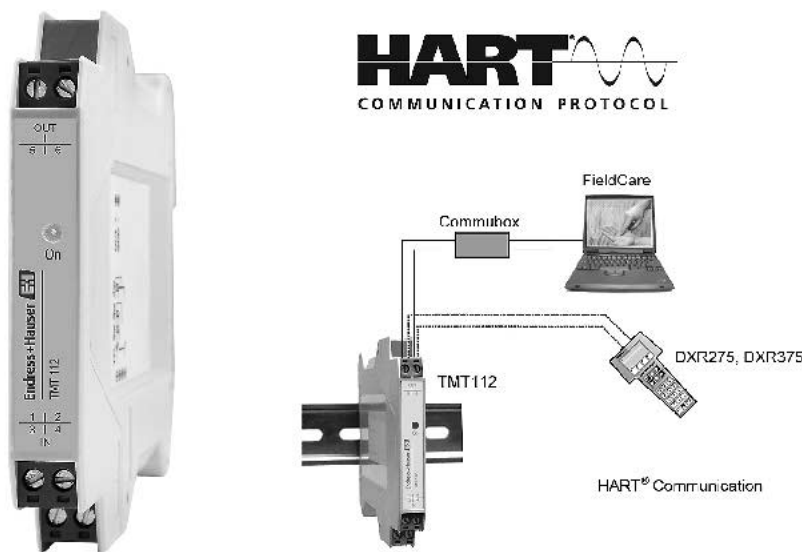


Technical information

## iTEMP<sup>®</sup> HART<sup>®</sup> DIN rail TMT112

Universal temperature transmitter for resistance thermometers (RTD), thermocouples, resistance and voltage transmitters, incorporating HART<sup>®</sup> protocol



### Application areas

- Temperature transmitter with HART<sup>®</sup> protocol for converting various input signals into a scalable 4 to 20 mA analog output signal
- Input:
  - Resistance thermometer (RTD)
  - Thermocouple (TC)
  - Resistance transmitter ( $\Omega$ )
  - Voltage transmitter (mV)
- HART<sup>®</sup> protocol for front end unit or panel unit operation using the hand operating module (DXR275, DXR375) or PC (e.g. ReadWin<sup>®</sup> 2000 or FieldCare)
- Installation on DIN rail according to IEC 60715

- Ex-Certification:
  - ATEX Ex ia
  - CSA IS
  - FM IS
- SIL2 compliant
- Galvanic isolation
- Output simulation
- Min./max. process value indicator function
- Customer-specific linearisation
- Linearization curve match
- Customer-specific measurement range settings or expanded SETUP (see Questionnaire, page 7)

### Features and benefits

- Universal settings with HART<sup>®</sup> protocol for various input signals
- 2-wire technology, 4 to 20 mA analog output
- High accuracy in total ambient temperature range
- Fault signal on sensor break or short circuit, presettable to NAMUR NE 43
- EMC to NAMUR NE 21, CE
- UL recognized component to UL 3111-1
- CSA General Purpose



## Function and system design

**Measuring principle** Electronic measurement and conversion of input signals in industrial temperature measurement.

**Measuring system** The iTEMP® HART® DIN rail TMT112 temperature transmitter is a 2-wire transmitter with an analog output. It has measurement input for resistance thermometers (RTD) in 2-, 3- or 4-wire connection, thermocouples and voltage transmitters. Setting up of the TMT112 is done using the HART® protocol with hand operating module (DXR275, DXR375) or PC (e.g. configuration software ReadWin® 2000 or FieldCare).

## Input

**Measured variable** Temperature (temperature linear), resistance and voltage.

**Measuring range** Depending upon the sensor connection and input signal. The transmitter evaluates a number of different measurement ranges.

### Type of input

	Type	Measurement ranges	Minimum measurement range
<i>Resistance thermometer (RTD)</i>	Pt100 Pt500 Pt1000 acc. to IEC 751 ( $\alpha = 0.00835$ ) Pt100 acc. to JIS C 1604-81 ( $\alpha = 0.003916$ )	-200 to 850 °C (-328 to 1562 °F) -200 to 250 °C (-328 to 482 °F) -200 to 250 °C (-238 to 482 °F) -200 bis 649 °C (-328 bis 1200 °F)	10 K (18 °F) 10 K (18 °F) 10 K (18 °F) 10 K (18 °F)
	Ni100 Ni500 Ni1000 acc. to DIN 43760 ( $\alpha = 0.006180$ )	-60 to 250 °C (-76 to 482 °F) -60 to 150 °C (-76 to 302 °F) -60 to 150 °C (-76 to 302 °F)	10 K (18 °F) 10 K (18 °F) 10 K (18 °F)
	<ul style="list-style-type: none"> <li>■ Connection type: 2-, 3- or 4-wire connection</li> <li>■ Software compensation of cable resistance possible in the 2-wire system (0 to 30 <math>\Omega</math>)</li> <li>■ Sensor cable resistance max. 40 <math>\Omega</math> per cable</li> <li>■ Sensor current: <math>\leq 0.2</math> mA</li> </ul>		
<i>Resistance transmitter</i>	Resistance $\Omega$	10 to 400 $\Omega$ 10 to 2000 $\Omega$	10 $\Omega$ 100 $\Omega$
<i>Thermocouples (TC)</i>	B (PtRh30-PtRh6) C (W5Re-W26Re) <sup>1</sup> D (W3Re-W25Re) <sup>1</sup> E (NiCr-CuNi) J (Fe-CuNi) K (NiCr-Ni) L (Fe-CuNi) <sup>2</sup> N (NiCrSi-NiSi) R (PtRh13-Pt) S (PtRh10-Pt) T (Cu-CuNi) U (Cu-CuNi) <sup>2</sup> acc. to IEC 584 Part1	0 to +1820 °C (32 to 3308 °F) 0 to +2320 °C (32 to 4208 °F) 0 to +2495 °C (32 to 4523 °F) -270 to +1000 °C (-454 to 1832 °F) -210 to +1200 °C (-346 to 2192 °F) -270 to +1372 °C (-454 to 2501 °F) -200 to +900 °C (-328 to 1652 °F) -270 to +1300 °C (-454 to 2372 °F) -50 to +1768 °C (-58 to 3214 °F) -50 to +1768 °C (-58 to 3214 °F) -270 to +400 °C (-454 to 752 °F) -200 to +600 °C (-328 to 1112 °F)	500 K (900 °F) 500 K (900 °F) 500 K (900 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 500 K (900 °F) 500 K (900 °F) 50 K (90 °F) 50 K (90 °F)
	<ul style="list-style-type: none"> <li>■ Cold junction internal (Pt100)</li> <li>■ Cold junction accuracy: <math>\pm 1</math> K</li> </ul>		
<i>Voltage transmitters</i>	Millivolt transmitter	-10 to 75 mV	5 mV

1. According to ASTM E988

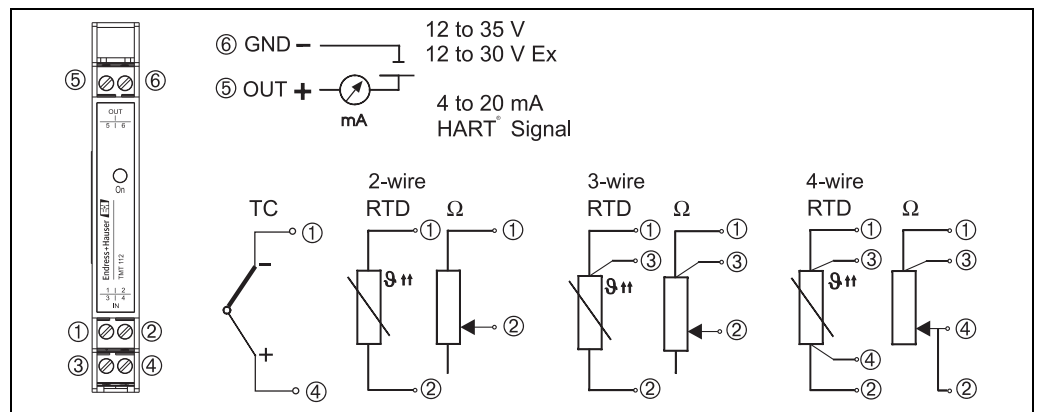
2. According to DIN 43710

## Output

<b>Output signal</b>	Analog 4 to 20 mA, 20 to 4 mA
<b>Signal on alarm</b>	<ul style="list-style-type: none"> <li>■ Measurement range undercut: Linear drop to 3.8 mA</li> <li>■ Exceeding measurement range: Linear rise to 20.5 mA</li> <li>■ Sensor breakage; Sensor short circuit (not for thermocouples TC): ≤ 3.6 mA or ≥ 21.0 mA (for configuration ≥ 21.0 mA, output is ≥ 21.5 mA)</li> </ul>
<b>Load</b>	Max. $(V_{\text{Power supply}} - 12 \text{ V}) / 0.022 \text{ A}$ (Current output)
<b>Linearization / transmission behaviour</b>	Temperature linear, resistance linear, voltage linear
<b>Filter</b>	Digital filter 1. degree: 0 to 100 s
<b>Galvanic isolation</b>	$U = 2 \text{ kV AC}$ (Input/output)
<b>min. current consumption</b>	≤ 3.5 mA
<b>Current limit</b>	≤ 23 mA
<b>Switch on delay</b>	4 s (during power up $I_a \approx 3.8 \text{ mA}$ )

## Power supply

### Electrical connection



Temperature transmitter terminal connections

For the unit operation via HART<sup>®</sup> protocol (terminals 5 and 6) a minimum load resistance of 250 Ω is necessary in the signal circuit!

<b>Supply voltage</b>	$U_b = 12 \text{ to } 35 \text{ V}$ , polarity protected
<b>Residual ripple</b>	Allowable ripple $U_{ss} \leq 3 \text{ V}$ at $U_b \geq 15 \text{ V}$ , $f_{\text{max.}} = 1 \text{ kHz}$

## Performance characteristics

**Response time** 1 s

**Reference operating conditions** Calibration temperature: +25 °C ± 5 K (77 °F ± 9 °F)

**Maximum measured error**



Note!

The accuracy data are typical values and correspond to a standard deviation of  $\pm 3\sigma$  (normal distribution), i.e. 99.8% of all the measured values achieve the given values or better values.

	Type	Measurement accuracy <sup>1</sup>
<b>Resistance thermometer RTD</b>	Pt100, Ni100	0.2 K or 0.08%
	Pt500, Ni500	0.5 K or 0.20%
	Pt1000, Ni1000	0.3 K or 0.12%
<b>Thermocouple TC</b>	K, J, T, E, L, U	typ. 0.5 K or 0.08%
	N, C, D	typ. 1.0 K or 0.08%
	R, S	typ. 1.4 K or 0.08%
	B	typ. 2.0 K or 0.08%

	Measurement range	Measurement accuracy <sup>1</sup>
<b>Resistance transmitter (Ω)</b>	10 to 400 Ω	± 0.1 Ω or 0.08%
	10 to 2000 Ω	± 1.5 Ω or 0.12%
<b>Voltage transmitter (mV)</b>	-10 to 75 mV	± 20 μV or 0.08%

1. % is related to the adjusted measurement range. The value to be applied is the greater.

Physical input range of the sensors	
10 to 400 Ω	Polynom RTD, Pt100, Ni100
10 to 2000 Ω	Pt500, Pt1000, Ni1000
-10 to 75 mV	Thermocouple type: C, D, E, J, K, L, N, U
-10 to 35 mV	Thermocouple type: B, R, S, T

**Influence of power supply**  $\leq \pm 0.01\%/V$  deviation from 24 V  
Percentages refer to the full scale value.

**Influence of ambient temperature (temperature drift)** Total temperature drift = input temperature drift + output temperature drift

Effect on the accuracy when ambient temperature changes by 1 K (1.8 °F):	
Input 10 to 400 Ω	typ. 0.0015% of measured value, min. 4 mΩ
Input 10 to 2000 Ω	typ. 0.0015% of measured value, min. 20 mΩ
Input -10 to 75 mV	typ. 0.005% of measured value, min. 1.2 μV
Input -10 to 35 mV	typ. 0.005% of measured value, min. 0.6 μV
Output 4 to 20 mA	typ. 0.005% of span

Typical sensitivity of resistance thermometers:	
Pt: $0.00385 * R_{\text{nominal}}/K$	Ni: $0.00617 * R_{\text{nominal}}/K$
Example Pt100: $0.00385 * 100 \Omega/K = 0.385 \Omega/K$	

Typical sensitivity of thermocouples:					
B: 10 μV/K	C: 20 μV/K	D: 20 μV/K	E: 75 μV/K	J: 55 μV/K	K: 40 μV/K
L: 55 μV/K	N: 35 μV/K	R: 12 μV/K	S: 12 μV/K	T: 50 μV/K	U: 60 μV/K

**Example for calculating measured error for ambient temperature drift:**

Input temperature drift  $\Delta\theta = 10 \text{ K}$  (18 °F), Pt100, measuring range 0 to 100 °C (32 to 212 °F)

Maximum process temperature: 100 °C (212 °F)

Measured resistance value: 138.5  $\Omega$  (IEC 60751) at maximum process temperature

Typical temperature drift in  $\Omega$ : (0.0015% of 138.5  $\Omega$ ) \* 10 = 0.02078  $\Omega$

Conversion to Kelvin: 0.02078  $\Omega$  / 0.385  $\Omega/\text{K}$  = 0.05 K (0.09 °F)

<b>Influence of load</b>	$\leq \pm 0.02\%/100 \Omega$ Values refer to the full scale value
<b>Long term stability</b>	$\leq 0.1\text{K}/\text{year}$ or $\leq 0.05\%/ \text{year}$ Values under reference operating conditions. % refer to the set span. The highest value is valid.
<b>Influence of cold junction</b>	Pt100 IEC 60751 Cl. B (internal reference junction for thermocouples TC)

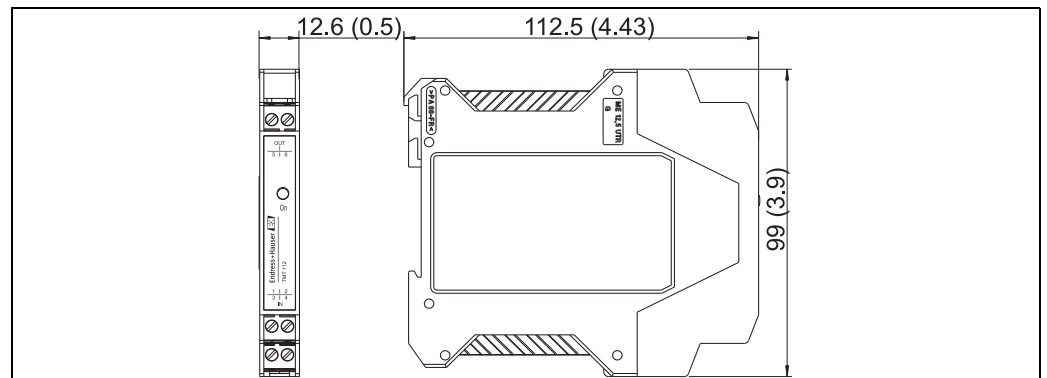
## Installation conditions

<b>Installation instructions</b>	<b>Orientation</b> No limit
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## Environment conditions

<b>Ambient temperature limits</b>	-40 to +85 °C (-40 to 185 °F), for Ex-areas see Ex-certification
<b>Storage temperature</b>	-40 to +100 °C (-40 to 212 °F)
<b>Climate class</b>	According to IEC 60654-1, Class C
<b>Condensation</b>	Permitted
<b>Degree of protection</b>	IP 20 (NEMA 1)
<b>Shock and vibration resistance</b>	4g / 2 to 150 Hz as per IEC 60 068-2-6
<b>Electromagnetic compatibility (EMC)</b>	Interference immunity and interference emission according to IEC 61326 and NAMUR NE 21

## Mechanical construction

**Design, dimensions**

T09-TMT112-06-10-xx-en-000

Housing for DIN rail mounting according to IEC 60715; Dimensions in mm (in)

<b>Weight</b>	Approx. 90 g (3.2 oz)
<b>Material</b>	Housing: Plastic PC/ABS, UL 94V0
<b>Terminals</b>	Keyed plug-in screw terminals, core size max. 2.5 mm <sup>2</sup> (16 AWG) solid, or strands with ferrules

## Human interface

<b>Display elements</b>	A yellow illuminated LED signalizes: Device is operational. With the PC software ReadWin <sup>®</sup> 2000 or FieldCare the current measured value can be displayed.
<b>Operating elements</b>	At the temperature transmitter no operating elements are available directly. The temperature transmitter will be configured by remote operation with the PC software ReadWin <sup>®</sup> 2000 or FieldCare.
<b>Remote operation</b>	<b>Configuration</b> Hand operating module DXR275, DXR375 or PC with Commubox FXA191/FXA195 and operating software (ReadWin <sup>®</sup> 2000 or FieldCare).

### Interface

PC interface Commubox FXA191 (RS232) or FXA195 (USB).

### Configurable parameters

Sensor type and connection type, engineering units (°C/°F), measurement range, internal/external cold junction compensation, cable resistance compensation on 2-wire connection, fault conditioning, output signal (4 to 20/20 to 4 mA), digital filter (damping), offset, measurement point identification + descriptor (8 + 16 characters), output simulation, customer specific linearisation, min./max. process value indicator function.

## Certificates and approvals

<b>CE-Mark</b>	The device meets the legal requirements of the EC directives. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.
<b>Hazardous area approvals</b>	For further details on the available Ex versions (ATEX, CSA, FM, etc.), please contact your nearest Endress+Hauser sales organisation. All relevant data for hazardous areas can be found in separate Ex documentation. If required, please request copies from us or your Endress+Hauser sales organisation.
<b>UL</b>	Recognized component to UL 3111-1
<b>Other standards and guidelines</b>	<ul style="list-style-type: none"> <li>■ IEC 60529: Degree of protection by housing (IP code)</li> <li>■ IEC 61010: Safety requirements for electrical measurement, control and laboratory use.</li> <li>■ IEC 61326: Electromagnetic compatibility (EMC requirements)</li> <li>■ NAMUR Standards working group for measurement and control technology in the chemical industry. (<a href="http://www.namur.de">www.namur.de</a>).</li> </ul>
<b>CSA GP</b>	CSA General Purpose



## Product structure

This information provides an overview of the order options available. The information is not exhaustive, however, and may not be fully up to date. **More detailed** information is available from your local Endress+Hauser representative.

**iTEMP® HART® DIN rail TMT112**

Temperature transmitter, HART protocol. Application: RTD, TC, Ohm, mV. 2-wire 4-20mA, SIL2, galvanic isolation. Fault reaction: NAMUR NE 43. Rail IEC 60715. Width: 12.6mm. UL listed.

Approval	
<b>A</b>	Non-hazardous area
<b>B</b>	ATEX II 2(1) G EEx ia IIC T4/T5/T6
<b>C</b>	FM IS, Class I, Div. 1+2, Group A, B, C, D
<b>D</b>	CSA IS, Class I, Div. 1+2, Group A, B, C, D
<b>E</b>	ATEX II 3G Ex nA IIC T4/T5/T6
<b>J</b>	CSA General Purpose
Configuration connection	
<b>A</b>	Factory setup Pt100 3-wire 0...100 °C
<b>1</b>	Thermocouple TC
<b>2</b>	RTD, 2-wire
<b>3</b>	RTD, 3-wire
<b>4</b>	RTD, 4-wire
Configuration sensor type	
<b>A</b>	Factory setup Pt100 3-wire 0...100 °C
<b>B</b>	Type B 0 to 1820 °C min. span 500 K
<b>C</b>	Type C 0 to 2320 °C min. span 500 K
<b>D</b>	Type D 0 to 2495 °C min. span 500 K
<b>E</b>	Type E -200 to 1000 °C min. span 50 K
<b>J</b>	Type J -200 to 1200 °C min. span 50 K
<b>K</b>	Type K -200 to 1372 °C min. span 50 K
<b>L</b>	Type L -200 to 900 °C min. span 50 K
<b>N</b>	Type N -270 to 1300 °C min. span 50 K
<b>R</b>	Type R -50 to 1768 °C min. span 500 K
<b>S</b>	Type S -50 to 1768 °C min. span 500 K
<b>T</b>	Type T -200 to 400 °C min. span 50 K
<b>U</b>	Type U -200 to 600 °C min. span 50 K
<b>V</b>	Voltage transmitter -10... 75 mV, Min. span 5 mV
<b>W</b>	Pt100 acc. to JIS C1604-81 -200 to 649 °C min. span 10 K
<b>1</b>	Pt100 acc. to IEC 60751 -200 to 850 °C min. span 10 K
<b>2</b>	Ni100 -60 to 250 °C min. span 10 K
<b>3</b>	Pt500 -200 to 250 °C min. span 10 K
<b>4</b>	Ni500 -60 to 150 °C min. span 10 K
<b>5</b>	Pt1000 -200 to 250 °C min. span 10 K
<b>6</b>	Ni100 -60 to 150 °C min. span 10 K
<b>7</b>	Resistance transmitter 10... 400 Ohm, Min. span 10 Ohm
<b>8</b>	Resistance transmitter 10...2000 Ohm, Min. span 100 Ohm
Configuration	
<b>A</b>	Factory setup Pt100 3-wire 0 to 100 °C
<b>B</b>	Measuring range, see additional specification
<b>C</b>	TC configuration range, see questionnaire
<b>D</b>	RTD configuration range, see questionnaire
Additional option	
<b>A</b>	Basic version
<b>B</b>	Works calibration certificate 6-point
TMT112-	← Order code



## Accessories

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- Commubox FXA191 (RS232) or FXA195 (USB)  
**Order code:** FXA191-... or FXA195-...
- PC-operating software: ReadWin® 2000 or FieldCare  
ReadWin® 2000 can be downloaded free of charge from the internet from the following address:  
**www.endress.com/readwin**
- Hand operating module 'HART® Communicator DXR375', **Order code:** DXR375-...

## Documentation

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- Brief operating instructions 'iTEMP® HART® DIN rail TMT112' (KA193R/09/a3)
- Functional safety manual TMT112 (SD010R/09/en)
- Additional documentation for use in explosion-hazardous areas:
  - ATEX II 2(1) G Ex ia IIC (XA022R/09/a3)
  - ATEX II3G Ex nA II (XA055R/09/a3)
- Functional safety manual TMT112 (SD010R/09/en)





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