Temperature transmitters

SITRANS TF, HART

Operating instructions · July 2012

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Temperature transmitter SITRANS TF with and without HART

Operating Instructions

7NG3135 SITRANS TF with built-in SITRANS TH200 (4 to 20 mA without HART)
7NG3136 SITRANS TF with built-in SITRANS TH300 (4 to 20 mA with HART)
7NG3130 SITRANS TF as field indicator

07/2012
A5E00981310-02

Legal information

Warning notice system

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 relevant 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 product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of 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.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

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Table of contents

Introduction 1

1.1 Purpose of this documentation

These instructions contain all information required to commission and use the device. It is your responsibility to read the instructions carefully prior to installation and commissioning. In order to use the device correctly, first review its principle of operation.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it, as well as service and maintenance engineers.

See also

Process instrumentation catalog (http://www.siemens.com/processinstrumentation/catalogs)

SITRANS T product information (http://www.siemens.com/sitranst)

1.2 History

This history establishes the correlation between the current documentation and the valid firmware of the device.

The documentation of this edition is applicable for the following firmware:

Edition	Firmware identifier nameplate	System integration	Installation path for PDM
01 02/2007	FW: 01.01.04	TH200: SIPROM T V1.2.3	TH200: Not relevant
02 07/2012		TH300: PDM V6.0 DD Rev. 01.01.04	TH300: SITRANS TH300

The most important changes in the documentation when compared with the respective previous edition are given in the following table. Go to the Internet for the latest software version.

Edition	Remark
01 02/2007	First edition
02 07/2012	• Editorial revision. • Modified technical specifications. • Further supplements on topic "Functional safety" • Revised: Abbreviations and glossary.

See also

Software downloads (http://www.siemens.com/processinstrumentation/downloads)

1.3 Checking the consignment

1. Check the packaging and the device for visible damage caused by inappropriate handling during shipping.
2. Report any claims for damages immediately to the shipping company.
3. Retain damaged parts for clarification.
4. Check the scope of delivery by comparing your order to the shipping documents for correctness and completeness.

⚠ WARNING

Using a damaged or incomplete device

Danger of explosion in hazardous areas.

- Do not use damaged or incomplete devices.

1.4 Transportation and storage

To guarantee sufficient protection during transport and storage, observe the following:

- Keep the original packaging for subsequent transportation.
- Devices/replacement parts should be returned in their original packaging.
- If the original packaging is no longer available, ensure that all shipments are properly packaged to provide sufficient protection during transport. Siemens cannot assume liability for any costs associated with transportation damages.

⚠ CAUTION

Insufficient protection during storage

The packaging only provides limited protection against moisture and infiltration.

- Provide additional packaging as necessary.

Special conditions for storage and transportation of the device are listed in "Technical data" (Page 85).

1.5 Notes on warranty

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

See also

SITRANS T product information (http://www.siemens.com/sitranst)

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

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

Safety information 2

2.1 Prerequisites for safe use

This device left the factory in good working condition. In order to maintain this status and to ensure safe operation of the device, observe these instructions and all the specifications relevant to safety.

Observe the information and symbols on the device. Do not remove any information or symbols from the device. Always keep the information and symbols in a completely legible state.

2.1.1 Warning symbols on the device

Symbol	Meaning
	Pay attention to the operating instructions

2.1.2 Laws and directives

Observe the test certification, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EC)

2.1.3 Conformity with European directives

The CE mark on the device is a sign of conformity with the following European directives:

Electromagnetic Compatibility EMC 2004/108/EC	Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
Atmosphère explosible ATEX 94/9/EC	Directive of the European Parliament and the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.

The directives applied can be found in the EC declaration of conformity for the associated device.

2.2 Improper device modifications

WARNING

Improper device modifications

Danger to personnel, system and environment can result from modifications to the device, particularly in hazardous areas.

- Only carry out modifications that are described in the instructions for the device. Failure to observe this requirement cancels the manufacturer's warranty and the product approvals.

2.3 Use in hazardous areas

Qualified personnel for hazardous area applications

Persons who install, assemble, commission, operate and service the device in a hazardous area must have the following specific qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures, aggressive and hazardous media.
- 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 pertinent safety regulations.

⚠ WARNING

Unsuitable device for the hazardous area

Danger of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labelled accordingly.

⚠ WARNING

Loss of safety of device with type of protection "Intrinsic safety Ex i"

If the device has already been operated in non-intrinsically safe circuits or the electrical specifications have not been observed, the safety of the device is no longer ensured for use in hazardous areas. There is a danger of explosion.

- Connect the device with type of protection "Intrinsic safety" solely to an intrinsically safe circuit.
- Observe the specifications for the electrical data on the certificate and in Chapter "Technical data (Page 85)".

⚠ WARNING

Risk of explosion due to electrostatic charge

To prevent an electrostatic charge in a hazardous area, close the key cover during operation and tighten the screws securely.

Type of protection "Flameproof enclosure" and "Dust protection by enclosure"

Only open devices with type of protection "Flameproof enclosure" in hazardous areas when the power to the device is turned off, otherwise there is a risk of explosion.

Type of protection "Intrinsic safety"

Connect the device only to certified, intrinsically safe circuits. These circuits must comply with the technical data specified on the nameplate, certificates and approvals. Should these circuits not match the details given in the certificates and approvals, then the safety required for the approval can no longer be guaranteed. The device's protection level "ia" is lowered to protection level "ib" if fail-safe circuits are connected with protection level "ib".

Type of protection "Non-sparking" nA and nA [ic]

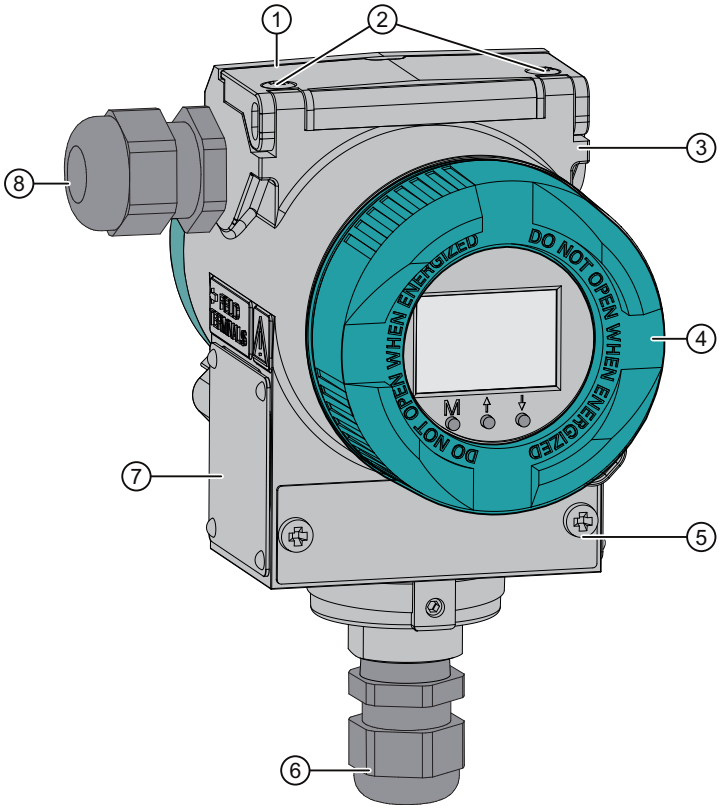
Only connect and disconnect devices of the protection type "non-sparking" when in a powered-down state.

Description

3

3.1 Layout

3.1.1 SITRANS TF design



①	Key cover	⑤	Measurement station plate
②	Screws of key cover	⑥	Sensor cable entry
③	Field housing	⑦	Nameplate
④	Cover with or without inspection window (with optional display module)	⑧	Cable inlet for auxiliary power supply/analog output

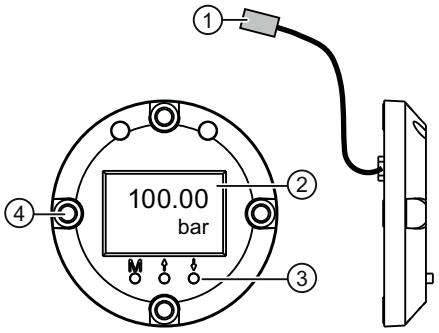
Figure 3-1 SITRANS TF temperature transmitter

See also

Display module for SITRANS TF (Page 16)

3.1.2 Display module for SITRANS TF

Overview



① Connector to transmitter
② Display in measurement view
③ Keys M, ↑, ↓
④ Fixing

Figure 3-2 Display module

SITRANS TF field housings can be equipped with a display module which only displays the 4 to 20 mA signals from the transmitter. The keys ③ are used exclusively for adapting the current display to the transmitter parameters, for example, to modify the display units (°C).

Use of the display module has no influence on the transmitter functions. An overview of the display functions can be found in Chapter "Optional modes (Page 47)".

Installing

Note

Limitations when retrofitting a display module

It is not possible to retrofit a display module if you are using a SITRANS TF field housing with protection against explosion.

The display module can be retrofitted and turned by 90° to suit the mounting position of the housing. More information on installing can be found in Chapter "Installing and connecting the display module (Page 24)".

The retrofitting set includes:

- 1 display module (digital display), 7MF4997-1BS
- 2 x M4 screws
- 2 spacers

3.2 Application range

The SITRANS TF temperature transmitter converts sensor signals into a load-independent DC signal according to the sensor characteristic. The following sensors and signal sources can be connected to the input block:

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

The output signal is a current of 4 to 20 mA corresponding to the sensor characteristic.

Explosion-proof transmitters can be installed and operated within potentially explosive atmospheres in compliance with the information given on the relevant certificates and approvals and in these Operating Instructions.

3.3 Product features

- Transmitter for universal use for:
  - Resistance thermometer
  - Thermocouples
  - Ω signals
  - mV signals
- IP67 degree of protection
- Optional display module for local measured values can be shown using optional display module.
- Two versions:
  - Aluminum die-casting
  - Stainless steel
- Remote installation option:
  - For difficult to access measuring points
  - For high-temperature measuring points
  - In case of vibrations in the process cell
  - To avoid long neck or protective rings
- Comprehensive approvals for operation in potentially explosive atmospheres. Types of protection "intrinsically safe, non incendive, and flameproof", for Europe and the USA.
- SIL 2 (optional, with order suffix C20)

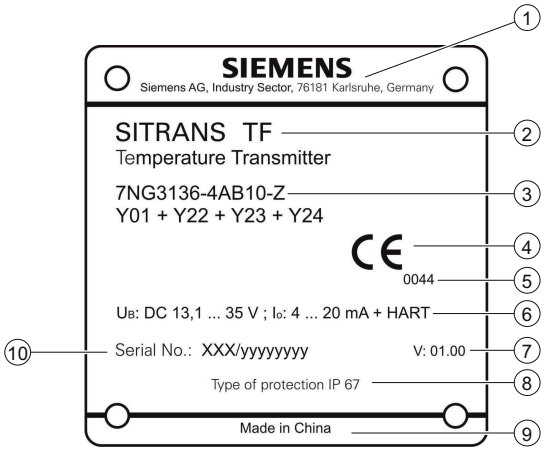
- SIL 3 (optional, with order suffix C23)
- Functions of TH200/300 temperature transmitters
  - Offline parameterization: SITRANS TF with TH200
  - Online parameterization: SITRANS TF with TH300

3.4 Structure of the label

Structure of labels on device housing

- Nameplate
- Ex plate for Ex devices
- Customer-specific measuring point label

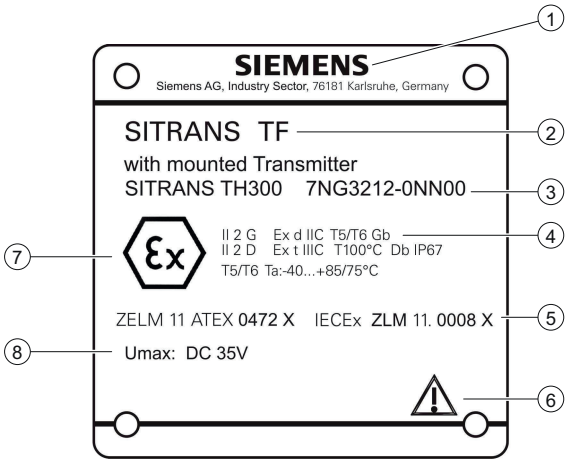
Nameplate example



①	Manufacturer	⑥	Electrical characteristics
②	Product name	⑦	SITRANS TF version
③	Order number	⑧	Type of IP protection
④	CE marking	⑨	Country of origin
⑤	ID number of notified body	⑩	Serial number

Figure 3-3 Structure of the label

Ex plate example

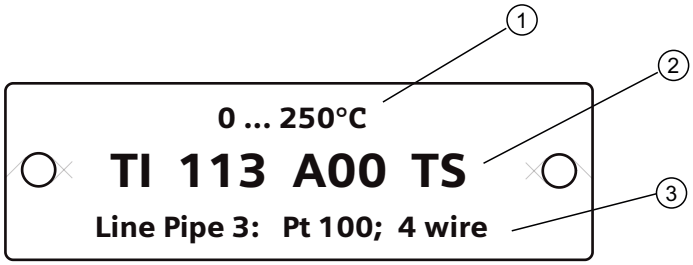


①	Manufacturer	⑤	Certificate numbers
②	Product name	⑥	Attention: use operating instructions
③	Order number of built-in temperature transmitter	⑦	ATEX marking
④	Types of Ex protection	⑧	Maximum voltage

Figure 3-4 Structure of Ex plate for Ex device

Customer-specific measuring point label

The measurement station plate is created using custom data.



① Measuring range; product name Y22
② Tag number/name; product name Y23
③ Measurement station message; product name Y24

Figure 3-5 Structure of measurement station plate

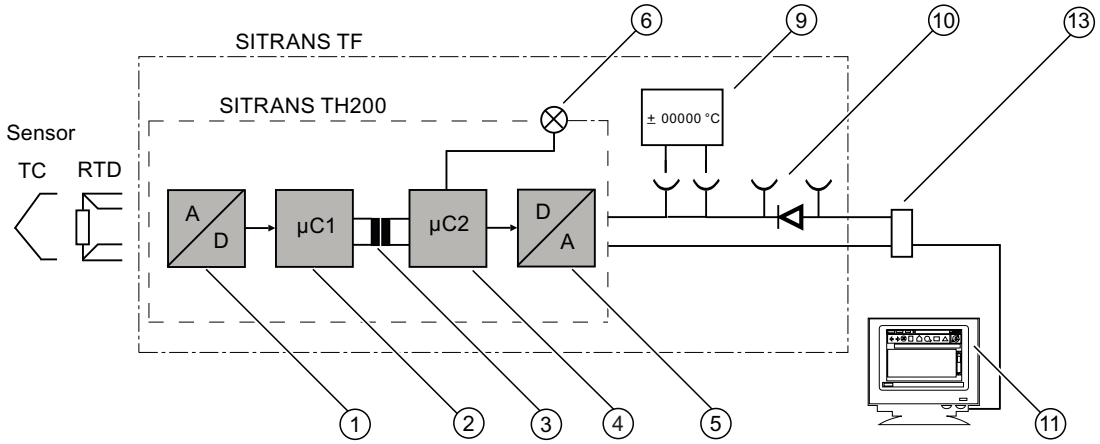
3.5 Mode of operation

3.5.1 Overview

The following function diagrams illustrate the mode of operation of the device with the built-in SITRANS TH200/TH300 temperature transmitters:

Function diagram SITRANS TF with built-in SITRANS TH200

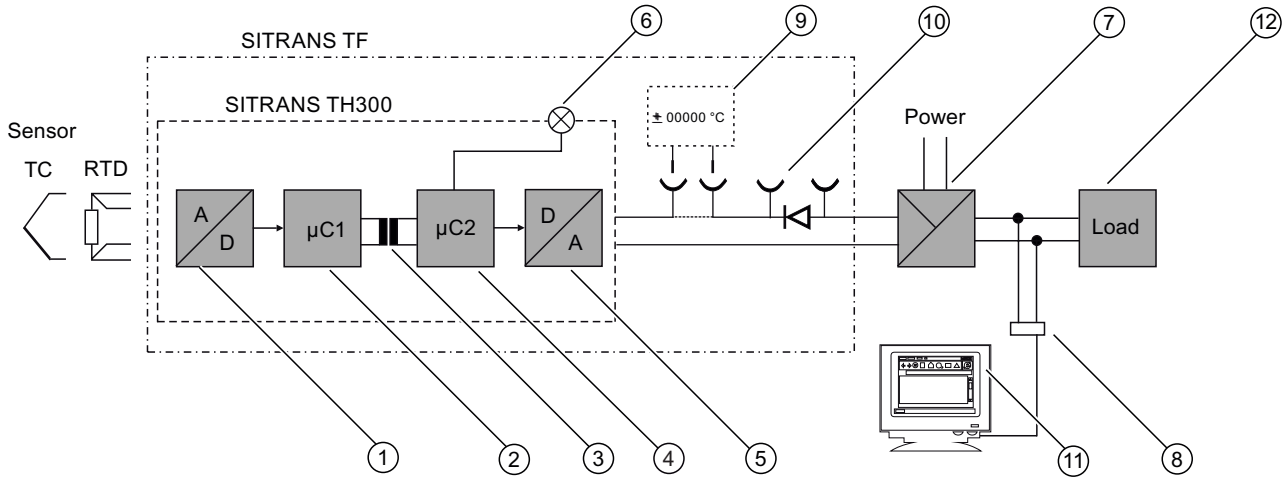
Offline parameter assignment with SIPROM T/modem for SITRANS TH200.



① Analog-to-digital converter
② Microcontroller on secondary side
③ Electrical isolation
④ Microcontroller on primary side
⑤ Digital-to-analog converter
⑥ LED; green/red
⑨ Display module, optional
⑩ Test sockets
⑪ Computer
⑬ SIPROM T-modem for SITRANS TH200

Function diagram SITRANS TF with built-in SITRANS TH300

Online parameterization with HART modem and SIMATIC PDM.



①	Analog-to-digital converter	⑦	Auxiliary power supply, e.g. feed splitter
②	Microcontroller on secondary side	⑧	HART modem
③	Electrical isolation	⑨	Display module, optional
④	Microcontroller on primary side	⑩	Test sockets
⑤	Digital-to-analog converter	⑪	Computer
⑥	LED; green/red	⑫	Load

See also

Description (Page 21)

3.5.2 Description

The items numbers specified below refer to the figures in Chapter "Overview (Page 20)":

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

3.6 Communication

SITRANS TH200

Parameterization of the SITRANS TH200 is only possible offline. A configuration produced offline on a PC using SIPROM T is transferred to the transmitter via the SIPROM T modem.

SITRANS TH200 does not have a HART interface.

SITRANS TH300

SITRANS TH300 is parameterized online. The transmitter uses the HART protocol for this, and communicates with the following external devices via its HART interface:

- HART communicator
- HART modem to the connected PG/PC with SIMATIC PDM

Both devices provide direct online access to all transmitter functions and parameters.

See also

HART communication with supply from voltage source (Page 41)

Installing/mounting 4

4.1 Basic safety instructions

⚠ WARNING

Exceeded maximum ambient or process media temperature

Danger of explosion in hazardous areas.

Device damage.

- Make sure that the maximum permissible ambient and process media temperatures of the device are not exceeded. Refer to the information in Chapter "Technical data (Page 85)".

⚠ WARNING

Open cable inlet or incorrect cable gland

Danger of explosion in hazardous areas.

- Close the cable inlets for the electrical connections. Only use cable glands or plugs which are approved for the relevant type of protection.

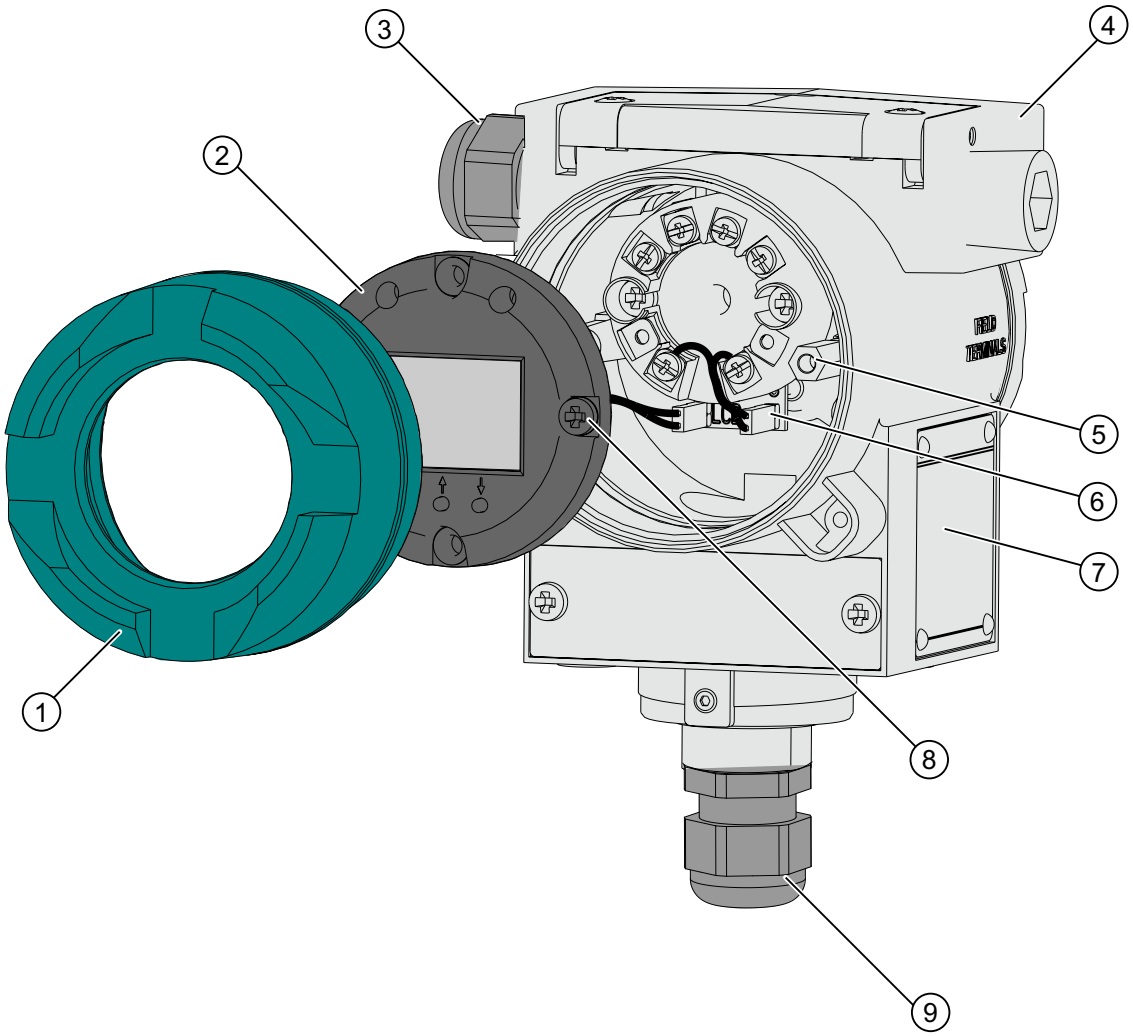
⚠ WARNING

Incorrect conduit system

Danger of explosion in hazardous areas as result of open cable inlet or incorrect conduit system.

- In the case of a conduit system, mount a spark barrier at a defined distance from the device input. Observe national regulations and the requirements stated in the relevant approvals.

4.2 Installing and connecting the display module



①	Cover with inspection window	⑥	Plug-in connector from SITRANS TH200 or TH300
②	Display module (digital display)	⑦	Ex nameplate
③	Cable gland for auxiliary power supply/ analog output	⑧	M4 screw
④	SITRANS TF field housing	⑨	Cable gland for sensor cable
⑤	Spacers		

Figure 4-1 Design of SITRANS TF with display module (digital display)

Procedure

1. Unscrew the front cover ①.
2. Screw the two spacers ⑤ into the right and left threads. Torque approx. 3 Nm.
3. Remove the left-hand shorting bars on the PC board located under the transmitter.

4. Insert the plug-in connector from the display module. The plus side with the red wire must face upward.

   Note

   Reverse polarity protection

   The display module has integrated reverse polarity protection. The display module will not function if the polarity is reversed, but will not be damaged. Make sure the polarity is correct. If the display module does not function, reverse the polarity of the plug-in connector.

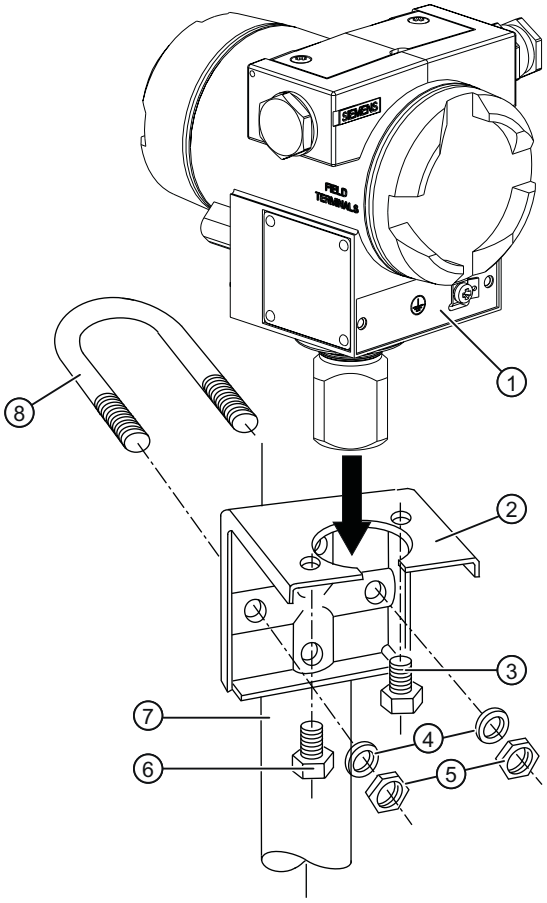
5. Using the two M4 screws ⑧ supplied, attach the display module to the two spacers ⑤ in the electronics compartment of the SITRANS TF field housing.
   Torque approx. 2.5 Nm.
6. Use the three buttons to assign parameters to the display module ②.
7. Screw the cover back into place. We recommend using a cover with an inspection window, e.g. 7MF4997-1BE.
8. To remove the display module, follow the reverse procedure.

See also

Display module for SITRANS TF (Page 16)

4.3 Mounting the device with mounting bracket

Example



① Housing with mounting holes
② Mounting bracket (90° rotatable)
③ Screw thread M8 or 5/16 UNF
④ Washer DIN 125 - 8.4
⑤ Nut M8
⑥ Screw thread M8 or 5/16 UNF
⑦ Pole
⑧ Pole clamp

Figure 4-2 Mounting example

Procedure

Note

Permitted mounting positions

The mounting holes in the bracket ② and the device housing ① determine the permitted mounting positions.

1. Secure the mounting bracket.
   Secure the mounting bracket ② with the pole clamp ⑧, washers ④ and nuts ⑤ on the pole ⑦.
2. Place the housing ① on the mounting bracket ②.
3. Fasten the mounting screws ③ and ⑥.

Connecting 5

5.1 Basic safety instructions

⚠ WARNING

Unsuitable cables and/or cable glands

Danger of explosion in hazardous areas.

- Only use suitable cables and cable glands complying with the requirements specified in Chapter "Technical data (Page 85)".
- Tighten the cable glands in accordance with the torques specified in Chapter "Technical data (Page 85)".
- When replacing cable glands use only cable glands of the same type.
- After installation check that the cables are seated firmly.

⚠ WARNING

Improper laying of shielded cables

Danger of explosion through compensating currents between hazardous area and the non-hazardous area.

- Only ground shielded cables that run into the hazardous area at one end.
- If grounding is required at both ends, use an equipotential bonding conductor.

⚠ WARNING

Connecting device in energized state

Danger of explosion in hazardous areas.

- Connect devices in hazardous areas only in a de-energized state.

Exceptions:

- Circuits of limited energy may also be connected in the energized state in hazardous areas.
- Exceptions for type of protection "Non-sparking nA" (Zone 2) are regulated in the relevant certificate

5.2 Safety information on connecting

5.2.1 Improvement of interference immunity

Note

Improvement of interference immunity

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires.
- Keep device and cables in distance to strong electromagnetic fields.
- Use shielded cables to guarantee the full specification according to HART.
- Refer to HART communication information in Chapter "Connect HART modem / HART communicator (Page 41)".

5.2.2 Safety instructions when connecting in hazardous areas

⚠ WARNING

Loss of explosion protection

Danger of explosion in hazardous areas if the device is open or not properly closed.

- Close the device as described in Chapter "Closing the device (Page 38)".

⚠ WARNING

Observe the degree of protection

The device must be connected to the power supply and signal circuits listed on the certificate or on the nameplate.

When installing the device in hazardous areas:

Use enclosures/connection heads with the degree of protection corresponding to the test certificate applicable in your country.

⚠ WARNING

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:

- The health and safety at work regulations
- The directive for "Installation of electrical systems in hazardous areas", DIN EN 60079-14 (previously VDE 0165, T1)
- The EC type examination certificate

When an auxiliary power supply is needed, check whether the auxiliary power supply matches that given on the nameplate and the inspection certificate valid in your country.

⚠ WARNING

Risk of explosion when using an unsuitable HART device

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

⚠ WARNING

Risk of explosion when using unsuitable cable glands/dummy plugs

Only use cable glands or dummy plugs which comply with the EC type examination certificate and the type of protection required at the location of use.

CAUTION

Limited range of use

If the device has been operated outside the ambient conditions specified for potentially explosive atmospheres, you may no longer operate the device in potentially explosive atmospheres. Make sure to permanently mask all Ex markings on the nameplate.

NOTICE

Loss of type of protection "Intrinsic safety"

If the device is not operated with an intrinsically-safe power supply, the type of protection "Intrinsic safety" is no longer guaranteed and the intrinsically safe approval may be revoked.

Permanently erase, therefore, the irrelevant types of protection on the nameplate before commissioning to ensure that erroneous deployment is avoided.

The 4 to 20 mA input and sensor circuits are electrically isolated and have been tested with a voltage of 1.5 kV DC for one minute.

The sensor circuit is galvanically isolated from the auxiliary power supply and signal circuit, up to a peak value of the rated voltage of 60 V. Be sure to observe the construction directives valid at the construction location for electrical resources in hazardous areas. In Europe, this is the standard EN 60079-14.

NOTICE
Electrical data and T_{amb} are dependent on Ex-protection class
See the certificate and Chapter "Technical data (Page 85)"

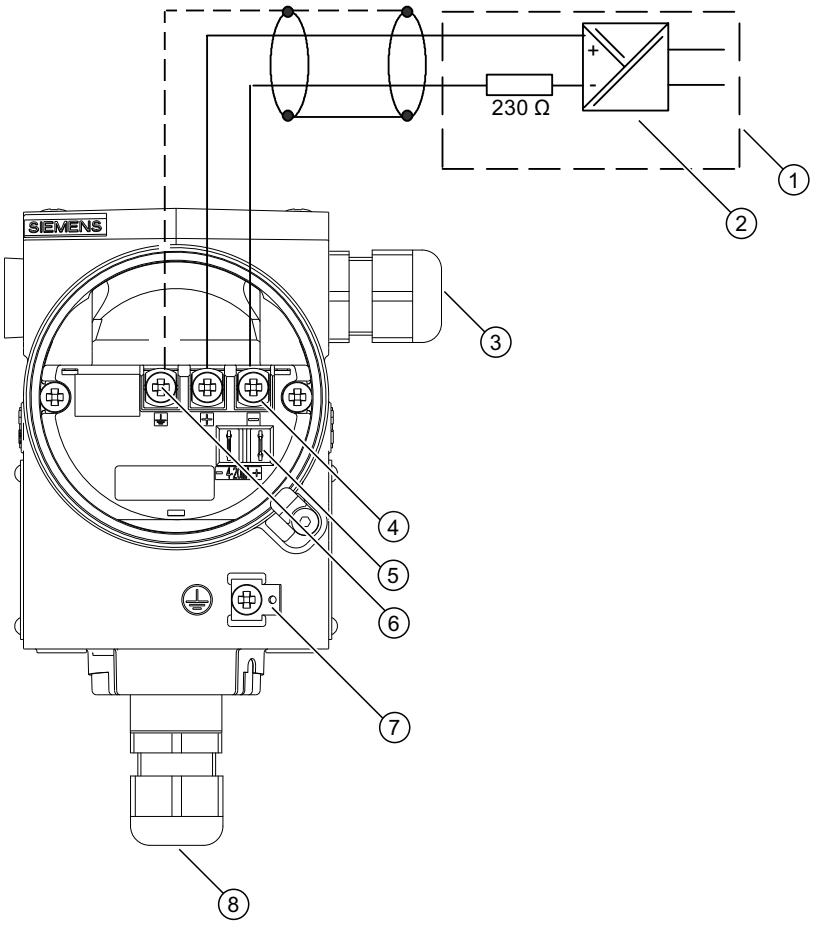
5.3 Opening the device

Procedure

1. Unscrew the cover of the electrical cable compartment. See Chapter "Layout (Page 15)". An identification text "FIELD TERMINAL" is provided at the side of the housing.

5.4 Auxiliary power supply electrical connection

Overview



①	Auxiliary power supply	⑤	Test connector for direct current measuring device or connection for external display
②	Example feed splitter for SITRANS TF with built-in SITRANS TH300	⑥	Shield support
③	Cable gland for auxiliary power supply/ analog output	⑦	Protective conductor connector
④	Connecting terminals "+" and "-"	⑧	Cable gland for sensor signal

Figure 5-1 Auxiliary power supply electrical connection

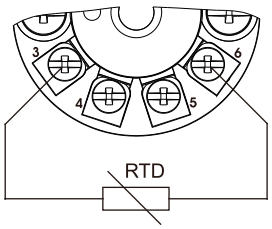
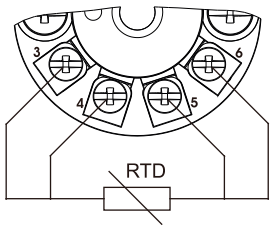
Procedure

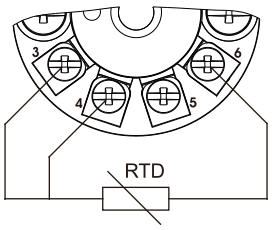
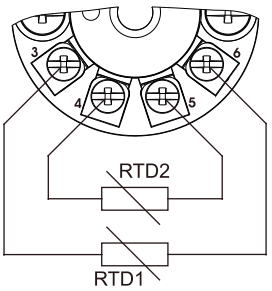
1. Connect the wires for the auxiliary power supply ① to terminals "1"(+) and "2"(-) ④. Ensure that the polarity is correct. The device is reverse polarity protected.
2. Connect the cable shield.
   Connect the shield of the signal cables to the shield support ⑥. The shield support is electrically connected with the housing.

5.5 Options for sensor connections

5.5.1 Resistance thermometer

Connector assignments

Resistance thermometer	
	
Two-wire input [1)]	Four-wire input

Resistance thermometer	
	
Three-wire input	Mean value / determination of difference [1]

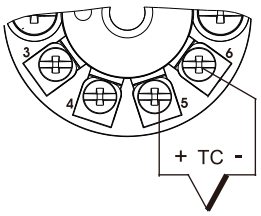
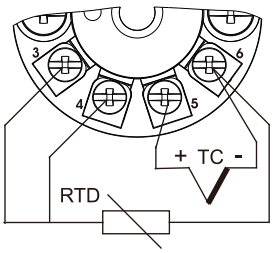
[1] Line resistance for correction is programmable.

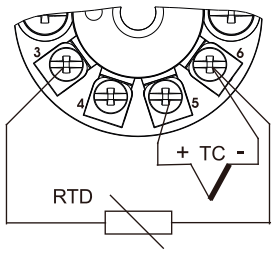
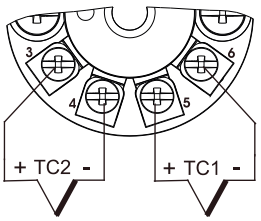
See also

Thermocouples (Page 35)

5.5.2 Thermocouples

Connector assignments

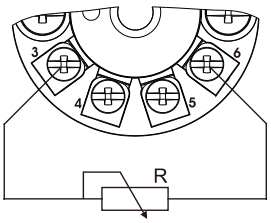
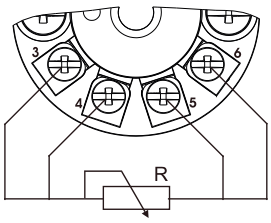
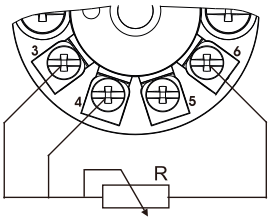
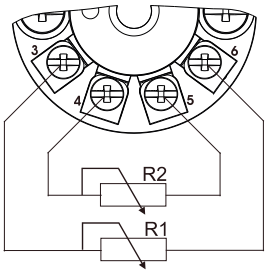
Thermocouples	
	
Cold junction compensation/ Internal/fixed value	Cold junction compensation with external Pt100 in three-wire input

Thermocouples	
	
Cold junction compensation with external Pt100 in two-wire input [1]	Mean value / determination of difference with internal cold junction compensation

[1] Line resistance for correction is programmable.

5.5.3 Resistor

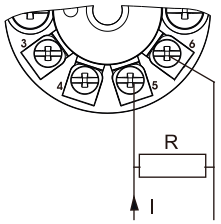
Connector assignments

Resistor	
	
Two-wire input [1]	Four-wire input
	
Three-wire input	Mean value /determination of difference [1]

[1] Line resistance for correction is programmable.

5.5.4 Current measurement

Connector assignments

Current measurement


Note

Current measurement

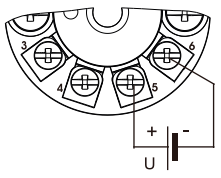
The following applies if you are using the transmitter for current measurement:

1. Connect an external measuring resistor R to the transmitter terminals 5 and 6.
2. Assign parameters for the measuring procedure using the transmitter-specific parameterization tools.

Additional information is available under: Parameterization of current measurement (Page 46)

5.5.5 Voltage measurement

Connector assignments

Voltage measurement


5.6 Test terminals for output signal

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

5.7 Closing the device

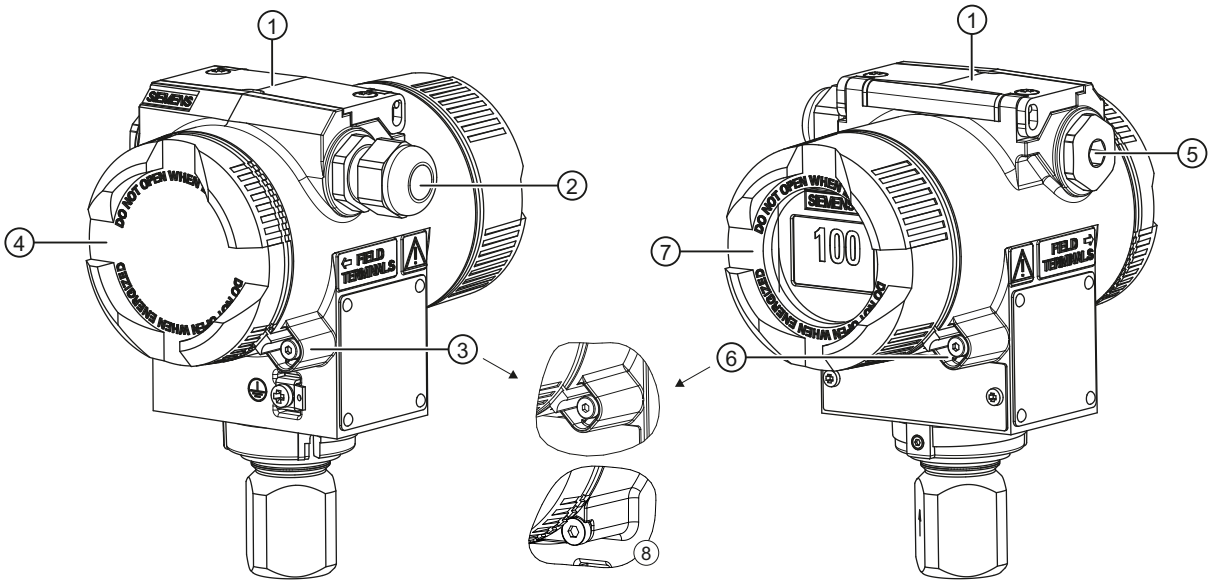
Procedure

Note

Key cover

Key cover ① without function. Key cover is sealed in the factory.

1. Screw the covers ④⑦ on as far as they will go.
2. Secure the covers with the cover catch ③⑥.
3. Check the tightness of the blanking plugs ⑤ and cable gland ② in accordance with the degree of protection.



①	Key cover	⑤	Blanking plug
②	Cable bushing	⑥	Safety catch (front)
③	Safety catch (back)	⑦	Cover (front), optionally with inspection window
④	Cover (rear) for electrical terminal compartment	⑧	Safety catch for stainless steel enclosure

Figure 5-2 Device view - left: rear view, right: front view

Operation 6

6.1 Overview

The PC is used to both assign the parameters and operate the SITRANS TH200 and SITRANS TH300. The PC is connected to the two-wire line using a suitable modem. The SITRANS TH300 can also be parameterized using a HART communicator. The signals needed for SITRANS TH300 communications in accordance with the HART protocol are superimposed on the output current in accordance with frequency shift keying (FSK).

Measurement transmitter data and data used to assign the parameters are stored in a non-volatile memory, the EEPROM.

6.2 Communication

6.2.1 Connect SIPROM T modem

6.2.1.1 Connect PC via SIPROM T modem

Requirements

Before you connect the SIPROM T modem to configure the transmitter parameters offline, the following requirements must be satisfied:

1. PC with SIPROM T software
2. 4 to 20 mA current loop, if present, is disconnected.
3. SIPROM T USB or SIPROM T RS232 modem

Procedure

Note

Connect SIPROM T modem to TH200

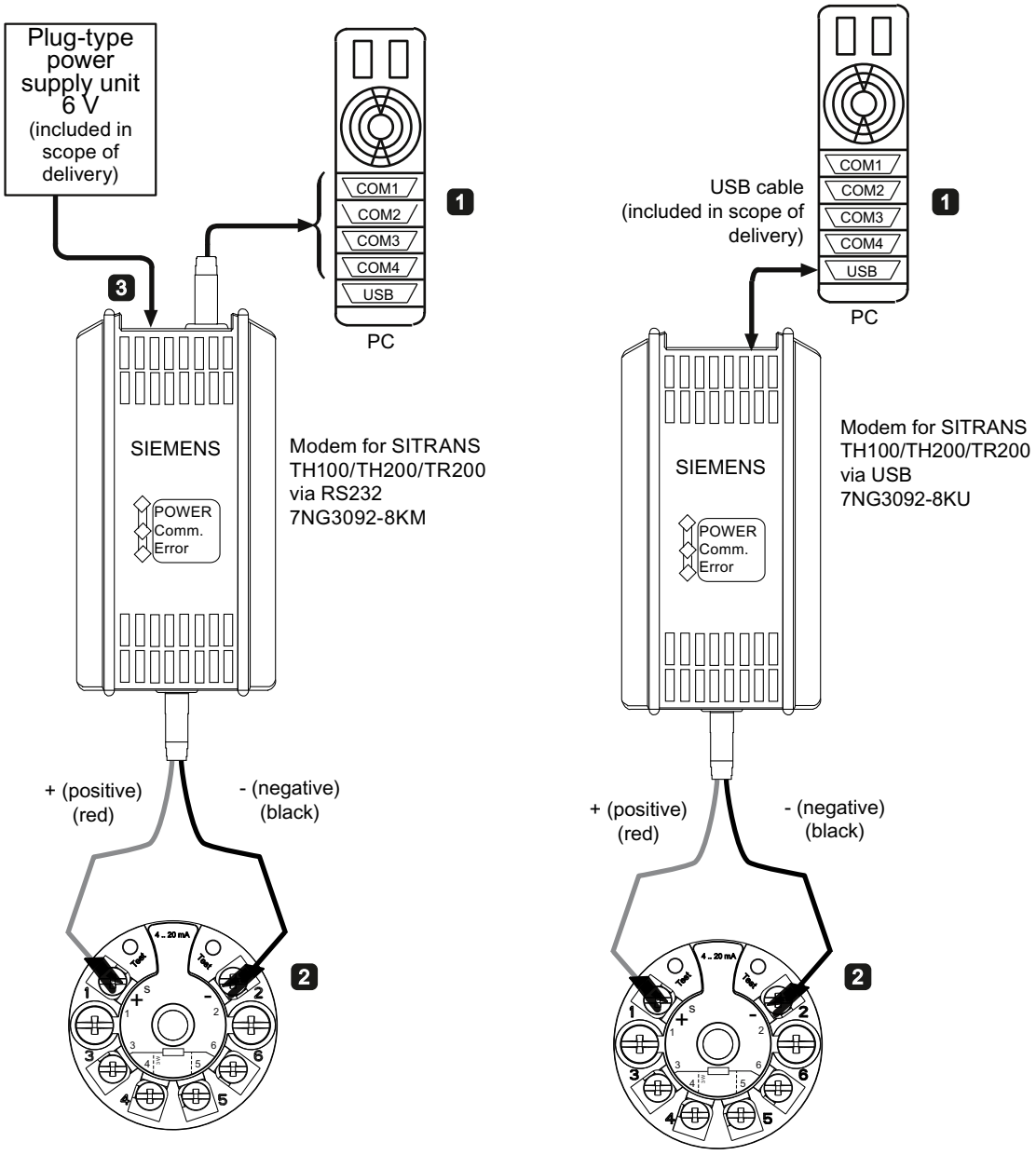
In the case of the device version with built-in SITRANS TH200, you must directly connect the SIPROM T modem to the transmitter terminals.

To do this, disconnect the display module plug and remove the display module from the housing.

Note

Switching off the power supply following parameterization

After the parameters have been assigned to the SITRANS TH200/TH300, do not switch the supply voltage for the transmitter off until the device's LED flashes red or lights constantly green.



1. Connect SIPROM T modem to a USB or RS232 port of your PC.
2. Connect the modem to your transmitter (terminals 1 and 2)

3. If you are using an RS232 modem, connect the modem power supply.
4. Assign parameters to your transmitter using SIPROM T.
   You can find additional information in the following documentation:
   - Modem for SITRANS TH100/TH200/TR200 and the SIPROM T parameterization software; Order No. 7NG3092-8KU
   - Supplied or separately ordered CD

6.2.2 Connect HART modem / HART communicator

6.2.2.1 HART communication with supply from voltage source

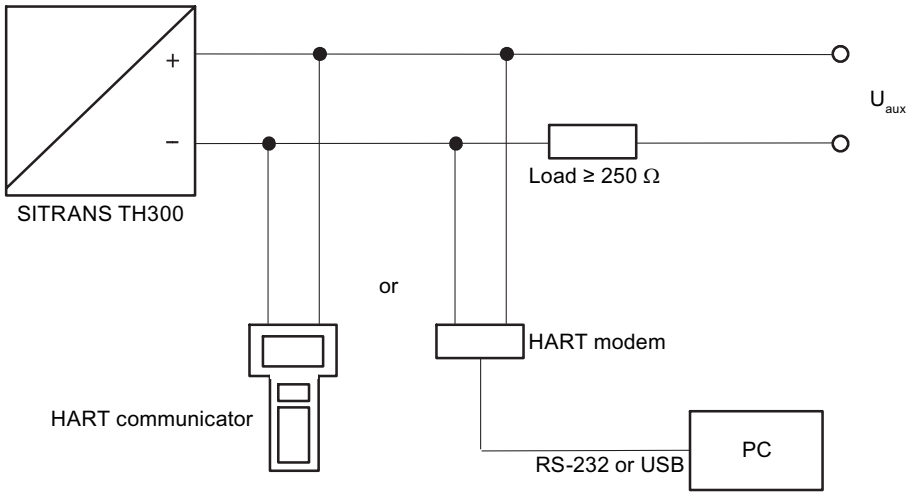
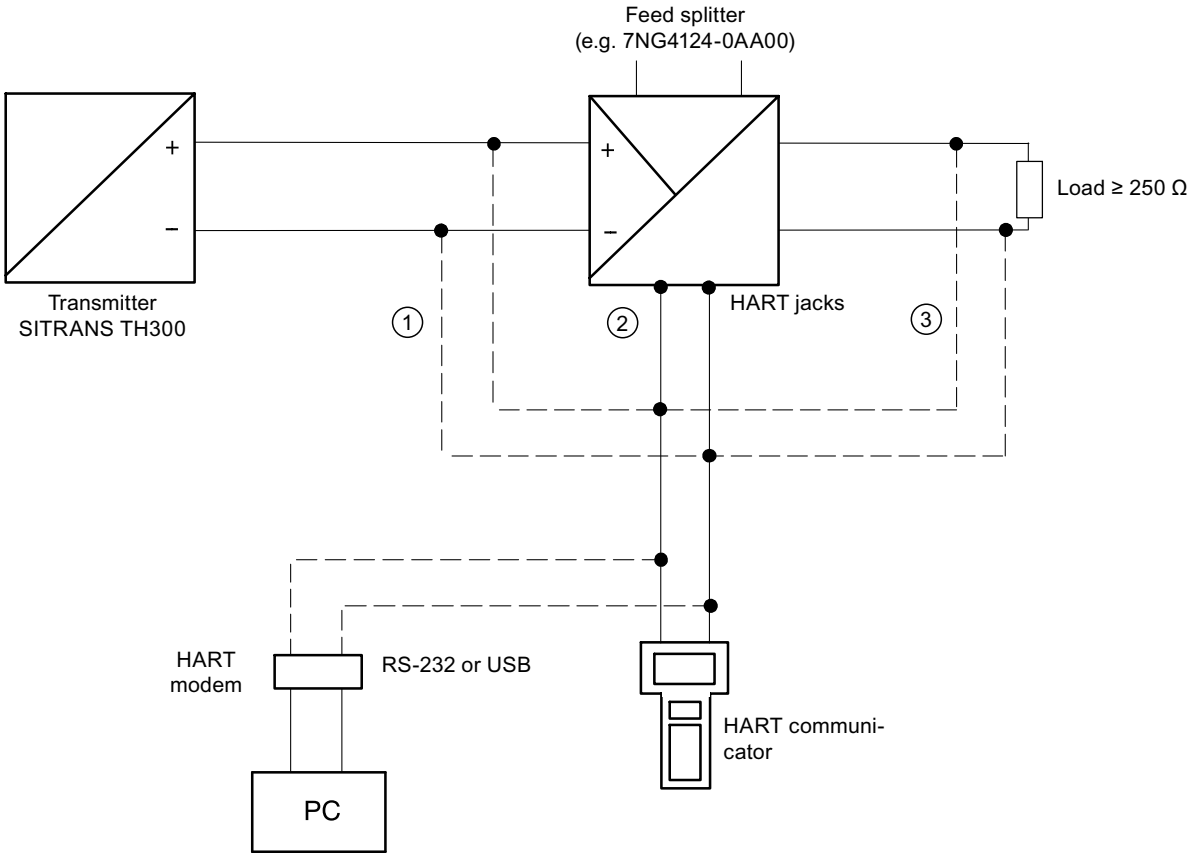


Figure 6-1 HART communication with supply from voltage source

6.2.2.2 HART communication with supply via feed splitter



① Only intrinsically safe HART communicators or HART modems are allowed to be used with an intrinsically safe power supply.

② HART communication via HART jacks of the feed splitter

③ Load ≥ 250 Ω only relevant if HART communication takes place via this branch. Otherwise, load of 0 to 650 Ω for versions ① or ②

Figure 6-2 HART communication with supply via feed splitter

6.3 SITRANS TF with SITRANS TH200 (offline)

Requirements

Before you use or assign parameters to the transmitter offline with SIPROM T, the following requirements must be satisfied:

- 4 to 20 mA current loop, if connected to the transmitter, is disconnected.
- The SIPROM T modem is powered via the plug-type power supply.
- The transmitter is connected to the PC via the modem.
- The display module is removed.

Procedure

1. Start SIPROM T: Start > Programs > Siemens Process Instruments > SIPROM T.
2. Select device to be parameterized: Extras > Settings > Device.
3. Set communication path: Extras > Settings > Communication path.
   Set whether your modem communicates via the RS232 or USB port.
4. Enter the device identification data.
5. Assign the input parameters:
   - Set sensor offset.
   - Define measuring limits unit.
   - Specify type of sensor connection, e.g.: "Three-wire".
   - Specify the start-of-scale and full-scale values.
6. Assign the output parameters
   - Set the analog output:
     Specify the lower and upper limits.
     Set sensor fault.
   - Set damping.
7. Transfer the modified configuration to the transmitter: click the "Download to PG/PC" button in the toolbar.

Further information can be found on the Internet in the documentation Modem and SIPROM T for SITRANS TH100/TH200/TR200 (http://support.automation.siemens.com/WW/view/en/23844748).

6.4 SITRANS TF with SITRANS TH300 (online)

6.4.1 Operation with the HART modem and SIMATIC PDM

Requirements

In order to use or assign parameters to the transmitter, you require a PG/PC, the SIMATIC PDM software tool, and a HART modem. Before you assign parameters to the transmitter, the following requirements must be satisfied:

- Transmitter power supply is switched on
- The load in the circuit is at least 250 Ω.
  Refer to the circuit diagram of the figure in Chapter HART communication with supply from voltage source (Page 41)
- SIMATIC PDM is installed on the PG/PC and ready for operation.

Operation with SIMATIC PDM

1. Connect HART modem to the PG/PC. Refer to Connect HART modem / HART communicator (Page 41).
2. Connect HART modem to the transmitter output circuit.
3. Start SIMATIC PDM.
4. Set transmitter parameters.
5. Download modified settings to device.
   Find additional information PDM V6.0 The Process Device Manager (http://support.automation.siemens.com/WW/view/de/21407212/0/en).

6.4.2 Operation with HART communicator

Action buttons

This button switches the HART communicator on and off. When switched-on, the hand-held terminal automatically establishes communication with the transmitter. The following 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 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 pressing the shift button first.

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

See also

Operation with the HART modem and SIMATIC PDM (Page 43)

6.5 Parameterization of current measurement

Requirements

Before you use the transmitter for current measurement, the following requirements must be satisfied:

- External measuring resistor R is connected to terminals 5 and 6, Chapter "Resistance thermometer (Page 34)".
- Transmitter is connected to a PC with SIPROM T or SIMATIC PDM or to a HART communicator.

Setting

1. Select sensor class and set to value "Millivolt transmitter".
2. Specify measured value scaling.
   Multiply the start-of-scale and full-scale values of the desired current range by the resistance value R.
3. Download the modifications to the transmitter.
4. Adapt the display if necessary.

Example

Measurement of a 0 to 20 mA current via an external resistance R of 10 Ω.

1. Sensor class: "Millivolt transmitter"
2. 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, the 0 to 20 mA current signal.

The voltage signal is scaled by the factor of the connected resistance value R.

If the measured values are called via the digital interface during the current measurement, the SIMATIC PDM displays the data as a voltage signal with the unit mV.

6.6 Display

6.6.1 Operating the display

Setting

In the basic setting, the display is the measured value display.

There are a total of 15 different modes for the field display. All modes are selected using the **M** button. To adjust the operating functions, proceed as follows:

1. Press the M button until the desired mode is displayed.
   The selected mode is shown in the lower left of the display.
   Each time the **M** button is pressed, the mode is incremented by one.
2. The ↑ and ↓ buttons are used to set the desired value or the physical unit. Continue pressing the ↑ or ↓ buttons until the desired value or physical unit is displayed.
3. Saving the setting:
   If you set a different mode, or if more than two minutes have passed since the last time the button was pressed, modified values are saved.
   See: Optional modes (Page 47).

Result

- The values are saved to memory.
- If the range of the field display has been exceeded, the display will show **9.9.9.9.9**.
- If an error occurs, the word "Error" is displayed, with ↑ or ↓.

6.6.2 Optional modes

Overview

Function	Mode	Button function			Display and description
	M	↑	↓	↑ and ↓	
Measured value [1]	1	Changing the decimal point (more)	Changing the decimal point (less)		Input value in measuring units, error signals, over/under-range signals.
Calibrate the start of scale value	2			Calibrate 4 mA.	Input current in mA
Calibrate the full scale value	3			Calibrate 20 mA.	Input current in mA
Electrical attenuation	4	greater than	less than		• Time constant T_{63} in s • Set range 0.1 ... 100 s • Default value = 0.1 s
Start of scale value	5	Increase	Decrease		Start of scale value in selected measuring unit default value = 0 °C
Full scale value	6	Increase	Decrease		Full scale value in selected measuring unit Default value = 100°C
Limit 1 exceeded	7	Increase	Decrease		↑ upper threshold for set limit, default value = 100°C
Limit 2 violation	8	Increase	Decrease		↓ lower threshold for set limit, default value = 0°C

Function	Mode	Button function			Display and description
	M	↑	↓	↑ and ↓	
"Error" display > 21 mA	9	Increase	Decrease		"Error" – set display to > 21 mA, default value = 21 mA
"Error" display < 4 mA	10	Increase	Decrease		"Error" – set display to < 4 mA, default value = 3.6 mA
Measured value display [1]	13	Change			• Input current in mA (default value) • Input value in % • Measuring unit
Measuring unit [1]	14	Change			Technical or custom measuring unit, default value = °C
Custom measuring unit	15	Change			Customer specifies a particular measuring unit.

[1] In modes 13 and 14, select the measuring units you want to show on the device's measured value display.

See also

Operating the display (Page 46)

Display module for SITRANS TF (Page 16)

Functional safety

7

7.1 General safety notes

7.1.1 Safety-instrumented system

This chapter describes the functional safety in general and not specific to a device. The devices in the examples are selected as representative examples. The device-specific information follows in the next chapter.

Description

The sensor, logic unit / control system and final controlling element combine to form a safety-instrumented system, which executes a safety function.

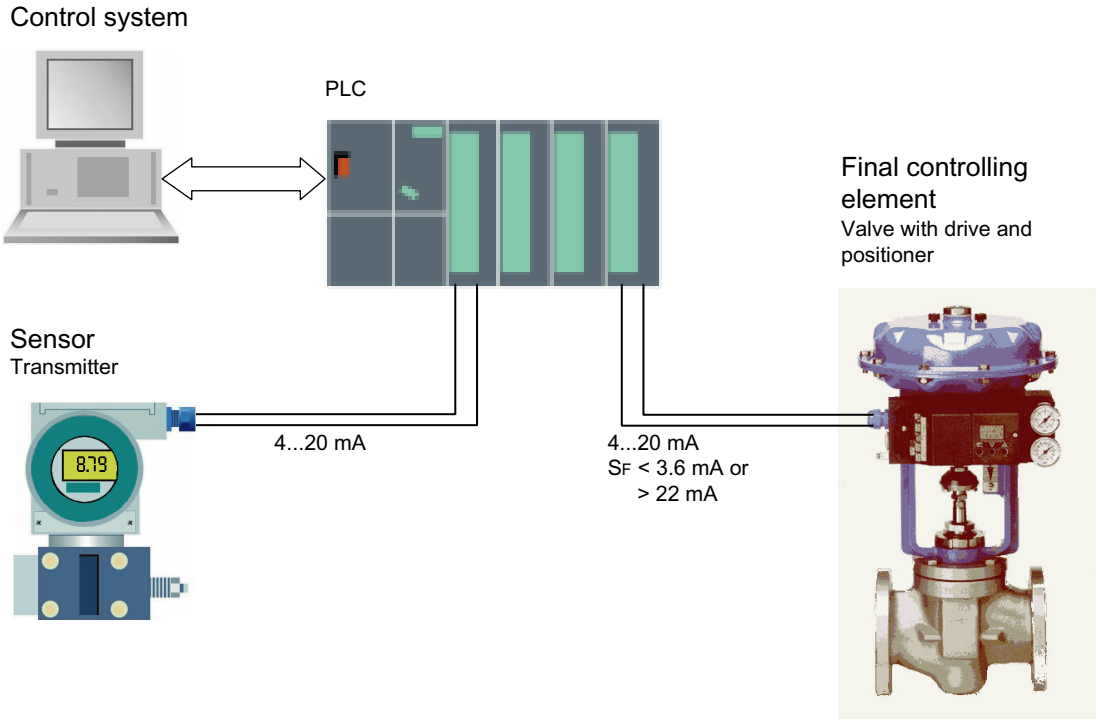


Figure 7-1 Example of a safety-instrumented system

Function of the system as shown in the example

The transmitter generates a process-specific analog signal. The downstream control system monitors this signal to ensure that it does not fall below or exceed a set limit value. In case of a fault, the control system generates a failure signal of < 3.6 mA or > 22 mA for the connected positioner, which switches the associated valve to the specified safety position.

7.1.2 Safety Integrity Level (SIL)

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to the probability range for the failure of a safety function.

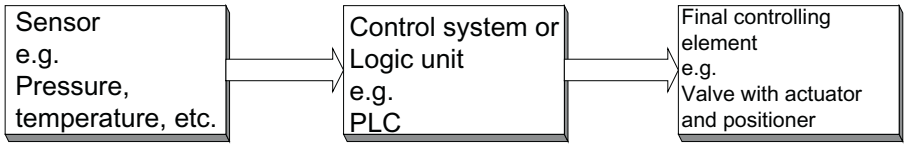
Description

The following table shows the dependency of the SIL on the "average probability of dangerous failures of a safety function of the entire safety-instrumented system" (PFD_{AVG}) The table deals with "Low demand mode", for example, the safety function is performed a maximum of once per year.

Table 7-1 Safety Integrity Level

SIL	Interval
4	$10^{-5} \leq PFD_{AVG} < 10^{-4}$
3	$10^{-4} \leq PFD_{AVG} < 10^{-3}$
2	$10^{-3} \leq PFD_{AVG} < 10^{-2}$
1	$10^{-2} \leq PFD_{AVG} < 10^{-1}$

The "average probability of dangerous failures of the entire safety-instrumented system" (PFD_{AVG}) is normally split between the three sub-systems in the following figure.



PFD_{AVG} percentage < 35 % < 15 % < 50%

Figure 7-2 Example of PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-instrumented system for type B subsystems depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT). Type B subsystems include analog transmitters and shut-off valves with complex components, e.g. microprocessors (also see IEC 61508, Part 2).

SFF	HFT		
	0	1 (0) [1]	2 (1) [1]
< 60 %	Not permitted	SIL 1	SIL 2
60 to 90 %	SIL 1	SIL 2	SIL 3
90 to 99 %	SIL 2	SIL 3	SIL 4
> 99 %	SIL 3	SIL 4	SIL 4

[1] As per IEC 61511-1, Chapter 11.4.4

According to IEC 61511-1, Chapter 11.4.4, the hardware fault tolerance (HFT) can be reduced by one (values in brackets) for sensors and final controlling elements with complex components if the following conditions are applicable for the device:

- The device is proven-in-use.
- The user can configure only the process-related parameters, e.g. control range, signal direction in case of a fault, limiting values, etc.
- The configuration level of the firmware is blocked against unauthorized operation.
- The function requires SIL of less than 4.

The device fulfills these conditions.

7.2 Device-specific safety information for single-channel operation (SIL 2)

7.2.1 Safety function

Temperature measurement is the safety function of the temperature transmitters.

It applies to output currents from 4 to 20 mA and ensures an accuracy of ± 2% in the maximum measurement range.

The output value will be updated at least every 620 ms (filter time constant of the electrical damping = 0 s).

The partial system is of type B. The calculations are valid for the operating mode with low demand rate in single-channel operation. The specific values are listed in the manufacturer declaration for the product (Declaration of Conformity, Functional Safety according to IEC 61508 and IEC 61511).

See also

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

7.2.2 Requirements

The temperature transmitter meets the following requirements:

- Functional safety up to SIL 2 under IEC 61508 or IEC 61511-1, for valid firmware versions see Declaration of Conformity (with order option C20 only)
- Explosion protection for corresponding versions
- Electromagnetic compatibility in compliance with EN 61326-1
- EC Declaration of Conformity

7.2.3 Settings

⚠ CAUTION

Current sensor function / simulation

The use of the current sensor function and the simulation in safety applications can result in undesirable operating states.

The use of both functions is not permitted in safety applications.

Operation/configuration

While operating/configuring, ensure compliance with the temperature transmitter technical data.

Checking the safety function

We recommend:

- Checking the status for warnings and alarms.
- Checking the upper and lower alarm current values.
- Performing a 2-point calibration.
- Checking that the measuring accuracy is in the range of ± 2% for the safety function. Check the measuring accuracy, for example, with a sensor calibration.

Note

Configuration in SITRANS TH300 not password protected

Insufficient password protection may result in undesirable changes to the configuration of the device.

We recommend that you enable password protection for your device after checking the safety function.

7.2.4 Behavior in case of faults

Repairs

Defective devices should be sent to the repair department with details of the fault and the cause. When ordering replacement devices specify the serial number of the original device. The serial number is on the nameplate.

The address of the responsible SIEMENS repair center, contacts, spare parts lists, etc. can be found on the Internet.

See also

Services & Support (http://www.siemens.com/automation/service&support)

7.2.5 Maintenance/Checking

Interval

We recommend checking the function of the temperature transmitter annually.

Checking the safety function

We recommend:

- Checking the status for warnings and alarms.
- Checking the upper and lower alarm current values.
- Performing a 2-point calibration.
- Checking that the measuring accuracy is in the range of ± 2% for the safety function. Check the measuring accuracy, for example, with a sensor calibration.

Checking safety

Check the safety function of the entire safety circuit in line with IEC 61508/61511 regularly. The testing intervals are determined during the calculation for each individual safety circuit in a system (PFD_{AVG}).

7.2.6 Safety characteristics

The safety characteristics necessary for using the system are listed in the "SIL declaration of conformity". These values apply under the following conditions:

- The SITRANS TH200/TH300 temperature transmitters are only used in applications with a low demand rate for the safety function (low demand mode).
- The communication is used for the following purposes only:
  - Device configuration
  - Reading diagnostic values
- The devices are operated differently:
  - SITRANS TH200: via SIPROM T
  - SITRANS TH300: via SIMATIC PDM or handheld communicator
- The safety function test was completed successfully.
- The transmitter is protected against unwanted and unauthorized changes/operation.
- The following condition applies to the transmitter:
  - The current signal is evaluated by a safe system.
- The specified error rates apply to the typical demand of an industrial environment as in IEC 60654-1 class C. IEC 60654-1 class C means a protected place of application, with an average temperature of max. 40 °C for an extended period of time.
- The calculation of error rates is based on a MTTR of 72 hours.

The maximum lifetime of the SITRANS TH200 or TH300 in a safety application is 20 years. Replace the device after this time.

7.3 Device-specific safety information for redundant operation (SIL 3)

7.3.1 Safety function

Temperature measurement is the safety function of the temperature transmitters.

It applies to output currents from 4 to 20 mA and ensures an accuracy of ± 2% of the maximum span.

The output value is updated at least every 620 ms (filter time constant of the electrical damping = 0 s).

The partial system is of type B. The calculations are valid for the operating mode with low demand rate in redundant operation. The specific values are listed in the manufacturer declaration for the product (Declaration of Conformity, Functional Safety according to IEC 61508 and IEC 61511).

See also

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

7.3.2 Requirements

Requirements

The temperature transmitters meet the following requirements:

- Two transmitters are required for redundant operation in accordance with SIL 3. Operation with one transmitter is not permissible.
- Functional safety up to SIL 3 under IEC 61508 or IEC 61511-1, for valid firmware versions see Declaration of Conformity (with order option C23 only)
- Explosion protection for corresponding versions
- Electromagnetic compatibility in compliance with EN 61326-1
- EC Declaration of Conformity

Description

The sensor, logic unit/control system and final controlling element combine to form a safety-instrumented system, which executes a safety function. The focal point of this description is the sensor. Please refer to the corresponding standards for the requirements placed on the PLC and final controlling element.

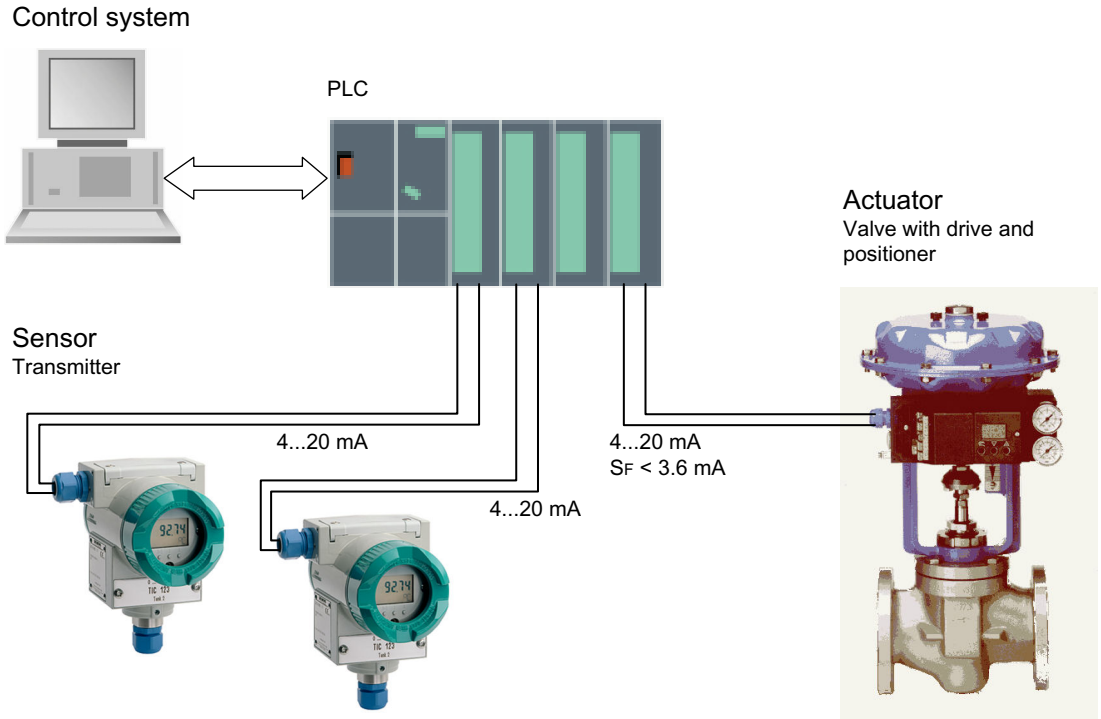


Figure 7-3 Safety-instrumented system in redundant operation (example: SITRANS TF transmitter)

The PLC program must monitor the measured values of both transmitters. As soon as the measured values differ by 2% or more, for example the system must be brought into a safe state and the fault must be located.

NOTICE
Differences in temperature ≥ 2 % will shut down the system The two transmitters are connected to the process at different positions. Actual differences in temperature ≥ 2% can occur when starting-up the process or if there are other temperature variations. Differences in temperature ≥ 2 % will shut down the system. • Match the monitoring accuracy of the PLC to the process. • Mount the two transmitters exposed to equal conditions.

7.3.3 Settings

⚠ CAUTION
Current sensor function / simulation The use of the current sensor function and the simulation in safety applications can result in undesirable operating states. The use of both functions is not permitted in safety applications.

Operation/configuration

While operating/configuring, ensure compliance with the temperature transmitter technical data.

Checking the safety function

We recommend for both transmitters:

- Checking the status for warnings and alarms.
- Checking the upper and lower alarm current values.
- Performing a 2-point calibration.

- Checking that the measuring accuracy is in the range of ± 2% for the safety function. Check the measuring accuracy, for example, with a sensor calibration.
- Checking the safety function trigger.

Note

Configuration in SITRANS TH300 not password protected

Insufficient password protection may result in undesirable changes to the configuration of the device.

We recommend that you enable password protection for your device after checking the safety function.

7.3.4 Behavior in case of faults

Repairs

Defective devices should be sent to the repair department with details of the fault and the cause. When ordering replacement devices, please specify the serial number of the original device. The serial number is on the nameplate.

The address of the responsible SIEMENS repair center, contacts, spare parts lists, etc. can be found on the Internet.

See also

Services & Support (http://www.siemens.com/automation/service&support)

7.3.5 Maintenance/Checking

Interval

We recommend checking the function of the temperature transmitter annually.

Checking the safety function

We recommend for both transmitters:

- Checking the status for warnings and alarms.
- Checking the upper and lower alarm current values.
- Performing a 2-point calibration.
- Checking that the measuring accuracy is in the range of ± 2% for the safety function. Check the measuring accuracy, for example, with a sensor calibration.
- Checking the safety function trigger.

Checking safety

Check the safety function of the entire safety circuit in line with IEC 61508/61511 regularly. The testing intervals are determined during the calculation for each individual safety circuit in a system (PFD_{AVG}).

7.3.6 Safety characteristics

The safety characteristics necessary for using the system are listed in the "SIL declaration of conformity". These values apply under the following conditions:

- Two temperature transmitters are required for redundant operation in accordance with SIL 3. The PLC program must monitor the measured values of both temperature transmitters. The system must be put into a safe state as soon as the measured values differ greatly.
- The SITRANS TH200/TH300 temperature transmitters are only used in applications with a low demand rate for the safety function (low demand mode).
- The communication is used for the following purposes only:
  - Device configuration
  - Reading diagnostic values
- The devices are operated differently:
  - SITRANS TH200: via SIPROM T
  - SITRANS TH300: via SIMATIC PDM or handheld communicator
- The safety function test was successful.
- The transmitters are protected against unwanted and unauthorized changes/operation.
- The following condition applies to the transmitters:
  - The current signal is evaluated by a safe system.
- The specified error rates apply to the typical demand of an industrial environment as in IEC 60654-1 class C. IEC 60654-1 class C means a protected place of application, with an average temperature of max. 40 °C for an extended period of time.
- The calculation of error rates is based on a MTTR of 72 hours.

The maximum lifetime of the SITRANS TH200 or TH300 in a safety application is 20 years. Replace the device after this time.

Commissioning 8

8.1 Commissioning

⚠ WARNING

Missing type of protection

If the transmitter is not operated with an intrinsically-safe power supply, the type of protection "Intrinsic safety" is no longer guaranteed and the intrinsically-safe approval may be revoked.

Permanently erase, therefore, the irrelevant types of protection on the nameplate before commissioning to ensure that erroneous deployment is avoided.

Procedure

1. Program the transmitter's operating data according to the actual requirements.
   If applicable, enter the changed operating data on the additional plate on the enclosure.
2. Assemble the transmitter.
3. Connect the sensor to the power supply, see Chapter "Connecting (Page 29)".
4. Turn on the auxiliary power supply.
5. Wait about 10 seconds. After this start-up time the transmitter is operational.

Note

Warming-up

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

8.2 LED operating indicator

- Operating indicator does not light: No supply voltage
- Constant green light: Everything OK, normal error-free operating state
- Constant/flashing red light: Disrupted operation
  - Flashing (ca. 2 Hz) red light: Indication of faults independent of the device, e.g. wire break, sensor short circuit, violation of sensor limits
  - Constant red light: Indication of errors in the device, e.g. **RAM-, ROM-, EEPROM-, CHECKSUM-, WATCHDOG-, STACK error** or violation of the permitted ambient temperature limits, and minimum supply voltage not reached.

Functions

9

9.1 General information

You can operate the SITRANS TH300 either via the SIMATIC PDM parameterization software or via the HART communicator. You can operate the SITRANS TH200 via the SIPROM T parameterization software.
The following functions are available to you when operating the SITRANS TH300/TH200:

- identification
  - Information on operational reliability: day, description, message, assembly number
- Device data; this information is read-only
  - Manufacturer and product name
  - Order number, device serial number
  - Revision numbers for 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
  - Interface type: standard, differential or averaging circuit
  - Connection type/sensor connection: two-wire, three-wire or four-wire input with resistance-type transmitters
  - Resistors for line compensation
  - Offset to the measurement signal
  - Additional information for the cold junction in thermocouples: internal, external or fixed
  - Enable/disable of wire break 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 on whether the transmitter is allowed to 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: boxes for describing the connected sensor in more detail
  - Type of sensor
  - Composition of the protective tube
  - Length of the protective tube
  - Screw thread / installation flange
  - Supplier / manufacturer
  - F no. of sensor
  - Order number
- Other functions that can be set in the parameters are:
  - Min/max pointer functions
  - Sensor calibration function with selectable trimming range within the limits of the measuring range
  - Trimming the analog output: from 4 to 16 mA with SITRANS TH200, from 4 to 20 mA with SITRANS TH300
  - Factory reset: resetting the operating data to the factory settings
  - Simulation of measurement input. Only in SITRANS TH300: electronics temperature and analog output.
  - Only in SITRANS TH300: individual password protection

The operating data are stored in a non-volatile memory, the EEPROM.

9.2 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.

9.3 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.

9.4 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.

9.5 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.

9.6 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.

9.7 Sensor factor

The sensor factor is used to adapt the characteristic curve when resistance thermometers are connected in series or parallel and when thermocouples are connected in series. 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 1: 3 x Pt500 parallel: Sensor factor= 5/3 = 1.67 (basis is Pt100)

Example 2: 4 x TC serial: Sensor factor = 4 x 1 = 4

9.8 Cold junction compensation with thermocouples

In order to measure the cold junction for thermocouples, you can choose between the following cold junction compensation versions:

- 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 a fixed value. The transmitter then compensates according to this constant cold junction temperature.
- External with Pt100: an external Pt100 measures the cold junction temperature in this version. You can connect the Pt100 to the transmitter in two-wire or three-wire input. The cold junction is compensated on the basis of the current temperature of the external Pt100.

9.9 Calculation of differential value/mean value

The differential and averaging circuit interfaces have the following special features compared to the standard connection:

Setting the start of scale value and full scale value:

- Enter the start of scale value and full scale value for both individual sensors first. The start of scale value and full scale value are the same for both sensors. It is not possible to assign different measuring ranges for the individual sensors in the parameters. Tip: use the largest measuring range.
- Following this, assign the parameters for the start of scale value and full scale value for the differentiation or the average value measurements.

Sensor calibration:

- Trim the individual sensors at the selected limits of the measuring range. The differentiation or average set in the parameters cannot be trimmed.

9.10 Electrical damping

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

9.11 Current sensor function (only in SITRANS TH300)

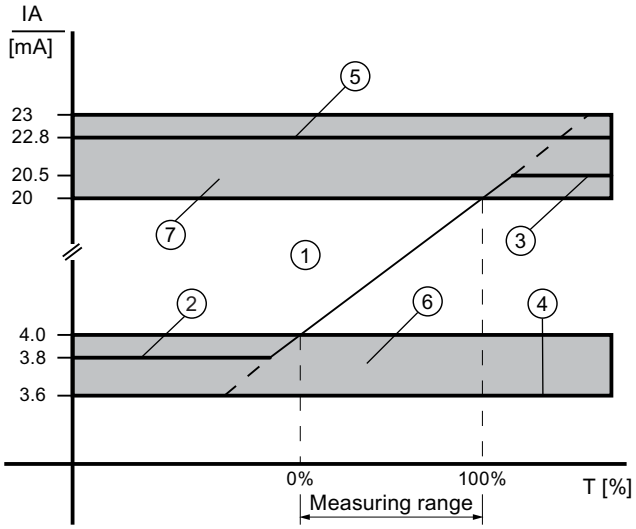
- You can switch the transmitter to constant current mode for test purposes. In that case, the output current no longer corresponds to the process variable.
- Using the operating software, you can set the value of the constant current for:
  - 4 mA
  - 20 mA
  - "Other value"; this value can be selected at will, the setting range is between 3.6 to 23 mA.

9.12 Alarm current

This function is used to set the magnitude of the alarm current. The alarm current signals a sensor fault or a hardware/firmware fault.

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

One example of this is shown in the following diagram. The specified accuracy values of the output signal only apply to the corresponding nominal ranges.



① Linear control range
② Lower limit of the control range (default value = 3.80 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

Figure 9-1 Current limits with output signal 4 to 20 mA

9.13 Sensor calibration

9.13.1 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.

9.13.2 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 trim point

With this function:

- You apply the process variable, e.g. temperature or resistance - on which the lower sensor calibration should be performed - to the transmitter input.
- You can use the operating software to instruct the transmitter to accept this process value. SITRANS TH200 uses the operating software SIPROM T; SITRANS TH300 uses the operating software SIMATIC PDM or the HART communicator.

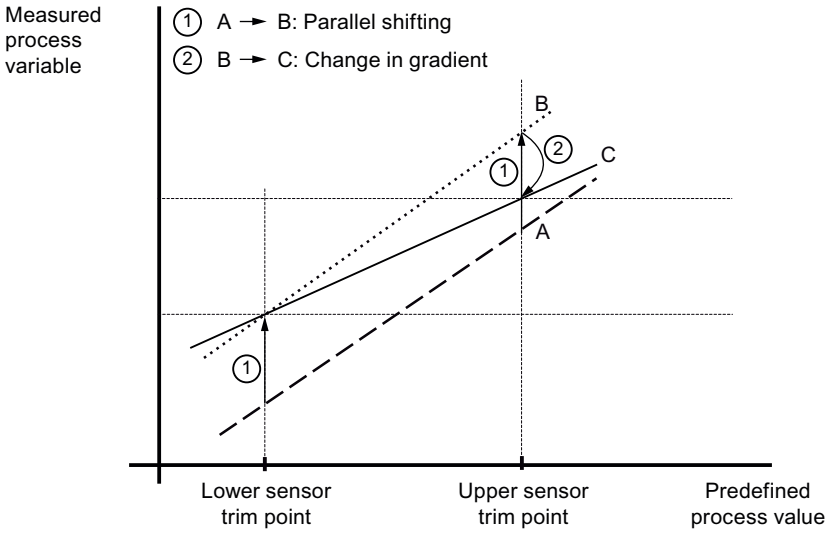
The acceptance of this process value is represented by an offset shift to the characteristic curve, see B in the "Sensor calibration" diagram.

Trimming the upper sensor trim point

With this function:

- You apply the process variable, e.g. temperature or resistance - on which the upper sensor calibration should be performed - to the transmitter input.
- You can use the operating software to instruct the transmitter to accept this process value.

The acceptance of this process value is represented by a gradient correction to the characteristic curve, see C in the "Sensor calibration" diagram. The lower sensor trim point is not affected by this.



A	Output curve
B	Characteristic curve after lower sensor calibration
C	Characteristic curve after upper sensor calibration

Figure 9-2 Sensor calibration

Note

If any of the following device parameters is changed by re-parameterization, a double point sensor calibration of SITRANS TH200/TH300 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 differentiation or averaging interface type.

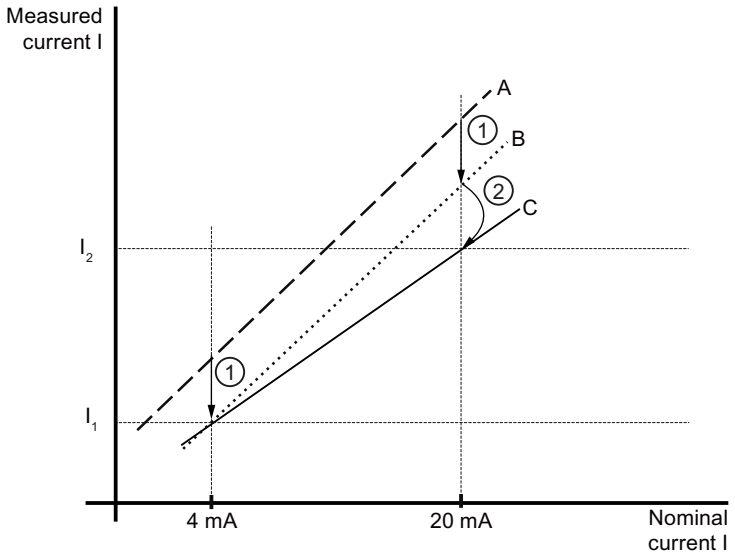
9.14 Current sensor calibration (digital-to-analog trim)

9.14.1 Function

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

- Device version 200: at 4 mA and at 16 mA
- Device version 300: at 4 mA and at 20 mA

The following figure shows the principle of trimming using the example of the 4 to 20 mA current output.



O Output characteristic
B Characteristic curve after current transmitter trim 4 mA
C Characteristic curve after current transmitter trim 20 mA
① A→B: Parallel offset
② B→C: Change in gradient

Figure 9-3 Current transmitter trim

See also

Application example: Current input calibration at 4 mA and 20 mA (Page 70)

9.14.2 Application example: Current input calibration at 4 mA and 20 mA

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

Trim at 4 mA (offset correction)

1. Use the menu item D/A trim to assign 4 mA output to the transmitter.
2. Read the measured value at the ammeter.
3. Enter the measured current value using the operating software.
   The transmitter uses this value for offset correction of the current.

Trim at 20 mA (gradient correction)

1. Use the menu item D/A trim to assign 20 mA output to the transmitter.
2. Read the measured value at the ammeter.
3. Enter the measured 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.

9.15 Special characteristic curve

The transmitter makes it possible to connect sensors to the device. Sensor characteristic curves valid for a large number of sensors are already programmed in the device.

Nevertheless, there are 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.

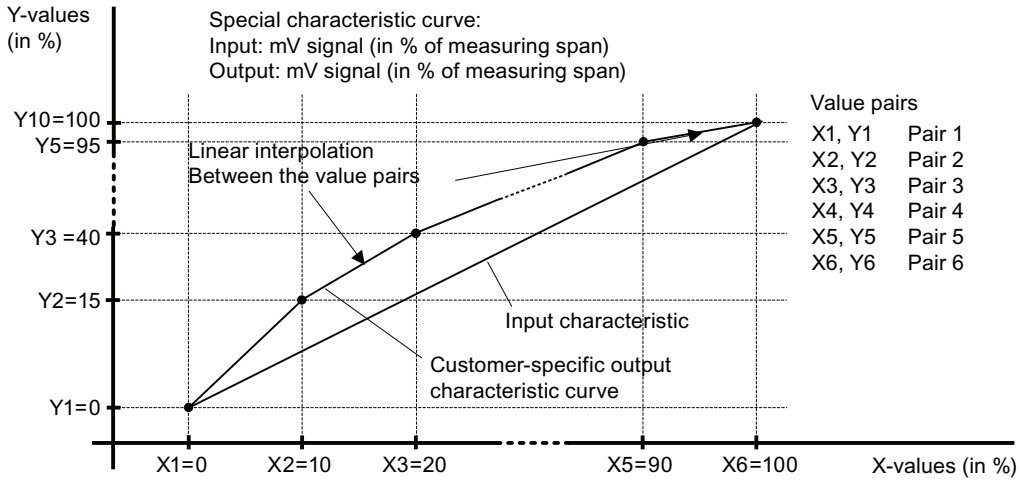


Figure 9-4 Principle of customer-specific characteristic curve correction

Notes on parameter assignment

Be sure to observe the following notes when assigning the parameters for the customer-specific special characteristic curve. These notes are irrespective of the parameter assignment software and apply to both device versions of the transmitter.

- The starting point of the characteristic curve correction is:
  - The resistance-type transmitter sensor class for the required special resistance thermometer;
  - The mV transmitter sensor class for the required special thermocouple.

  The sensor characteristic curve of the resistance-type transmitter or mV transmitter form the basis (0 to 100%) for the following characteristic curve correction.
- The individual pairs of values must always be specified 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. If a correction of the first and last pair of values is required, this is only possible 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

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

- At the start of scale value: - 10 mV (equals -100 °C)
- At full scale value: 40 mV (equals +400 °C)

Proceed as follows

Note

It may be necessary to perform a sensor calibration at the start of scale value (-10 mV) and full scale value (40 mV) before the sensor characteristic is recorded and the correction values have been entered.

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

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 for a parameter

Determining the pairs of values X[i] and Y[i] using, as an example, the pair of values i = 3 is explained below.

Calculation X[i=3]

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

The characteristic curve parameter X[3] = 0 mV corresponds with 20 % as a percentage in relation to
start of scale value = - 10 mV and full scale value = 40 mV.

Calculation Y[i=3]

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

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 %.

9.16 Factory parameters

Using the menu command **Device → Factory trim → Reset factory settings**, the configuration of the transmitter is reset to its default values.

Note

Factory reset

- The menu command **Device → Factory trim → Reset factory settings** always resets the parameters of the transmitter to the default values in the table listed below.
- This factory reset has the same effect for "devices supplied ex stock" or "devices set customer-specifically".
- Furthermore, resetting the transmitter to its default values also resets a customer-specific digital-to-analog converter trim and sensor calibration (one point trim or two point trim).

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

Parameter	Reset to value
DAY	Is not reset
Description	Is not reset
Message	Is not reset
Serial number	Is not reset
Installation date (electronics)	Is not reset
Sensor class	Resistance thermometer
Sensor type	Pt100 DIN IEC 751
Interface	Standard connection
Sensor connection	Three-wire input
Sensor factor	1.00
Sensor offset 1	0.00 °C
Start of scale value	0 °C
Full scale value	100 °C
Unit	°C

Parameter	Reset to value
Break monitoring	ON
Short circuit monitoring	ON
Short circuit limit	10 Ω
Lower end point analog output	Is not reset
Upper end point analog output	Is not reset
Alarm value	Is not reset
Linearization type	Linear to temperature
Attenuation	0.00 s
Runtime meters PV	Are all reset to 0 h
Runtime meters, field device	Are not reset
Min/max pointers PV	Are all reset to 0
Min/max pointers for electronics temperature	Are not reset
Manufacturer data sensor	Are not reset

9.17 Diagnostics

9.17.1 Diagnostic functions

The diagnostic concept of the SITRANS TH200 and the SITRANS TH300 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.

Diagnostics interrupts

Diagnostics interrupts can be output via:

- Analog output
- Operating indicator (LED)
- Only in SITRANS TH300: HART communication

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 function	Priority	HART [1]	Analog output	LED
Hardware/firmware defect				
RAM/ROM error	1	Status	On alarm value	Red
Flash/EEPROM error	1	Status	On alarm value	Red
Watchdog error	1	Status	On alarm value	Red
Electronics defect (hardware/firmware)	1	Status	On alarm value	Red

Diagnostic function	Priority	HART [1]	Analog output	LED
Electronics temperature outside limit [2]	1	Status	On alarm value	Red
Undershoot of min. supply voltage	1	-	< 3.6 mA	Red
Sensor error				
Sensor breakage	2	Status	On alarm value	Red 2 Hz
Sensor short circuit	2	Status	On alarm value	Red 2 Hz
Measured value (PV) outside the sensor limit [3]	2	Status	On alarm value	Red 2 Hz

1) Only in TH300

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

3) A diagnostics 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%.

Diagnostics warnings

Diagnostics warnings can be output via:

- Only in SITRANS TH300: HART communication

The device transmits the diagnostics event that has occurred via the operating software. The analog output value is unchanged.

Diagnostics function	Priority	HART [1]	Analog output	LED
Measured value out of the measuring range		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) Only in TH300

9.17.2 Violations of specification

WARNING

Non-observance of Ex ambient conditions

If the device has been operated outside the ambient conditions specified for potentially explosive atmospheres, you may no longer operate the device in potentially explosive atmospheres.

Additionally make sure to permanently mask all Ex markings on the nameplate.

CAUTION

Operation outside the permissible temperature limits

If you use the transmitter outside the permissible temperature limits, it no longer corresponds to the specification. The transmitter then outputs the parameterized fault current.
The message "Ambient temperature error/electronics temperature error" remains set in the device even after the power supply has been switched off and on again.

Operate the transmitter within the permissible temperature limits again, and reset the message "Ambient temperature error/electronics temperature error".

Reset

If you have guaranteed by means of sensor and D/A trimming that the transmitter is working with a tolerable accuracy, you can reset the transmitter.

Use the software tool SIPROM T or SIMATIC PDM to carry out the reset:

- 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

Note

Incorrect configuration

The configuration will not be completely stored in the device if the supply voltage fails during a write operation to the device. The diagnostic bit "HW/FW error" is set via HART.

Faulty or incomplete configurations are signaled by continuous lighting-up of the red diagnostics LED on the device.

Repeat the loading procedure for the configuration. The device will then revert to working in accordance with the specifications.

9.18 Runtime meters in temperature classes

The SITRANS TH200 and the SITRANS TH300 offer various runtime meters. Runtime meters are used to monitor the connected process sequence.

1. Runtime meter for transmitter electronics

- Monitors the number of operating hours during which the transmitter remained in continuous operation, depending on the ambient temperature.
- The operating hours sequence of the transmitter is recorded in 9 ambient temperature ranges.
- Starts with the first commissioning at the factory.
- Runtime meter and temperature ranges cannot be reset or set by the user.
- The runtime meter is only updated if the device is in measuring mode. The runtime meter is not updated in simulation mode.

2. Runtime meter for process variable

- Monitors the sequence of the sensor connected to the transmitter in various process areas.
- The operating hours sequence of the process variable is recorded in 9 ranges. It is subdivided according to the connected sensor and its sensor limits. The user cannot set the ranges.
- The runtime meter is automatically reset if one of the following parameters is changed in the device:
  - Sensor class
  - Sensor type
  - Interface
  - Sensor connection
  - Sensor factor

The runtime meters can be read out using the parameterization software SIPROM T for SITRANS TH200 or SIMATIC PDM or HART communicator for SITRANS TH300. The runtime meters are automatically stored in the non-volatile memory once every hour. All runtime meters are available again after the next restart if the device is disconnected from its supply voltage.

9.19 Slave pointer

This device offers a total of two min/max pointer pairs by means of which the following measured variables can be monitored for the lowest and highest values:

- Min/max pointer pair for measured value (e.g. temperature differential T1-T2 with two resistance thermometers in a differential circuit)
- Min/max pointer pair for electronics temperature (cannot be reset)

Resetting the min/max pointer is only possible for the measured value. A reset is performed:

- At the user's request
- Automatically when any of the following parameters is changed in the device:
  - Sensor class
  - Sensor type
  - Interface
  - Sensor connection
  - Sensor factor

9.20 Simulation (only in SITRANS TH300)

The "Simulation" diagnostic function makes it possible to receive and process (quasi) measured data without a process value at the device. In this way, individual process sequences are run through in "cold" status to enable process statuses to be simulated. Furthermore, applying simulation values enables you to check the cable routing for the analog output.

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

- **Measurement input:**
  - Fixed value simulation or ramp simulation for primary process variable
  - Fixed value simulation or ramp simulation for electronics temperature
- **Measurement output:**
  - Fixed value simulation of the analog output

The simulation of the primary process variable, electronics temperature, and analog output is handled in the same way in terms of parameter assignment and function. For this reason, the following will only deal with the general simulation procedures "Fixed value" and "Ramp function", taking the example of the measurement input.

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

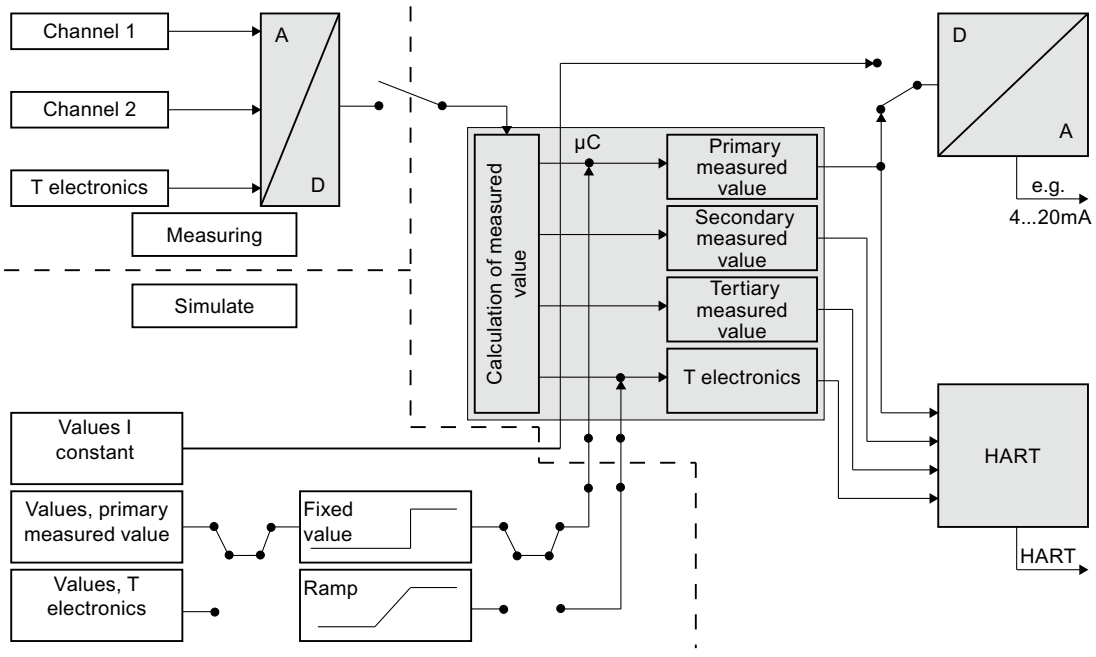


Figure 9-5 Block diagram of simulation

Simulation measurement input

Note

Simulation

- While simulation is activated, the transmitter will not react to changes in the sensor input signals.
- If the internal electronics temperature is to be simulated, the device parameters are not allowed to be set to "Thermocouple with internal cold junction compensation" for this purpose. In this case, the internal electronics temperature is a measured variable and cannot be replaced by a simulation value.

- Simulation as fixed value
  You can assign fixed simulation values in the parameters for both simulation paths (primary measured value and electronics temperature) by taking the physical unit into account. The analog output adopts a value according to the specification for the primary measured value.
- Simulation with a periodic ramp function
  As well as the adjustable fixed values, you can also assign a periodically recurring ramp function in the parameters for both simulation paths. Adjustable start-of-scale and full-scale values together determine the limits between which the simulation values move with a rising or falling tendency. You can calculate the step width with the step number, which is also adjustable.

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

  The duration between two successive simulation values is defined by the step duration. The analog output follows the simulated values in the simulation for the primary measured value.

9.21 Individual password protection (only in SITRANS TH300)

Description

The individual password protection prevents unauthorized write access to the device.

Note

Password protection

- Change the default password immediately after commissioning the device. You will then prevent write access to the device by unauthorized persons.
- Store your new password in a secure location.
- Consult the Siemens contact person in your region to receive your "super pin".
- When you activate the password protection in the device, write protection will be set automatically after the device has been switched on.

In the condition of goods delivered, every transmitter is set with the default password **2457**. Password protection is deactivated. If you reset the transmitter to the factory setting, the current password will not be reset to the default password. Should you no longer know your password, then the data in the device can only be altered using a "super pin", therefore not using the default password. The super pin can be obtained from your regional Siemens contact person.

Procedure for writing data in a password protected device

1. Select the "Deactivate password protection" menu in the parameterization software.
2. Enter your 4-digit password. Password protection is deactivated.
3. Change the values according to your application.
4. Select the "Activate password protection" menu in the parameterization software. The device is write protected again.

Service and maintenance 10

The device is maintenance-free.

Note

Function check of device

If the device is located outside the building, device function must be checked after an overvoltage event.

An overvoltage event can occur, for example, during a thunderstorm.

10.1 Cleaning

Cleaning the enclosure

- Clean the outside of the enclosure and the display window using a cloth moistened with water or a mild detergent.
- Do not use aggressive cleaning agents or solvents. Plastic components or painted surfaces could be damaged.

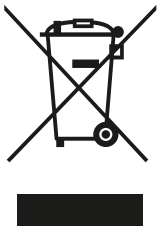
⚠ WARNING

Electrostatic charge

Danger of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic enclosures with a dry cloth.

- Prevent electrostatic charging in hazardous areas.

10.2 Device



Devices identified by this symbol may not be disposed of in the municipal waste disposal services under observance of the Directive 2002/96/EC on waste electronic and electrical equipment (WEEE).

They can be returned to the supplier within the EC or to a locally approved disposal service. Observe the specific regulations valid in your country.

Technical data

11

11.1 Technical data

Input	
Resistance thermometer	
• Measured variable	Temperature
• Sensor type	• Pt25 … Pt1000 (IEC 60751) • Pt25 … Pt1000 (JISC1604) • Ni25 … Ni1000 (IEC 60751)
• Min. measuring span	10 °C (18 °F)
• Characteristic curve	Linear to temperature or special characteristic curve
• Type of connection	Two-, three- or four-wire input
Resistance-type transmitter	
• Measured variable	Ohmic resistance
• Sensor type	Resistance, potentiometer
• Measuring range	0 ... 2200 Ω
• Min. measuring span	5 ... 25 Ω
• Characteristic curve	Linear to resistance or special characteristic curve
• Type of connection	Two-, three- or four-wire input
Thermocouples	
• Measured variable	Temperature
• Sensor type - thermo pairs	• Type B, E, J, K, N, R, S, T (DIN IEC 584-1) • Type L, U (DIN 43710) • Type C, D (ASTM 988)
• Min. measuring span	50 ... 100 °C (90 ... 180 °F)
• Characteristic curve	Linear to temperature or special characteristic curve
• Cold junction compensation	Internally, externally with Pt100 or externally with fixed value
Millivoltmeter	
• Measured variable	DC voltage
• Sensor type	• DC voltage source • DC voltage source is possible via a resistor connected externally
• Measuring range	-100 ... 1100 mV
• Min. measuring span	2 ... 20 mV

Input	
• Characteristic curve	Linear to voltage or special characteristic curve
• Input resistance	≥ 1 MΩ

Output	
Output signal	4 ... 20 mA, two-wire
SITRANS TH300 communication	In accordance with HART protocol Rev. 5.9

Digital measuring accuracy			
Resistance-type transmitter			
Input	Measuring range Ω	Minimum measuring range Ω	Digital accuracy Ω
• Resistor	0 ... 390	5	0.05
• Resistor	0 ... 2200	25	0.25
Resistance thermometer			
Input	Measuring range °C (°F)	Minimum measuring span °C (°F)	Digital accuracy °C (°F)
• Pt25 (IEC 60751)	-200 … 850 (-328 … 1562)	10 (18)	0,2 (0.36)
• Pt50 (IEC 60751)	-200 … 850 (-328 … 1562)	10 (18)	0,15 (0.27)
• Pt100 to Pt200 (IEC 60751)	-200 … 850 (-328 … 1562)	10 (18)	0,1 (0.18)
• Pt500 (IEC 60751)	-200 … 850 (-328 … 1562)	10 (18)	0,15 (0.27)
• Pt1000 (IEC 60751)	-200 … 350 (-328 … 662)	10 (18)	0,15 (0.27)
• Pt25 (JIS C1604-81)	-200 … 649 (-328 … 1200)	10 (18)	0,2 (0.36)
• Pt50 (JIS C1604-81)	-200 … 649 (-328 … 1200)	10 (18)	0,15 (0.27)
• Pt100 to Pt200 (JIS C1604-81)	-200 … 649 (-328 … 1200)	10 (18)	0,1 (0.18)
• Pt500 (JIS C1604-81)	-200 … 649 (-328 … 1200)	10 (18)	0,15 (0.27)
• Pt1000 (JIS C1604-81)	-200 … 350 (-328 … 662)	10 (18)	0,15 (0.27)
• Ni25 … Ni1000	-60 … 250 (-76 … 482)	10 (18)	0,1 (0.18)
Thermocouples			
Input	Measuring range °C (°F)	Minimum measuring span °C (°F)	Digital accuracy °C (°F)
• Type B	0 … 300 (32 … 572)	100 (180)	3 (5.40)

Digital measuring accuracy			
• Type B	300 … 1820 (572 … 3308)	100 (180)	2 (3.60)
• Type C (W5)	0 … 2300 (32 ... 4172)	100 (180)	2 (3.60)
• Type D (W3)	0 … 1750 (32 ... 3182)	100 (180)	1 (1.80)
• Type D (W3)	1750 … 2300 (3182 … 4172)	100 (180)	2 (3.60)
• Type E	-200 … 1000 (-328 ... 1832)	50 (90)	1 (1.80)
• Type J	-210 … 1200 (-346 ... 2192)	50 (90)	1 (1.80)
• Type K	-200 … 1370 (-328 ... 2498)	50 (90)	1 (1.80)
• Type L	-200 … 900 (-328 ... 1652)	50 (90)	1 (1.80)
• Type N	-200 … 1300 (-328 ... 2372)	50 (90)	1 (1.80)
• Type R	-50 ... 1760 (-58 ... 3200)	100 (180)	2 (3.60)
• Type S	-50 ... 1760 (-58 ... 3200)	100 (180)	2 (3.60)
• Type T	-200 ... 400 (-328 ... 752)	40 (72)	1 (1.80)
• Type U	-200 ... 600 (-328 ... 1112)	50 (90)	2 (3.60)

Millivolt transmitter			
Input	Measuring range mV	Minimum measuring span mV	Digital accuracy µV
• Millivolt transmitter	-10 ... 70	2	40
• Millivolt transmitter	-100 ... 1100	20	400

Measuring accuracy	
Analog output error (digital-to-analog conversion)	< 1 % of the output current span (16 mA)
Fault due to internal cold junction	< 0.5°C (0.9°F)
Temperature influence of the ambient temperature	
• Analog measuring error	0.02 % of the output current span (16 mA)/ 10 °C (18 °F)
• Digital measuring error	
In resistance thermometers	0.06 °C (32 °F)/10 °C (50 °F)
In thermocouples	0.6 °C (33.08 °F)/10 °C (50 °F)
Influence of the auxiliary power supply	< 0.001 % of the output current span (16 mA)/ V

Digital measuring accuracy	
Influence of load	< 0.002 % of the output current span (16 mA)/ 100 Ω
Long-term drift (start of scale value, measuring span)	• < 0.02 % of the measuring span in the first month • < 0.2 % of the measuring span after one year • < 0.3 % of the span after five years

Ambient conditions	
Range of ambient temperature	-40 to + 85 °C (-40 to 185 °F)
Ambient temperature for Ex type	See Ex certificates
Storage temperature	-40 to + 85 °C (-40 to 185 °F)
Relative humidity	≤ 98%, condensing
Electromagnetic compatibility [1)]	According to DIN EN 61326-1 and NAMUR recommendation NE21

[1)] Single, brief failures can occur during measurement in environments with strong electrostatic interference. The tolerance of the display must be increased by 2.5 % if there are powerful radio transmitters in the vicinity. In the case of lightning the customer has to inspect the device functionality if the cable is longer than 30 meters or if it runs outside.

Degree of protection	IP67 according to EN 60529 and NEMA 4X according to NEMA 250

Construction	
Weight	Approx. 1.5 kg, without options
Housing materials	• Low-copper aluminum die casting GD-AlSi12 or stainless steel enclosure • Polyester-based paint for AlSi12 housing • Stainless steel nameplate
Electrical connection, sensor connection	Screw terminals, cable entry via M20 x 1.5 or ½ - 14NPT screwed joint
Mounting bracket optional	Steel, zinc plated and yellow chromed or stainless steel
Display module (digital display), optional	In current loop, see Chapter "Technical specifications of display module (Page 90)"

Auxiliary power supply	
Without display module for SITRANS TF with built-in SITRANS TH200 or TH300	DC 11 ... 35 V (for Ex type see Ex certificate)
With display module for SITRANS TF with built-in SITRANS TH200 or TH300	DC 13.1 ... 35 V (for Ex type see Ex certificate)
Electrical isolation	V_{rms} = 1 kV, 50 Hz, 1 min

Certificates and approvals	
Explosion protection **ATEX, IECEx** *and further approval authorities*	
For operation in hazardous areas, use only the electrical data and operating conditions on the ATEX/ IECEx Certificate.	
Type of protection "Intrinsic safety" according to ZELM 11 ATEX 0471 X and IECEx ZLM 11.0003X	• II 2(1) G Ex ib [ia Ga] IIC T4/T6 Gb • II 2 G Ex ib IIC T4 Gb • II 3(1) G Ex ic [ia Ga] IIC T4/T6 Gc • II 3 G Ex ic IIC T4/T6 Gc • II 1 D Ex ia IIIC T100°C Da Device with display only available with T4.
Type of protection "Flameproof enclosure" according to ZELM 11 ATEX 0472 X and IECEx ZLM 11.0008X	• II 2 G Ex d IIC T5/T6 Gb • II 2 D Ex t IIIC T100°C Db IP67
Type of protection "Non-sparking" according to ZELM 11 ATEX 0471 X (according to IECEx ZLM 11.0003X for Ex nA only)	• II 3 G Ex nA IIC T4/T6 Gc • II 3 G Ex nA[ic] IIC T4/T6 Gc • II 3 G Ex nA[ic] IIC T4 Gc (display option)
Explosion protection FM for USA	
For operation in hazardous areas, use only the electrical data, operating conditions and installation instructions on the FM Certificate of Compliance.	
Types of protection according to FM 3017742	• XP Cl I, Div 1, GP BCD T4/T6 • DIP Cl II, III, Div 1, GP EFG T4/T6 • NI Cl I Div 2, GP ABCD T4/T6 • S Cl II, III, Div 2, GP FG T4/T6

Hardware and software requirements for the SIPROM T parameterization software for SITRANS TF with inbuilt temperature transmitter TH200	
Computer	• IBM compatible, 486 MB or higher • 3½" floppy disk drive • Hard disk with approx. 5 MB free space • Minimum 4 MB RAM main memory • VGA graphics adapter or compatible with minimum 16 colors • One free serial interface with RS232 or USB connection • Mouse or compatible pointer and printer, recommended
Operating system	Microsoft Windows 2000 or higher
SIMATIC PDM for SITRANS TH300, see SIMATIC PDM manual	

Communication	
Load on HART connection	230 ... 1100 Ω
Management	
• Two-wire protected	≤ 3 km
• Multi-wire protected	≤ 1.5 km
Protocol	HART protocol Rev. 5.9

11.2 Technical specifications of display module

Display module	
Operating range for SITRANS devices	• SITRANS TF temperature transmitter • SITRANS TF as field indicator
Power supply	From two-wire line with loop current 4 ... 20 mA
Reverse polarity protection	Yes
Measuring range of input signal	3.5 mA to 23 mA
Own power consumption	< 3 mA
Voltage drop via connecting terminals	< 2.1 V
Maximum load on input	≤ 120 mA
Linearity	< ± 0.2 %
Measuring rate	≥ 2 Hz
Temperature impact	< ± 0.1%/10 °C
Functional temperature range	-25 ... +85 °C (-13 ... +185 °F) (with Ex version see Ex certificate)

Display module	
Operating and storage temperature	-40 ... +85 °C (-40 ... +185 °F) (with Ex version see Ex certificate)
Best readability	-10 ... +70 °C (14 ... +158 °F)
Display	Maximum 5 digits
Display range	-99999 ... +99999
Adjustability of zero point and full-scale value	-99999 ... +99999
Decimal point change	Automatic and manual
Error message	"Error" message when current measuring range exceeds 21 mA and falls below 3.6 mA in accordance with NAMUR NE 43. These limits can be set between 3.5 and 23 mA.
Limits	Freely programmable
Measuring range and limit violation displays	Message ↑ or ↓ in case of over/under violation.
Setting of zero point, full-scale value and unit	With three buttons
Units	mA or % or physical variable:
• Available units in modes M13 and M14	°C, °F, °R, K, bar, mbar, mmH_2O, inH_2O, ftH_2O, mmHg, inHg, ftHg, psi, Pa, kPa, MPa, g/cm^2, kg/cm^2, torr, atm, l/min, m^3/h, m^3/s, l/h, kg/h, t/h, pH, t, mV, V, Ω, A, ppm
• Optional input of freely programmable units	In mode M15, maximum 5 characters
Programmable attenuation	0.1 ... 100 s in steps of 0.1 s
Electromagnetic compatibility	According to DIN EN 61326-1 and NAMUR recommendation NE21
Mounting	Mount in SITRANS TF field housing using two M4 screws and two spacers.
Housing material	Plastic
Dimensions	• Diameter: 65.5 mm (2.58") • Height 12.4 mm (0.5") to max. 15.4 mm (0.6")
Wiring	Two-wire cable with two-pole connector (marked "+" and "-")

See also

Display module dimension drawing (Page 94)

Dimension drawings

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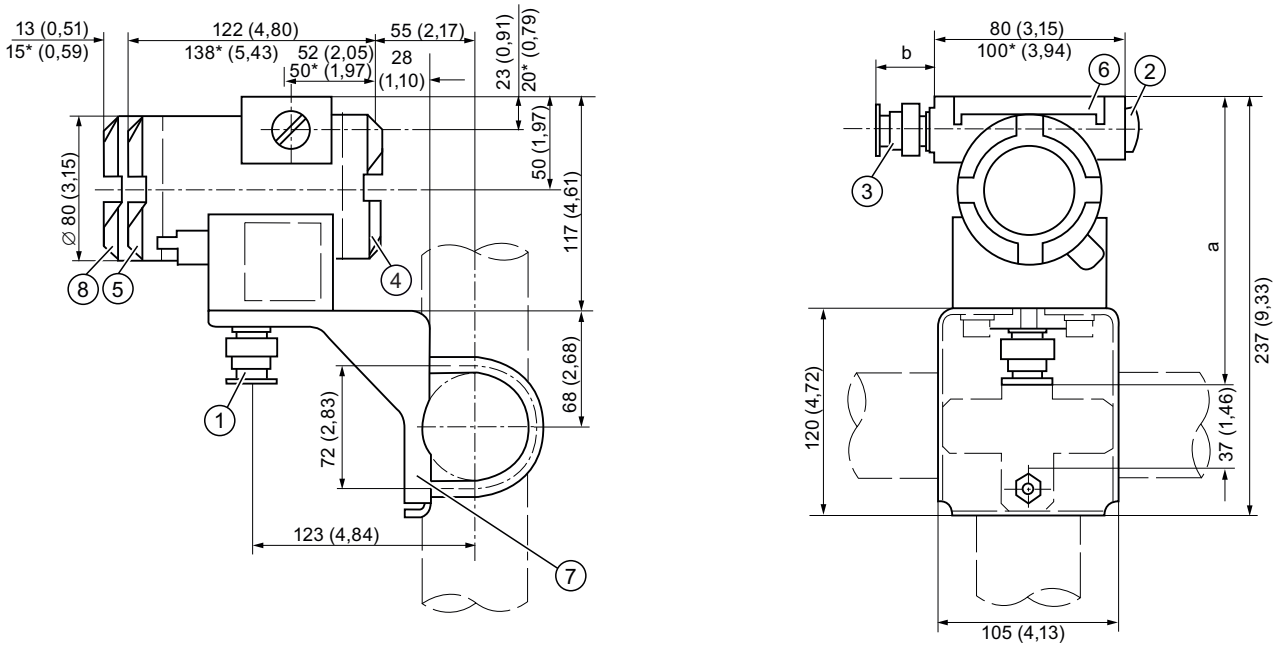
12.1 SITRANS TF dimension drawing



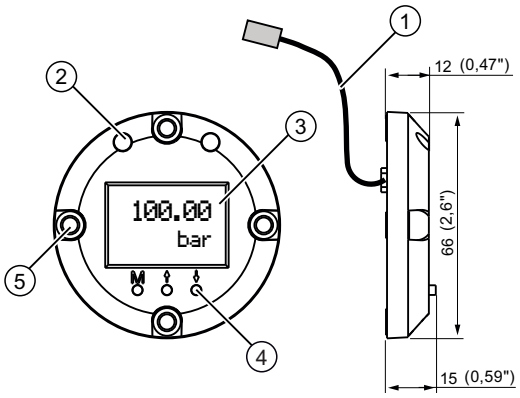
a:	max. 164 (M20 x 1.5) max. 189 (½ - 14NPT)	b:	max. 25 (M20 x 1.5) max. 50 (½ - 14NPT)
①	Sensor connection (M20 x 1.5 or ½ - 14NPT screwed joint)	⑤	Connection side sensor
②	Blanking plug	⑥	Cover (without function)
③	Electrical connection (M20 x 1.5 or ½ - 14NPT screwed joint)	⑦	Mounting bracket (optional) with clamp for attaching to a vertical or horizontal pipe
④	Connection side output signal	⑧	Cover with inspection window for digital display

Figure 12-1 SITRANS TF dimension drawing

*) Indicates the size for stainless steel enclosure

Dimensions in mm (inches)

12.2 Display module dimension drawing



① Connecting cable with plug-in connector
② Through holes
③ Display
④ Buttons
⑤ 2 x 2 M4 screw holes

Figure 12-2 Display module with display

Spare parts/accessories

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Name	Order number
CD "SITRANS T - temperature transmitters" containing documentation in German/English/French/Spanish/Italian/Portuguese and the SIPROM T parameterization software	A5E00364512
Modem for SITRANS TH200 incl. SIPROM T parameterization software	
• With USB connection	7NG3092-8KU [1]
• With RS232 connection	7NG3092-8KM [1]
HART modem for SITRANS TH300	
• With RS232 serial interface	
• With USB interface	
SIMATIC PDM parameterization software for SITRANS TH300	
• For operation and parameterization including communication via HART modem	
• Please refer to Catalog FI 01 for information about more SIMATIC PDM options.	
Mounting bracket and fasteners	
• Steel	
• For M20 x 1.5 thread; 7NG313.-..B.. • For ½ - 14NPT thread; 7NG313.-..C..	7MF4997-1AC 7MF4997-1AB
• Stainless steel	
• For M20 x 1.5 thread; 7NG313.-..B.. • For ½ - 14NPT thread; 7NG313.-..C..	7MF4997-1AJ [1] 7MF4997-1AH
Display module (digital display)	7MF4997-1BS [2]
Cover	
• Aluminum die-casting, without inspection window, including gasket	7MF4997-1BB
• Stainless steel, without inspection window, including gasket	7MF4997-1BC
• Aluminum die-casting, with inspection window, including gasket	7MF4997-1BE [1]
• Stainless steel, with inspection window, including gasket	7MF4997-1BF
Measurement station plate, blank, x 5	7MF4997-1CA
Fixing screws, x 50 for: • Measurement station plate • Earthing and connecting terminals • Display module	7MF4997-1CD
Inbuilt SITRANS TH200	
• For 7NG3135-0....	7NG3211-1NN00 [1]
• For 7NG3135-1....	7NG3211-1AN00 [1]
• For 7NG3135-2....	7NG3211-1AN00 [1]
• For 7NG3135-4....	7NG3211-1NN00 [1]
• For 7NG3135-5....	7NG3211-1NN00 [1]
Inbuilt SITRANS TH300	

Name	Order number
• For 7NG3136-0....	7NG3212-0NN00 [1]
• For 7NG3136-1....	7NG3212-0AN00 [1]
• For 7NG3136-2....	7NG3212-0AN00 [1]
• For 7NG3136-4....	7NG3212-0NN00 [1]
• For 7NG3136-5....	7NG3212-0NN00 [1]

[1] Available from stock.

[2] Retrofitting the "Intrinsic safety" version is not possible.

Appendix A

A.1 Certificate

The certificates can be found on the enclosed CD and on the Internet under:

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

A.2 Technical support

Technical Support

You can contact Technical Support for all IA and DT products:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- E-mail (mailto:support.automation@siemens.com)
- **Phone:** +49 (0) 911 895 7 222
- **Fax:** +49 (0) 911 895 7 223

Further information about our technical support is available on the Internet at
Technical Support (http://www.siemens.com/automation/csi/service)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base on the Internet at:

Services & Support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter with the latest information about our products.
- A Knowledge Manager to find the right documents for you.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- Your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have any questions about the products described in this manual and do not find the right answers.

Find your contact partner at:

Partner (http://www.automation.siemens.com/partner)

Documentation for various products and systems is available at:

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

List of abbreviations

B

B.1 Abbreviations

Abbreviation	Full term in English	Meaning
FIT	Failure in Time	Frequency of failure Number of faults withing 10^9 hours
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
MooN	"M out of N" voting	Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used. A safety-instrumented system or part that consists of "N" independent channels. The channels are connected to each other in such a way that "M" channels are in each case sufficient for the device to perform the safety instrumented function. Example: Pressure measurement: 1oo2 architecture. A safety-instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault in a device or system and restoration of functionality
PFD	Probability of Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Failure on Demand	Average probability of dangerous failures of a safety function on demand
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety-instrumented system into a dangerous or non-permissible functional status.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of a sensor, logic unit/control system and final controlling element.
TI	Test Interval	Testing interval of the protective function

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