

SITRANS T measuring instruments for temperature

Transmitters for rail mounting

SITRANS TR300
two-wire system, universal, HART

Overview



"HART" to beat - the universal SITRANS TR300 transmitter

- Two-wire devices for 4 to 20 mA, HART
- Device for rail mounting
- Universal input for virtually any type of temperature sensor
- Configurable over HART

Benefits

- Compact design
- Electrically isolated
- Test sockets for multimeters
- Diagnostics LED (green/red)
- Sensor monitoring open circuits and short-circuits
- Self-monitoring
- Configuration status stored in EEPROM
- Expanded diagnostic functions, such as slave pointer, operating hours counter etc.
- Special characteristic
- Electromagnetic compatibility to EN 61326 and NE21
- SIL 2 (with order code C20)

Application

SITRANS TR300 transmitters can be used in all industrial sectors. Their compact design enables simple mounting on standard DIN rails on-site in protective boxes or in control cabinets. The following sensors/signal sources can be connected over their universal input module:

- Resistance thermometers (two, three or four-wire system)
- Thermocouple elements
- Resistance-based sensors and DC voltage sources

The output signal is a direct current from 4 to 20 mA in accordance with the sensor characteristic, superimposed by the digital HART signal.

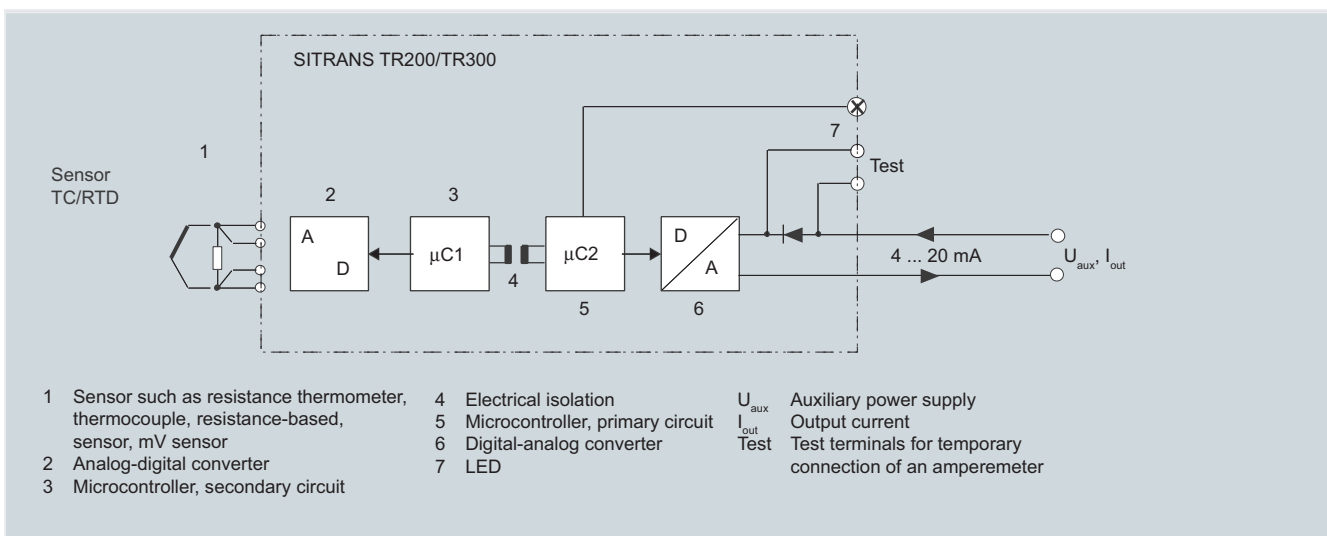
Transmitters of the "intrinsically-safe" type of protection can be installed within potentially explosive atmospheres. The devices comply with the Directive 94/9/EC (ATEX).

Function

The SITRANS TR300 is configured over HART. This can be done using a handheld communicator or even more conveniently with a HART modem and the SIMATIC PDM parameterization software. The configuration data are then permanently stored in the non-volatile memory (EEPROM).

Once the sensors and power supply have been correctly connected, the transmitter outputs a temperature-linear output signal and the diagnostics LED displays a green light. In the case of a sensor short-circuit, the LED flashes red, an internal device fault is indicated by a steady red light.

The test socket can be used to connect an ammeter at any time for monitoring purposes and plausibility checks. The output current can be read without any interruption, or even without opening the current loop.



SITRANS TR300 function diagram

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Technical specifications

Input

Resistance thermometer

Measured variable	Temperature
Sensor type	
• to IEC 60751	Pt25 ... Pt1000
• to JIS C 1604; a=0.00392 K-1	Pt25 ... Pt1000
• to IEC 60751	Ni25 ... Ni1000
• Special type	over special characteristic (max. 30 points)
Sensor factor	0.25 ... 10 (adaptation of the basic type, e.g. Pt100 to version Pt25 ... Pt1000)
Units	°C or °F
Connection	
• Standard connection	1 resistance thermometer (RTD) in 2-wire, 3-wire or 4-wire system
• Generation of average value	2 identical resistance thermometers in 2-wire system for generation of average temperature
• Generation of difference	2 identical resistance thermometers (RTD) in 2-wire system (RTD 1 – RTD 2 or RTD 2 – RTD 1)
Interface	
• Two-wire system	Parameterizable line resistance $\leq 100 \Omega$ (loop resistance)
• Three-wire system	No balancing required
• Four-wire system	No balancing required
Sensor current	≤ 0.45 mA
Response time T_{63}	≤ 250 ms for 1 sensor with open-circuit monitoring
Open-circuit monitoring	can be switched off
Short-circuit monitoring	can be switched off (value is adjustable)
Range	Parameterizable (see table "Digital measuring errors")
Min. measured span	10 °C (18 °F)
Characteristic	Temperature-linear or special characteristic

Resistance-based sensors

Measured variable	Actual resistance
Sensor type	Resistance-based, potentiometers
Units	Ω
Connection	
• Normal connection	1 resistance-based sensor (R) in 2-wire, 3-wire or 4-wire system
• Generation of average value	2 resistance-based sensors in 2-wire system for generation of average value
• Generation of difference	2 resistance thermometers in 2-wire system (R1 – R2 or R2 – R1)
Interface	
• Two-wire system	Parameterizable line resistance $\leq 100 \Omega$ (loop resistance)
• Three-wire system	No balancing required
• Four-wire system	No balancing required
Sensor current	≤ 0.45 mA
Response time T_{63}	≤ 250 ms for 1 sensor with open-circuit monitoring

Open-circuit monitoring

Short-circuit monitoring

Range

Min. measured span

Characteristic

Thermocouple elements

Measured variable

Sensor type (thermocouples)

• Type B

• Type C

• Type D

• Type E

• Type J

• Type K

• Type L

• Type N

• Type R

• Type S

• Type T

• Type U

Units

Connection

• Standard connection

• Generation of average value

• Generation of difference

Response time

Open-circuit monitoring

Cold junction compensation

• Internal

• External

• External fixed

Range

Min. measured span

Characteristic

mV Sensor

Measured variable

Sensor type

Units

Response time T_{63}

Open-circuit monitoring

Short-circuit monitoring

Can be switched off

Can be switched off (value is adjustable)

Parameterizable, max. 0 ... 2200 Ω (see Table "Digital measuring errors")5 Ω ... 25 Ω (see Table "Digital measuring errors")

Resistance-linear or special characteristic

Temperature

Pt30Rh-Pt6Rh to DIN IEC 584

W5 %-Re to ASTM 988

W3 %-Re to ASTM 988

NiCr-CuNi to DIN IEC 584

Fe-CuNi to DIN IEC 584

NiCr-Ni to DIN IEC 584

Fe-CuNi to DIN 43710

NiCrSi-NiSi to DIN IEC 584

Pt13Rh-Pt to DIN IEC 584

Pt10Rh-Pt to DIN IEC 584

Cu-CuNi to DIN IEC 584

Cu-CuNi to DIN 43710

°C or °F

1 thermocouple (TC)

2 thermocouples (TC)

2 thermocouples (TC)
TC1 – TC2 or TC2 – TC1 ≤ 250 ms for 1 sensor with open-circuit monitoring

Can be switched off

With integrated Pt100 resistance thermometer

With external Pt100 IEC 60571 (2-wire or 3-wire connection)

Cold junction temperature can be set as fixed value

Parameterizable (see table "Digital measuring errors")

Min. 50 ... 199 °C (90 ... 180 °F) (see table "Digital measuring errors")

Temperature-linear or special characteristic

DC voltage

DC voltage source (DC voltage source possible over an externally connected resistor)

mV

 ≤ 250 ms for 1 sensor with open-circuit monitoring

Can be switched off

Can be switched off (value is adjustable)

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SITRANS TR300 two-wire system, universal, HART

Range	-10 ... 70 mV -100 ... 1100 mV
Min. measured span	2 mV or 20 mV
Overload capacity of the input	-1.5 ... +3.5 V DC
Input resistance	≥ 1 MΩ
Characteristic	Voltage-linear or special characteristic
Output	
Output signal	4 ... 20 mA, 2-wire Communication acc. to HART Rev. 5.9
Power supply	11 ... 35 V DC (to 30 V with EEX)
Max. load	(U _{aux} - 11 V)/0.023 A
Overrange	3.6 ... 23 mA, continuously adjustable (default range: 3.84 ... 20.50 mA)
Error signal (e.g. in the event of sensor breakage)	3.6 ... 23 mA, continuously adjustable (default value: 22.8 mA)
Sample cycle	0.25 s nominal
Damping	Software filter 1st order 0 ... 30 s (parameterizable)
Protection	Against reversed polarity
Electrically isolated	Input against output (1 kV _{eff})
Measuring accuracy	
Digital measuring errors	See Table "Digital measuring errors"
Reference conditions	
• Power supply	24 V ± 1 %
• Load	500 Ω
• Storage temperature	23 °C
• Warming-up time	> 5 min
Error in the analog output (digital/analog converter)	< 0.025 % of span
Error due to internal cold junction	< 0.5 °C (0.9 °F)
Temperature effect	< 0.1 % der max. span/10°C (18 °F)
Power supply effect	< 0.001 % of span/V
Effect of load impedance	< 0.002 % of span/100 Ω
Long-term drift	
• in the first month	< 0.02 % of max. span
• after one year	< 0.2 % of max. span
• after 5 years	< 0.3 % of max. span
Rated conditions	
<u>Ambient temperature</u>	
Storage temperature	-40 ... +85 °C (-40 ... 185 °F)
Functional temperature	-40 ... +85 °C (-40 ... 185 °F)
Relative humidity	< 98 %, with condensation
Electromagnetic compatibility	acc. to DIN EN 61326 and NE21
Design	
Material	Molded plastic
Approx. weight	50 g (0.11 lb)
Dimensions	See "Dimension drawings"
Cross-section of cables	Max. 2.5 mm ² (AWG 13)
Degree of protection to EN 60529	
• Enclosure	IP40
• Terminals	IP00

Certificate and approvals

Explosion protection ATEX

EC type test certificate

• "Intrinsic safety" type of protection

• Type of protection, "equipment has limited energy"

• Type of protection, "equipment is non-arcing"

Software requirements for SIPROM T

PC operating system:

Factory setting:

- Pt100 (IEC 751) with three-wire circuit
- Measuring range: 0 ... 100 °C (32 ... 212 °F)
- Fault current: 22.8 mA
- Sensor offset: 0 °C (0 °F)
- Damping 0.0 s

Digital measuring errors

Resistance thermometer

input	Range	Min. measured span		Digital accuracy	
		°C	(°F)	°C	(°F)
<u>to IEC 60751</u>					
Pt25	-200 ... +850 (-328 ... +1562)	10	(18)	0.2	(0.36)
Pt50	-200 ... +850 (-328 ... +1562)	10	(18)	0.15	(0.27)
Pt100 ... Pt200	-200 ... +850 (-328 ... +1562)	10	(18)	0.1	(0.18)
Pt500	-200 ... +850 (-328 ... +1562)	10	(18)	0.15	(0.27)
Pt1000	-200 ... +350 (-328 ... +662)	10	(18)	0.15	(0.27)
<u>to JIS C1604-81</u>					
Pt25	-200 ... +649 (-328 ... +1200)	10	(18)	0.2	(0.36)
Pt50	-200 ... +649 (-328 ... +1200)	10	(18)	0.15	(0.27)
Pt100 ... Pt200	-200 ... +649 (-328 ... +1200)	10	(18)	0.1	(0.18)
Pt500	-200 ... +649 (-328 ... +1200)	10	(18)	0.15	(0.27)
Pt1000	-200 ... +350 (-328 ... +662)	10	(18)	0.15	(0.27)
Ni 25 ... Ni1000	-60 ... +250 (-76 ... +482)	10	(18)	0.1	(0.18)

Windows ME, 2000 and XP; also Windows 95, 98 and 98 SE, but only in connection with RS 232 modem.

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Resistance-based sensors

Input	Range	Min. measured span	Digital accuracy
	Ω	Ω	Ω
Resistance	0 ... 390	5	0.05
Resistance	0 ... 2200	25	0.25

Thermocouple elements

Input	Measuring range	Min. measured span		Digital accuracy	
		°C	(°F)	°C	(°F)
Type B	0 ... 1820 (32 ... 3308)	100	(180)	2 ¹⁾	(3.60) ¹⁾
Type C (W5)	0 ... 2300 (32 ... 4172)	100	(180)	2	(3.60)
Type D (W3)	0 ... 2300 (32 ... 4172)	100	(180)	1 ²⁾	(1.80) ²⁾
Type E	-200 ... +1000 (-328 ... +1832)	50	(90)	1	(1.80)
Type J	-210 ... +1200 (-346 ... +2192)	50	(90)	1	(1.80)
Type K	-230 ... +1370 (-382 ... +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)

¹⁾ The digital accuracy in the range 0 to 300 °C (32 to 572 °F) is 3 °C (5.4 °F).

²⁾ The digital accuracy in the range 1750 to 2300 °C (3182 to 4172 °F) is 2 °C (3.6 °F).

mV Sensor

input	Range	Min. measured span	Digital accuracy
	mV	mV	μV
mV Sensor	-10 ... +70	2	40
mV Sensor	-100 ... +1100	20	400

The digital accuracy is the accuracy after the analog/digital conversion including linearization and calculation of the measured value.

An additional error is generated in the output current 4 to 20 mA as a result of the digital/analog conversion of 0.1 % of the set span (digital-analog error).

The total error under reference conditions at the analog output is the sum from the digital error and the digital-analog error (poss. with the addition of cold junction errors in the case of thermocouple measurements).

Selection and Ordering Data

Order No.
Temperature transmitter SITRANS TR300 for mounting on a standard DIN rail, two-wire system, 4 ... 20 mA, HART, with electrical isolation, with documentation on CD <ul style="list-style-type: none"> Without explosion protection ▶ 7NG3033-0JN00 D) With explosion protection to ATEX ▶ 7NG3033-1JN00 D)
Further designs Please add "-Z" to Order No. and specify Order code(s) Customer-specific setting of operating data (specify operating data in plain text) with test protocol (5 measuring points) SIL 2 (functional safety)
Accessories CD for measuring instruments for temperature ▶ A5E00364512 with documentation in German, English, French, Spanish, Italian, Portuguese and SIPROM T parameterization software HART modem <ul style="list-style-type: none"> With RS 232 connection ▶ 7MF4997-1DA D) With USB connection ▶ 7MF4997-1DB D) SIMATIC PDM operating software ▶ See Section 9
▶ Available ex stock.

¹⁾ Y01: Please specify all data that does not correspond to factory settings (see below).

D) Subject to export regulations AL: N, ECCN: EAR99H.

Power supply units see "SITRANS I supply units and isolation amplifiers".

Factory setting:

- Pt100 (IEC 751) with three-wire circuit
- Measuring range: 0 ... 100 °C (32 ... 212 °F)
- Fault current: 22.8 mA
- Sensor offset: 0 °C (0 °F)
- Damping 0.0 s

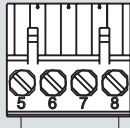
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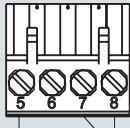
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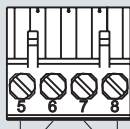
Resistance thermometer



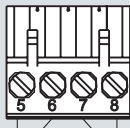
Two-wire system ¹⁾



Three-wire system

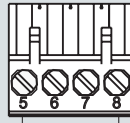


Four-wire system

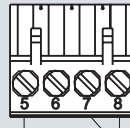


Generation of average value/difference ¹⁾

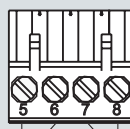
Resistance



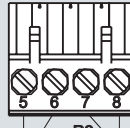
Two-wire system ¹⁾



Three-wire system

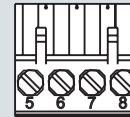


Four-wire system

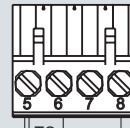


Generation of average value/difference ¹⁾

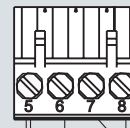
Thermocouple



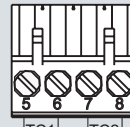
Cold junction compensation Internal/fixed value



Cold junction compensation with external Pt100 in two-wire system ¹⁾



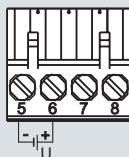
Cold junction compensation with external Pt100 in three-wire system



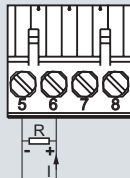
Generation of average value / difference with internal cold junction compensation

¹⁾ Programmable line resistance for the purpose of correction.

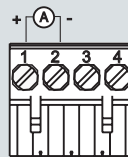
Voltage measurement



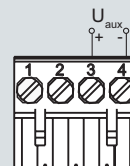
Current measurement



Test terminals



Power supply/ 4 ... 20 mA (U_{aux})



SITRANS TR300, sensor connection assignment