

## Temperature Measurement

Transmitters for mounting in sensor head

### SITRANS TH400 fieldbus transmitter

#### Overview



#### SITRANS TH400 fieldbus transmitters

##### Versions:

- For FOUNDATION fieldbus
- For PROFIBUS PA

The SITRANS TH400 temperature transmitter is a small field bus transmitter for mounting in the connection head of form B. Extensive functionality enables the temperature transmitter to be precisely adapted to the plant's requirements. Operation is very simple in spite of the numerous setting options. Thanks to its universal concept it can be used in all industries and is easy to integrate in the context of Totally Integrated Automation applications.

Transmitters of the "intrinsically safe" type of protection can be installed within potentially explosive atmospheres. The devices comply with the Directive 94/9/EC (ATEX), as well as FM and CSA regulations.

Installing SITRANS TH400 in temperature sensors turns them into complete, bus-capable measuring points; compact - and in a single device.

#### Application

- Linearized temperature measurement with resistance thermometers or thermal elements
- Differential, mean-value or redundant temperature measurement with resistance thermometers or thermal elements
- Linear resistance and bipolar millivolt measurements
- Differential, mean-value or redundant resistance and bipolar millivolt measurements

#### Function

##### Features

- Mounting in connection head, type B, to DIN 43729, or larger
- Polarity-neutral bus connection
- 24-bit analog-digital converter for high resolution
- Electrically isolated
- Intrinsically-safe version for use in potentially explosive areas
- Special characteristic
- Sensor redundancy

##### With PROFIBUS PA communication

- Function blocks: 2 x analog

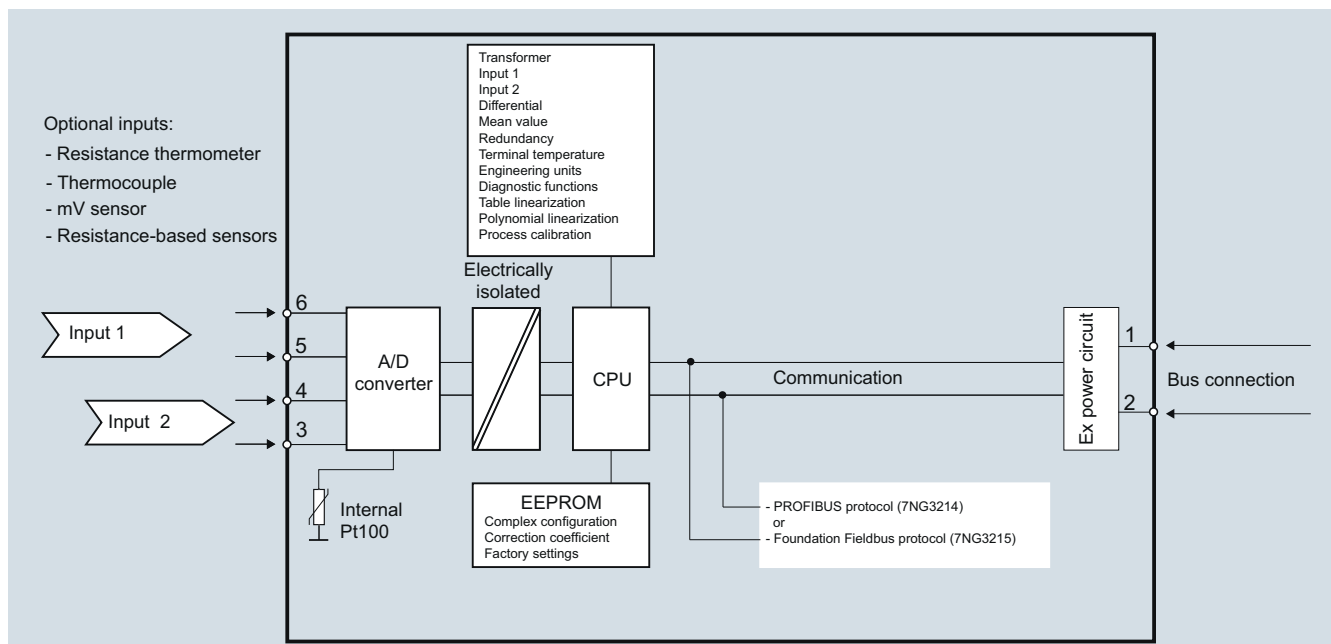
##### With FOUNDATION fieldbus communication

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

##### Mode of operation

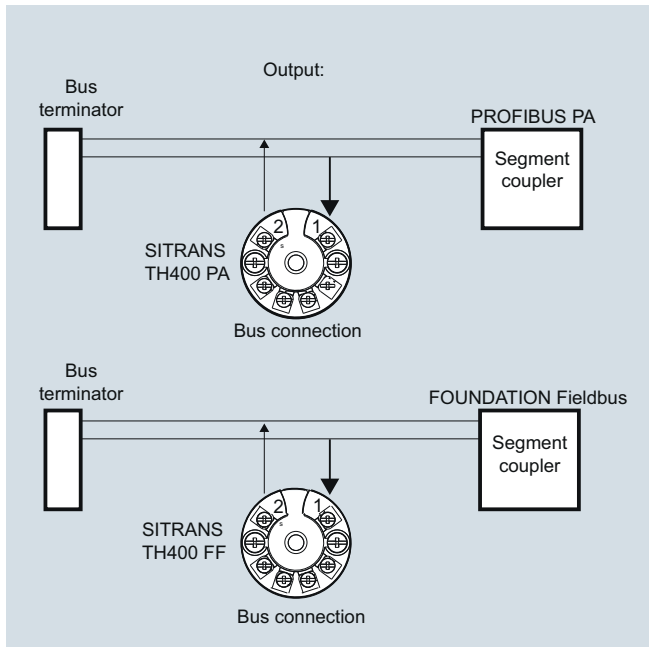
The following function diagram explains the mode of operation of the transmitter.

The only difference between the two versions of the SITRANS TH400 (7NG3214-... and 7NG3215-...) is the type of fieldbus protocol used (PROFIBUS PA or FOUNDATION fieldbus).



SITRANS TH400, function diagram

### System communication



SITRANS TH400, communication interface

### Technical specifications

#### Input

Analog-to-digital conversion

- Measurement rate < 50 ms
- Resolution 24-bit

Resistance thermometer

Pt25 ... Pt1000 to IEC 60751/JIS C 1604

- Measuring range -200 ... +850 °C (-328 ... +1562 °F)

Ni25 ... Ni1000 to DIN 43760

- Measuring range -60 ... +250 °C (-76 ... +482 °F)

Cu10 ... Cu1000,  $\alpha = 0.00427$ 

- 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  $\Omega$  ... 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
- Type E
- Type J
- Type K
- Type N
- Type R
- Type S
- Type T

to DIN 43710

- Type L
- Type U

to ASTM E988-90

- Type W3
- Type W5

External cold junction compensation

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

#### mV sensor - voltage input

Measuring range -800 ... +800 mV

Input resistance 10 M $\Omega$ 

#### Output

Filter time (programmable) 0 ... 60 s

Update time &lt; 400 ms

#### Measuring accuracy

Accuracy is defined as the higher value of general values and basic values.

#### General values

Type of input

All

Absolute accuracy

 $\pm 0.05$  % of the measured value

Temperature coefficient

 $\pm 0.002$  % of the measured value/°C

#### Basic values

Type of input

Pt100 and Pt1000

Ni100

Cu10

Resistance-based sensors

Voltage source

Thermocouple, type: E, J, K, L, N, T, U

Thermocouple, type: B, R, S, W3, W5

Cold junction compensation

Basic accuracy

 $\pm 0.1$  °C $\pm 0.15$  °C $\pm 1.3$  °C $\pm 0.05$   $\Omega$  $\pm 10$   $\mu$ V $\pm 0.5$  °C $\pm 1$  °C $\pm 0.5$  °C

Temperature coefficient

 $\pm 0.002$  °C/°C $\pm 0.002$  °C/°C $\pm 0.02$  °C/°C $\pm 0.002$   $\Omega$ /°C $\pm 0.2$  %  $\mu$ V/°C $\pm 0.01$  °C/°C $\pm 0.025$  °C/°C

#### Reference conditions

Warming-up time 30 s

Signal-to-noise ratio Min. 60 dB

Calibration condition 20 ... 28 °C (68 ... 82 °F)

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##### 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

###### Mechanical testing

- Vibrations (DIN class B) to IEC 60068-2-6 and IEC 60068-2-64 4 g/2 ... 100 Hz

###### Electromagnetic compatibility

EMC noise voltage influence < ± 0.1 % of span

Extended EMC noise immunity: NAMUR NE 21, criterion A, Burst < ± 1 % of span

EMC 2004/108/EC Emission and Noise Immunity to EN 61326

##### Construction

Material	Molded plastic
Weight	55 g (0.12 lb)
Dimensions	See Dimensional drawings
Cross-section of cables	Max. 2.5 mm <sup>2</sup> (AWG 13)
Degree of protection	
• Transmitter enclosure	IP40
• Terminal	IP00

##### Auxiliary power

Power supply	
• Standard, Ex "nA", Ex "nL", NI	9.0 ... 32 V DC
• ATEX, FM, UL and CSA	9.0 ... 30 V DC
• In FISCO/FNICO installations	9.0 ... 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

- "Intrinsic safety" type of protection

EC type test certificate

- Type of protection for "equipment is non-arcing"

Explosion protection: FM for USA

- FM approval
- Degree of protection

Explosion protection CSA for Canada

- CSA approval
- Degree of protection

Other certificates

##### Communication

Parameterization interface

- PROFIBUS PA connection

- Protocol
- Address (for delivery)

- FOUNDATION fieldbus connection

- Protocol
- Functionality
- Version
- Function blocks

##### Factory setting

###### only 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

###### only 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

KEMA 06 ATEX 0264

II 1 G Ex ia IIC T4...T6  
II 2(1) G Ex ib[ia] IIC T4...T6  
II 1 D Ex iaD

KEMA 06 ATEX 0263 X

II 3 GD Ex nA[nL] IIC T4...T6  
II 3 GD Ex nL IIC T4...T6  
II 3 GD Ex nA[ic] IIC T4...T6  
II 3 GD Ex ic IIC T4...T6

FM 3027985

- IS Class I, Div 1, Groups A, B, C, D T4/T5/T6, FISCO
- IS Class I, Zone 0, AEx ia, IIC T4/T5/T6, FISCO
- NI Class I, Div 2, Groups A, B, C, D T4/T5/T6, FNICO

CSA 1861385

- IS Class I, Div 1, Groups A, B, C, D T4/T5/T6
- Ex ia IIC T4/T5/T6 and Ex ib [ia] IIC T4/T5/T6
- NI Class I, Div 2, Groups A, B, C, D T4/T5/T6
- Ex nA II T4/T5/T6

EAC Ex(GOST), NEPSI, IECEx

Profile 3.0

126

FF protocol

Basic or LAS

ITK 4.6

2 x analog and 1 x PID

# Temperature Measurement

## Transmitters for mounting in sensor head

### SITRANS TH400 fieldbus transmitter

2

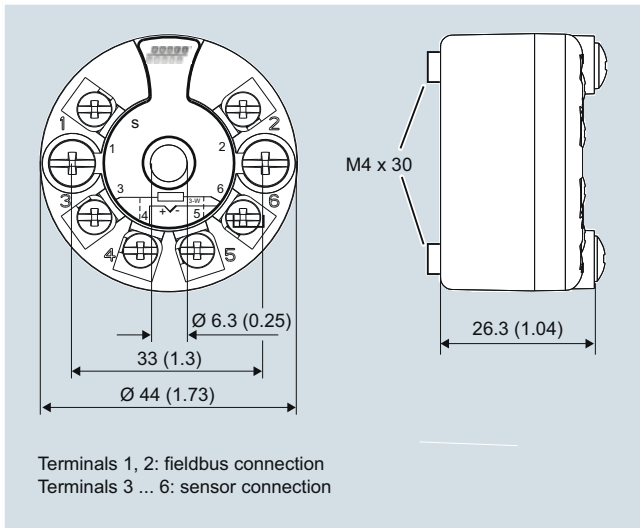
Selection and Ordering data	Article No.	Accessories	Article No.
<b>Temperature transmitter SITRANS TH400</b> for installation in connection head, with electrical isolation, order operating instructions separately.		<b>MiniDVD for temperature measuring instruments</b> ▶	<b>A5E00364512</b>
<ul style="list-style-type: none"> <li>• Bus-compatible to PROFIBUS PA               <ul style="list-style-type: none"> <li>- No explosion protection or Zone 2/Div 2 to ATEX/FM/CSA/IECEX/NEPSI ▶ ◆ <b>7NG3214-0NN00</b></li> <li>- With explosion protection "Intrinsically safe to ATEX/FM/CSA/IECEX/NEPSI" ▶ ◆ <b>7NG3214-0AN00</b></li> </ul> </li> <li>• Bus-compatible to FOUNDATION Fieldbus               <ul style="list-style-type: none"> <li>- No explosion protection or Zone 2/Div 2 to ATEX/FM/CSA/IECEX/NEPSI ▶ ◆ <b>7NG3215-0NN00</b></li> <li>- With explosion protection "Intrinsically safe to ATEX/FM/CSA/IECEX/NEPSI" ▶ ◆ <b>7NG3215-0AN00</b></li> </ul> </li> </ul>		With documentation in German, English, French, Spanish, Italian, Portuguese and SIPROM T parameterization software	
		<b>SIMATIC PDM operating software</b>	<b>See Chapter 8</b>
		<b>DIN rail adapters for head transmitters</b> (Quantity delivered: 5 units)	<b>7NG3092-8KA</b>
		<b>Connecting cable</b> 4-wire, 150 mm, for sensor connections when using head transmitters in the high hinged cover (set with 5 units)	<b>7NG3092-8KC</b>
		for additional PA components	<b>See Catalog IK PI</b>
		▶ Available ex stock.	
		◆ We can offer shorter delivery times for configurations designated with the Quick Ship Symbol ◆. For details see page 9/5 in the appendix.	
		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 example mV and ohm, the start value and the end value of the required measuring span and the unit must be entered here.	
		<b>Ordering example 1:</b> 7NG3214-0NN00-Z Y01+Y17+U03 Y01: 0...100 °C Y17: TICA1234HEAT	
		<b>Ordering example 2:</b> 7NG3214-0NN00-Z Y01+Y17+Y25+U25 Y01: 0...500 °C Y17: TICA5678HEAT Y25: 33	
		<b>Factory setting:</b>	
		<ul style="list-style-type: none"> <li>• For SITRANS TH400 PA:               <ul style="list-style-type: none"> <li>- Pt100 (IEC 751) with 3-wire circuit</li> <li>- Unit: °C</li> <li>- Failure mode: Last valid value</li> <li>- Filter time: 0 s</li> <li>- PA address: 126</li> <li>- PROFIBUS Ident No.: Manufacturer-specific</li> </ul> </li> <li>• For SITRANS TH400 FF:               <ul style="list-style-type: none"> <li>- Pt100 (IEC 751) with 3-wire circuit</li> <li>- Unit: °C</li> <li>- Failure mode: Last valid value</li> <li>- Filter time: 0 s</li> <li>- Node address: 22</li> </ul> </li> </ul>	
<b>Further designs</b> Please add "-Z" to Article No. and specify Order code(s) and plain text.	Order code		
With test protocol (5 measuring points)	<b>C11</b>		
<b>Customer-specific programming</b> 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	<b>Y01<sup>1)</sup></b>		
Measuring point no. (TAG), max. 32 characters	<b>Y17<sup>2)</sup></b>		
Measuring point descriptor, max. 32 characters	<b>Y23<sup>2)</sup></b>		
Measuring point message, max. 32 characters	<b>Y24<sup>2)</sup></b>		
Bus address, specify in plain text	<b>Y25<sup>2)</sup></b>		
Pt100 (IEC) 2-wire, R <sub>L</sub> = 0 Ω	<b>U02<sup>3)</sup></b>		
Pt100 (IEC) 3-wire	<b>U03<sup>3)</sup></b>		
Pt100 (IEC) 4-wire	<b>U04<sup>3)</sup></b>		
Thermocouple type B	<b>U20<sup>3)4)</sup></b>		
Thermocouple type C (W5)	<b>U21<sup>3)4)</sup></b>		
Thermocouple type D (W3)	<b>U22<sup>3)4)</sup></b>		
Thermocouple type E	<b>U23<sup>3)4)</sup></b>		
Thermocouple type J	<b>U24<sup>3)4)</sup></b>		
Thermocouple type K	<b>U25<sup>3)4)</sup></b>		
Thermocouple type L	<b>U26<sup>3)4)</sup></b>		
Thermocouple type N	<b>U27<sup>3)4)</sup></b>		
Thermocouple type R	<b>U28<sup>3)4)</sup></b>		
Thermocouple type S	<b>U29<sup>3)4)</sup></b>		
Thermocouple type T	<b>U30<sup>3)4)</sup></b>		
Thermocouple type U	<b>U31<sup>3)4)</sup></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>		

## Temperature Measurement

Transmitters for mounting in sensor head

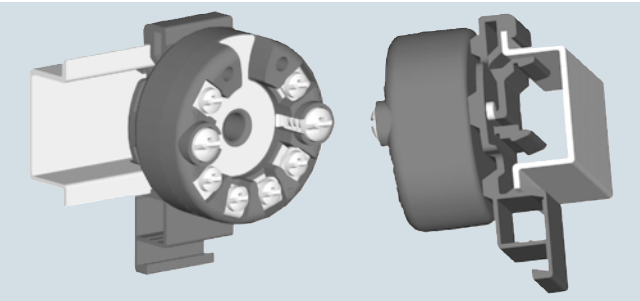
### SITRANS TH400 fieldbus transmitter

#### Dimensional drawings

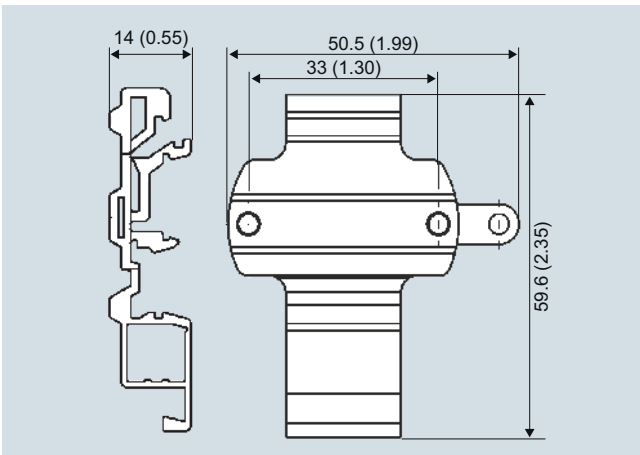


SITRANS TH400 dimensions in mm (inches) and connections

#### Mounting on DIN rail



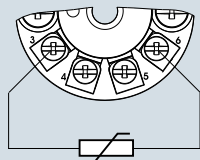
SITRANS TH400, mounting of transmitter on DIN rail



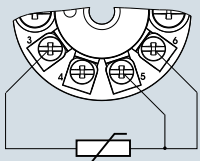
DIN rail adaptor, dimensions in mm (inch)

**Schematics**

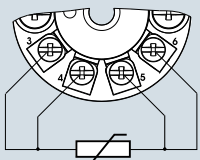
**Resistance thermometer**



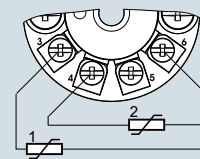
Two-wire system <sup>1)</sup>



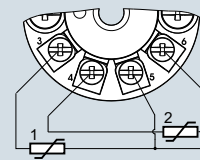
Three-wire system



Four-wire system

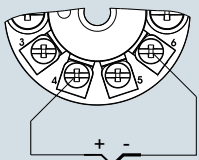


Mean-value/differential or redundancy generation 2 x two-wire system <sup>1)</sup>

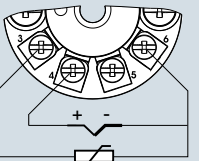


Mean-value/differential or redundancy generation 1 sensor in two-wire system <sup>1)</sup>  
1 sensor in three-wire system

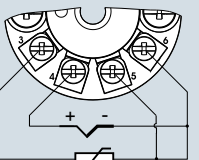
**Thermocouple**



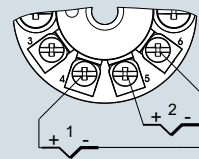
Internal cold junction compensation



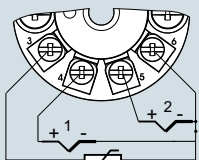
Cold junction compensation with external Pt100 in two-wire system <sup>1)</sup>



Cold junction compensation with external Pt100 in three-wire system

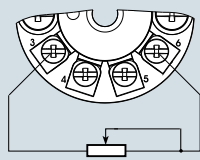


Mean value, differential or redundancy generation with internal cold junction compensation

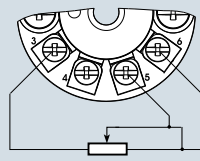


Mean value, differential or redundancy generation and cold junction compensation with internal Pt100 in two-wire system <sup>1)</sup>

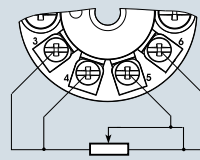
**Resistance**



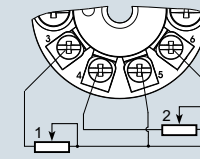
Two-wire system <sup>1)</sup>



Three-wire system

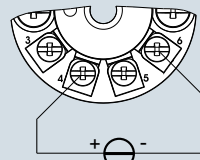


Four-wire system

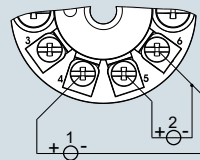


Mean value, differential or redundancy generation 1 resistor in two-wire system <sup>1)</sup>  
1 resistor in three-wire system

**Voltage measurement**



One voltage source



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

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