

# Temperature Measurement

## Transmitters for field mounting

### SITRANS TF fieldbus transmitter

#### Overview



#### Our field devices for heavy industrial use

- FOUNDATION fieldbus
- PROFIBUS PA

The SITRANS TF temperature transmitter works where others can't cope.

#### Benefits

- For universal use as a transmitter for resistance thermometers, thermocouple elements,  $\Omega$  or mV signals
- Rugged two-chamber enclosure in die-cast aluminium or stainless steel
- Degree of protection IP67
- 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 protection, for Europe and USA

#### Application

The SITRANS TF can be used everywhere where temperatures need to be measured under particularly harsh conditions. Which is why 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

##### Features

- Polarity-neutral bus connection
- 24-bit analog-digital converter for high resolution
- Electrically isolated
- Version for use in hazardous areas
- Special characteristic
- Sensor redundancy

##### Transmitter with PROFIBUS PA communication

- Function blocks: 2 x analog

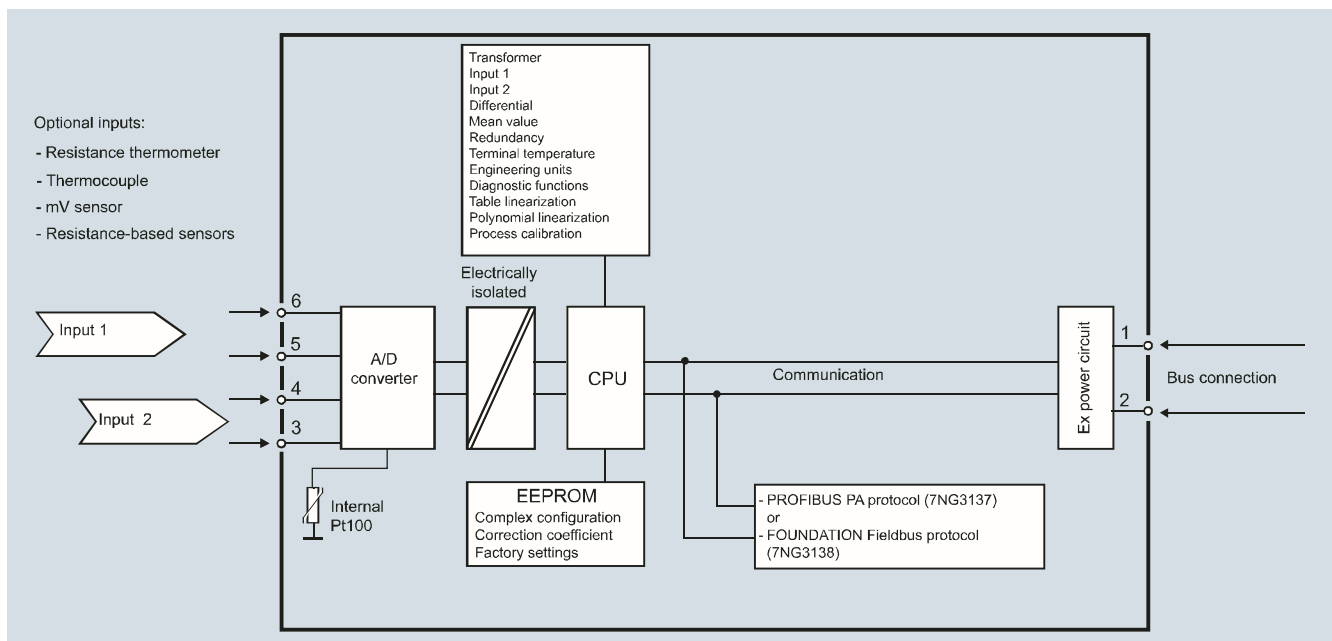
##### Transmitter with FOUNDATION fieldbus communication

- Function blocks: 2 x analog and 1 x PID
- Functionality: Basic or LAS

#### Mode of operation

The following function diagram explains the mode of operation of the transmitter.

The only difference between the two versions of the SITRANS TF (7NG3137-... and 7NG3138-...) is the type of field bus protocol used (PROFIBUS PA or FOUNDATION fieldbus).



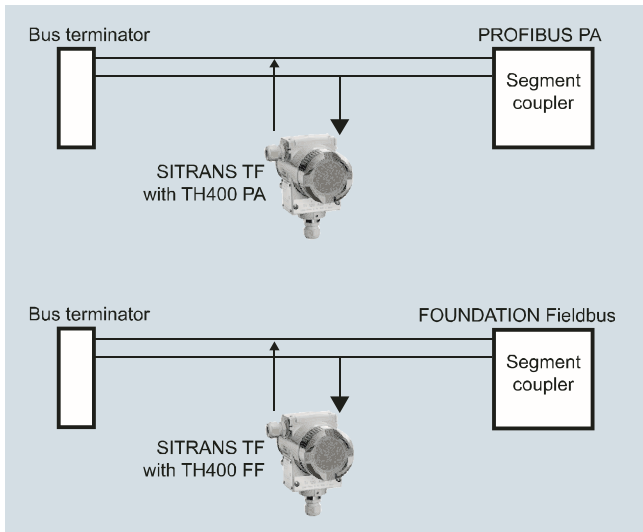
SITRANS TF with TH400, function diagram

# Temperature Measurement

## Transmitters for field mounting

### SITRANS TF fieldbus transmitter

#### System communication



SITRANS TF with TH400, communication interface

#### Technical specifications

##### Input

Analog/digital conversion

- Measurement rate < 50 ms
- Resolution 24-bit

##### Resistance thermometer

Pt25 ... 1000 to IEC 60751/JIS C 1604

- Measuring range -200 ... +850 °C (-328 ... +1562 °F)
- Ni25 ... 1000 to DIN 43760
- Measuring range -60 ... +250 °C (-76 ... +482 °F)
- Cu10 ... 1000,  $\alpha = 0.00427$
- Measuring range -50 ... +200 °C (-58 ... +392 °F)

Line resistance per sensor cable

Max. 50  $\Omega$ 

Sensor current

Nominal 0.2 mA

Sensor fault detection

- Sensor break detection Yes
- Sensor short-circuit detection Yes, < 15  $\Omega$

##### Resistance-based sensors

Measuring range 0 ... 10 k $\Omega$ 

Line resistance per sensor cable

Max. 50  $\Omega$ 

Sensor current

Nominal 0.2 mA

Sensor fault detection

- Sensor break detection Yes
- Sensor short-circuit detection Yes, < 15  $\Omega$

##### Thermocouple

to IEC 584

- Type B Measuring range 400 ... 1820 °C (752 ... 3308 °F)
- Type E -100 ... +1000 °C (-148 ... +1832 °F)
- Type J -100 ... +1000 °C (-148 ... +1832 °F)
- Type K -100 ... +1200 °C (-148 ... +2192 °F)
- Type N -180 ... +1300 °C (-292 ... +2372 °F)

• Type R	-50 ... +1760 °C (-58 ... +3200 °F)	
• Type S	-50 ... +1760 °C (-58 ... +3200 °F)	
• Type T	-200 ... +400 °C (-328 ... +752 °F)	
to DIN 43710		
• Type L	-200 ... +900 °C (-328 ... +1652 °F)	
• Type U	-200 ... +600 °C (-328 ... +1112 °F)	
to ASTM E988-90		
• Type W3	0 ... 2300 °C (32 ... 4172 °F)	
• Type W5	0 ... 2300 °C (32 ... 4172 °F)	
External cold junction compensation	-40 ... +135 °C (-40 ... +275 °F)	
Sensor fault detection		
• Sensor break detection	Yes	
• Sensor short-circuit detection	Yes, < 3 mV	
• Sensor current in the event of open-circuit monitoring	4 $\mu$ A	
<u>mV sensor - voltage input</u>		
Measuring range	-800 ... +800 mV	
Input resistance	10 M $\Omega$	
<b>Output</b>		
Filter time (programmable)	0 ... 60 s	
Update time	< 400 ms	
<b>Measuring accuracy</b>		
Accuracy is defined as the higher value of general values and basic values.		
<b>General values</b>		
Type of input	Absolute accuracy	Temperature coefficient
All	$\leq \pm 0.05$ % of the measured value	$\leq \pm 0.002$ % of the measured value/°C
<b>Basic values</b>		
Type of input	Basic accuracy	Temperature coefficient
Pt100 and Pt1000	$\leq \pm 0.1$ °C	$\leq \pm 0.002$ °C/°C
Ni100	$\leq \pm 0.15$ °C	$\leq \pm 0.002$ °C/°C
Cu10	$\leq \pm 1.3$ °C	$\leq \pm 0.02$ °C/°C
Resistance-based sensors	$\leq \pm 0.05$ $\Omega$	$\leq \pm 0.002$ $\Omega$ /°C
Voltage source	$\leq \pm 10$ $\mu$ V	$\leq \pm 0.2$ $\mu$ V/°C
Thermocouple, type: E, J, K, L, N, T, U	$\leq \pm 0.5$ °C	$\leq \pm 0.01$ °C/°C
Thermocouple, type: B, R, S, W3, W5	$\leq \pm 1$ °C	$\leq \pm 0.025$ °C/°C
Cold junction compensation	$\leq \pm 0.5$ °C	
<u>Reference conditions</u>		
Warming-up time	30 s	
Signal-to-noise ratio	Min. 60 dB	
Calibration condition	20 ... 28 °C (68 ... 82 °F)	

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### SITRANS TF fieldbus transmitter

#### Conditions of use

##### Ambient conditions

Permissible ambient temperature -40 ... +85 °C (-40 ... +185 °F)

Permissible storage temperature -40 ... +85 °C (-40 ... +185 °F)

Relative humidity ≤ 98 %, with condensation

##### Insulation resistance

• Test voltage 500 V AC for 60 s

• Continuous operation 50 V AC/75 V DC

##### Electromagnetic compatibility

NAMUR NE21

EMC 2004/108/EC Emission and Noise Immunity EN 61326-1, EN 61326-2-5

#### Construction

Weight Approx. 1.5 kg (3.3 lb) without options

Dimensions See "Dimensional drawings"

Enclosure materials

- Die-cast aluminum, low in copper, GD-AISI 12 or stainless steel
- Polyester-based lacquer for GD AISI 12 enclosure
- Stainless steel rating plate

Electrical connection, sensor connection

- screw terminals
- Cable inlet via M20 x 1.5 or ½ -14 NPT screwed gland
- Bus connection with M12 plug (optional)

Mounting bracket (optional) Steel, galvanized and chrome-plated or stainless steel

Degree of protection IP67 to EN 60529

#### Auxiliary power

##### Power supply

• Standard, Ex "d", Ex "nA", Ex "nL", XP, NI 10.0 ... 32 V DC

• Ex "ia", Ex "ib" 10.0 ... 30 V DC

• In FISCO/FNICO installations 10.0 ... 17.5 V DC

Power consumption < 11 mA

Max. increase in power consumption in the event of a fault < 7 mA

#### Certificates and approvals

##### Explosion protection ATEX

EC type test certificate ZELM 99 ATEX 0007

• Type of protection "intrinsic safety i" (version: 7NG313x-1xxxx) II 2(1) G Ex ia IIC T4/T6

Conformity statement ZELM 07 ATEX 3349

• "Operating equipment that is non-ignitable and has limited energy" type of protection (version: 7NG313x-2xxxx) II 3 G Ex nA [nL] IIC T4/T6  
II 3 G Ex nL IIC T4/T6

EC type test certificate CESI 99 ATEX 079

• "Flame-proof enclosure" type of protection (version: 7NG313x-4xxxx) II 2 G Ex d IIC T5/T6  
II 1D Ex tD A20 IP65 T100 °C, T85 °C

##### Explosion protection: FM for USA

• FM approval FM 3017742

• Type of protection XP, DIP, NI and S (version 7NG313x-5xxxx)

- XP / I / 1 / BCD / T5, T6; Type 4X
- DIP / II, III / 1 / EFG / T5, T6; Type 4X

- NI / I / 2 / ABCD / T5, T6; Type 4X

- S / II, III / 2 / FG T5, T6; Type 4X

Other certificates GOST, INMETRO, NEPSI

#### Communication

##### Parameterization interface

##### • PROFIBUS PA connection

- Protocol

A&D profile, Version 3.0

- Protocol

EN 50170 Volume 2

- Address (for delivery)

126

- Function blocks

2 x analog

##### • FOUNDATION fieldbus connection

- Protocol

FF protocol

- Protocol

FF design specifications

- Functionality

Basic or LAS

- Version

ITK 4.6

- Function blocks

2 x analog and 1 x PID

#### Factory setting

##### for SITRANS TH400 PA

Sensor

Pt100 (IEC)

Type of connection

3-wire circuit

Unit

°C

Failure mode

Last valid value

Filter time

0 s

PA address

126

PROFIBUS Ident No.

Manufacturer-specific

##### for SITRANS TH400 FF

Sensor

Pt100 (IEC)

Type of connection

3-wire circuit

Unit

°C

Failure mode

Last valid value

Filter time

0 s

Node address

22

# Temperature Measurement

## Transmitters for field mounting

**SITRANS TF**  
**fieldbus transmitter**

2

Selection and Ordering data	Article No.
<b>Temperature transmitter in field enclosure</b> with fieldbus communication and electrical isolation, with documentation on CD	7 NG 3 1 3 - - 0
<b>Integrated transmitter</b> SITRANS TH400 with PROFIBUS PA	
• Without Ex protection	7 0
• With Ex ia (ATEX)	7 1
• With Ex nAL for zone 2 (ATEX)	7 2
• Total device SITRANS TF Ex d <sup>1)</sup>	7 4
• Total device SITRANS TF according to FM (XP, DIP, NI, S) <sup>1)</sup>	7 5
SITRANS TH400, with FOUNDATION fieldbus	
• Without Ex protection	8 0
• With Ex ia (ATEX)	8 1
• With Ex nAL for zone 2 (ATEX)	8 2
• Total device SITRANS TF Ex d <sup>1)</sup>	8 4
• Total device SITRANS TF according to FM (XP, DIP, NI, S) <sup>1)</sup>	8 5
<b>Enclosure</b> Die-cast aluminium Stainless steel precision casting	A E
<b>Connections/cable inlet</b> Screwed glands M20x1.5 Screwed glands ½-14 NPT	B C
<b>Mounting bracket and fastening parts</b> None Made of steel Stainless steel	0 1 2
<b>Further designs</b> Please add <b>-Z</b> to Article No. and specify Order code(s) and plain text.	Order code
Test report (5 measuring points)	<b>C11</b>
Bus connection	
• M12 plug (metal), without mating connector	<b>M00<sup>2)</sup></b>
• M12 plug (metal), with mating connector	<b>M01<sup>3)</sup></b>
Explosion protection	
• Explosion protection Ex ia to INMETRO (Brazil) (only with 7NG313.-1....)	<b>E25</b>
• Explosion protection Ex d to INMETRO (Brazil) (only with 7NG313.-4....)	<b>E26</b>
• Explosion protection Ex d to NEPSI (China) (only with 7NG313.-4....)	<b>E56</b>
<b>Customer-specific programming</b> Add *Ashley_18_09_13* to Article No. and specify Order code(s)	
Measuring range to be set Enter in plain text (max. 5 digits): Y01: ... to ... °C, °F	<b>Y01<sup>2)</sup></b>
Meas. point no. (TAG), max. 32 characters	<b>Y15<sup>4)</sup></b>
Meas. point descriptor, max. 32 characters	<b>Y23<sup>4)</sup></b>
Meas. point message, max. 32 characters	<b>Y24</b>
Bus address, specify in plain text	<b>Y25<sup>4)</sup></b>
Pt100 (IEC) 2-wire, R <sub>L</sub> = 0 Ω	<b>U02</b>
Pt100 (IEC) 3-wire	<b>U03</b>
Pt100 (IEC) 4-wire	<b>U04</b>
Thermocouple type B	<b>U20</b>
Thermocouple type C (W5)	<b>U21</b>
Thermocouple type D (W3)	<b>U22</b>
Thermocouple type E	<b>U23</b>
Thermocouple type J	<b>U24</b>
Thermocouple type K	<b>U25</b>

Selection and Ordering data	Order code
Thermocouple type L	<b>U26</b>
Thermocouple type N	<b>U27</b>
Thermocouple type R	<b>U28</b>
Thermocouple type S	<b>U29</b>
Thermocouple type T	<b>U30</b>
Thermocouple type U	<b>U31</b>
With TC: CJC internal	<b>U40</b>
With TC: CJC: external (Pt100, 3-wire)	<b>U41</b>
With TC: CJC: external with fixed value, specify in plain text	<b>Y50</b>
Special differing customer-specific programming, specify in plain text	<b>Y09<sup>5)</sup></b>

Selection and Ordering data	Article No.
<b>Accessories</b>	
<b>CD for measuring instruments for temperature</b>	<b>A5E00364512</b>
with documentation in German, English, French, Spanish, Italian and Portuguese, and parameterization software SIPROM T (included in delivery with SITRANS TF)	
<b>SIMATIC PDM parameterization software</b> also for SITRANS TF with TH400 PA	<b>see Sec. 8</b>
<b>Mounting bracket and fastening parts</b>	
Made of steel for 7NG313.-.B..	<b>7MF4997-1AC</b>
Made of steel for 7NG313.-.C..	<b>7MF4997-1AB</b>
Made of stainless steel for 7NG313.-.B..	<b>7MF4997-1AJ</b>
Made of stainless steel for 7NG313.-.C..	<b>7MF4997-1AH</b>
<b>Connection board</b>	<b>A5E02391790</b>
▶ Available ex stock.	

### Ordering example 1:

7NG3137-0AB01-Z Y01+Y15+Y25+U03  
 Y01: 0...100 C  
 Y15: TICA1234HEAT  
 Y25: 33

### Ordering example 2:

7NG3137-0AC01-Z Y01+Y15+Y25+U25+U40  
 Y01: 0...300 C  
 Y15: TICA 1234 ABC 5678  
 Y25: 35

### Factory setting:

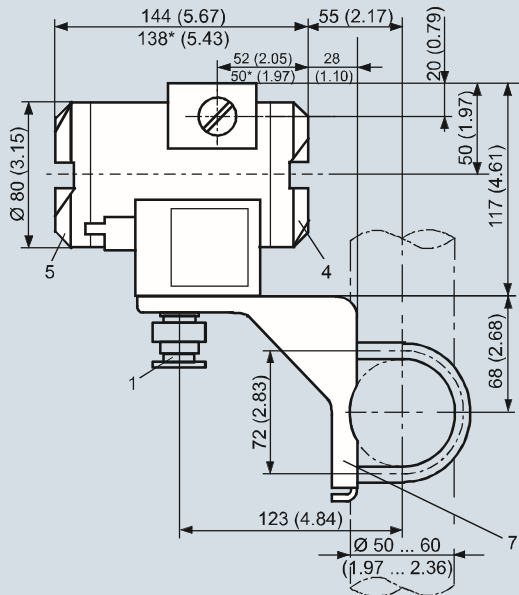
- for SITRANS TH400 PA:
  - Pt100 (IEC) with 3-wire circuit
  - Unit: °C
  - Failure mode: last valid value
  - Filter time: 0 s
  - PA address: 126
  - PROFIBUS Ident No.: manufacturer-specific
- for SITRANS TH400 FF:
  - Pt100 (IEC) with 3-wire circuit
  - Unit: °C
  - Failure mode: last valid value
  - Filter time: 0 s
  - Node address: 22

# Temperature Measurement Transmitters for field mounting

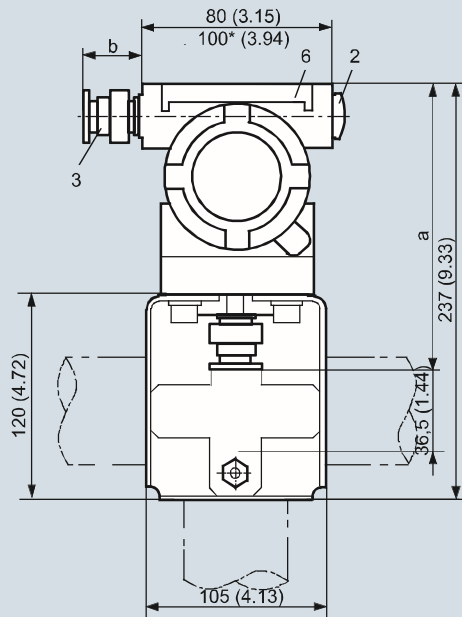
## SITRANS TF fieldbus transmitter

### Dimensional drawings

2



- 1 Sensor connection (screwed gland M20x1,5 or ½-14 NPT)
- 2 Blanking plug
- 3 Electrical connection (screwed plug M20x1,5 or ½-14 NPT), optional M12 plug
- 4 Terminal side, bus connection

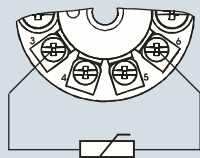


- 5 Terminal side, sensor
- 6 Protective cover (without function)
- 7 Mounting bracket (optional) with clamp securing to a vertical or horizontal pipe

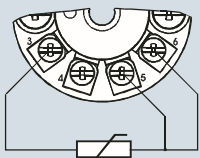
SITRANS TF with TH400, dimensions in mm (inches)

Schematics

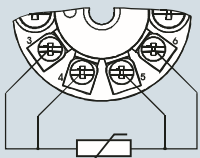
Resistance thermometer



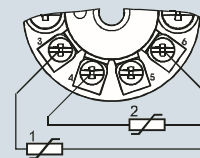
Two-wire system <sup>1)</sup>



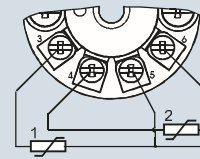
Three-wire system



Four-wire system



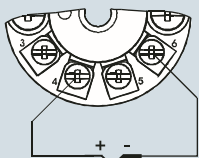
Mean-value/differential or redundancy generation 2 x two-wire system <sup>1)</sup>



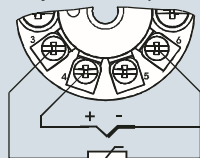
Mean-value/differential or redundancy generation 1 sensor in two-wire system <sup>1)</sup>  
1 sensor in three-wire system

<sup>1)</sup> Programmable line resistance for the purpose of correction.

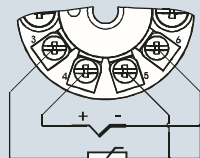
Thermocouple



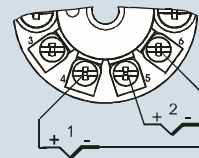
Internal cold junction compensation



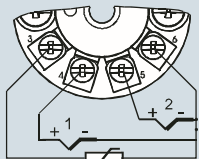
Cold junction compensation with external Pt100 in two-wire system <sup>1)</sup>



Cold junction compensation with external Pt100 in three-wire system

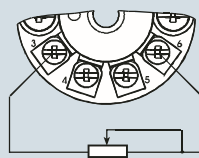


Mean value, differential or redundancy generation with internal cold junction compensation

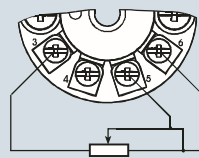


Mean value, differential or redundancy generation and cold junction compensation with internal Pt100 in two-wire system <sup>1)</sup>

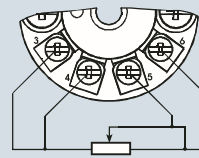
Resistance



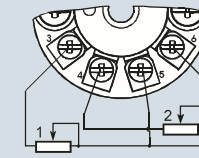
Two-wire system <sup>1)</sup>



Three-wire system

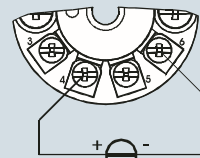


Four-wire system

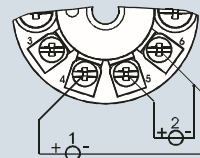


Mean value, differential or redundancy generation 1 resistor in two-wire system <sup>1)</sup>  
1 resistor in three-wire system

Voltage measurement



One voltage source



Measurement of mean value, differential and redundancy with 2 voltage sources