

# Temperature Measurement

## Temperature transmitters

### Rail transmitters / SITRANS TR200 (4 to 20 mA, universal)

#### Overview



#### Keep flexible - with the universal SITRANS TR200 transmitter

- 2-wire device for 4 to 20 mA
- Enclosure for rail mounting
- Universal input for virtually any type of temperature sensor
- Configurable over PC

#### Benefits

- Compact design
- Galvanic isolation
- 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
- SIL2 (with order note C20), SIL2/3 (with C23)

#### Application

SITRANS TR200 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 thermometer (2, 3, 4-wire connection)
- Thermocouples
- 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.

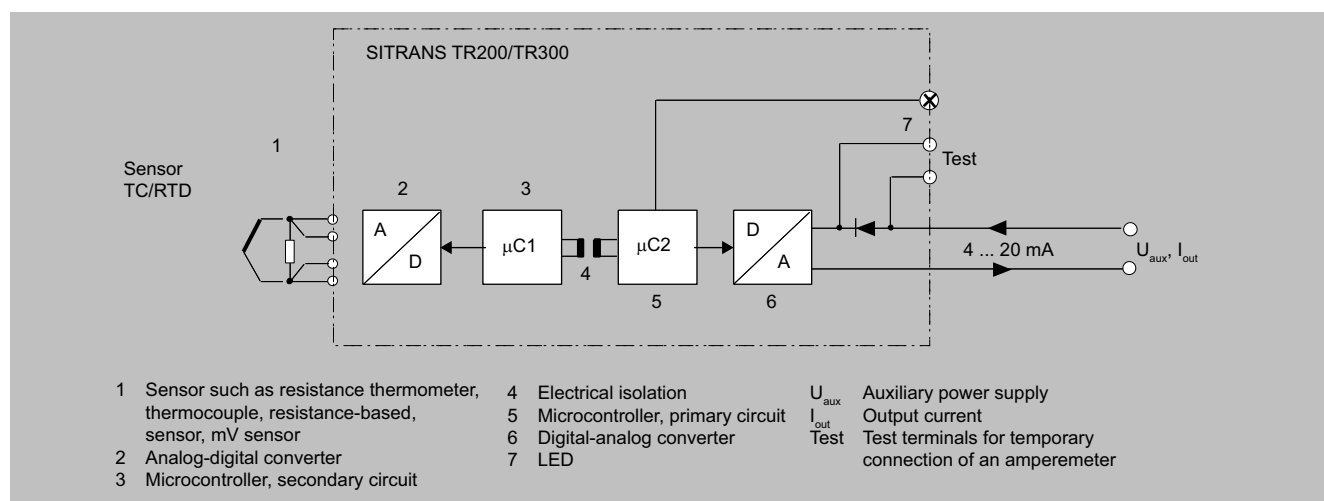
Transmitters of the "intrinsically safe" type of protection can be installed within hazardous areas. The devices meet the directive 2014/34/EU (ATEX).

#### Function

The SITRANS TR200 is configured over a PC. For this purpose, the USB or RS 232 modem is connected to the output terminals. The configuration data can now be edited using the SIPROM T software tool. 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 TR200 function diagram

### Selection and ordering data

	Article No.
<b>SITRANS TR200 rail transmitter</b> Installation on DIN rail 2-wire system, 4 to 20 mA, programmable, with galvanic isolation	
• Without explosion protection	7NG3032-0JN00
• With explosion protection according to ATEX	7NG3032-1JN00

Options	Order code
<b>Add "-Z" to article number, specify order code and, if applicable, plain text</b>	
With test report (5 measuring points)	C11
Functional safety SIL2	C20
Functional safety SIL2/3	C23
<b>Customer-specific programming</b>	
Measuring range to be set Specify in plain text (max. 5 digits): Y01: ... to ... °C, °F	Y01 <sup>1)</sup>
Measuring point number (TAG) max. 8 characters	Y17 <sup>2)</sup>
Measuring point description, max. 16 characters	Y23 <sup>2)</sup>
Measuring point message, max. 32 characters	Y24 <sup>2)</sup>
Text on front plate, max. 16 characters	Y29 <sup>2)3)</sup>
Pt100 (IEC) 2-wire, R <sub>L</sub> = 0 W	U02 <sup>4)</sup>
Pt100 (IEC) 3-wire	U03 <sup>4)</sup>
Pt100 (IEC) 4-wire	U04 <sup>4)</sup>
Type B thermocouple	U20 <sup>4)5)</sup>
Type C thermocouple (W5)	U21 <sup>4)5)</sup>
Type D thermocouple (W3)	U22 <sup>4)5)</sup>
Type E thermocouple	U23 <sup>4)5)</sup>
Type J thermocouple	U24 <sup>4)5)</sup>
Type K thermocouple	U25 <sup>4)5)</sup>
Type L thermocouple	U26 <sup>4)5)</sup>
Type N thermocouple	U27 <sup>4)5)</sup>
Type R thermocouple	U28 <sup>1)4)5)</sup>
Type S thermocouple	U29 <sup>4)5)</sup>
Type T thermocouple	U30 <sup>4)5)</sup>
Type U thermocouple	U31 <sup>4)5)</sup>
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 <sup>6)</sup>
Fault current 3.6 mA (instead of 22.8 mA)	U36 <sup>2)</sup>

<sup>1)</sup> For customer-specific programming for RTD and TC, the start value and the end value of the required measuring span must be specified here.

<sup>2)</sup> For this selection, Y01 or Y09 must also be selected.

<sup>3)</sup> Text on front plate is not saved in the device.

<sup>4)</sup> For this selection, Y01 must also be selected.

<sup>5)</sup> Internal cold junction compensation is selected as the default for TC.

<sup>6)</sup> 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.	
<b>Modem</b>	
Modem with USB interface and SIPROM T software	7NG3092-8KN

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

#### Ordering example 1:

7NG3032-0JN00-Z Y01+Y17+Y29+U03

Y01: -10 ... +100 °C

Y17: TICA123

Y29: TICA123

#### Ordering example 2:

7NG3032-0JN00-Z Y01+Y17+Y23+Y29+U25

Y01: -10 ... +100 °C

Y17: TICA123

Y23: TICA123HEAT

Y29: TICA123HEAT

#### 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

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### Rail transmitters / SITRANS TR200 (4 to 20 mA, universal)

#### Technical specifications

SITRANS TR200 (4 ... 20 mA, universal)	
<b>Input</b>	
<b><u>Resistance thermometer</u></b>	
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 resistance thermometers in 2-wire connection for generation of average temperature
• Differentiation	2 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 $T_{63}$	$\leq 250 \text{ ms}$ 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
<b><u>Resistance-based sensor</u></b>	
Measured variable	Ohmic resistance
Sensor type	Resistance-based, potentiometers
Units	$\Omega$
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 $T_{63}$	$\leq 250 \text{ ms}$ 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 $\Omega$ (see "Digital measuring error" table)
Min. measuring span	5 ... 25 $\Omega$ (see "Digital measuring error" table)
Characteristic curve	Resistance-linear or special characteristic curve
<b><u>Thermocouples</u></b>	

### Technical specifications (continued)

SITRANS TR200 (4 ... 20 mA, 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 $T_{63}$	≤ 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
<b><u>mV sensor</u></b>	
Measured variable	DC voltage
Sensor type	DC voltage source (DC voltage source possible over externally connected resistance)
Units	mV
Response time $T_{63}$	≤ 250 ms for 1 sensor with break monitoring
Break monitoring	Can be switched off
Measuring range	Assignable max. -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
<b>Output</b>	
Output signal	4 ... 20 mA, 2-wire
Auxiliary power	11 ... 35 V DC (to 30 V with Ex i/lc; to 32 V with Ex nA)
Max. load	$(U_{aux} - 11 V)/0.023 A$
Overrange	3.6 ... 23 mA, continuously adjustable (default range: 3.84 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)
Sample cycle	0.25 s nominal
Damping	Software filter 1st order 0 ... 30 s (parameterizable)
Protection	Against reverse polarity

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### Rail transmitters / SITRANS TR200 (4 to 20 mA, universal)

#### Technical specifications (continued)

SITRANS TR200 (4 ... 20 mA, universal)	
Galvanic isolation	Input against output 2.12 kV DC (1.5 kV <sub>rms</sub> AC)
<b>Measuring accuracy</b>	
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 thermometer	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
<b>Operating conditions</b>	
<b>Ambient conditions</b>	
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
<b>Structural design</b>	
Material	Plastic, electronic module potted
Weight	122 g
Dimensions	See "Dimensional drawings"
Cross-section of cables	Max. 2.5 mm <sup>2</sup> (AWG 13)
Degree of protection according to IEC 60529	
• Enclosure	IP20
<b>Certificates and approvals</b>	
ATEX explosion protection	
EC type-examination certificate	PTB 07 ATEX 2032X
• "Intrinsic safety" type of protection	<ul style="list-style-type: none"> <li>• II 2(1) G Ex ia/ib IIC T6/T4</li> <li>• II 3(1) G Ex ia/ib IIC T6/T4</li> <li>• II 3 G Ex ic IIC T6/T4</li> <li>• II 2(1) D Ex iaD/ibD 20/21 T115 °C</li> </ul>
• "Non-sparking equipment" type of protection	II 3 G Ex nA IIC T6/T4
Other certificates	NEPSI
<b>Software requirements for SIPROM T</b>	
PC operating system	Windows ME, 2000, XP, Win 7, 8 and 10; in connection with RS 232 modem, also Windows 95, 98 and 98 SE

#### **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 (continued)

#### Digital measuring error

##### Resistance thermometer

Input	Measuring range °C (°F)	Minimum measuring span		Digital accuracy	
		°C	(°F)	°C	(°F)
<b>According to IEC 60751</b>					
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)
<b>According to JIS C1604-81</b>					
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 ... 2200	25	0.25

##### Thermocouples

Input	Measuring range °C (°F)	Minimum measuring span		Digital accuracy	
		°C	(°F)	°C	(°F)
Type B	100 ... 1820 (212 ... 3308)	100	(180)	2 <sup>1)</sup>	(3.6) <sup>1)</sup>
Type C (W5)	0 ... 2300 (32 ... 4172)	100	(180)	2	(3.6)
Type D (W3)	0 ... 2300 (32 ... 4172)	100	(180)	1 <sup>2)</sup>	(1.8) <sup>2)</sup>
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	-200 ... +400 (-328 ... +752)	40	(72)	1	(1.8)
Type U	-200 ... +600 (-328 ... +1112)	50	(90)	2	(3.6)

<sup>1)</sup> The digital accuracy in the range 100 to 300 °C (212 to 572 °F) is 3 °C (5.4 °F).

<sup>2)</sup> 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	-100 ... +1100	20	400

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

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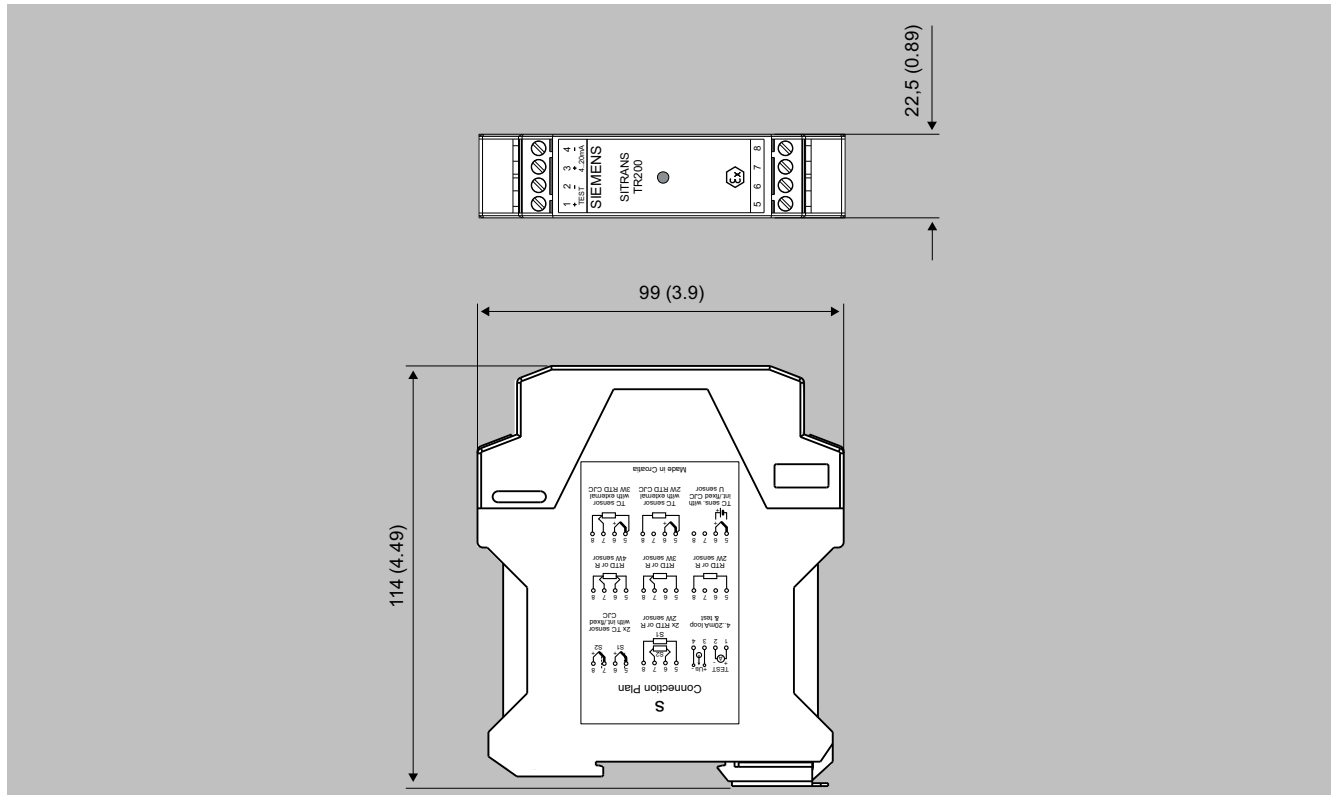
### Rail transmitters / SITRANS TR200 (4 to 20 mA, universal)

#### Technical specifications (continued)

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).

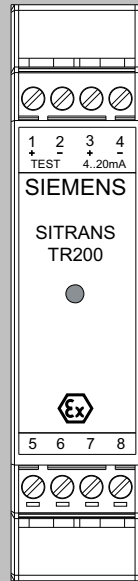
The total error under reference conditions at the analog output is the sum from the digital error and the digital-analog error (poss. with the addition of reference junction errors in the case of thermocouple measurements).

#### Dimensional drawings



SITRANS TR200, dimensions in mm (inch)

#### Circuit diagrams



#### Connections

1 (+) and 2 (-)	Test terminals (test) for measurement of the output current with a multimeter
3 (+) and 4 (-)	Power supply $U_{aux}$ , output current $I_{out}$
5, 6, 7 and 8	Sensor connection, see schematics

SITRANS TR200, connector assignment

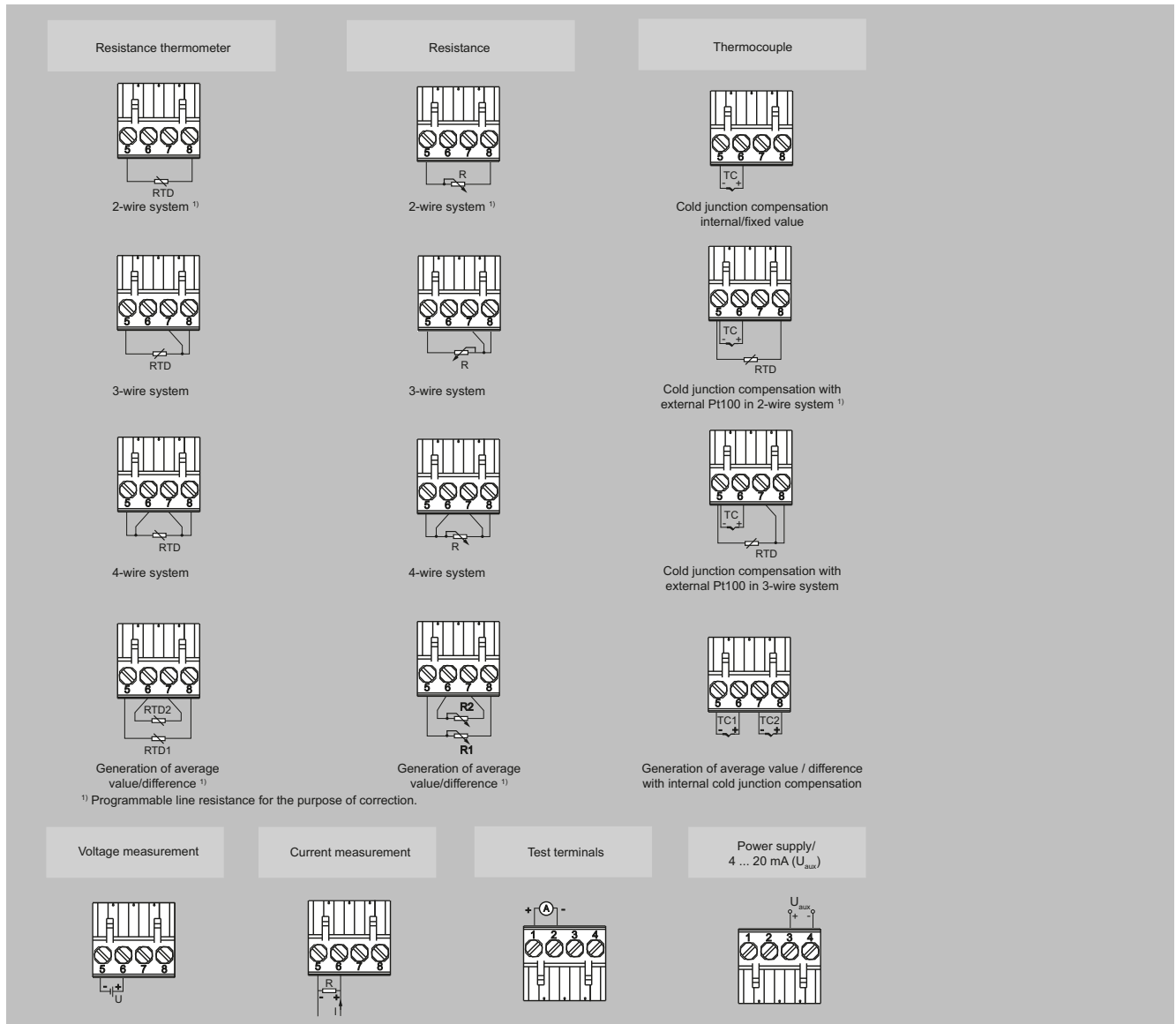


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### Rail transmitters / SITRANS TR200 (4 to 20 mA, universal)

#### Circuit diagrams (continued)



SITRANS TR200, sensor connection assignment