SITRANS T measuring instruments for temperature
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, thermocouple 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 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
  - 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**: 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: NiCrCuNi 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
### 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

### 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
  - \( U_{\text{eff}} = 1 \text{kV}, 50 \text{Hz}, 1 \text{min} \)

### Measuring accuracy
<table>
<thead>
<tr>
<th>Digital measuring errors</th>
<th>Reference conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Auxiliary power supply</td>
<td>24 V ± 1 %</td>
</tr>
<tr>
<td>- Load</td>
<td>500 Ω</td>
</tr>
<tr>
<td>- Storage temperature</td>
<td>23 °C (73.4 °F)</td>
</tr>
<tr>
<td>- Warming-up time</td>
<td>&gt; 5 min</td>
</tr>
<tr>
<td>Error in the analog outpu</td>
<td>&lt; 0.025 % of span</td>
</tr>
<tr>
<td>(digital/analog converter)</td>
<td></td>
</tr>
<tr>
<td>Error due to internal cold junction</td>
<td>&lt; 0.5 °C (0.9 °F)</td>
</tr>
<tr>
<td>Temperature effect</td>
<td>&lt; 0.1 % of max. span/10 °C (18 °F)</td>
</tr>
<tr>
<td>Power supply effect</td>
<td>&lt; 0.002 % of span/100 Ω</td>
</tr>
<tr>
<td>Effect of load impedance</td>
<td>&lt; 0.02 % of span/100 Ω</td>
</tr>
<tr>
<td>Long-term drift</td>
<td>&lt; 0.02 % of max. span</td>
</tr>
<tr>
<td>in the first month</td>
<td>&lt; 0.2 % of max. span</td>
</tr>
<tr>
<td>after one year</td>
<td>&lt; 0.3 % of max. span</td>
</tr>
<tr>
<td>after 5 years</td>
<td></td>
</tr>
</tbody>
</table>

### Rated conditions
- **Ambient temperature**
  - -40 ... +85 °C (-40 ... +185 °F)
- **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-AISI 12 or stainless steel, poly-ester-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 chromo-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
  - \( U_{\text{eff}} = 1 \text{kV}, 50 \text{Hz}, 1 \text{min} \)

### 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

### Communication (second line)
- 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 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td></td>
</tr>
<tr>
<td>according to IEC 60751</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pt25</td>
<td>-200 ... + 850 (-328 ... +1652)</td>
<td>10 (18)</td>
<td>0.2 (0.36)</td>
</tr>
<tr>
<td>Pt50</td>
<td>-200 ... + 850 (-328 ... +1652)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
<tr>
<td>Pt100 ... Pt200</td>
<td>-200 ... + 850 (-328 ... +1652)</td>
<td>10 (18)</td>
<td>0.1 (0.18)</td>
</tr>
<tr>
<td>Pt500</td>
<td>-200 ... + 350 (-328 ... +662)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
<tr>
<td>Pt1000</td>
<td>-200 ... + 350 (-328 ... +662)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
</tbody>
</table>

according to JIS C1604-81

<table>
<thead>
<tr>
<th>Input</th>
<th>Measuring range</th>
<th>Min. measured span</th>
<th>Digital accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td></td>
</tr>
<tr>
<td>Pt25</td>
<td>-200 ... + 649 (-328 ... +1200)</td>
<td>10 (18)</td>
<td>0.2 (0.36)</td>
</tr>
<tr>
<td>Pt50</td>
<td>-200 ... + 649 (-328 ... +1200)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
<tr>
<td>Pt100 ... Pt200</td>
<td>-200 ... + 649 (-328 ... +1200)</td>
<td>10 (18)</td>
<td>0.1 (0.18)</td>
</tr>
<tr>
<td>Pt500</td>
<td>-200 ... + 350 (-328 ... +662)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
<tr>
<td>Pt1000</td>
<td>-200 ... + 350 (-328 ... +662)</td>
<td>10 (18)</td>
<td>0.15 (0.27)</td>
</tr>
<tr>
<td>Ni 25 ... Ni1000</td>
<td>-60 ... + 250 (-76 ... +482)</td>
<td>10 (18)</td>
<td>0.1 (0.18)</td>
</tr>
</tbody>
</table>

Resistance-based sensors

Input | Measuring range | Min. measured span | Digital accuracy |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ω</td>
<td>Ω</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>Resistance</td>
<td>0 ... 390</td>
<td>5</td>
<td>0.05</td>
</tr>
<tr>
<td>Resistance</td>
<td>0 ... 2200</td>
<td>25</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Thermocouple elements

Input | Measuring range | Min. measured span | Digital accuracy |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td>°C (°F)</td>
<td></td>
</tr>
<tr>
<td>Type B</td>
<td>0 ... 1820 (32 ... 3308)</td>
<td>100 (180)</td>
<td>2 (3.60)</td>
</tr>
<tr>
<td>Type C (W5)</td>
<td>0 ... 2300 (32 ... 4172)</td>
<td>100 (180)</td>
<td>2 (3.60)</td>
</tr>
<tr>
<td>Type D (W3)</td>
<td>0 ... 2300 (32 ... 4172)</td>
<td>100 (180)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type E</td>
<td>-200 ... +1000 (-328 ... +1832)</td>
<td>50 (90)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type J</td>
<td>-210 ... +1200 (-346 ... +2192)</td>
<td>50 (90)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type K</td>
<td>-230 ... +1370 (-382 ... +2498)</td>
<td>50 (90)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type L</td>
<td>-200 ... +900 (-328 ... +1652)</td>
<td>50 (90)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type N</td>
<td>-200 ... +1300 (-328 ... +2372)</td>
<td>50 (90)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type R</td>
<td>-50 ... +1760 (-58 ... +3200)</td>
<td>100 (180)</td>
<td>2 (3.60)</td>
</tr>
<tr>
<td>Type S</td>
<td>-50 ... +1760 (-58 ... +3200)</td>
<td>100 (180)</td>
<td>2 (3.60)</td>
</tr>
<tr>
<td>Type T</td>
<td>-200 ... +460 (-328 ... +752)</td>
<td>40 (72)</td>
<td>1 (1.80)</td>
</tr>
<tr>
<td>Type U</td>
<td>-300 ... +600 (-328 ... +1112)</td>
<td>50 (90)</td>
<td>2 (3.60)</td>
</tr>
</tbody>
</table>

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 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mV</td>
<td>mV</td>
<td>µV</td>
</tr>
<tr>
<td>mV sensors</td>
<td>-10 ... +70</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>mV sensors</td>
<td>-100 ... +1100</td>
<td>20</td>
<td>400</td>
</tr>
</tbody>
</table>

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 T measuring instruments for temperature
Transmitter for field mounting/field indicator

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

Dimensional drawings

SITRANS TF, dimensions in mm (inches)

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

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SITRANS T measuring instruments for temperature
Transmitter for field mounting/field indicator

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

Selection and Ordering data

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Temperature transmitter in field housing</th>
<th>Integrated transmitter</th>
<th>SITRANS TF field indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>7NG313</td>
<td>D)</td>
<td></td>
<td>7NG313</td>
</tr>
</tbody>
</table>

Two-wire system 4 ... 20 mA, with electrical isolation, with documentation on CD-ROM

Integrated transmitter
- SITRANS TH200, programmable
  - without Ex protection
  - with Ex ia
  - with Ex nAL for zone 2
  - total device SITRANS TF EEx d
  - total device SITRANS TF according to FM (XP, DIP, NI, S)
- SITRANS TH300, communication capability according to HART V 5.9
  - without Ex-protection
  - with Ex ia
  - with Ex nAL for zone 2
  - total device SITRANS TF EEx d
  - total device SITRANS TF according to FM (XP, DIP, NI, S)

SITRANS TF field indicator for 4 ... 20 mA signals, with documentation on CD-ROM
- with Ex-protection
- with Ex ia
- with Ex nAL for zone 2
- total device SITRANS TF EEx d
- total device SITRANS TF according to FM (XP, DIP, NI, S)

Enclosure
- die-cast aluminium
- stainless steel precision casting

Connections/cable inlet
- screwed glands M20x1.5
- screwed glands ½-14 NPT

Digital indicator
- without
- with

Mounting bracket and securing parts
- without
- made of steel
- made of stainless steel

Further designs
Please add “Z” to Order No. and specify Order code(s) and plain text.

Customer-specific setting of operating data
- measuring range (max. 27 characters)
- measuring point description (max. 16 char.)
- measuring point text (max. 27 char.)
- test protocol (5 measuring points)
- SIL 2 (functional safety)

Selection and Ordering data

Order No.

SITRANS TH200
- incl. parameterization software T
  - with USB interface
  - with RS 232 interface

CD for measuring instruments for temperature
- with documentation in German, English, French, Spanish, Italian and Portuguese, and parameterization software SITRANS TF

HART modem
- with RS 232 interface
- with USB interface

SIMATIC PDM parameterization software
- also for SITRANS TH300

Modem for SITRANS TH200

Mounting bracket and securing parts
- made of steel
- made of stainless steel

Digital indicator

Connection board

Accessories

Order No.

Modem for SITRANS TH200 incl. parameterization software T
- C) with USB interface
- C) with RS 232 interface

CD for measuring instruments
- A) with documentation in German, English, French, Spanish, Italian and Portuguese, and parameterization software SITRANS TF

HART modem
- D) with RS 232 interface
- D) with USB interface

SIMATIC PDM parameterization software
- see chap. 9

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

Power supply units see “SITRANS I supply units and input isolators”.

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Schematics

Resistance thermometer

Resistance

Thermocouple

Two-wire system 1

Two-wire system 1

Cold junction compensation

Internal/fixed value

Three-wire system

Three-wire system

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

Four-wire system

Four-wire system

Cold junction compensation with external Pt100 in three-wire system

Generation of average value / difference 1

Generation of average value / difference 1

Generation of average value / difference with internal cold junction compensation

Voltage measurement

Current measurement

1) Programmable line resistance for the purpose of correction.

SITRANS TF, sensor connection assignment