

Temperature Measurement

Temperature transmitters

Compact and head transmitters / SITRANS TH300 (4 to 20 mA, HART, universal)

Overview



Robust and durable HART - the universal SITRANS TH300 transmitter

- 2-wire device for 4 to 20 mA, HART 5
- Mounting in the connection head of the temperature sensor
- Universal input for virtually any type of temperature sensor
- Configurable over HART

Benefits

- Compact design
- Flexible mounting and center hole allow you to select your preferred mounting type
- Galvanic isolation
- Test sockets for multimeters
- Diagnostics LED (green/red)
- Sensor monitoring open circuits and short-circuits
- Self-monitoring
- Configuration status stored in EEPROM
- SIL2 (with order note C20), SIL2/3 (with C23)
- Expanded diagnostic functions, such as slave pointer, operating hours counter, etc.
- Special characteristic
- Electromagnetic compatibility to EN 61326 and NE21

Application

SITRANS TH300 transmitters can be used in all industrial sectors. Its compact size means that it can be installed in connection heads of type B or larger. The following sensors/signal sources can be connected over their universal input module:

- Resistance thermometer (2, 3, 4-wire connection)
- Thermocouples
- Resistance-based sensors and DC voltage sources

The output signal is a load-independent direct current of 4 to 20 mA corresponding to the sensor characteristic overlaid by the digital HART signal.

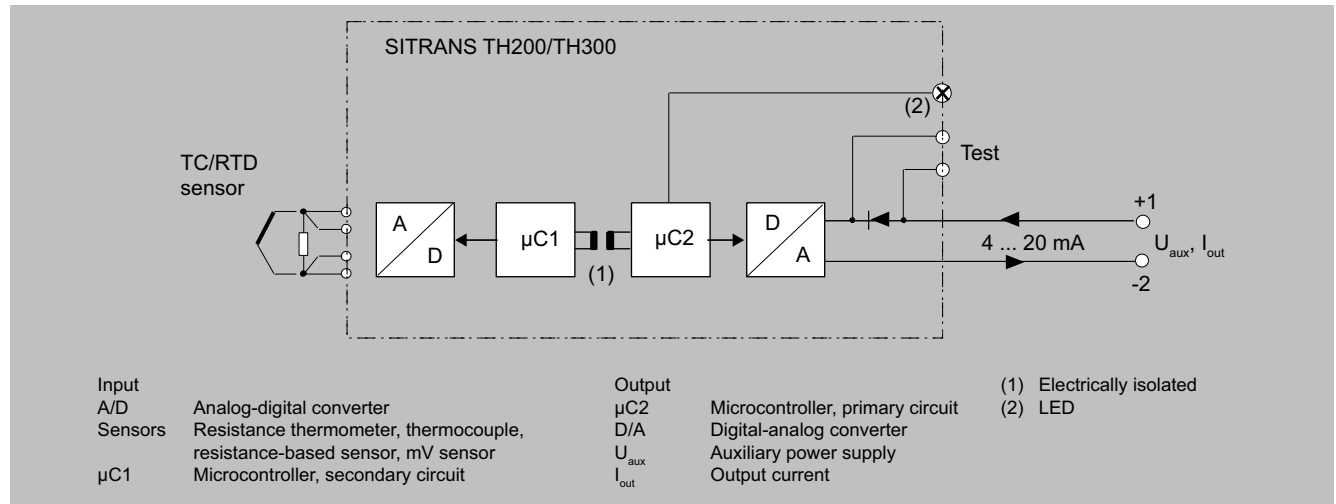
Transmitters of the "intrinsically safe" type of protection can be installed within potentially explosive atmospheres. The devices meet the directive 2014/34/EU (ATEX) as well as the FM and CSA requirements.

Function

The SITRANS TH300 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 break, 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 TH 300 function diagram

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Selection and ordering data

	Article No.
SITRANS TH300 head transmitter For installation in connection head type B, 2-wire system 4 ... 20 mA, communication-capable according to HART, with galvanic isolation	
Without explosion protection	7NG3212-0NN00
With explosion protection	
• According to ATEX	7NG3212-0AN00
• According to FM (cFM _{US})	7NG3212-0BN00

Options	Order code
Add "-Z" to article number, specify order code and, if applicable, plain text	
Test report (5 measuring points)	C11
Functional safety SIL2	C20
Functional safety SIL2/3	C23
Customer-specific programming	
Measuring range to be set Specify in plain text (max. 5 digits): Y01: ... to ... °C, °F	Y01 ¹⁾
Measuring point number (TAG) max. 8 characters	Y17 ²⁾
Measuring point description, max. 16 characters	Y23 ²⁾
Measuring point message, max. 32 characters	Y24 ²⁾
Pt100 (IEC) 2-wire, R _L = 0 Ω	U02 ³⁾
Pt100 (IEC) 3-wire	U03 ³⁾
Pt100 (IEC) 4-wire	U04 ³⁾
Type B thermocouple	U20 ³⁾⁴⁾
Type C thermocouple (W5)	U21 ³⁾⁴⁾
Type D thermocouple (W3)	U22 ³⁾⁴⁾
Type E thermocouple	U23 ³⁾⁴⁾
Type J thermocouple	U24 ³⁾⁴⁾
Type K thermocouple	U25 ³⁾⁴⁾
Type L thermocouple	U26 ³⁾⁴⁾
Type N thermocouple	U27 ³⁾⁴⁾
Type R thermocouple	U28 ³⁾⁴⁾
Type S thermocouple	U29 ³⁾⁴⁾
Type T thermocouple	U30 ³⁾⁴⁾
Type U thermocouple	U31 ³⁾⁴⁾
For TC: Cold junction compensation: external (Pt100, 3-wire)	U41
For TC: Cold junction compensation: external with fixed value: Specify in plain text	Y50
Enter special deviating customer-specific setting in plain text	Y09 ⁵⁾
Fault current 3.6 mA (instead of 22.8 mA)	U36 ²⁾
Cable extension Transmitter with installed cable extension 200 mm (7.87 inches), for Pt100 in 4-wire connection	W01

- 1) For customer-specific programming for RTD and TC, the start value and the end value of the required measuring span must be specified here.
- 2) For this selection, Y01 or Y09 must also be selected.
- 3) For this selection, Y01 must also be selected.
- 4) Internal cold junction compensation is selected as the default for TC.
- 5) For customer-specific programming for mV and ohm, the start value and the end value of the required measuring span and the unit must be entered here.

Selection and ordering data (continued)

Accessories

	Article No.
Other accessories for assembly, connection and transmitter configuration, see page 2/198.	
HART modem	
With USB interface	7MF4997-1DB
SIMATIC PDM operating software	See Catalog FI 01 section 8
Mounting rail adapter for head transmitter (Quantity delivered: 5 units)	7NG3092-8KA
Connecting cable 4-wire, 200 mm (7.87 inches), for sensor connections when using head transmitters in the high spring flap (set with 5 units)	7NG3092-8KC

For supply units, see Catalog FI01 section "Supplementary components"

Ordering example 1:

7NG3212-0NN00-Z Y01+Y17+U03

Y01: -10 ... +100 °C

Y17: TICA123

Ordering example 2:

7NG3212-0NN00-Z Y01+Y23+U25

Y01: -10 ... +100 °C

Y23: TICA1234HEAT

Factory setting:

- Pt100 (IEC 751); 3-wire connection
- Measuring range: 0 ... 100 °C (32 ... 212 °F)
- Fault current: 22.8 mA
- Sensor offset: 0 °C (0 °F)
- Damping 0.0 s

Technical specifications

SITRANS TH300 (4 ... 20 mA, HART, universal)

Input	
<u>Resistance thermometer</u>	
Measured variable	Temperature
Sensor type	
• According to IEC 60751	Pt25 ... Pt1000
• According to JIS C 1604; $\alpha = 0.00392 \text{ K}^{-1}$	Pt25 ... Pt1000
• According to IEC 60751	Ni25 ... Ni1000
• Special type	Via special characteristic curve (max. 30 points)
Sensor factor	0.25 ... 10 (adaptation of the basic type, e.g. Pt100 to version Pt25 ... 1000)
Units	°C or °F
Connection	
• Standard connection	1 resistance thermometer (RTD) in 2-wire, 3-wire or 4-wire connection
• Averaging	2 identical resistance thermometers in 2-wire connection for generation of average temperature
• Differentiation	2 identical resistance thermometers (RTD) in 2-wire connection (RTD 1 – RTD 2 or RTD 2 – RTD 1)
Connection	
• 2-wire connection	Wire resistance can be configured $\leq 100 \Omega$ (loop resistance)
• 3-wire connection	No trim necessary
• 4-wire connection	No trim necessary
Sensor current	$\leq 0.45 \text{ mA}$
Response time	$\leq 250 \text{ ms}$ for 1 sensor with break monitoring
Break monitoring	Always active (cannot be switched off)
Short-circuit monitoring	Can be switched on/off (default value: ON)
Measuring range	Assignable (see "Digital measuring error" table)
Min. measuring span	10 °C (18 °F)
Characteristic curve	Temperature-linear or special characteristic curve
<u>Resistance-based sensor</u>	
Measured variable	Ohmic resistance
Sensor type	Resistance-based, potentiometers
Units	Ω
Connection	
• Standard connection	1 resistance-based sensor (R) in 2-wire, 3-wire or 4-wire connection
• Averaging	2 resistance-based sensors in 2-wire connection for averaging
• Differentiation	2 resistance thermometers in 2-wire connection (R1 – R2 or R2 – R1)
Connection	
• 2-wire connection	Wire resistance can be configured $\leq 100 \Omega$ (loop resistance)
• 3-wire connection	No trim necessary
• 4-wire connection	No trim necessary
Sensor current	$\leq 0.45 \text{ mA}$
Response time	$\leq 250 \text{ ms}$ for 1 sensor with break monitoring
Break monitoring	Always active (cannot be switched off)
Short-circuit monitoring	Can be switched on/off (default value: OFF)
Measuring range	Assignable max. 0 ... 2200 Ω (see "Digital measuring error" table)
Min. measuring span	5 ... 25 Ω (see "Digital measuring error" table)
Characteristic curve	Resistance-linear or special characteristic curve
<u>Thermocouples</u>	

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Technical specifications (continued)

SITRANS TH300 (4 ... 20 mA, HART, universal)	
Measured variable	Temperature
Sensor type (thermocouples)	
• Type B	Pt30Rh-Pt6Rh acc. to IEC 584
• Type C	W5%-Re acc. to ASTM 988
• Type D	W3%-Re acc. to ASTM 988
• Type E	NiCr-CuNi acc. to IEC 584
• Type J	Fe-CuNi acc. to IEC 584
• Type K	NiCr-Ni acc. to IEC 584
• Type L	Fe-CuNi acc. to DIN 43710
• Type N	NiCrSi-NiSi acc. to IEC 584
• Type R	Pt13Rh-Pt acc. to IEC 584
• Type S	Pt10Rh-Pt acc. to IEC 584
• Type T	Cu-CuNi acc. to IEC 584
• Type U	Cu-CuNi acc. to DIN 43710
Units	°C or °F
Connection	
• Standard connection	1 thermocouple (TC)
• Averaging	2 thermocouples (TC)
• Differentiation	2 thermocouples (TC) (TC1 – TC2 or TC2 – TC1)
Response time	≤ 250 ms for 1 sensor with break monitoring
Break monitoring	Can be switched off
Cold junction compensation	
• Internal	With integrated Pt100 resistance thermometer
• External	With external Pt100 IEC 60751 (2-wire or 3-wire connection)
• External fixed	Reference junction temperature can be set as fixed value
Measuring range	Assignable (see "Digital measuring error" table)
Min. measuring span	Min. 40 ... 100 °C (72 ... 180 °F) (see "Digital measuring error" table)
Characteristic curve	Temperature-linear or special characteristic curve
mV sensor	
Measured variable	DC voltage
Sensor type	DC voltage source (DC voltage source possible over externally connected resistance)
Units	mV
Response time	≤ 250 ms for 1 sensor with break monitoring
Break monitoring	Can be switched off
Measuring range	<ul style="list-style-type: none"> • -10 ... +70 mV • -100 ... +1100 mV
Min. measuring span	2 mV or 20 mV
Overload capability of the input	-1.5 ... +3.5 V DC
Input resistance	≥ 1 MΩ
Characteristic curve	Voltage-linear or special characteristic curve
Output	
Output signal	4 ... 20 mA, 2-wire with communication acc. to HART Rev. 5.9
Auxiliary power	11 ... 35 V DC (to 30 V with Ex ia and ib; to 32 V with Ex nA/nL/ic)
Max. load	$(U_{aux} - 11 V)/0.023 A$
Overrange	3.6 ... 23 mA, continuously adjustable (default range: 3.80 mA ... 20.5 mA)
Error signal (e.g. in case of sensor breakage) (conforming to NE43)	3.6 ... 23 mA, continuously adjustable (default value: 22.8 mA)

Technical specifications (continued)

SITRANS TH300 (4 ... 20 mA, HART, universal)	
Sample cycle	0.25 s nominal
Damping	Software filter 1st order 0 ... 30 s (parameterizable)
Protection	Against reverse polarity
Galvanic isolation	Input against output 2.12 kV DC (1.5 kV _{rms} AC)
Measuring accuracy	
Digital measuring error	See "Digital measuring error" table
Reference conditions	
• Auxiliary power	24 V ± 1%
• Load	500 Ω
• Ambient temperature	23 °C
• Warming-up time	> 5 min
Error in the analog output (digital/analog converter)	< 0.025% of measuring span
Error due to internal reference junction	< 0.5 °C (0.9 °F)
Effect of ambient temperature	
• Analog measuring error	0.02% of measuring span/10 °C (18 °F)
• Digital measuring error	
- With resistance thermometers	0.06 °C (0.11 °F)/10 °C (18 °F)
- With thermocouples	0.6 °C (1.1 °F)/10 °C (18 °F)
Auxiliary power effect	< 0.001% of meas. span/V
Effect of load impedance	< 0.002% of meas. span/100 Ω
Long-term drift	
• In the first month	< 0.02% of measuring span
• After one year	< 0.2% of measuring span
• After 5 years	< 0.3% of measuring span
Operating conditions	
Ambient conditions	
Ambient temperature	-40 ... +85 °C (-40 ... +185 °F)
Storage temperature	-40 ... +85 °C (-40 ... +185 °F)
Relative humidity	< 98%, with condensation
Electromagnetic compatibility	According to EN 61326 and NE21
Structural design	
Material	Molded plastic
Weight	50 g (0.11 lb)
Dimensions	See "Dimensional drawings"
Cross-section of cables	Max. 2.5 mm ² (AWG 13)
Degree of protection according to IEC 60529	
• Enclosure	IP40
• Terminals	IP00
Certificates and approvals	
ATEX explosion protection	
EC type-examination certificate	PTB 05 ATEX 2040X
• "Intrinsic safety" type of protection	<ul style="list-style-type: none"> • II 1 G Ex ia IIC T6...T4 Ga • II 2 (1) G Ex [ia Ga] ib IIC T6...T4 Gb • II 3 (1) G Ex [ia Ga] ic IIC T6...T4 Gc • II 3 G Ex ic IIC T6...T4 Gc • II 2 D Ex ia Db
• "Increased safety" type of protection	II 3 G Ex ec IIC T6...T4 Gc
Explosion protection: FM for USA	

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Technical specifications (continued)

SITRANS TH300 (4 ... 20 mA, HART, universal)	
• FM approval	FM 3024169
• Degrees of protection	<ul style="list-style-type: none"> • IS / CI I, II, III / Div 1 / GP ABCDEFG T6, T5, T4 • CI I / ZN 0 / AEx ia IIC T6, T5, T4 • NI / CI I / Div 2 / GP ABCDEFG T6, T5, T4 • NI / CI I / ZN 2 / IIC T6, T5, T4
Explosion protection to FM for Canada („FMUs")	
• FM approval	FM 3024169C
• Degrees of protection	<ul style="list-style-type: none"> • IS / CI I, II, III / Div 1 / GP ABCDEFG T6, T5, T4 • NI / CI I / DIV 2 / GP ABCD T6, T5, T4 • NIFW / CI I, II, III / DIV 2 / GP ABCDEFG T6, T5, T4 • DIP / CI II, III / Div 2 / GP FG T6, T5, T4 • CI I / ZN 0 / Ex ia IIC T6, T5, T4 • CI I / ZN 2 / Ex nA nL IIC T6, T5, T4
Other certificates	NEPSI

Factory setting:

- Pt100 (IEC 751) in the 3-wire connection
- 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 error

Resistance thermometer

Input	Measuring range °C (°F)	Minimum measuring span		Digital accuracy	
		°C	(°F)	°C	(°F)
According to IEC 60751					
Pt25	-200 ... +850 (-328 ... +1562)	10	(18)	0.3	(0.54)
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)
According to JIS C1604-81					
Pt25	-200 ... +649 (-328 ... +1200)	10	(18)	0.3	(0.54)
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)

Resistance-based sensor

Input	Measuring range Ω	Minimum measuring span Ω	Digital accuracy
			Ω
Resistance	0 ... 390	5	0.05
Resistance	0 ... 2200	25	0.25

Technical specifications (continued)

Thermocouples

Input	Measuring range °C (°F)	Minimum measuring span		Digital accuracy	
		°C	(°F)	°C	(°F)
Type B	100 ... 1820 (212 ... 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	-200 ... +1200 (-328 ... +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)

¹⁾ The digital accuracy in the range 100 to 300 °C (212 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	Measuring range mV	Minimum measuring span mV	Digital accuracy
			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 0.025% of the set measuring span (digital-analog error).

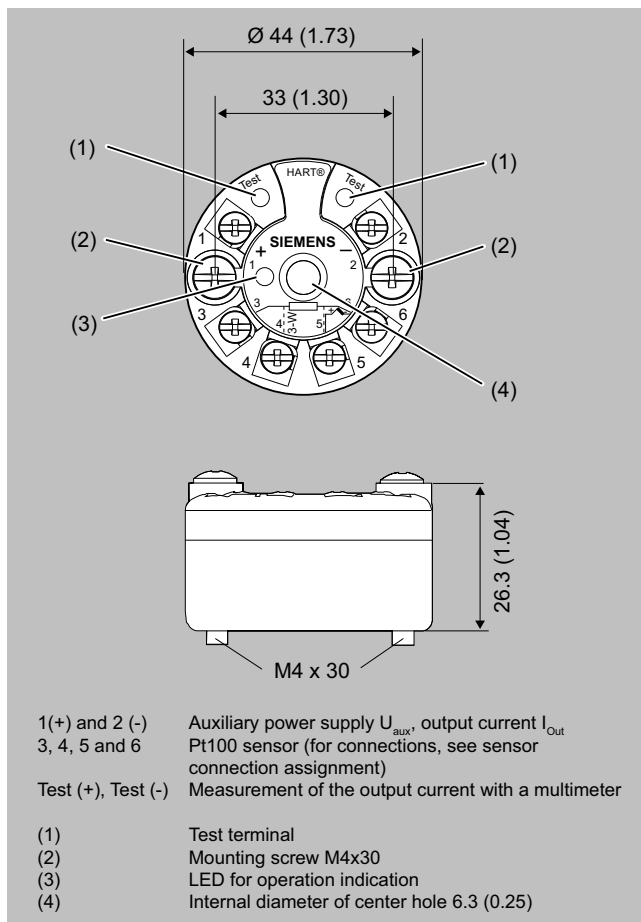
The total error under reference conditions at the analog output is the sum from the digital error and the digital-analog error (poss. with the addition of reference junction errors in the case of thermocouple measurements).

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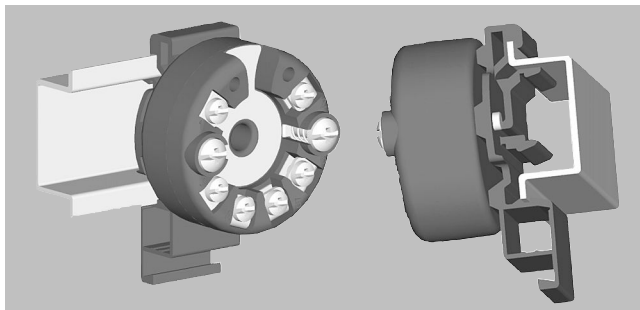
Compact and head transmitters / SITRANS TH300 (4 to 20 mA, HART, universal)

Dimensional drawings



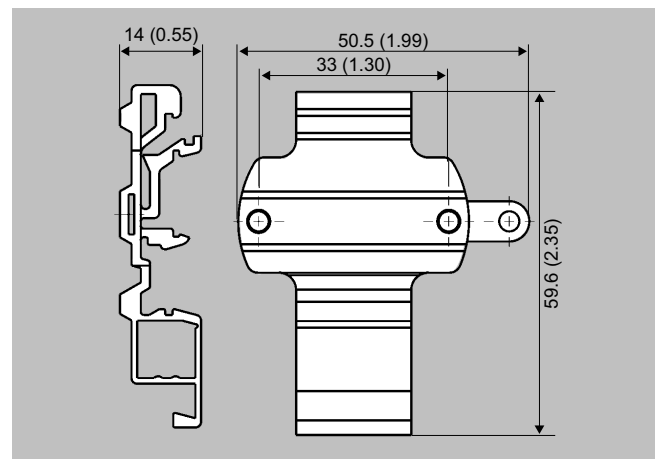
SITRANS TH300, dimensions and pin assignment, dimensions in mm (inch)

Mounting on DIN rail



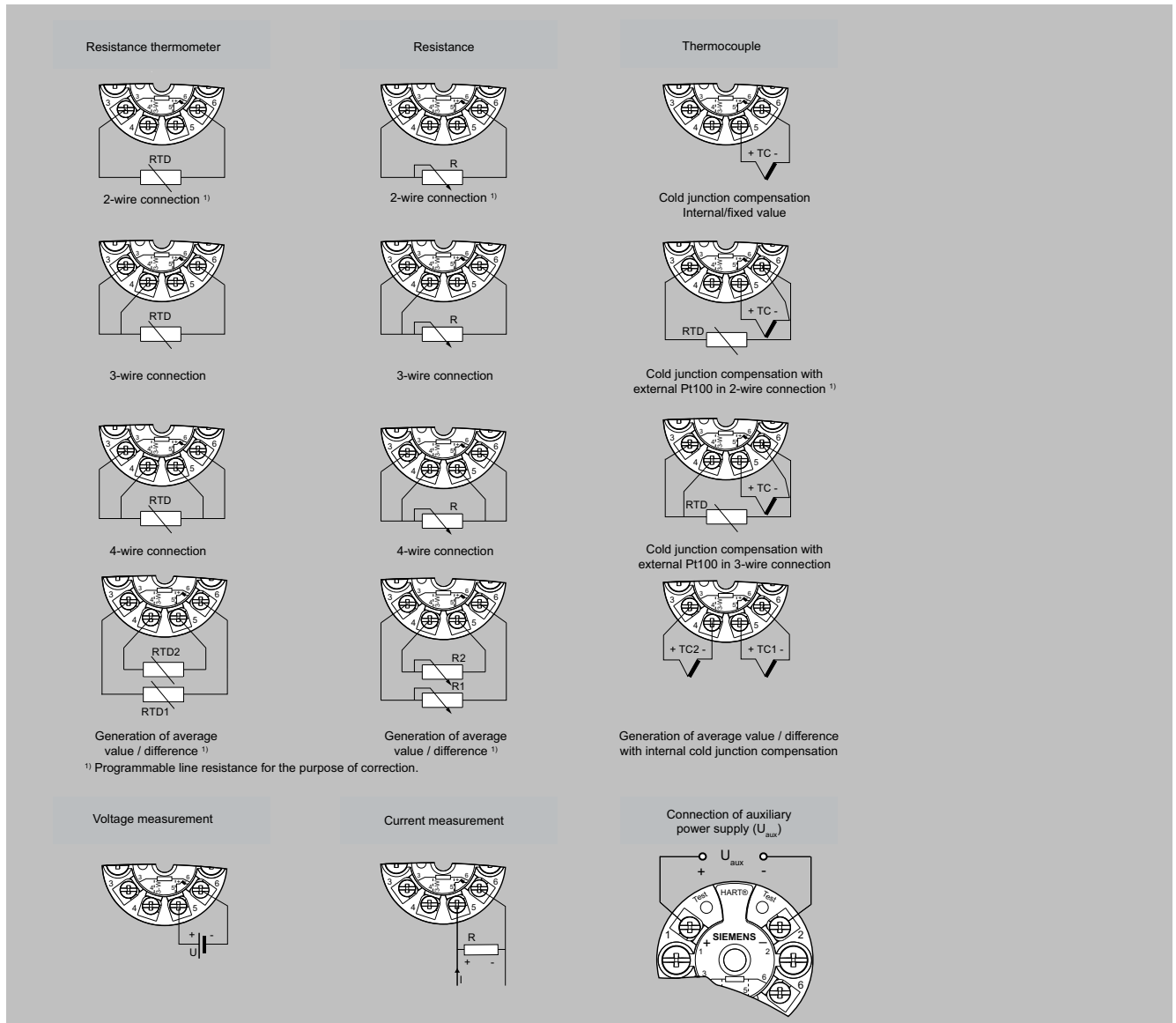
SITRANS TH300, mounting of transmitter on DIN rail

Dimensional drawings (continued)



Mounting rail adapter, dimensions in mm (inch)

Circuit diagrams



SITRANS TH300, sensor connection assignment