectable to a human. Voltages of this kind occur as soon as a component or an assembly is touched by a person who is not grounded against static electricity. The damage to a module as a result of overvoltage cannot usually be detected immediately. It may only become apparent after a long period of operation.

2.5 Laws and directives

The regulations of the test certification valid in your country are to be observed.

Electrical connection in hazardous zones with explosive atmospheres

The national directives and laws for hazardous areas valid in your country must be observed for electrical connection. For example, in Germany these are:

- Operational safety regulations
- Directive for the installation of electrical systems in hazardous areas DIN EN 60079-14 (previously VDE 0165, T1)

Description

3

3.1 Application range

The SITRANS TR200 and SITRANS TR300 temperature transmitters are 2-wire devices for DIN rail installation. They are suitable for use in all sectors, thanks to their universal sensor input and type of installation. The following sensor and signal sources can be connected to their input stage:

- Resistance thermometer
- Thermocouples
- Resistance-type transmitter/potentiometer
- DC voltage sources

The output signal is an output current of 4 to 20mA that corresponds to the sensor characteristic curve.

Explosion-proof transmitters can be installed and operated within hazardous area in accordance with the information on the EC type examination certificate to ATEX and these operating instructions.

3.2 Product features

- Transmitter with two-wire technology
- Installation on a DIN rail to DIN EN 50022
- The transmitters are freely programmable, for example their sensor activation and measuring range.
  - SITRANS TR200 with a special modem in connection with the SIPROM T software
  - SITRANS TR300 via the HART protocol
- Electrical isolation
- Intrinsically safe version for use in a zone 1 hazardous area, non-sparking and energy limited equipment in a zone 2 hazardous area
- Two additional test pins for connecting a multimeter make it possible to measure the current signal without interrupting the current loop.
- Status reporting: LED green or red
- Special characteristic curve
- Diagnostic functions of the SITRANS TR300: Min/max pointer, runtime meter, simulation

3.3 Structure of the type plate

The type plate is located on the housing and carries the order number and other important product information.

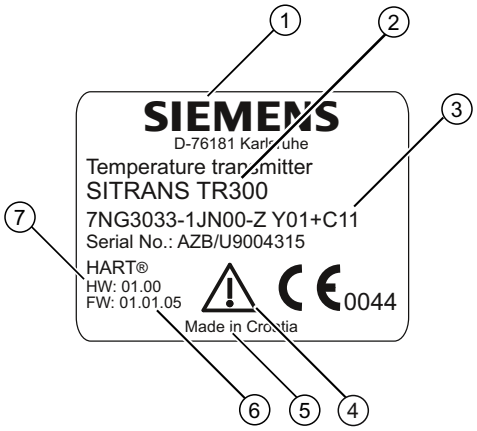

Figure 3-1 Layout of a type plate: SITRANS TR300 example

①	Manufacturer	⑤	Place of manufacture
②	Product name	⑥	Firmware revision
③	Order no.	⑦	Hardware revision
④	Pay attention to the operating instructions		

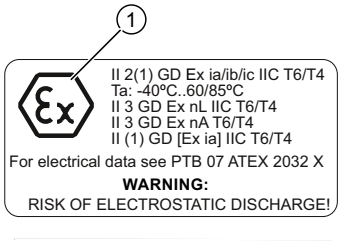

Figure 3-2 Layout of an Ex plate

① Ex marking with EX data

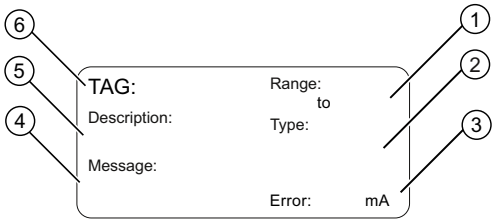

Figure 3-3 Customer-specific plate, blank

①	Measurement range	④	Message
②	Sensor type	⑤	Description
③	Error signal	⑥	Marking (TAG)

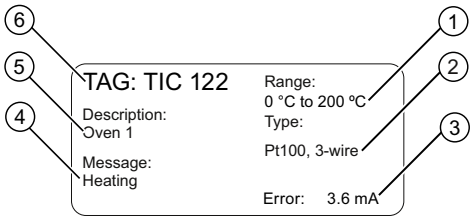

Figure 3-4 Example of customer-specific plate, filled out

①	Measurement range	④	Message
②	Sensor type	⑤	Description
③	Error signal	⑥	Marking (TAG)

3.4 Operating principle

The mode of operation of the transmitter is explained below, using the function block diagram.

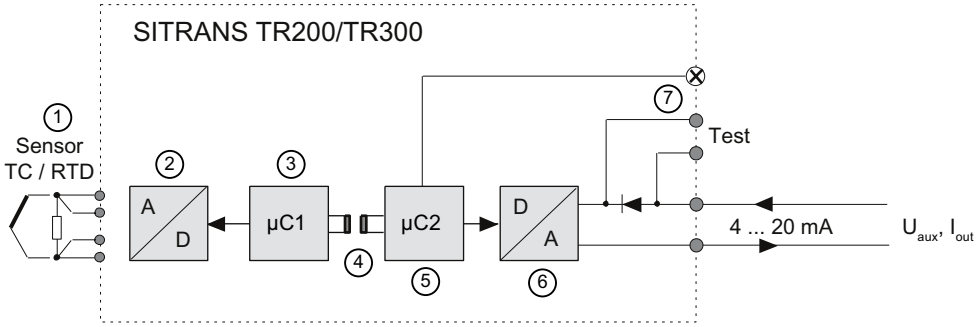

Figure 3-5 SITRANS TR200/TR300 function block diagram

①	Sensor such as resistance thermometer, thermocouple, resistance-type transmitter, millivolt transmitter
②	Analog-to-digital converter
③	Microcontroller, secondary side
④	Electrical isolation
⑤	Microcontroller primary side
⑥	Digital-to-analog converter
⑦	LEDs
U_{aux}	Auxiliary power supply
I_{out}	Output current
Test	Test terminals for temporary connection of an amperemeter

Mode of operation of transmitters

- The sensor ① supplies an electrical signal.
- This signal is converted to a digital signal in an analog-to-digital converter ②.
- The digital signal is evaluated in a secondary-side microcontroller ③ and corrected to match the sensor characteristic curve.
- The signal is transferred across the electrical isolation ④ to the primary-side microcontroller ⑤.
- The analog output value is computed in the primary-side microcontroller ⑤. The functional status is indicated by LED ⑦ and the communications data prepared.
- Then the digital-to-analog converter ⑥ converts the signal into the output current of 4 to 20 mA.
- The auxiliary power supply source is located in the output signal circuit.

3.5 Communication

3.5.1 Overview

SITRANS TR200

This device version does not have an interface to HART. Setting the parameters of the SITRANS TR200 is only possible in the "Offline" state using the modem for SITRANS TH100/TH200/TR200.

SITRANS TR300

The device has a parameter assignment interface according to the HART specification. This parameterization interface permits access to all the functions of the device via a HART modem or a HART communicator. Connect the HART modem or a HART communicator as shown in the diagram "HART communication with supply from a voltage source".

⚠ WARNING

Only intrinsically safe HART modems or HART communicators are allowed to be operated in the intrinsically safe area or on intrinsically safe circuits.

See also

HART communication with supply from a voltage source (Page 17)

3.5.2 HART communication with supply from a voltage source

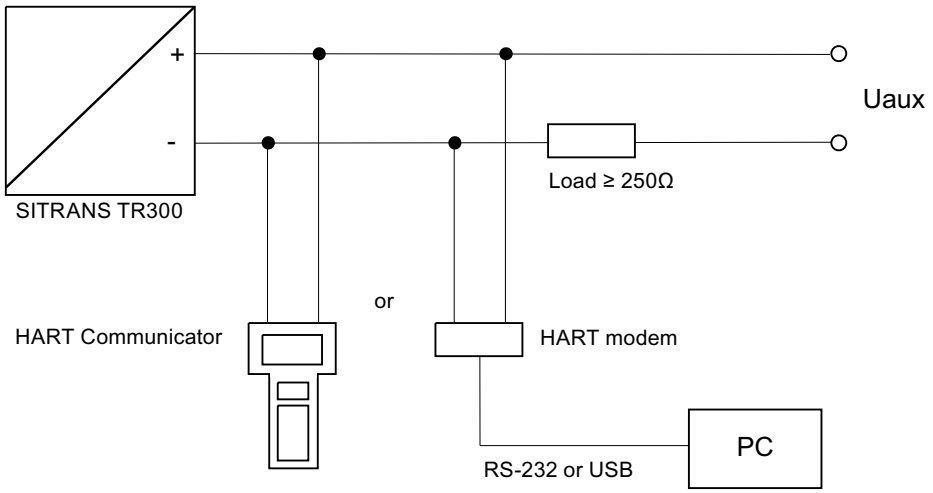

Figure 3-6 HART communication with supply from a voltage source

3.5.3 HART communication with supply from a feed splitter

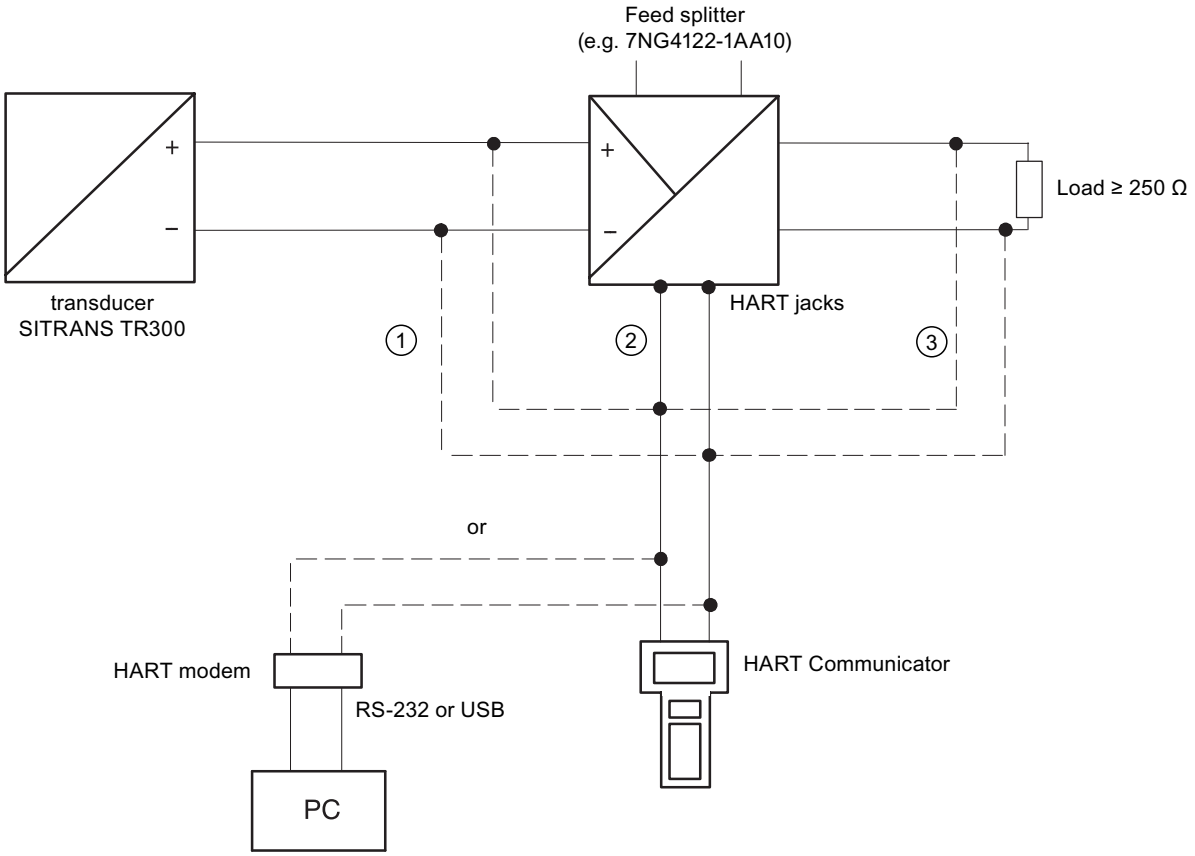

Figure 3-7 HART communication with supply from a feed splitter

①	Only intrinsically safe HART communicators or HART modems are allowed to be used with an intrinsically safe supply.
②	HART communication via the HART jacks of the feed splitter
③	Load ≥ 250 Ω is relevant only if HART communication is performed via this branch. Otherwise for variant ① or ② load 0 to 650 Ω

Installation

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The transmitter is secured to a 35 mm DIN rail to DIN EN 50022.

Comply with the ambient conditions specified in the technical data.

⚠ WARNING

Hazardous areas

- Gas hazardous area:
  - The enclosure has IP20 degree of protection. In this way installation for 'intrinsically safe' mode can be achieved without any additional enclosure, providing the supply itself is intrinsically safe.
  - For nL and nA modes, use a suitable protective enclosure / terminal box which satisfies at least IP54 degree of protection.
- Dust hazardous zone:
  For use in a dust hazardous zone, install in a suitable metal protective enclosure / terminal box which satisfies at least IP6X degree of protection.

CAUTION

Electromagnetic Compatibility

If the sensor is installed outside closed buildings, the function of the device must be checked following a lightning strike.

Connecting

5

5.1 General connection information

⚠ WARNING

The regulations of the test certification valid in your country are to be observed.

Electrical connection in hazardous areas

The national directives and laws for hazardous areas valid in your country must be observed for electrical connection. In Germany these are, for example:

- Safe working regulations
- Directive for the installation of electrical systems in hazardous areas, DIN EN 60079-14 (previously VDE 0165, T1)
- The EC-type examination certificate

Where a auxiliary power supply is required, check to ensure that it corresponds with that on the type plate and with the test certification valid for your country.

- Sensor connection
- Auxiliary power supply:
  Connect the wires for the auxiliary power supply to terminals "3 (+)" and "4 (-)" as shown in the figure in chapter Auxiliary power supply/current loop 4 to 20 mA and test terminals (Page 24), ensuring that the polarity is correct. The device is reverse polarity protected. i.e. if polarity is reversed the device will not work but will not be damaged.
- Test terminals (Test):
  Connect the amperemeter to the two test terminals "1 (+)" and "2 (-)" as shown in the figure in chapter Auxiliary power supply/current loop 4 to 20 mA and test terminals (Page 24). The 4 to 20 mA output current can now be checked.
- Connection cable:
  - Max. cable cross-section 2.5 mm^2.
  - Lay the signal cable segregated from cables with voltages > 60 V.
  - Use cables with twisted wires.
  - Either avoid running cables close to large electrical plant or use screened cables (if used under NE21 conditions there is no need for cables to be screened).

5.2 Connector pin assignment

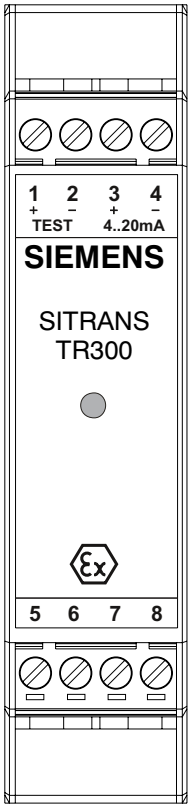


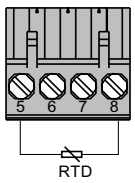
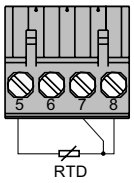
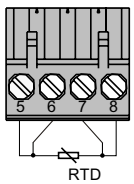
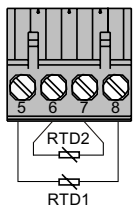
Figure 5-1 Connector pin assignment SITRANS TR200/TR300

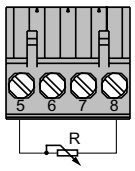
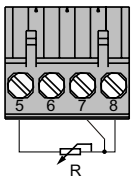
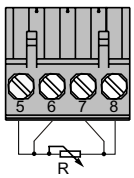
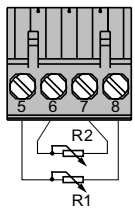
Ports

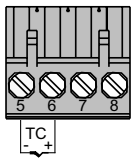
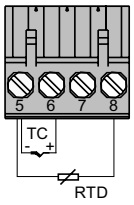
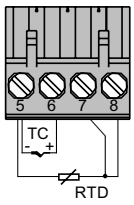
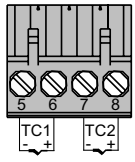
1 (+) and 2 (-)	Test terminals (test) for measuring the output current using an amperemeter
3 (+) and 4 (-)	Auxiliary power supply U_{aux}, output current I_{out}
5, 6, 7 and 8	Connection of sensors, see terminal diagrams SITRANS TR200/TR300 (Page 23)

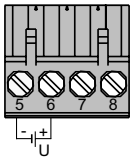
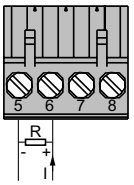
5.3 Terminal diagrams SITRANS TR200/TR300

5.3.1 Sensor/input

Resistance thermometer			
			
Two-wire input [1]	Three-wire input	Four-wire input	Calculation of mean value/ differential value [1]
[1] Line resistance to the correction can be programmed			

Resistance-type sensor			
			
Two-wire input [1]	Three-wire input	Four-wire input	Calculation of mean value/ differential value [1]
[1] Line resistance for correction is programmable.			

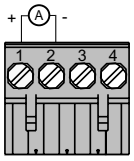
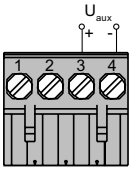
Thermocouple			
			
Cold junction compensation/fixed value	Cold junction compensation with external Pt100 in two-wire input[1]	Cold junction compensation with external Pt100 in three-wire input	Calculation of mean value/ differential value with internal cold junction compensation
[1] Line resistance for correction is programmable.			

Voltage measurement	Current measurement
	

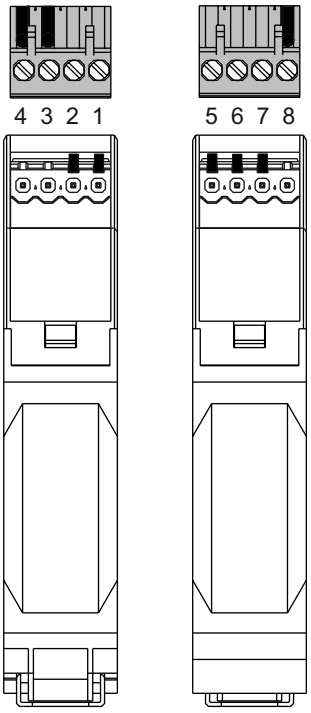
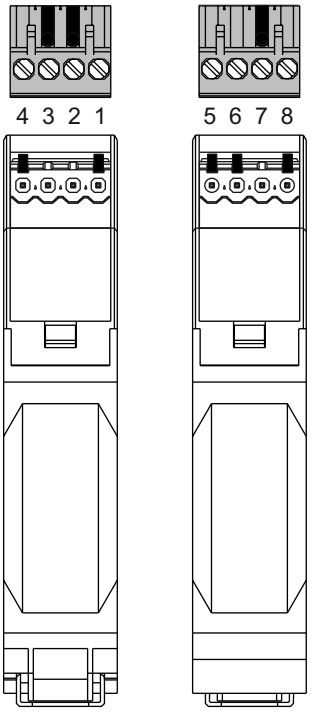
See also

Connector pin assignment (Page 22)

5.3.2 Auxiliary power supply/current loop 4 to 20 mA and test terminals

Test terminals (Test)	Auxiliary power supply connection/4 to 20 mA (U_{aux})
	

5.3.3 Coding profiles

Coding profile for SITRANS TR200/TR300 with protection against explosions (intrinsically safe)	Coding profile for SITRANS TR200/TR300 without protection against explosions
	
MLFB: 7NG303*-1JN00	MLFB: 7NG303*-0JN00

5.4 Connection in hazardous areas

⚠ WARNING

When installing the device in hazardous areas, use housings with the degree of protection corresponding to the inspection certificate valid in your country. Observe the specifications of the EC-type examination certificate or the inspection certificate valid in your country.

The bus input circuit and sensor circuit are galvanically isolated and tested with a test voltage of AC 500 V/1 minute. According to the intrinsic safety rules of explosion protection, the requirements for separating the bus input circuit from the ground are met.

The electrical isolation does not satisfy the requirements for an "Infallible electrical isolation" in the sense of intrinsic safety standards EN 50020 and IEC 60079-11. In every case be sure to comply with the locally applicable regulations for installation of electrical equipment in hazardous areas. In Europe, these are the standard EN 60079-14.

Use only cable entries and covers that are approved for the relevant use.

At an ambient temperature ≥ 60°C, use heat-resistant cables approved at least for an ambient temperature at least 20 K higher.

Zones 0 and 1

- Only connect the transmitter to devices that are certified as intrinsically safe in accordance with the EC-type examination certificate. Be sure to comply with the parameters and limits listed there.
- If the connection head is made of aluminum, the requirements of EN 50284, section 4.3.1 must be observed for uses where the device category 1 G is required.

Zone 2 in nL type of protection - Limited energy

- Install the transmitter in a housing meeting the protection IP54 to EN 60529, e.g. in a type B connection head to DIN 43729.
- Only connect the transmitter to the following devices:
  - Devices that are certified as intrinsically safe in category 1 or 2.
  - nL-certified devices (limited energy) in category 3.
- The maximum permitted input voltage is U_i = DC 30 V. The relevant permitted values for external capacitance and inductance must be adhered to.

Zone 2 in type of protection "nA" - non-sparking

- Install the transmitter in a housing meeting the protection IP54 to EN 60529, e.g. in a type B connection head to DIN 43729.
- Adhere to the conditions for installers applicable to this type of protection.
- The maximum approved input voltage is U_m = DC 32 V.
- Take measures to ensure that the supply voltage does not rise above 40% of the rated voltage.

Additional requirements for use in dust explosion protected areas

- Only use the transmitter in a potentially explosive atmosphere with flammable dust when the following points are ensured:
  - The transmitter is installed in a form B metal head in accordance with DIN 43729. The metal head must have a protection of at least IP6X in accordance with EN 60529.
  - The transmitter is approved for use in an explosive atmosphere with flammable dust.
- For a dust layer up to 5 mm thick a surface temperature of the housing 20 K above the ambient temperature is permissible.
- If the transmitter is used in a potentially explosive atmosphere consisting of an air/dust mixture and the housing used is made of aluminum, observe the requirements from chapter 6.2.1 of IEC 61241-0.

5.5 Notes on measuring current

If you use the transmitter for measuring current, connect an external measuring resistor R across the transmitter connection terminals 5 and 6. The transmitter uses this resistor to perform the required current measurement as a voltage measurement. Therefore, the following instructions must be complied with in the parameter assignment software SIPROM T for SITRANS TR200 and SIMATIC PDM or HART communicator for SITRANS TR300:

- Sensor class selection = Millivolt transmitter
- Process value scale: Multiply each of the start of scale value and end of scale value for desired current range with the value of the resistor R that is connected externally across terminals 5 and 6 of the transmitter.
- **Example:** Measurement of a 0 to 20 mA current via an external resistor R of 10 Ohm
  sensor class = millivolt transmitter
  process value scale:
  - *Start of scale value = 0 mA · 10 Ω = 0 mV*
  - *Full scale value = 20 mA · 10 Ω = 200 mV*

  The 4 to 20 mA output current now follows the profile of the sensor input, i.e. the 0 to 20 mA current signal.

If during current measurement the measured values are called up via the digital interface, such as HART for SITRANS TR300, the measurement data are shown in the operating software as voltage signals mV units. The voltage signals are scaled by the factor of the externally connected resistance value R.

5.6 LED operating indicator

- Operating indicator does not light: no supply voltage
- Constant green light: Everything OK, normal error-free operating status
- Constant/flashing red light: incorrect operation
  - Flashing (approx. 2 Hz) red: Indication of faults independent of the device, e.g. broken wire, sensor short circuit, transgression of the sensor limits
  - Constant red light: Indication of errors in the device, such as **RAM, ROM, EEPROM, CHECKSUM, WATCHDOG, STACK errors** or when exceeding or dropping below the permissible ambient temperature

5.7 Test terminals for output signal

The "Test +" and "Test -" test terminals are used for checking the 4 to 20mA current with an amperemeter. The voltage drop across the amperemeter must not exceed 0.4V for a 23mA output current.

Commissioning

6

Adjust the transmitter operating data to the requirements of the actual measurement duty. Make sure that the operating data match the type plate data.

Proceed as follows

1. Install the transmitter on a DIN rail to DIN EN 50022.
2. Connect the sensor and the auxiliary power supply as described in the SITRANS TR200/TR300 terminal diagrams (Page 23).
3. Turn on the auxiliary power supply.
4. Wait until the operating mode display LED lights up.

The transmitter operates after the operating mode display LED lights up.

Note

To obtain stable measured values, the transmitter needs to be allowed to warm up for five minutes or so after the power supply is switched on.

Operation

7

7.1 Operating and parameterizing the SITRANS TR200/TR300

Operation and parameterization

The SITRANS TR200 and SITRANS TR300 are operated and parameterized using a PC. The PC is connected to the two-wire line using a suitable coupling module. The SITRANS TR300 can also be parameterized using a HART communicator. The signals needed for SITRANS TR300 communications in accordance with the HART protocol are superimposed on the output current in accordance with frequency shift keying. Frequency shift keying is also abbreviated to FSK.

Measurement transmitter and parameterization data are stored in non-volatile memory.

7.2 Operating the with SITRANS TR200 PC/laptop and modem

NOTICE
Parameters may only be assigned to the SITRANS TR200 in the "offline" state using the parameter assignment modem and the SIPROM T operating software. Any 4 to 20mA current loop connected to the transmitter needs to be disconnected before parameters are assigned.

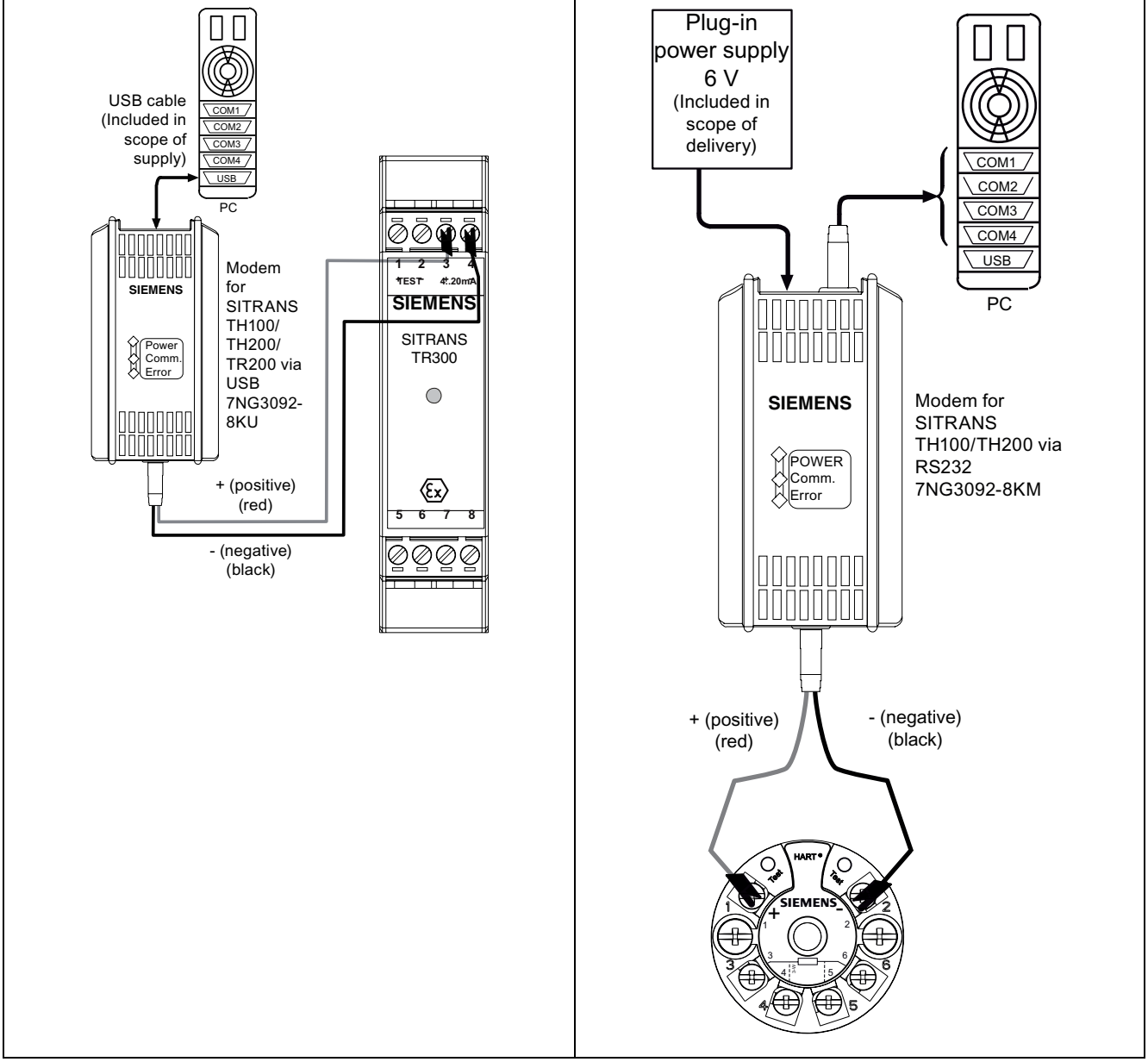
Proceed as follows

- For parameterization, connect the transmitter to the PC via the modem.
- Use the SIPROM T parameterization software to configure the transmitter.

The power required by the transmitter is provided via:

- the USB interface of the PC if using a USB modem
- an external plug-in power supply if using an RS232 modem

SITRANS TR200 parameterization using a USB modem	SITRANS TR200 parameterization using an RS232 modem



Note

After parameterization of the SITRANS TR200, switch off the power supply to the transmitter only after the LED on the device flashes red or lights up green and remains lit.

For detailed information on the parameterization of the transmitter, refer to the operating instructions for the following products:

- Modem for SITRANS TH100/TH200/TR200 and the SIPROM T parameterization software; order numbers: 7NG3092-8KM and 7NG3092-8KU
- "sitrans t - temperature transmitters" CD, order number A5E00364512

7.3 SITRANS TR300 operation

7.3.1 Operation using a HART modem and SIMATIC PDM

The transmitter can be operated and parameterized with the PC, using the SIMATIC PDM parameter assignment software and a HART modem.

Commissioning procedure

- For this, connect the HART modem to the output circuit.
- The transmitter power supply must be operational.
- The load in the circuit must be at least 250 Ω, refer to the circuit diagram in chapter HART communication with supply from a voltage source (Page 17)
- Operation is via the SIMATIC PDM parameterization software.

7.3.2 Operation with HART communicator

Action buttons

This button switches the HART communicator on and off. After switch-on, the hand-held terminal automatically establishes communication with the transmitter. The online menu appears on the display.

This button moves the cursor up through the menu bar. The selected menu line is indicated.

This button moves the cursor down through the menu bar. The selected menu line is indicated.

This button moves the cursor to the right through the menu bar or branches into a subroutine. The name of the selected subroutine is displayed at the top edge of the display.

This button moves the cursor to the left through the menu bar or exits a subroutine.

Function keys

Function keys F1 to F4 are located below the digital display. The various functions of the keys in the individual menus are displayed on the bottom edge of the display.

Alphanumeric button and shift buttons

Alphanumeric values can be entered using these buttons. The function (number or letter button) depends on the menu in question. Letters are selected by confirming the corresponding shift button first.

Refer to the operating instructions of the HART communicator for further information about operation and technical data.

Functions

8

8.1 General information

You can operate the SITRANS TR300 using either the SIMATIC PDM parameterization software or the HART communicator. You can operate the SITRANS TR200 using the SIMATIC PDM parameterization software.
The following functions are available to you when operating the SITRANS TR300/TR200:

- Identification
  - Information on operational safety: Day, description, message, assembly number
- Device data; this information is read-only
  - Manufacturer and product name
  - Order number, device serial number
  - Revision numbers for the firmware and hardware revision
- Information about the measuring procedure
  - Sensor class and sensor type, e.g. Pt100 resistance thermometer or thermocouple type B
  - Sensor factor
  - Sensor characteristic curve, e.g. linear temperature
  - Measuring range and measuring unit
- Information on measurement interface
  - Type of interface: standard, differential or mean value circuit
  - Type of connection/sensor connection: two-wire, three-wire or four-wire connection with resistance-type transmitters
  - Resistors for line compensation
  - Offset to the measuring signal
  - Additional information for the cold junction in thermocouples: internal, external or fixed
  - Enable/disable the broken wire or short circuit test
- Information about the output signal
  - Filter time constant for noise suppression attenuation
  - Output limit values: alarm and saturation limits
- Certificates and approvals

  - The following information is read-only: Information whether the transmitter may be operated in intrinsically safe mode or not. This function can only be performed using the SIMATIC PDM parameterization software or with the HART communicator.

- Free material parameters: Fields for more detailed description of the sensor that is connected
  - Type of the sensor
  - Composition of the protective tube
  - Length of the protective tube
  - Screw thread / installation flange
  - Supplier / manufacturer
  - F no. of sensor
  - Order no.
- Further parameterizable functions are:
  - Slave pointer functions
  - Sensor calibration function with selectable trimming range within the limits of the measuring range
  - Calibrating the analog output: for SITRANS TR200 from 4 to 16 mA, for SITRANS TR300 from 4 to 20 mA
  - Factory reset: Resetting the operating data to the factory settings
  - Simulation of measurement input. Only for SITRANS TR300: Electronic temperature and analog output.

The operating data is stored in a non-volatile memory (EEPROM).

8.2 Broken wire monitoring

Broken wire monitoring on a specific measurement channel can be performed for thermocouples and millivolt transmitters. Break monitoring is permanently active in resistance thermometers and resistance-type transmitters. No reference temperature of the internal sensor which measures the electronics temperature can be obtained if there is a broken wire.

When broken wire monitoring is switched on, all sensor cables are permanently monitored for broken wires. The programmed fault current, 3.6mA to 23mA, is output in the event of an error.

Note

If a broken wire occurs when broken wire monitoring is switched off, invalid values may be obtained for the measured value and the internal electronics temperature in the min/max pointer pairs and their runtime meters.

8.3 Short-circuit monitoring

Short circuit monitoring on a specific measurement channel is only possible with resistance thermometers and resistance-type transmitters. The threshold value for the short circuit check can be set in the parameters.

The programmed fault current, 3.6mA to 23mA, is output in the event of a sensor short circuit.

8.4 Line compensation

Trimming the line resistance values can be performed in the following measurements:

- Resistance thermometer or resistance-type transmitter in two-wire connection
- Resistance thermometer or resistance-type transmitter for calculating differential value or mean value
- Thermocouple with external cold junction with Pt100 in two-wire connection

The trimming is performed by numerical preset of the measured line resistance. The line resistance is the combined total of sending and return conductors.

8.5 Type of characteristic curve (rising or falling)

The type of the characteristic curve at the 4 to 20 mA analog output can be selected (rising or falling). The characteristic curve type is defined as follows by setting the parameters for the start of scale value and full scale value:

- Rising characteristic: Full scale value is greater than start of scale value.
- Falling characteristic: Full scale value is less than start of scale value.

8.6 Measured value offset

An offset response on a specific measurement channel can be set in the parameters for applications in which the process variable to be measured cannot be measured directly at the measuring point.

8.7 Sensor factor

The sensor factor is used for adapting the characteristic curve when resistance thermometers and thermocouples are connected in series or in parallel. You must multiply the sensor factor with the basic series of the resistance thermometer or thermocouple. Values from 0.25 to 10.0 can be set as the scaling factor in resistance thermometers, while values from 1 to 10 can be set for thermocouples.

Example: 3 x Pt500 parallel: Sensor factor= 5/3 = 1.67 (basis is Pt100)

8.8 Cold junction compensation with thermocouples

When measuring the cold junction of a thermocouple you can choose between the following types of connection for the resistance thermometer:

Either use the built-in Pt100 or an external Pt100, which is necessary if the measuring point of the cold junction is remote from the temperature transmitter.

The following cold junction compensation variants can be selected:

- Internal: In this case, the thermocouple or the compensating line is directly connected to the transmitter. The cold junction temperature is obtained by an internal Pt100.
- External with fixed value: Specify the external cold junction temperature, e.g. of a thermostat as the fixed value. The transmitter then compensates according to this constant cold junction temperature.
- External with Pt100: In this variant an external Pt100 measures the cold junction temperature. You can connect the Pt100 to the transmitter with a two-wire or three-wire connection. Cold junction compensation takes place using the actual temperature of the external Pt100.

8.9 Calculation of differential value/mean value

The differential value and mean value connection interfaces have the following special features compared to the standard interface:

Setting start of scale value and end of scale value:

- Firstly enter the start of scale value and end of scale value for both individual sensors. The start of scale value and end of scale value are thus the same for both sensors. You cannot parameterize different measuring ranges for individual sensors. Tip: Use the largest measuring range.
- Then assign the parameters for the start of scale value and end of scale value for the differential value and mean value measurement.

Sensor calibration:

- Trim the sensor to the respective measuring range limits for the two individual sensors. The differential value and mean value set in the parameters cannot be trimmed.

8.10 Electrical damping

You can set the filter time constant of electrical damping to a point within a range from 0 to 30 s.

8.11 Current transmitter function (only for SITRANS TR300)

You can use this function to switch the transmitter into constant current mode for test purposes. In that case, the output current no longer corresponds to the process variable.

8.12 Alarm current

You can use this function to set the value of the alarm current. The alarm current signals a sensor fault or a hardware/firmware fault.

The value of the alarm current can be freely selected within the preset limits of the current control range, 3.6mA to 23mA. The upper and lower limits of the linear control range can also be freely selected within the preset limits of the current control range, 3.6mA to 23mA.

The following diagram shows an example. The specified accuracy values of the output signal only apply to the corresponding nominal ranges.

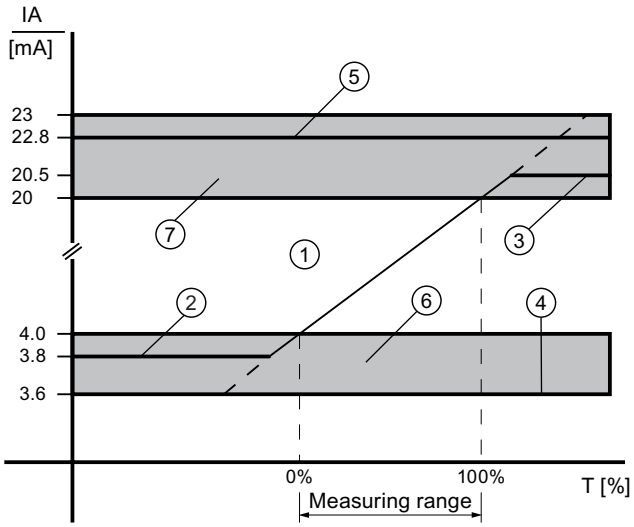


Figure 8-1 Current limits for output signal 4 to 20mA

① Linear control range
② Lower limit of the control range (default value = 3.84 mA)
③ Upper limit of the control range (default value = 20.5 mA)
④ Lower fault current value (default value = 3.6 mA)
⑤ Upper fault current value (default value = 22.8 mA)
⑥ Recommended setting range for lower fault current range and lower control range limit
⑦ Recommended setting range for upper fault current range and upper control range limit

8.13 Sensor calibration

8.13.1 Sensor calibration (one point)

This function allows the characteristic curve of the sensor that is connected to be shifted to intersect the zero point. This allows calibration of the start of scale value of the input sensor. This does not affect the measuring span.

Entering a one point trim is equivalent to entering a sensor offset. The result of the one-point trim is saved in the "offset sensor" variables.

8.13.2 Sensor calibration (two point)

This function allows the characteristic curve of the sensor that is connected to be shifted to intersect two calibration points. The results are then correct measured values at the sensor trim points. A two point trim makes it possible to reduce the proportion of errors due to the characteristic curve.

Trimming the lower sensor calibration point

With these function:

- Apply the process variable on which the lower sensor calibration should be performed is applied, e.g. temperature or resistance, to the transmitter input.
- Use the operating software to command the transmitter to load this process value. SITRANS TR200 uses SIPROM T operating software, SITRANS TR300 uses SIMATIC PDM operating software or the HART communicator.

Loading the process value represents an offset shift of the characteristic curve, see B, in the "Sensor calibration" diagram.

Trimming the upper sensor calibration point

With these function:

- Apply the process variable on which the upper sensor calibration should be performed is applied, e.g. temperature or resistance, to the transmitter input.
- Use the operating software to command the transmitter to load this process value.

Loading the process value represents a slope correction of the characteristic curve, see C, in the "Sensor calibration" diagram. The lower sensor trim point is not affected by this.

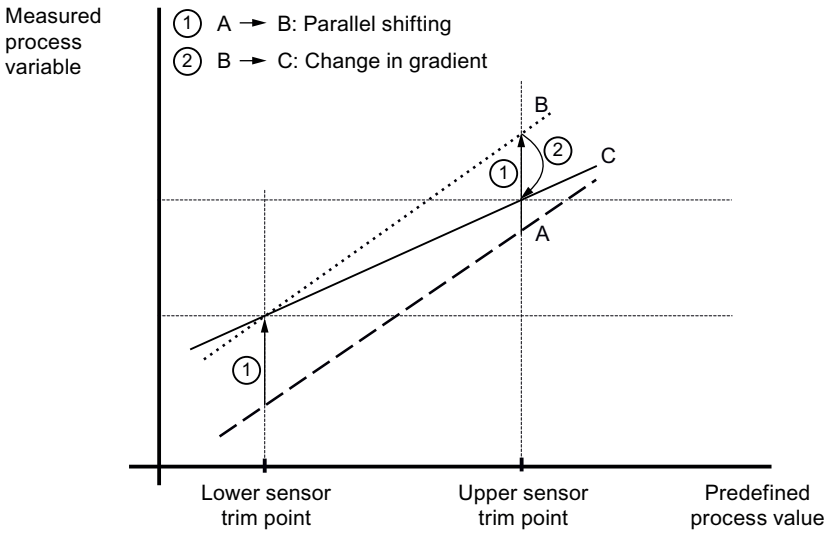


Figure 8-2 Sensor calibration

O	Output characteristic
B	Characteristic curve after lower sensor trim
C	Characteristic curve after upper sensor trim

Note

If any of the following device parameters is changed by re-parameterization, a two point sensor calibration of SITRANS TR200/TR300 performed specifically for a customer is automatically reset:

- Sensor class
- Sensor type
- Interface
- Sensor connection
- Sensor factor

A double point sensor calibration performed by the user is also reset if the device is restored to its factory settings.

The sensor calibration can be performed both for measurement channel 1 and for measurement channel 2 in the differential value or mean value interface type.

8.14 Current sensor calibration (digital-to-analog trim)

This function allows you to calibrate the current output by the transmitter irrespective of the process circuit. This function allows compensation of inaccuracies in the process chain downstream from the transmitter. The trim can only be performed as follows:

- SITRANS TR200: at 4 mA and at 16 mA
- SITRANS TR300: at 4 mA and at 20 mA

The "Sensor calibration: Example of 4 to 20-mA output" diagram shows an example of the principle of calibration for a 4 to 20 mA current output.

Application example: Current output calibration at 4 mA and 20 mA

The current is to be measured as a voltage drop from 1 to 5 V at a resistance of 250 Ω +/- 5%. To trim the tolerance of the resistance, set the current sensor so that the voltage drop at 4 mA is exactly 1 V and at 20 mA is exactly 5 V.

NOTICE
The multimeter used must have a higher accuracy class than the transmitter.

Trim at 4 mA:

1. Use the menu item D/A trim to assign 4 mA output to the transmitter.
2. Read the measured value at the voltmeter.
3. Calculate the current value from the measured value.
4. Enter the calculated current value using the operating software.

The transmitter uses this value for offset correction of the current.

Trim at 20 mA:

1. Use the menu item D/A trim to assign 20 mA output to the transmitter.
2. Read the measured value at the voltmeter.
3. Calculate the current value from the measured value.
4. Enter the calculated current value using the operating software.

The transmitter uses this value for gradient correction of the current. The value for 4 mA is not affected by this.

Scaled trim for the digital-to-analog converter (only for SITRANS TR300 and SIMATIC PDM):

This transmitter offers the additional possibility of scaled trimming of the analog output.

Use the menu item scaled D/A trim (only for SITRANS TR300 and SIMATIC PDM) after inputting the customer-specific scaling (for the above example: the lower scaled trim point = 1 V, the upper scaled trim point = 5 V) the value read off from the measurement device can be input directly into the SIMATIC PDM.

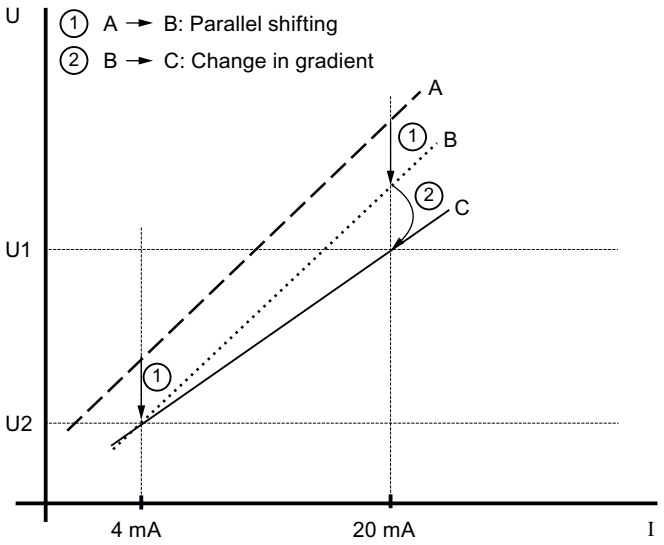


Figure 8-3 Current sensor calibration: Example 4 to 20 mA output

O	Output characteristic
B	Characteristic curve after lower sensor trim
C	Characteristic curve after upper sensor trim

8.15 Special characteristic curve

The transmitter offers the facility for connecting multiple sensors to the device. Sensor characteristic curves valid for these sensors are already programmed into the device.

There are however sensors (e.g. Cu100) for which this device does not offer sensor linearization as standard. In this case, however, it is possible to store a customer-specific special characteristic curve in the device. The sensor characteristic curve is then corrected by scaling the measured value output.

The transmitter requires pairs of values (x-values, y-values) for customer-specific characteristic curve correction. These pairs of values form sampling points and the output characteristic curve is generated in between these points by linear interpolation from the input characteristic curve. The maximum number of sampling points is restricted to 30 pairs of values. The individual pairs of values are entered as a percentage of the set measuring span.

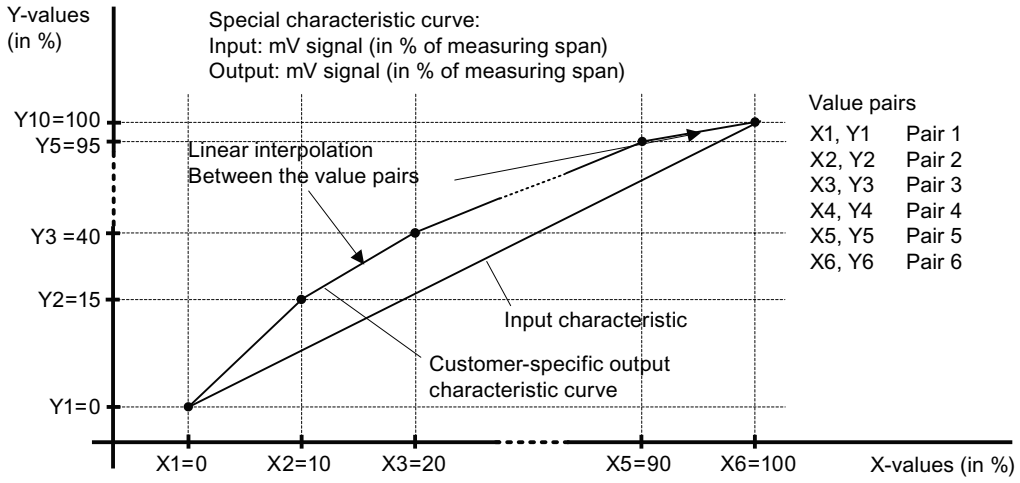


Figure 8-4 Principle of customer-specific characteristic correction

Instructions on parameterization

Then assigning parameters to customer-specific characteristic curves, the following instructions apply. These instructions apply irrespective of which parameterization software is used, and apply to both transmitter device versions.

- The start point for characteristic curve correction is:
  - the resistance-type transmitter sensor class for the desired special resistance thermometer
  - the mV transmitter sensor class for the desired special thermocouple.

  The sensor characteristic curve for the resistance-type transmitter or mV transmitter forms the basis (0 to 100 %) of the subsequent characteristic curve correction.
- Always enter the individual pairs of values in the unit % of the set measuring span.
- The first pair of values is always (X = 0 %; Y = 0 %). The last pair of values is always (X = 100%; Y = 100%). The first and last pairs of values are specified by the parameter assignment software and cannot be changed. Correction of the first and last pairs of values can be performed only by means of a two point trim of the sensor.

- The x-values must rise monotonously when the characteristic curve is input, the y-values must rise or fall monotonously.
- The x-values do not have to be input in equidistant intervals.

Example

Requirement

The transmitter is used for measuring a customer-specific thermocouple. The thermocouple supplies the following mV signals in this case:

- At the start of measurement: - 10 mV (corresponding to -100 °C)
- At the end of measurement: 40 mV (corresponding to +400 °C)

Proceed as follows

Note

Before the sensor characteristic curve is recorded and the correction values are entered it may be necessary to perform a sensor calibration at the start of measurement (-10 mV) and end of measurement (40 mV).

1. The selection of the mV transmitter sensor class is performed using the SIPROM T or SIMATIC PDM parameterization software.
2. Characteristic curve correction of the thermocouple should be performed across 6 pairs of values. The type of cold junction compensation is fixed value = 0 °C.
3. Parameter inputs

Sensor signal at transmitter input	Characteristic curve pair			Measured value [i] after characteristic curve correction
	Pair of values	X[i]	Y[i]	
-10 mV	i = 1	0 %	0 %	-100 °C
-5 mV	i = 2	10 %	15 %	-25 °C
0 mV	i = 3	20 %	20 %	0 °C
15 mV	i = 4	50 %	55 %	175 °C
35 mV	i = 5	90 %	95 %	375 °C
40 mV	i = 6	100 %	100 %	400 °C

Example of a parameter

The establishment of the value pairs X[i] and Y[i] is explained below, using the example of the value pair i = 3.

Calculation X[i=3]

The characteristic curve parameter X[3] = 0 mV corresponds to 20 % as a percentage in relation to
the start of measurement = -10 mV and end of measurement = 40 mV.

$$\underline{\underline{X[3] =}} \frac{\text{Sensor signal [mV] - start of scale value [mV]}}{\text{Full scale value [mV] - start of scale value [mV]}} \cdot 100\% = \frac{\text{0 mV - (-10 mV)}}{\text{40 mV - (-10 mV)}} \cdot 100\% = \underline{\underline{20\%}}$$

Calculation Y[i=3]

$$\underline{\underline{Y[3] =}} \frac{\text{Temperature value [°C] - start of scale value [°C]}}{\text{Full scale value [°C] - start of scale value [°C]}} \cdot 100\% = \frac{\text{0°C - (-100°C)}}{\text{400°C - (-100°C)}} \cdot 100\% = \underline{\underline{20\%}}$$

The following pair of values must be transferred to the parameter assignment software for the characteristic curve correction of the pair of values i = 3: X[3] = 20 % and Y[3] = 20 %.

8.16 Factory parameters

The menu item **Device → Factory parameters → Reload factory settings** resets the configuration of the transmitter to its default values.

Note

Factory Reset

- The menu item **Device → Factory parameters → Reload factory settings** resets the configuration of the transmitter to the default values in the table below.
- This Factory Reset has the same effect on "ex stock devices" as it has on "customer-specific configured devices".
- Furthermore, resetting the transmitter to its default values also resets any customer-specific digital-to-analog trim and sensor calibration (one point trim or two point trim).

Once a factory reset has been performed, the transmitter has the following configuration:

Parameters	Reset to value
TAG	Are not reset.
Description	Are not reset.
Message	Are not reset.
Serial number	Are not reset.
Installation date (electronics)	Are not reset.
Sensor class	Resistance thermometer
Sensor type	Pt100 DIN IEC 751
Interface	Normal connection
Sensor connection	Three-wire input
Sensor factor	1.00
Sensor offset 1	0.00 °C
Zero point	0 °C
End of measurement	100 °C
Unit	°C
Broken wire monitoring	ON
Short-circuit monitoring	OFF
Short circuit limit	1.00 Ω
Lower end point analog output	Are not reset.
Upper end point analog output	Are not reset.
Alarm value	Are not reset.
Linearization type	Linear to temperature
Damping	0.00 s
Operating hours counters PV	Are all reset to 0 h.
Operating hours counters, field device	Are not reset.
Slave pointers PV	Are all reset to 0.
Slave pointers electronics temperature	Are not reset.
Manufacturer data sensor	Are not reset.

8.17 Diagnostics functions

The diagnostic concept of the SITRANS TR200 and the SITRANS TR300 envisages that a diagnostic warning can be set in the parameters for diagnostic functions that are used for monitoring limit values. A diagnostic interrupt can be set in the parameters for diagnostic functions that are used for monitoring error conditions.

Diagnostic interrupts are output via:

- Analog output
- Operating indicator (LED)
- Only for SITRANS TR300: HART communication

Diagnostic warnings are output via:

- Only for SITRANS TR300: HART communication

Diagnostic interrupt: The device goes into the alarm current state. In addition, the diagnostic event is made available via the operating software. The following table summarizes all the diagnostic functions that can be set in the parameters. If multiple errors occur simultaneously, the priority settings apply. Priority 1 is the highest priority.

Diagnostic warning: The device transmits the diagnostic event that has occurred via the operating software. The analog output value is unchanged.

Diagnostic function	Priority	HART (only for TR300)	Analog output	LED
Diagnostic interrupt				
Hardware/firmware defect				
• RAM/ROM error • Flash/EEPROM error • Watchdog error • Electronics defect (hardware/firmware)	1 1 1 1	Status Status Status Status	On alarm value On alarm value On alarm value On alarm value	Red Red Red Red
Electronics temperature outside the limit [1]	1	Status	On alarm value	Red
Sensor error				
• Sensor breakage • Sensor short circuit	2 2	Status Status	On alarm value On alarm value	Red 2 Hz Red 2 Hz
Measured value (PV) outside the sensor limit [2]	2	Status	On alarm value	Red 2 Hz

Diagnostic warning				
Measured value out of the measurement area		Status	Unchanged	Green
Output saturation warning		Status	Unchanged	Green
Measured value (PV) outside the sensor limit		Status	Unchanged	Green
Electronics temperature outside the limit		Status	Unchanged	Green

1) A diagnostic interrupt is not triggered unless the measured value is higher or lower than the limit value by 3 °C (5.40°F).

2) A diagnostic warning is triggered immediately when the measured value exceeds the limit value. The diagnostic interrupt is triggered in any case if the limit value is exceeded by more than 2%.

Note

- The configuration will not be completely stored in the device if the supply voltage fails during a write operation to the device. In this case, a new configuration must be written to the device. The device will then revert to working in accordance with the specifications.
- The transmitter detects a defective device configuration and signals this by the red diagnostic LED being continuously lit. In this case, HART additionally sets the "HW/FW error" diagnostic bit.

⚠ CAUTION

- The specification of the transmitter is no longer guaranteed if the device detects that it has been exposed to temperatures beyond its ambient temperature limits (-40 °C to +85 °C). In this case, the transmitter outputs the fault current set in its parameters as the output signal. The "Ambient temperature error/electronics temperature error" flag remains set in the device even after the power supply has been switched off and on again.
- The SIPROM T or SIMATIC PDM parameterization software can be used to reset the "Ambient temperature error/electronics temperature error" flag within the device.
  - SIPROM T menu item for SITRANS TR200:
    Device ➞ **Device status** ➞ Device reset after ambient temperature error
  - SIMATIC PDM menu item for SITRANS TR300:
    View ➞ **Device status** ➞ Device reset after ambient temperature error

    The rest can only be performed if it has been ensured by sensor trim and D/A trim that the transmitter is operating within the user's accuracy tolerances.
- Even after recalibration, devices approved for explosion protection may no longer be used in explosion-protected environments.

8.18 Operating hours counter in temperature classes

The SITRANS TR200/TR300 has different operating hours counters. The operating hours counters are for monitoring the connected process flows.

1. Operating hours counter for transmitter electronics

- Monitors the number of operating hours that the transmitter has been in continuous operation subject to the ambient temperature.
- Records the process of operating hours of the transmitter in 9 ranges of ambient temperature.
- Begins with the first commissioning at the plant.
- The user cannot reset or adjust the operating hours counter or temperature ranges.
- The operating hours counter is only updated when it is in measuring mode. The operating hours counter is not updated in simulation mode.

2. Operating hours counter for process variable

- Monitors the process of the sensor connected to the transmitter in different process ranges.
- Records the process of operating hours of the process variable in 9 ranges. Subdivision takes place subject to the connected sensor and its sensor limits. The user cannot adjust the ranges.
- The operating hours counter is reset automatically if one of its following parameters is changed:
  - Sensor class
  - Sensor type
  - Interface connection
  - Sensor connection
  - Sensor factor

The parameter assignment software SIPROM T for SITRANS TR200 or SIMATIC PDM or HART communicator on SITRANS TR300 can read out the operating hours counters. The operating hours counters are automatically stored to the non-volatile memory once an hour. If the power supply to the device is interrupted, the operating hours counters are available upon restarting the device.

8.19 Slave pointer

This device has two slave pointer pairs that can monitor the following measured variables for negative and positive peak values:

- Slave pointer pair for a measured value, e.g. temperature difference T1-T2 for two resistance thermometers in a differential circuit
- Slave pointer pair for the electronics temperature (not resettable)

Only the measured value on the slave pointer can be reset. It can only be reset:

- Upon user request
- Automatically after one of its following parameters is changed:
  - Sensor class
  - Sensor type
  - Interface connection
  - Sensor connection
  - Sensor factor

8.20 Simulation (only for SITRANS TR300)

With the "Simulation" diagnostic function, you can receive and process (quasi-) measurement data without having a process value at the device. This allows you to run individual process operations in the "cold" state and thus simulate process states. In addition, you can check the wire layout for the analog output by adding on the simulation values.

The value to be simulated can be predetermined as a fixed value or in the form of a ramp function. The following simulations for the measuring input and analog output are possible:

Measuring input:

- Fixed value simulation or ramp simulation for a primary process variable
- Fixed value simulation or ramp simulation for electronics temperature

Measuring outputs:

- Fixed value simulation of the analog output

Simulation of the primary process variable, electronics temperature, and analog output are managed the same way for parameterization and function. For this reason, only the general simulation processes "fixed value" and "ramp function" are described in the following using the measuring input as an example.

For safety reasons, all simulation data are held only in the working memory. This means that when the device is restarted any simulation which may be active will be shut down.

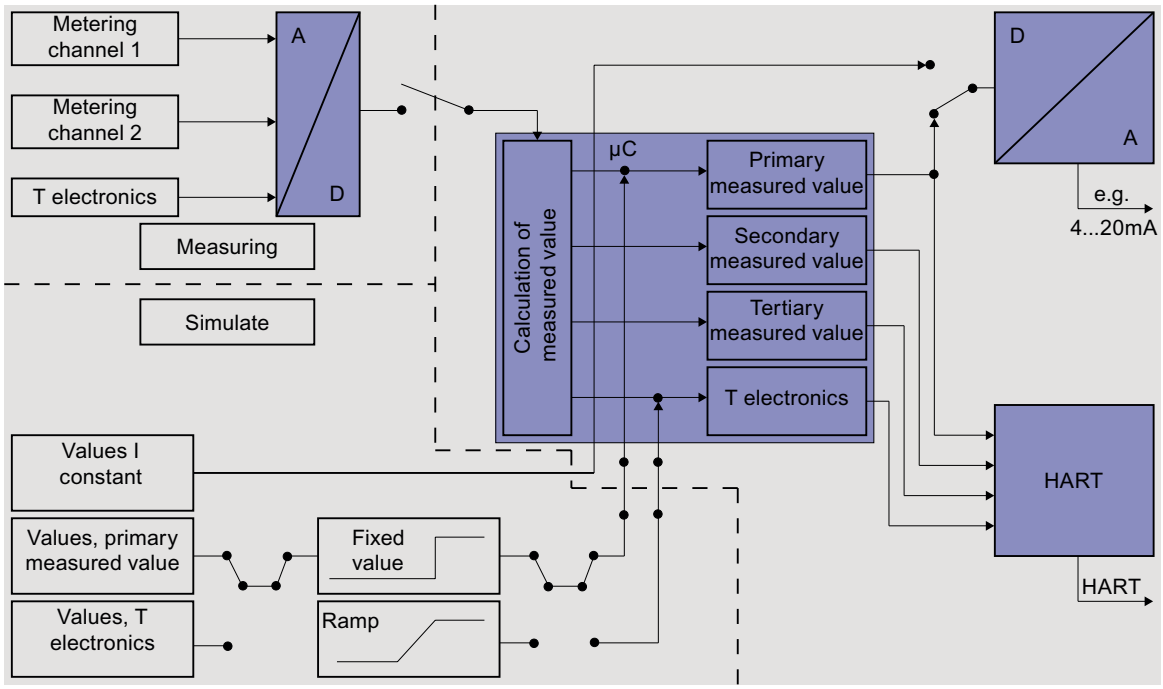


Figure 8-5 Block diagram of simulation

Note

Simulation

- The transmitter does not respond to sensor input signals when the simulation is active.
- The device may not be parameterized to "thermocouple with internal cold-junction compensation" for simulating the internal electronics temperature. In this case, the internal electronics temperature is a measured variable and cannot be replaced by a simulation value.

Measuring input simulation

- Simulation as fixed value

  Taking the physical unit into account you can parameterize fixed simulation values for both the primary measured value and electronics temperature. The analog output value sets itself to the appropriate specification for the primary measured value.

- Simulation with a periodical ramp function

  In addition to adjustable fixed values, you can parameterize a ramp function that returns periodically for each of the two simulation paths. An adjustable lower and upper value determines the limits that the simulation values can move between with a rising or falling tendency. The step width can be calculated with the step number, which is also adjustable.

$$\text{Step width} = \frac{\text{Upper value} - \text{lower value}}{\text{Increment}}$$

The duration between two consecutive simulation values is predefined by the step duration. The analog output follows the simulated values when simulating for the first primary measured value.

Maintenance and servicing

9

9.1 Maintenance

The transmitter is maintenance-free.

Technical specifications

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input	
Resistance thermometer	
Measured variable	Temperature
Sensor type	Pt25 to Pt1000 to IEC 60751 Pt25 to Pt1000 (JIS C 1604; a = 0.00392 K^{-1}) Ni25 to Ni1000 to IEC 60751 special type with special characteristic curve (max. 30 points)
Sensor factor	0.25 to 10 (Adaptation of the basic type, e.g. Pt100, to version Pt25 to Pt1000)
Units of measurement	°C or °F
Interface connection	
Normal connection	1 resistance thermometer (RTD) in two-wire, three-wire or four-wire input
Calculation of mean value	2 equal resistance thermometers in two-wire input for calculation of the mean value of the temperature
Calculation of differential value	2 identical resistance thermometers (RTD) in two-wire input (RTD1 - RTD2 or RTD2 - RTD1)
Connection	
Two-wire input	Parameterizable line resistance ≤100 Ω (loop resistance)
Three-wire input	No trim necessary
Four-wire input	No trim necessary
Sensor current	≤ 0.45 mA
Response time	≤ 250 ms for 1 sensor with broken wire monitoring
Broken wire monitoring	Always active (cannot be switched off)
Short-circuit monitoring	Can be switched off (value can be adjusted)
Measuring range	Programmable
Min. measuring span	10 °C (18 °F)
Characteristic curve	Linear to temperature or special characteristic curve

Resistance-type sensor	
Measured variable	Ohmic resistance
Sensor type	Resistance, potentiometer
Units of measurement	Ω
Interface connection	
Normal connection	1 resistance-type transmitter (R) in two-wire, three-wire or four-wire input
Calculation of mean value	2 resistance-type transmitters in two-wire input for calculation of the mean value
Calculation of differential value	2 resistance-type transmitters in two-wire input (R1 - R2 or R2 - R1)
Connection	
Two-wire input	Parameterizable line resistance ≤100 Ω (loop resistance)
Three-wire input	No trim necessary
Four-wire input	No trim necessary
Sensor current	≤ 0.45 mA
Response time	≤ 250 ms for 1 sensor with broken wire monitoring
Broken wire monitoring	Always active (cannot be switched off)
Short-circuit monitoring	Can be switched off (value can be adjusted)
Measuring range	Parameterizable max. 0 to 2200 Ω
Min. measuring span	5 Ω to 25 Ω
Characteristic curve	Linear to resistance or special characteristic curve

Thermocouples	
Measured variable	Temperature
Sensor type (thermo pairs)	Type B: Pt30Rh-Pt6Rh (DIN IEC 584) type C: W5%-Re (ASTM 988) type D: W3%-Re (ASTM 998) type E: NiCr-CuNi (DIN IEC 584) type J: Fe-CuNi (DIN IEC 584) type K: NiCr-Ni (DIN IEC 584) type L: Fe-CuNi (DIN 43710) type N: NiCrSi-NiSi (DIN IEC 584) type R: Pt13Rh-Pt (DIN IEC 584) type S: Pt10Rh-Pt (DIN IEC 584) type T: Cu-CuNi (DIN IEC 584) type U: Cu-CuNi (DIN 43710)
Units of measurement	°C or °F
Interface connection	
Normal connection	1 thermocouple (TC)
Calculation of mean value	2 equal thermocouples (TC)

Calculation of differential value	2 identical thermocouples (TC) (TC1 - TC2 or TC2 - TC1)
Response time	≤ 250 ms for 1 sensor with broken wire monitoring
Broken wire monitoring	Can be switched off
Cold junction compensation	Internal: with integrated resistance thermometer Pt100 external: with external Pt100 IEC 60751 (two-wire or three-wire input) external fixed: Cold junction temperature can be set as fixed value
Measuring range	Programmable
Min. measuring span	Min. 50 to 100 °C (90 to 180 °F)
Characteristic curve	Linear to temperature or special characteristic curve

Millivolt transmitter	
Measured variable	DC voltage
Sensor type	DC voltage source (DC voltage source is possible via a resistor that is connected externally)
Units of measurement	mV
Response time	≤ 250 ms for 1 sensor with broken wire monitoring
Broken wire monitoring	Can be switched off
Measuring range	Parameterizable max. -100 to 1100 mV
Min. measuring span	2 mV or 20 mV
Overload capacity of the input	-1.5 VDC to 3.5 VDC
Input resistance	≥ 1 MΩ
Characteristic curve	Linear to voltage or special characteristic curve

Output	
Output signal	4 to 20 mA, two-wire line SITRANS TR300 supports communication additionally via HART Rev. 5.9
Auxiliary power supply	DC 11 to 35 V (to 30 V for Ex)
Max. load	$(U_{aux}$ -11 V)/0.023 A
Overshoot range	3.6 mA to 23 mA , infinitely adjustable (default range: 3.84 mA to 20.50 mA)
Error signal (e.g. in case of sensor failure)	3.6 mA to 23 mA , infinitely adjustable (default value: 22.8 mA)
Sampling cycle	0.25 s
Damping	Software filter 1st order 0 to 30 s (can be set in parameters)
Security	Against reverse polarity

Electrical isolation	Input to output DC 2.12 kV (AC 1.5 kV)

Measuring accuracy	
Digital measuring errors	See the following tables, resistance thermometer and resistance-type transmitter
Reference conditions	
Auxiliary power supply	24 V +/- 1 %
Load	500 Ω
Ambient temperature	23 °C
Warm-up time	> 5 min
Analog output error (digital-to-analog conversion)	< 0.1 % of the measuring span
Fault due to internal cold junction	< 0.55 °C (0.9°F)
Temperature influence	< 0.1 % of max. measuring span/10°C (18°F)
Influence of auxiliary power supply	< 0.005 % of the measuring span/V
Influence of load	< 0.012 % of maximum measuring span/100 Ohm
Long-term drift	< 0.02 % of the max. measuring span in the first month < 0.03 % of the max. measuring span after one year < 0.04 % of the max. measuring span after five years

Ambient conditions	
Range of ambient temperature	-40 to +85 °C (-40 to +185 °F)
Storage temperature	-40 to +85 °C (-40 to +185 °F)
Relative atmospheric humidity	≤ 98 %, condensing

Rated conditions	
Electromagnetic Compatibility	According to DIN EN 61326 and NAMUR recommendation NE21
Error due to EMC influences during installation	
Electrostatic discharge (ESD) according to EN 61000-4-2	< 0.10 % of the measuring span
HF irradiation according to EN 61000-4-3	< 0.10 % of the measuring span
Burst according to EN 61000-4-4	< 0.10 % of the measuring span
HF energizing according to EN 61000-4-6	< 0.20 % of the measuring span

Construction	
Material	plastic, encapsulated electronics
Weight	122 g
dimensions	See "dimensional drawing"
Cross section of the connecting cables	Max. 2.5 mm^2 (AWG 13)
Type of protection:	In accordance with IEC 60529
Enclosure	IP20

Certificates and approvals	
EC-type examination certificate	PTB 07 ATEX 2032 X The technical data listed in the EC type examination certificate apply exclusively for applications in potentially explosive areas.
Type of protection to ATEX	
"Intrinsic safety"	II 2 (1) GD Ex ia/ib/ic IIC T6/T4
"Energy limited equipment"	II 3 GD Ex nL IIC T6/T4
"Non-sparking equipment"	II 3 GD Ex nA T6/T4
"Associated equipment"	II (1) GD [Ex ia] IIC T6/T4
Instructions for installation in a dust hazardous zone: For use in a dust hazardous zone, the transmitter must be installed in a suitable metal protective enclosure which satisfies at least IP6X (to EN 60529) degree of protection	

Resistance thermometer			
input	**Measuring range** **°C (°F)**	**Minimum measuring span** **°C (°F)**	**Digital accuracy** **°C (°F)**
Pt25 (IEC 60751)	-200 to +850 (-328 to 1562)	10 (18)	0,2 (0.36)
Pt50 (IEC 60751)	-200 to +850 (-328 to 1562)	10 (18)	0,15 (0.27)
Pt100 to Pt200 (IEC 60751)	-200 to +850 (-328 to 1562)	10 (18)	0,1 (0.18)
Pt500 (IEC 60751)	-200 to +850 (-328 to 1562)	10 (18)	0,15 (0.27)
Pt1000 (IEC 60751)	-200 to +350 (-328 to 662)	10 (18)	0,15 (0.27)
Pt25 (JIS C1604-81)	-200 to +649 (-328 to 1200)	10 (18)	0,2 (0.36)
Pt50 (JIS C1604-81)	-200 to +649 (-328 to 1200)	10 (18)	0,15 (0.27)
Pt100 to Pt200 (JIS C1604-81)	-200 to +649 (-328 to 1200)	10 (18)	0,1 (0,18)
Pt500 (JIS C1604-81)	-200 to +649 (-328 to 1200)	10 (18)	0,15 (0.27)
Pt1000 (JIS C1604-81)	-200 to +350 (-328 to 662)	10 (18)	0,15 (0.27)
Ni25 to Ni1000	-60 to +250 (-76 to 482)	10 (18)	0,1 (0,18)

Resistance-type sensor			
input	**Measuring range** Ω	**Minimum measuring range** Ω	**Digital accuracy** Ω
Resistance-type sensor	0 to 390	5	0,05
Resistance-type sensor	0 to 2200	25	0,25

Thermocouples			
input	**Measuring range** **°C (°F)**	**Minimum measuring span** **°C (°F)**	**Digital accuracy** **°C (°F)**
Type B	0 to 1820 (32 to 3308)	100 (180)	2 (3.60) [1]
Type C (W5)	0 to 2300 (32 to 4172)	100 (180)	2 (3.60)
Type D (W3)	0 to 2300 (32 to 4172)	100 (180)	1 (1.80) [2]
Type E	-200 to 1000 (-328 to 1832)	50 (90)	1 (1.80)
Type J	-210 to 1200 (-346 to 2192)	50 (90)	1 (1.80)
Type K	-200 to 1370 (-328 to 2498)	50 (90)	1 (1.80)
Type L	-200 to 900 (-328 to 1652)	50 (90)	1 (1.80)
Type N	-200 to 1300 (-328 to 2372)	50 (90)	1 (1.80)
Type R	-50 to 1760 (-58 to 3200)	100 (180)	2 (3.60)
Type S	-50 to 1760 (-58 to 3200)	100 (180)	2 (3.60)
Type T	-200 to 400 (-328 to 752)	40 (72)	1 (1.80)
Type U	-200 to 600 (-328 to 1112)	50 (90)	2 (3.60)

[1] The digital accuracy in the range 0 to 300 °C (32 to 572 °F) is 3 °C (5.40 °F).

[2] The digital accuracy in the range 1750 to 2300 °C (3182 to 4172 °F) is 2 °C (3.60 °F).

Millivolt transmitter			
input	**Measurement range** **mV**	**Minimum measured span** **mV**	**Digital accuracy** **µV**
Millivolt transmitter	-10 to 70	2	40
Millivolt transmitter	-100 to 1100	20	400

The digital accuracy is the accuracy following analog-to-digital conversion including linearization and measured value calculation.

The 4 to 20 mA output current is subject to an additional error max. 0.1 % of the set measuring span, arising from the digital-to-analog conversion. This error is called the digital-to-analog error.

The overall error at the analog output under reference conditions is the total of the digital error and the digital-to-analog error. It may be necessary to add the cold junction error if thermocouple measurements are performed.

Dimension drawings

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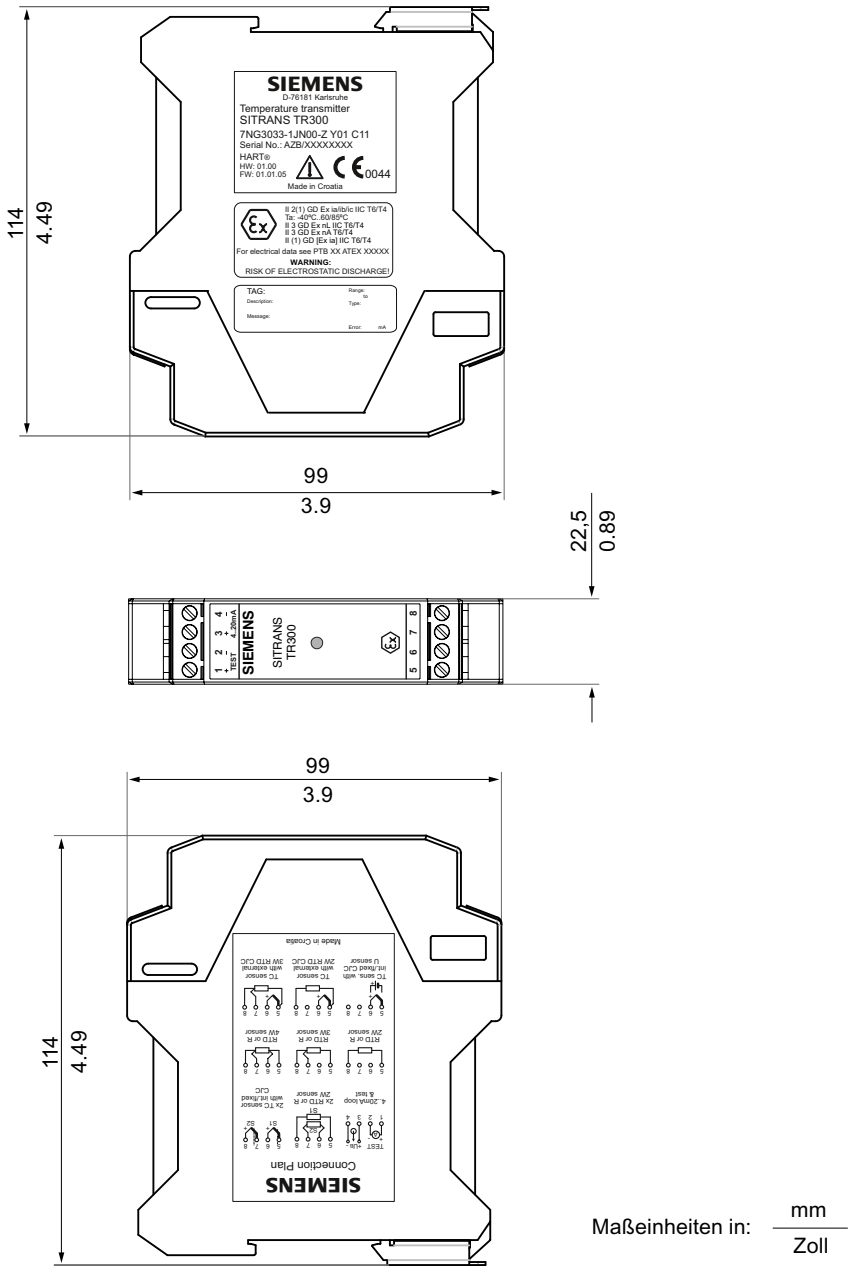

Figure 11-1 SITRANS TR200/TR300 dimensional drawing

Spare Parts/Accessories

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Name	Order no.
SITRANS TR200 temperature transmitter for installation on DIN rails, two-wire technology 4 to 20 mA, programmable, with electrical isolation, with documentation on CD	
• Without explosion protection	7NG3032-0JN00 [1]
• With explosion protection according to ATEX protection type intrinsic safety Ex ia/ib/ic, non-sparking (nA), energy limited (nL)	7NG3032-1JN00 [1]
SITRANS TR300 temperature transmitter for installation on DIN rails, two-wire technology 4 to 20 mA, HART, with electrical isolation, with documentation on CD	
• Without explosion protection	7NG3033-0JN00 [1]
• With explosion protection according to ATEX protection type intrinsic safety Ex ia/ib/ic, non-sparking (nA), energy limited (nL)	7NG3033-1JN00 [1]

[1] Available ex-stock.

Additional specifications Add "-Z" to order no. and specify order code.	Order code
Set the operating data as desired (Describe operating data in plain text)	Y01
with test report (5 measuring points)	C11

Designation	Order no.
Modem for SITRANS TH100, TH200 and TR200 including the SIPROM T parameterization software	
• With USB connection	7NG3092-8KU [1]
• With RS232 connection	7NG3092-8KM [1]
CD for temperature measuring instruments containing documentation in German/English/French/Spanish/Italian/Portuguese and the SIPROM T parameterization software	A5E00364512 [1]
HART modem	
• With RS232 serial interface	7MF4997-1DA [1]
• With USB interface	7MF4997-1DB [1]
SIMATIC PDM parameterization software Also for SITRANS TR300	
• For operation and parameterization including communication via HART modem	
• Please refer to catalog FI 01 for information about more SIMATIC PDM options.	

[1] Available from stock.

Appendix

A

A.1 Certificates

You can find the certificates on the "sitrans t - temperature transmitters" CD, available separately, order no. A5E00364512; and on the Internet.

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

Glossary

Analog

One variable, e.g. voltage which is infinitely adjustable, in contrast to "Digital".

ATEX

ATEX is an abbreviation of the French term "Atmosphère explosible" (potentially explosive atmosphere). ATEX stands for both EC directives in the area of explosion protection: ATEX product directive 94/9/EC and ATEX operating directive 1999/92/EC.

Auxiliary power supply

Auxiliary power supply is an electrical supply voltage or reference voltage, such as many electrical circuits require in addition to the standard power supply.
The auxiliary power supply is specially stabilized, has a specific level and polarity and/or has other properties that are important for correct operation of circuit components.

Auxiliary voltage

→ *Auxiliary power supply*

CE

Communautés **E**uropéenes: European communities

DC

Direct **C**urrent: Direct Current

Digital

Representation of a variable, e.g. time, in the form of characters or numbers. In its digital representation, this variable can be changed only in pre-defined steps. In contrast to "Analog".

DIN

Deutsches **I**nstitut für **N**ormung e. V. - German institute for standardization

EC low-voltage directive

The EC low voltage directive applies to electrical resources with rated voltages of:

- AC from 50 V to 1000 V;
- DC from 75 V to 1500 V.

EEPROM

Electrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory

EEPROMs are often used where individual bytes of data (e.g. configuration data or runtime meters) change over time and must be stored safely in the event of a mains power failure.

EMC

Electro**m**agnetic **c**ompatibility

Definition in accordance with EMC law:

EMC is the capability of a device to operate satisfactorily in an electromagnetic environment without itself emitting electromagnetic signals which interfere with other devices in that environment.

EN

Europäische **N**orm - European standard

EU

European **C**ommunity

Firmware

Firmware (FW) is software which is embedded in a chip in electronic devices – unlike software that is stored on hard drives, CD ROMs, or other media. These days, firmware is mostly stored in a flash memory or EEPROM.

Firmware usually contains the elementary functions for controlling the device, as well as input and output routines.

Frequency shift keying

Frequency shift keying in a simple form of modulation in which the digital values 0 and 1 are represented by two different frequencies.

Frequency Shift Keying (FSK)

→ *Frequency shift keying*

HART

HART (Highway Addressable Remote Transducer) is a standardized, widely used communications system used to structure industrial fieldbuses. The communications system provides digital communications for multiple participants (field devices) via a common databus. HART is based especially on the equally widely used 4/20 mA standard for the transfer of analog sensor signals. The cabling from existing older systems can be used directly and both systems operated in parallel.

HART specifies several protocol levels in the OSI model. It facilitates the transfer of process and diagnostics data and control signals between field devices and high-level control systems. Standardized parameter sets can be used for the manufacture-independent operation of all HART devices.

Typical applications include transmitters for measuring mechanical and electrical dimensions.

IP

International **P**rotection = international degree of protection

Microcontroller

Microcontrollers (also written µControllers, µC, MCU) are single-chip computer systems which have virtually all their components - such as main processor, program memory, working memory and the input/output interfaces - accommodated on a single chip.

Non-volatile memory

→ *EEPROM*

RS -232

RS: **R**ecommended **S**tandard

A recognized industry standard for serial data transfer. For cable lengths shorter than 15 m. No differential evaluation. Transmit and receive on different lines.

Sensor

In electrical engineering, a sensor is a component that can qualitatively measure not only specific physical or chemical properties (such as heat radiation, temperature, humidity, pressure, excess pressure, sound, brightness, magnetism, acceleration, force) as well as the physical condition of its surroundings or register them as quantitatively measured variables.

USB

The Universal Serial Bus (USB) is a serial bus system for connecting a PC/laptop to external devices such as: modems.

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