

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

Overview



Our field devices for heavy industrial use

- HART, Universal
- 4 to 20 mA, universal
- Field indicator for 4 to 20 mA signals

The temperature transmitter SITRANS TF works where others feel uncomfortable.

Benefits

- Universal use
 - as transmitter for resistance thermometer, thermocouple element, Ω or mV signal
 - as field indicator for any 4 to 20 mA signals
- Local sensing of measured values over digital display
- Rugged two-chamber enclosure in die-cast aluminium or stainless steel
- Degree of protection IP66/67/68
- Test terminals for direct read-out of the output signal without breaking the current loop
- Can be mounted elsewhere if the measuring point
 - is hard to access,
 - is subject to high temperatures,
 - is subject to vibrations from the system,
 - or if you want to avoid long neck tubes and/or protective tubes.
- Can be mounted directly on American-design sensors
- Wide range of approvals for use in potentially explosive atmospheres. "Intrinsically safe, non-sparking and flameproof" type of protections, for Europe and USA.
- SIL2 (with Order code C20), SIL2/3 (with C23)

Application

SITRANS TF can be used everywhere where temperatures need to be measured under particularly adverse conditions, or where a convenient local display is ideal. For that reasons users from all industries have opted for this field device. The rugged enclosure protects the electronics. The stainless steel model is almost completely resistant to sea water and other aggressive elements. The inner workings offer high measuring accuracy, universal input and a wide range of diagnostic options.

Function

Configuration

The communication capability over the HART protocol V 5.9 of the SITRANS TF with an integrated SITRANS TH300 permits parameterization using a PC or HART communicator (hand-held communicator). The SIMATIC PDM makes it easy.

Parameterization is carried out using a PC for SITRANS TF with the integrated and programmable SITRANS TK. Available for this purpose are a special modem and the software tool SIPROM T.

Mode of operation

Mode of operation of SITRANS TF as temperature transmitter

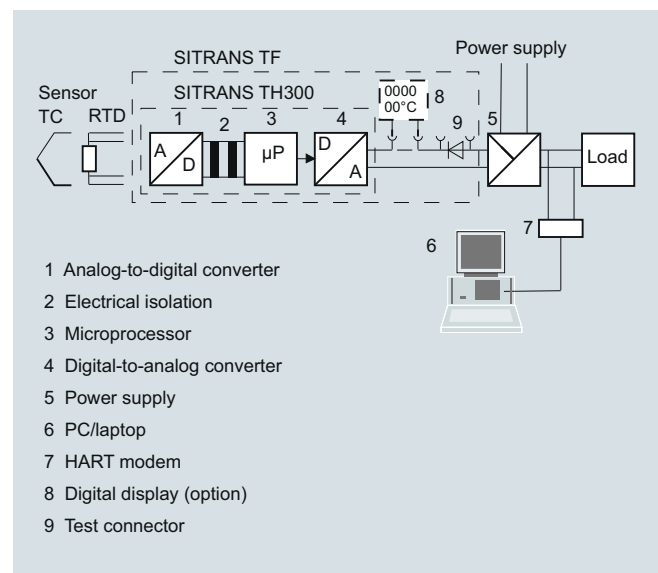
The sensor signal, whether resistance thermometer, thermocouple element or Ω or mV signal, is amplified and linearized. Sensor and output side are electrically isolated. An internal cold junction is integrated for measurements with thermocouple elements.

The device outputs a temperature-linear direct current of 4 to 20 mA. As well as the analog transmission of measured values from 4 to 20 mA, the HART version also supports digital communication for online diagnostics, measured value transmission and configuration.

SITRANS TF automatically detects when a sensor should be interrupted or is indicating a short-circuit. The practical test terminals allow direct measurement of 4 to 20 mA signals over an ammeter without interrupting the output current loop.

Mode of operation of SITRANS TF as field indicator

Any 4 to 20 mA signal can be applied to the generous terminal block. As well as a range of predefined measurement units, the adjustable indicator also supports the input of customized units. This means that any 4 to 20 mA signal can be represented as any type of unit, e.g. pressure, flow rate, filling level or temperature.



Mode of operation: SITRANS TF with integrated transmitter and digital display

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

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
Units	°C and °F
Connection	
• Normal connection	1 resistance thermometer (RTD) in 2-wire, 3-wire or 4-wire system
• Generation of average value	Series or parallel connection of several resistance thermometers in a two-wire system for the generation of average temperatures or for adaptation to other device types
• Generation of difference	2 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	≤ 250 ms for 1 sensor with open-circuit monitoring
Open-circuit monitoring	Always active (cannot be disabled)
Short-circuit monitoring	can be switched on/off (default value: ON)
Measuring range	parameterizable (see table "Digital measuring errors")
Min. measured span	10 °C (18 °F)
Characteristic curve	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-based sensor in 2-wire system (R 1 – R 2 or R 2 – R 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	≤ 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)

Measuring range	parameterizable max. 0 ... 2200 Ω (see table "Digital measuring errors")
Min. measured span	5 ... 25 Ω (see Table "Digital measuring errors")
Characteristic curve	Resistance-linear or special characteristic
<u>Thermocouples</u>	
Measured variable	Temperature
Sensor type (thermocouples)	
• Type B	Pt30Rh-Pt6Rh to DIN IEC 584
• Type C	W5 %-Re acc. to ASTM 988
• Type D	W3 %-Re acc. to ASTM 988
• Type E	NiCr-CuNi to DIN IEC 584
• Type J	Fe-CuNi to DIN IEC 584
• Type K	NiCr-Ni to DIN IEC 584
• Type L	Fe-CuNi to DIN 43710
• Type N	NiCrSi-NiSi to DIN IEC 584
• Type R	Pt13Rh-Pt to DIN IEC 584
• Type S	Pt10Rh-Pt to DIN IEC 584
• Type T	Cu-CuNi to DIN IEC 584
• Type U	Cu-CuNi to DIN 43710
Units	°C or °F
Connection	
• Normal connection	1 thermocouple (TC)
• Generation of average value	2 thermocouples (TC)
• Generation of difference	2 thermocouples (TC) (TC 1 – TC 2 or TC 2 – TC 1)
Response time	≤ 250 ms for 1 sensor with open-circuit monitoring
Open-circuit 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	Cold junction temperature can be set as fixed value
Measuring range	parameterizable (see table "Digital measuring errors")
Min. measured span	Min. 40 ... 100 °C (72 ... 180 °F) (see table "Digital measuring errors")
Characteristic curve	Temperature-linear or special characteristic
<u>mV sensor</u>	
Measured variable	DC voltage
Sensor type	DC voltage source (DC voltage source possible over an externally connected resistor)
Units	mV
Response time	≤ 250 ms for 1 sensor with open-circuit monitoring
Open-circuit monitoring	Can be switched off
Measuring range	-10 ... +70 mV -100 ... +1100 mV
Min. measured span	2 mV or 20 mV
Overload capability of the input	-1.5 ... +3.5 V DC
Input resistance	≥ 1 M Ω
Characteristic curve	Voltage-linear or special characteristic

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

Output Output signal 4 ... 20 mA, 2-wire Communication with SITRANS TH300 acc. to HART Rev. 5.9		Auxiliary power Without digital display 11 ... 35 V DC (30 V for Ex ib; 32 V for Ex ic and Ex nA) With digital display 13.1 ... 5 V DC (30 V for Ex ib; 32 V for Ex ic and Ex nA)	
Digital display Digital display (optional) In current loop Display Max. 5 digits Digit height 9 mm (0.35 inch) Display range -99 999 ... + 99 999 Units any (max. 5 char.) Setting: with 3 buttons Zero point, full-scale value and unit Load voltage 2.1 V		Electrically isolated Between input and output • Test voltage $U_{eff} = 1 \text{ kV}$, 50 Hz, 1 min	
Measuring accuracy Digital measuring errors See table "Digital measuring errors" Reference conditions • Auxiliary power 24 V \pm 1 % • Load 500 Ω • Ambient temperature 23 °C (73.4 °F) • 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) Influence of ambient temperature • Analog measuring error 0.02 % of span/10 °C (18 °F) • Digital measuring errors - 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 span/V Effect of load impedance < 0.002 % of span/100 Ω Long-term drift • In the first month < 0.02 % of span • After one year < 0.3 % of span • After 5 years < 0.4 % of span		Certificates and approvals Explosion protection ATEX • "Intrinsic safety" type of protection with digital display: II 2 (1) G Ex ib [ia Ga] IIC T4 Gb II 2 G Ex ib IIC T4 Gb II 1D Ex ia IIIC T100 °C Da without digital display: II 2 (1) G Ex ib [ia Ga] IIC T6 Gb II 2 G Ex ib IIC T6 Gb II 1D Ex ia IIIC T100 °C Da ZELM 11 ATEX 0471 X - EC type test certificate • "Operating equipment that is non-ignitable and has limited energy for zone 2" type of protection II 3 G Ex ic IIC T6/T4 Gc II 3 G Ex nA IIC T6/T4 Gc II 3 G Ex nA [ic] IIC T6/T4 Gc ZELM 11 ATEX 0471 X - EC type test certificate • "Flame-proof enclosure" type of protection II 2 G Ex d IIC T6/T5 Gb II 2 D Ex tb IIIC T100 °C Db ZELM 11 ATEX 0472 X - EC type test certificate Explosion protection to FM Certificate of Compliance 3017742 • Identification (XP, DIP, NI, S) • XP/II/1/BCD/T5 Ta = 85 °C (185 °F), T6 Ta = 60 °C (140 °F), Type 4X • DIP/II, III/1/EFG/T5 Ta = 85 °C (185 °F), T6 Ta = 60 °C (140 °F), Type 4X • NI/II/2/ABCD/T5 Ta = 85 °C (185 °F), T6 Ta = 60 °C (140 °F), Type 4X • S/II, III/2/FG/T5 Ta = 85 °C (185 °F), T6 Ta = 60 °C (140 °F), Type 4X Other certificates IECEx, EAC Ex(GOST), INMETRO, NEPSI, KOSHA	
Conditions of use <u>Ambient conditions</u> Storage temperature -40 ... +85 °C (-40 ... +185 °F) Condensation Permissible Electromagnetic compatibility According to EN 61326 and NAMUR NE21 Degree of protection to EN 60529 IP66/67/68		Hardware and software requirements • For the parameterization software SIPROM T for SITRANS TF with TH200 - Personal computer PC with CD-ROM drive and USB - PC operating system Windows 98, NT, 2000, XP, 7 and Win 8 • For the parameterization software SIMATIC PDM for SITRANS TH300 See chapter 8 "Software", "SIMATIC PDM"	
Construction Weight Approx. 1.5 kg (3.3 lb) without options Dimensions See "Dimensional drawings" Enclosure material Die-cast aluminum, low in copper, GD-AlSi 12 or stainless steel, polyester-based lacquer, stainless steel rating plate Electrical connection, sensor connection Screw terminals, cable inlet via M20 x 1.5 or 1/2-14 NPT screwed gland Mounting bracket (optional) Steel, galvanized and chrome-plated or stainless steel		Communication Load for HART connection 230 ... 1100 Ω • Two-core shielded $\leq 3.0 \text{ km}$ (1.86 mi) • Multi-core shielded $\leq 1.5 \text{ km}$ (0.93 mi) Protocol HART protocol, version 5.9	
		Factory setting (transmitter): • Pt100 (IEC 751) with 3-wire circuit • Measuring range: 0 ... 100 °C (32 ... 212 °F) • Error signal in the event of sensor breakage: 22.8 mA • Sensor offset: 0 °C (0 °F) • Damping 0.0 s	

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

Digital measuring errors

Resistance thermometer

Input	Measuring range °C / (°F)	Min. mea- sured span		Digital accuracy	
		°C	(°F)	°C	(°F)
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)
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 sensors

Input	Measuring range Ω	Min. mea- sured span Ω	Digital accuracy Ω
Resistance	0 ... 2200	25	0.25

Thermocouples

Input	Measuring range °C / (°F)	Min. mea- sured span		Digital accuracy	
		°C	(°F)	°C	(°F)
Type B	100 ... 1820 (212 ... 3308)	100	(180)	2 ¹⁾	(3.6) ¹⁾
Type C (W5)	0 ... 2300 (32 ... 4172)	100	(180)	2	(3.6)
Type D (W3)	0 ... 2300 (32 ... 4172)	100	(180)	1 ²⁾	(1.8) ²⁾
Type E	-200 ... +1000 (-328 ... +1832)	50	(90)	1	(1.8)
Type J	-200 ... +1200 (-328 ... +2192)	50	(90)	1	(1.8)
Type K	-200 ... +1370 (-328 ... +2498)	50	(90)	1	(1.8)
Type L	-200 ... +900 (-328 ... +1652)	50	(90)	1	(1.8)
Type N	-200 ... +1300 (-328 ... +2372)	50	(90)	1	(1.8)
Type R	-50 ... +1760 (-58 ... +3200)	100	(180)	2	(3.6)
Type S	-50 ... +1760 (-58 ... +3200)	100	(180)	2	(3.6)
Type T	-20 ... +400 (-328 ... +752)	40	(72)	1	(1.8)
Type U	-200 ... +600 (-328 ... +1112)	50	(90)	2	(3.6)

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 span mV	Min. mea- sured span mV	Digital accuracy μV
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 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).

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

Selection and Ordering data	Order code
Customer-specific programming	
Add "-Z" to Article No. and specify Order code(s)	
Measuring range to be set Specify in plain text (max. 5 digits): Y01: ... to ... °C, °F	Y01³⁾
Measuring point no. (TAG), max. 8 characters	Y17⁴⁾
Meas. point descriptor, max. 16 characters	Y23⁵⁾
Meas. point message, max. 32 characters	Y24⁵⁾
Only inscription on measuring point label: specify in plain text: Measuring range	Y22⁵⁾
Pt100 (IEC) 2-wire, $R_L = 0 \Omega$	U02⁶⁾
Pt100 (IEC) 3-wire	U03⁶⁾
Pt100 (IEC) 4-wire	U04⁶⁾
Thermocouple type B	U20⁶⁾⁷⁾
Thermocouple type C (W5)	U21⁶⁾⁷⁾
Thermocouple type D (W3)	U22⁶⁾⁷⁾
Thermocouple type E	U23⁶⁾⁷⁾
Thermocouple type J	U24⁶⁾⁷⁾
Thermocouple type K	U25⁶⁾⁷⁾
Thermocouple type L	U26⁶⁾⁷⁾
Thermocouple type N	U27⁶⁾⁷⁾
Thermocouple type R	U28⁶⁾⁷⁾
Thermocouple type S	U29⁶⁾⁷⁾
Thermocouple type T	U30⁶⁾⁷⁾
Thermocouple type U	U31⁶⁾⁷⁾
With TC: CJC external (Pt100, 3-wire)	U41
With TC: CJC external with fixed value, specify in plain text	Y50
Special differing customer-specific programming, specify in plain text	Y09⁸⁾
Fail-safe value 3.6 mA (instead of 22.8 mA)	U34⁴⁾

Supply units see Chapter "Supplementary Components".

- 1) Without cable gland.
- 2) Option does not include ATEX/IECEx approval, only country-specific approval.
- 3) For customer-specific programming for RTD and TC, the start value and the end value of the required measuring span must be specified here. For specification on TAG plate, please select Y22.
- 4) For this selection, Y01 or Y09 must also be selected. For specification on TAG plate, please select Y23.
- 5) If only Y22, Y23 or Y24 are ordered and the label only has to be on the tag plate, Y01 does not have to be specified.
- 6) For this selection, Y01 must also be selected.
- 7) Internal reference junction compensation is selected as the default for TC.
- 8) For customer-specific programming, for example 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	Article No.
Accessories Further accessories for assembly, connection and transmitter configuration, see page 2/238.	
Modem for SITRANS TH100, TH200, TR200 and TF with TH200 incl. parameterization software T with USB interface	7NG3092-8KN
HART modem With USB interface	7MF4997-1DB
SIMATIC PDM parameterization software also for SITRANS TH300	see chapter 8
Mounting bracket and securing parts Made of steel for 7NG313.-.B.. Made of steel for 7NG313.-.C.. Made of stainless steel for 7NG313.-.B.. Made of stainless steel for 7NG313.-.C..	7MF4997-1AC 7MF4997-1AB 7MF4997-1AJ 7MF4997-1AH
Digital indicator¹⁾	7MF4997-1BS
Connection board	A5E02226423

¹⁾ It is not possible to upgrade devices with Ex protection

Ordering example 1:

7NG3135-0AB11-Z Y01+Y23+U03
Y01: -10 ... +100 °C
Y23: TICA1234HEAT

Ordering example 2:

7NG3136-0AC11-Z Y01+Y23+Y24+U25
Y01: -10 ... +100 °C
Y23: TICA 1234 ABC
Y24: HEATING BOILER 56789

Factory setting (transmitter):

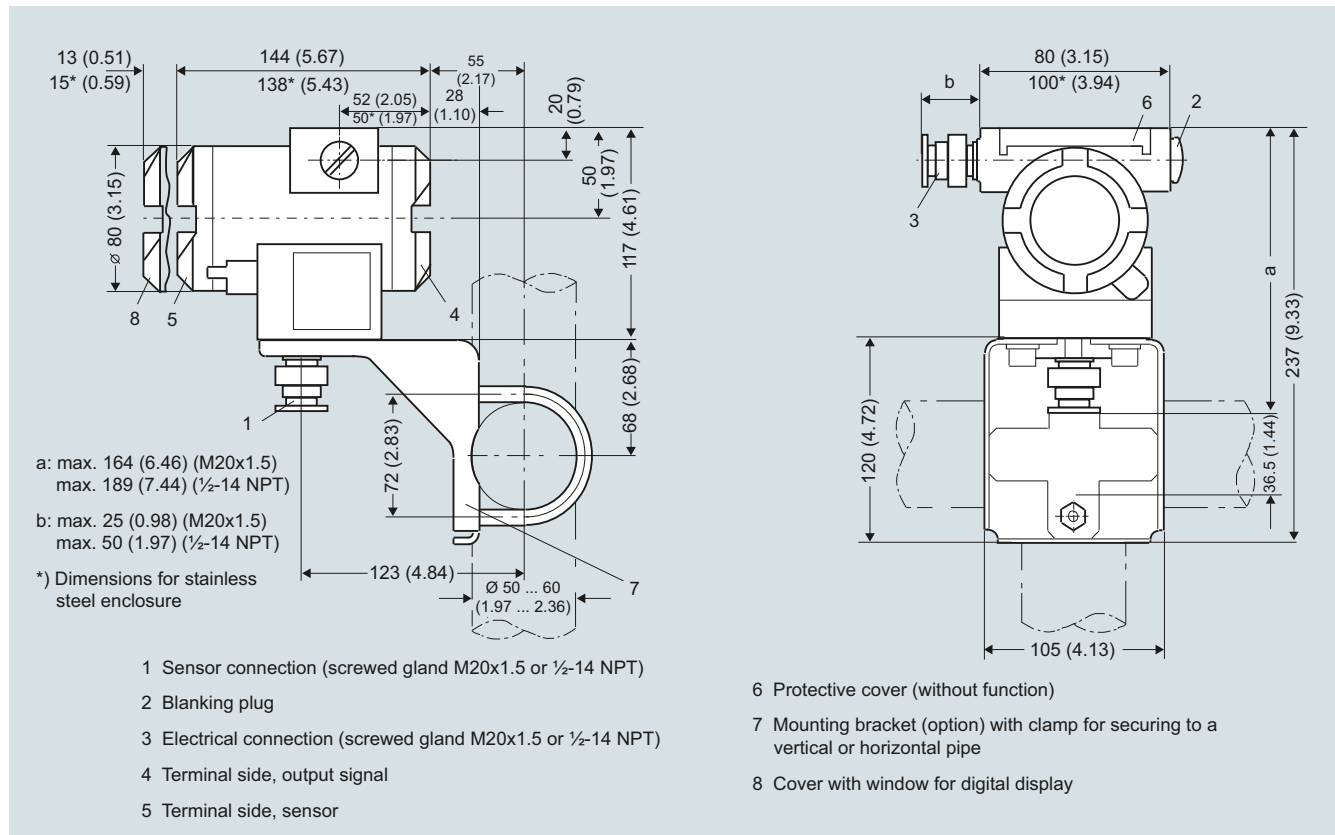
- Pt100 (IEC 751) with three-wire circuit
- Measuring range: 0 ... 100 °C (32 ... 212 °F)
- Fault current 22.8 mA
- Sensor offset: 0 °C (0 °F)
- Damping 0.0 s

Temperature Measurement

Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and SITRANS TF - Field indicator for 4 to 20 mA

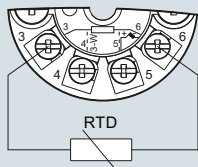
Dimensional drawings



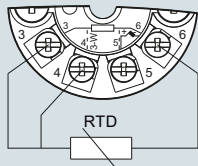
SITRANS TF, dimensions in mm (inches)

Schematics

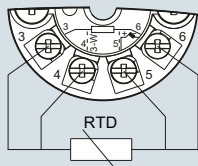
Resistance thermometer



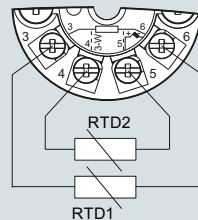
Two-wire system ¹⁾



Three-wire system



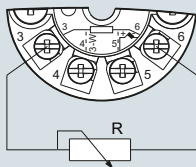
Four-wire system



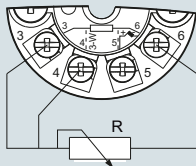
Generation of average value / difference ¹⁾

¹⁾ Programmable line resistance for the purpose of correction.

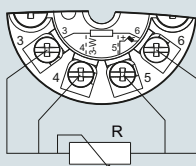
Resistance



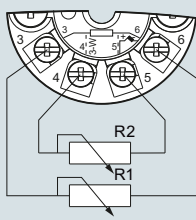
Two-wire system ¹⁾



Three-wire system

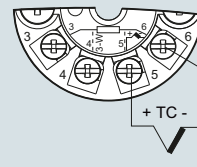


Four-wire system

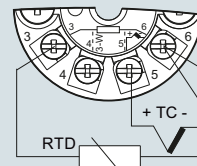


Generation of average value / difference ¹⁾

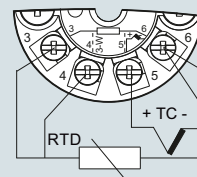
Thermocouple



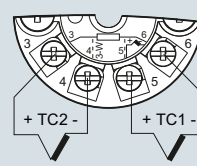
Cold junction compensation
Internal/fixed value



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

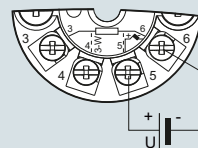


Cold junction compensation with
external Pt100 in three-wire system

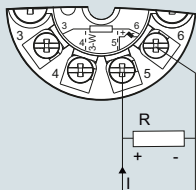


Generation of average value / difference
with internal cold junction compensation

Voltage measurement



Current measurement



SITRANS TF, sensor connection assignment