Transmitter for field mounting/field indicator

SITRANS TF - Transmitter, two-wire system and - 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, thermoelement, 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
- Type of protection IP67
- Test terminals for direct read-out of the output signal without breaking the current loop
- Can be mounted elsewhere if the measuring point
  - is not easily accessible
  - 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 protection, for Europe and USA.
- SIL 2 (with order code C20)

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. Which is why users from all industries have opted for this field device. The rugged enclosure protects the electronics. The stainless steel model is even 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 TH200. 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

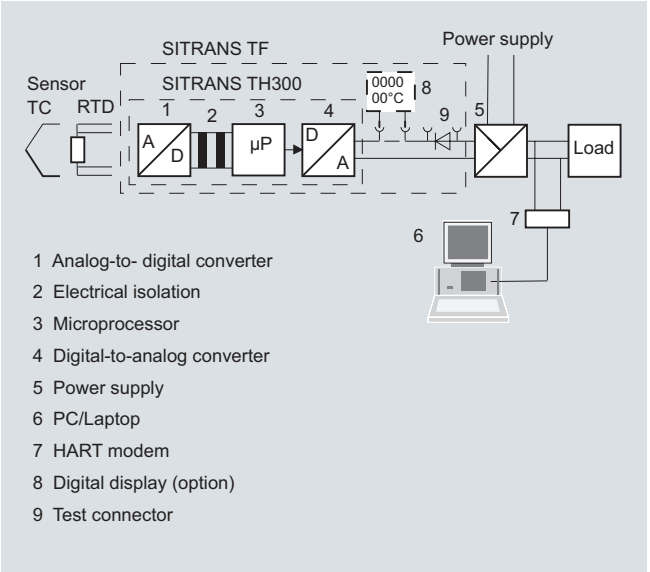
The sensor signal, whether resistance thermometer, thermocouple or Ω and/or V signal, is amplified and linearized. Sensor and output side are electrically isolated. An internal cold junction is integrated for measurements with thermocouples.

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 model also supports digital communication for online diagnostics, measured value transmission and configuration.

SITRANS TF automatically detects when a sensor should 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.



Operating principle: SITRANS TF with an integrated transmitter and digital display

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 ≤ 100 Ω (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 (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-based sensor in 2-wire system (R 1 – R 2 or R 2 – R 1)
Interface	
• Two-wire system	Parameterizable line resistance ≤ 100 Ω (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 (see table "Digital measuring errors")
Min. measured span	5 ... 25 Ω (see table "Digital measuring errors")
Characteristic	Resistance-linear or special characteristic
Thermocouple	
Measured variable	Temperature
Sensor type (thermocouples)	
• Type B	Pt30Rh-Pt6Rh to DIN IEC 584
• Type C	W5 %-Re to ASTM 988
• Type D	W3 %-Re 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	
• Standard 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 60571 (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. 50 ... 100 °C (90 ... 180 °F) (see table "Digital measuring errors")
Characteristic	Temperature-linear or special characteristic
mV Sensor	
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
Short-circuit monitoring	Can be switched off (value is adjustable)
Measuring 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 spec. characteristic

Transmitter for field mounting/field indicator

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

Output	
Output signal	4 ... 20 mA, 2-wire
Communication with SITRANS TH300	to HART Rev. 5.9
Digital display	
Digital display (optional)	in current loop
Display	max. 5 digits
Digit height	9 mm (0.35")
Display range	-99999 ... +99999
Units	Any (max. 5 char.)
Setting: Zero point, upper range value and unit	With 3 keys
Load voltage	2.1 V
Measuring accuracy	
Digital measuring errors	See table "Dig. measuring errors"
Reference conditions	
• Auxiliary power supply	24 V ± 1 %
• Load	500 Ω
• Storage temperature	23 °C (73.4 °F)
• Warming-up time	> 5 min
Error in the analog ouput (digital/analog converter)	< 0.025 % of span
Error due to internal cold junction	< 0.5 °C (0.9 °F)
Temperature effect	< 0.1 % of 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	
Ambient temperature	
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	IP67
Design	
Approx. 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 ½-14 NPT threaded gland
Mounting bracket (optional)	Steel, galvanized and chrome-plated or stainless steel
Power supply	
Without digital display	11 ... 35 V DC (30 V with Ex)
With digital display	13.1 ... 35 V DC (30 V with Ex)
Electrically isolated	Between input and output
• Test voltage	U_{eff} = 1 kV, 50 Hz, 1 min

Certificate and approvals	
Explosion protection ATEX	
• "Intrinsically-safe" type of protection	With digital indicator: II 2 (1) G EEx ia IIC T4 Without digital indicator: II 2 (1) G EEx ia IIC T6
- EC type test certificate	ZELM 99 ATEX 0007
• "Operating equipment that is non-sparking and has limited energy for zone 2" type of protection	II 3G EEx nAL IIC T6/T4
- EC type test certificate	ZELM 99 ATEX 0007
• Flame-proof enclosure" type of protection	II 2 G EEx d IIC T5/T6
- EC type test certificate	CESI 99 ATEX 079
Explosion protection to FM	Certificate of Compliance 3017742
• Identification (XP, DIP, NI, S)	• XP / I / 1/BCD / T5 Ta = 85 °C (185 °F), T6 Ta = 50 °C (112 °F), Type 4X • DIP / II, III / 1 / EFG / T5 Ta = 85 °C (185 °F), T6 Ta = 50 °C (112 °F), Type 4X • NI / I / 2 / ABCD / T5 Ta = 85 °C (185 °F), T6 Ta = 50 °C (112 °F), Type 4X • S / II, III / 2 / FG / T5 Ta = 85 °C (185 °F), T6 Ta = 50 °C (112 °F), Type 4X
Hardware and software requirements	
• For the parameterization software SIPROM T for SITRANS TH200	
- Personal computer	PC with CD-ROM drive and USB/RS 232 interface
- PC operating system	Windows 98, NT, 2000, XP
• For the parameterization software SIMATIC PDM for SITRANS TH300	See chapter 9, "Software", "SIMATIC PDM"
Communication	
Load for HART connection	230 ... 1100 Ω
• Two-core shielded	≤ 3.0 km (1.86 mi)
• Multi-core shielded	≤ 1.5 km (0.93 mi)
Protocol	HART protocol, version 5.x

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

Digital measuring errors

Resistance thermometer

Input	Measuring range	Min. measured span		Digital accuracy	
	°C (°F)	°C	(°F)	°C	(°F)
according to IEC 60751					
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)
according to JIS C1604-81					
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)

Resistance-based sensors

Input	Measuring 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)	°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 sensors

Input	Measuring range	Min. measured span	Digital accuracy
	mV	mV	µV
mV sensors	-10 ... +70	2	40
mV sensors	-100 ... +1100	20	400

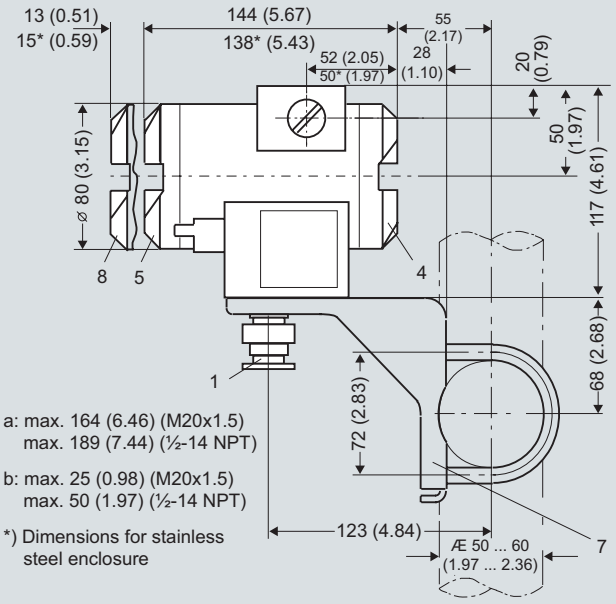
The digital accuracy is the accuracy after the analog/digital conversion including linearization and calculation of the measured value.

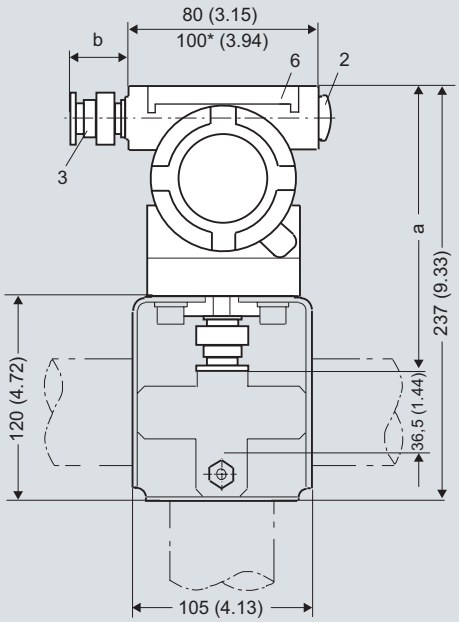
An additional error is generated in the output current 4 to 20 mA as a result of the digital/analog conversion of 0.1 % of the set span (digital-analog error).

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).

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

Dimensional drawings





1 Sensor connection (screwed gland M20x1,5 or ½-14 NPT)

2 Blanking plug

3 Electrical connection (screwed gland M20x1,5 or ½-14 NPT)

4 Terminal side, output signal

5 Terminal side, sensor

6 Protective cover (without function)

7 Mounting bracket (option) with clamp for securing to a vertical or horizontal pipe

8 Cover with window for digital display

SITRANS TF, dimensions in mm (inches)

Selection and Ordering data		Order No.
Temperature transmitter in field housing Two-wire system 4 ... 20 mA, with electrical isolation, with documentation on CD-ROM	D)	**7NG313■-■■■■■**
Integrated transmitter		
• SITRANS TH200, programmable		
- without Ex protection		**50**
- with EEx ia		**51**
- with EEx nAL for zone 2		**52**
- total device SITRANS TF EEx d[1]		**54**
- total device SITRANS TF according to FM (XP, DIP, NI, S)[1]		**55**
• SITRANS TH300, communication capability according to HART V 5.9		
- without Ex-protection		**60**
- with EEx ia		**61**
- with EEx nAL for zone 2		**62**
- total device SITRANS TF EEx d[1]		**64**
- total device SITRANS TF according to FM (XP, DIP, NI, S)[1]		**65**
SITRANS TF field indicator for 4 ... 20 mA signals, with documentation on CD-ROM		**7NG313■-■■■■■**
• without Ex-protection		**001**
• with EEx ia		**011**
• with EEx nAL for zone 2		**021**
• total device SITRANS TF EEx d[1]		**041**
• total device SITRANS TF according to FM (XP, DIP, NI, S)[1]		**051**
Enclosure		
• die-cast aluminium		**A**
• stainless steel precision casting		**E**
Connections/cable inlet		
• screwed glands M20x1.5		**B**
• screwed glands ½-14 NPT		**C**
Digital indicator		
• without		**0**
• with		**1**
Mounting bracket and securing parts		
• without		**0**
• made of steel		**1**
• made of stainless steel		**2**
Further designs Please add "-**Z**" to Order No. and specify Order code(s) and plain text.		Order code
Customer-specific setting of operating data		**Y01**[2]
Inscription on measuring-point label		
• measuring range (max. 27 characters)		**Y22**[3]
• meas. point description (max. 16 char.)		**Y23**[3]
• measuring point text (max. 27 char.)		**Y24**[3]
Test protocol (5 measuring points)		**C11**[4]
SIL 2 (functional safety)		**C20**[5]

Power supply units see "SITRANS I supply units and input isolators".

1) Without cable gland.
2) Y01: Please specify all data that does not correspond to factory settings (see above) (e.g. Y01 = thermocouple element type K; internal cold junction; 0 ... 800 °C; fault current 3.6 mA).
3) Y22, Y23, Y24: If no order is placed for Y01, these data are only noted on the measuring point label and are not programmed in the transmitter.
4) Can only be ordered together with Y01.
5) Only with 7NG3135-... and 7NG3136-...

Selection and Ordering data		Order No.
Accessories		
Modem for SITRANS TH200 incl. parameterization software T		
• with USB interface	▶ C)	**7NG3092-8KU**
• with RS 232 interface	▶ C)	**7NG3092-8KM**
CD for measuring instruments for temperature with documentation in German, English, French, Spanish, Italian and Portuguese, and parameterization software SIPROM T (included in delivery with SITRANS TF)	▶	**A5E00364512**
HART modem		
• with RS 232 interface	▶ D)	**7MF4997-1DA**
• with USB interface	▶ D)	**7MF4997-1DB**
SIMATIC PDM parameterization software also for SITRANS TH300		**see chap. 9**
Mounting bracket and securing parts		
• made of steel for 7NG313.-..B..		**7MF4997-1AC**
• made of steel for 7NG313.-..C..		**7MF4997-1AB**
• made of stainless steel for 7NG313.-..B..	▶	**7MF4997-1AJ**
• made of stainless steel for 7NG313.-..C..		**7MF4997-1AH**
Digital indicator[1]		**7MF4997-1BS**
Connection board		**A5E02226423**

▶ Available ex stock.
Power supply units see "SITRANS I supply units and input isolators".

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

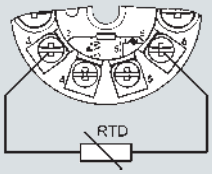
C) Subject to export regulations AL: N, ECCN: EAR99.
D) Subject to export regulations AL: N, ECCN: EAR99H.

Factory setting (transmitter):

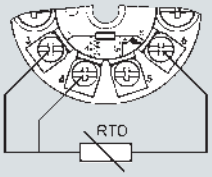
- Pt100 (IEC 751) with three-wire circuit
- Measuring range: 0 ... 100 °C (32 ... 212 °F)
- Fault current 22.8 mA
- Sensor offset: 0 °C (0 °F)
- Damping 0.0 s

Schematics

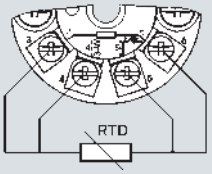
Resistance thermometer



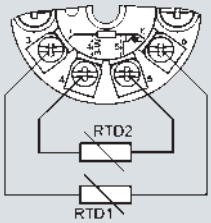
Two-wire system [1)]



Three-wire system

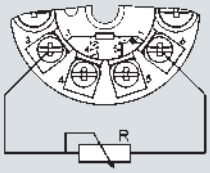


Four-wire system

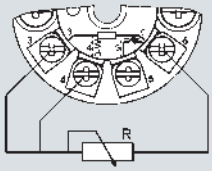


Generation of average value / difference [1)]

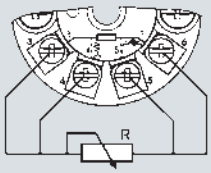
Resistance



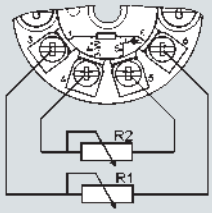
Two-wire system [1)]



Three-wire system

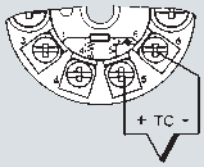


Four-wire system

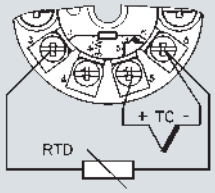


Generation of average value / difference [1)]

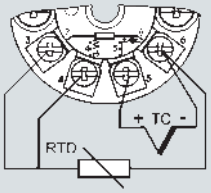
Thermocouple



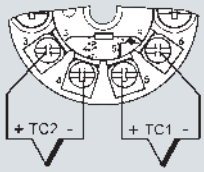
Cold junction compensation
Internal/fixed value



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



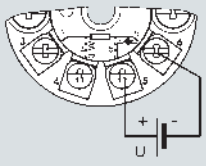
Cold junction compensation with external Pt100 in three-wire system



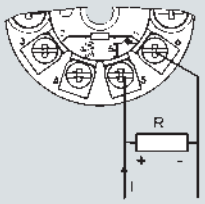
Generation of average value / difference with internal cold junction compensation

[1)] Programmable line resistance for the purpose of correction.

Voltage measurement



Current measurement



SITRANS TF, sensor connection assignment