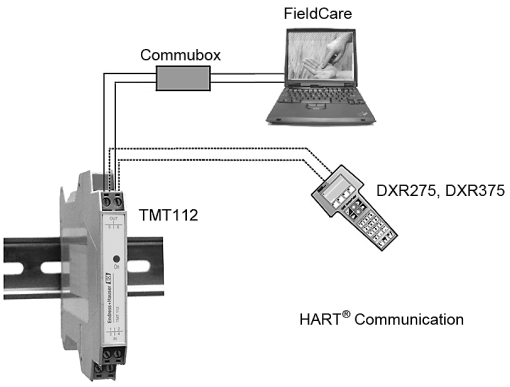
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical information

iTEMP® HART® DIN rail TMT112

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



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

Features and benefits
- Universal settings with HART® 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
- 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)

CE Ex FM CSA cULus

TI114R/09/en
51009802

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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
Resistance thermometer (RTD)	Pt100 Pt500 Pt1000 acc. to IEC 751 (α = 0.00835)	-200 to 850 °C (-328 to 1562 °F) -200 to 250 °C (-328 to 482 °F) -200 to 250 °C (-238 to 482 °F)	10 K (18 °F) 10 K (18 °F) 10 K (18 °F)
	Pt100 acc. to JIS C 1604-81 (α = 0.003916)	-200 bis 649 °C (-328 bis 1200 °F)	10 K (18 °F)
	Ni100 Ni500 Ni1000 acc. to DIN 43760 (α = 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)
	■ Connection type: 2-, 3- or 4-wire connection ■ Software compensation of cable resistance possible in the 2-wire system (0 to 30 Ω) ■ Sensor cable resistance max. 40 Ω per cable ■ Sensor current: ≤ 0.2 mA		
Resistance transmitter	Resistance Ω	10 to 400 Ω 10 to 2000 Ω	10 Ω 100 Ω
Thermocouples (TC)	B (PtRh30-PtRh6) C (W5Re-W26Re)[1] D (W3Re-W25Re)[1] E (NiCr-CuNi) J (Fe-CuNi) K (NiCr-Ni) L (Fe-CuNi)[2] N (NiCrSi-NiSi) R (PtRh13-Pt) S (PtRh10-Pt) T (Cu-CuNi) U (Cu-CuNi)[2] 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)
	■ Cold junction internal (Pt100) ■ Cold junction accuracy: ± 1 K		
Voltage transmitters	Millivolt transmitter	-10 to 75 mV	5 mV

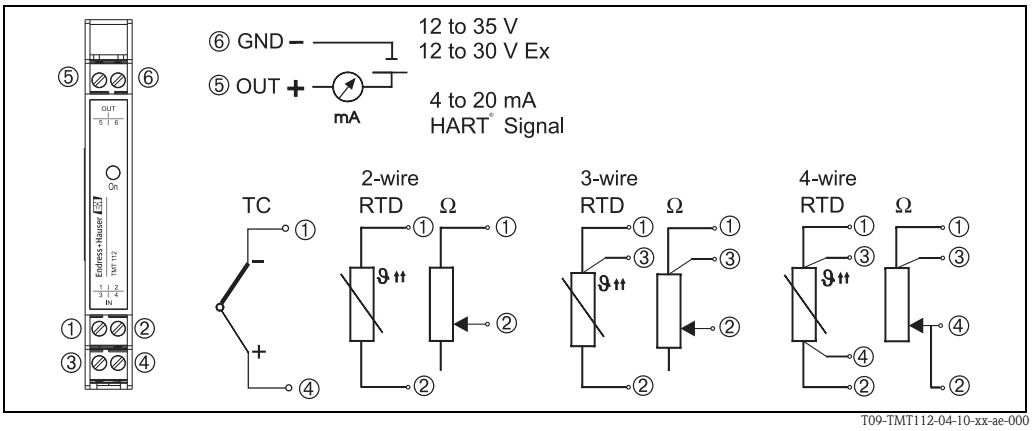
1. According to ASTM E988
2. According to DIN 43710

Output

Output signal	Analog 4 to 20 mA, 20 to 4 mA
Signal on alarm	■ Measurement range undercut: Linear drop to 3.8 mA ■ Exceeding measurement range: Linear rise to 20.5 mA ■ 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)
Load	Max. ($V_{Power\ supply}$ – 12 V) / 0.022 A (Current output)
Linearization / transmission behaviour	Temperature linear, resistance linear, voltage linear
Filter	Digital filter 1. degree: 0 to 100 s
Galvanic isolation	U = 2 kV AC (Input/output)
min. current consumption	≤ 3.5 mA
Current limit	≤ 23 mA
Switch on delay	4 s (during power up $I_a \approx 3.8$ mA)

Power supply

Electrical connection



Temperature transmitter terminal connections

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

Supply voltage	U_b = 12 to 35 V, polarity protected
Residual ripple	Allowable ripple $U_{ss} \leq 3$ V at $U_b \geq 15$ V, $f_{max.} = 1$ 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 ± 3σ (normal distribution), i.e. 99.8% of all the measured values achieve the given values or better values.

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

	Measurement range	Measurement accuracy[1]
Resistance transmitter (Ω)	10 to 400 Ω 10 to 2000 Ω	± 0.1 Ω or 0.08% ± 1.5 Ω or 0.12%
Voltage transmitter (mV)	-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

≤ ± 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 * $R_{nominal}$/K	Ni: 0.00617 * $R_{nominal}$/K

Example Pt100: 0.00385 x 100 Ω/K = 0.385 Ω/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 $\Delta\vartheta$ = 10 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 Ω (IEC 60751) at maximum process temperature

Typical temperature drift in Ω: (0.0015% of 138.5 Ω) * 10 = 0.02078 Ω
Conversion to Kelvin: 0.02078 Ω / 0.385 Ω/K = 0.05 K (0.09 °F)

Influence of load

≤ ±0.02%/100 Ω
Values refer to the full scale value

Long term stability

≤ 0.1K/year or ≤ 0.05%/year
Values under reference operating conditions. % refer to the set span. The highest value is valid.

Influence of cold junction

Pt100 IEC 60751 Cl. B (internal reference junction for thermocouples TC)

Installation conditions

Installation instructions

Orientation
No limit

Environment conditions

Ambient temperature limits

–40 to +85 °C (-40 to 185 °F), for Ex-areas see Ex-certification

Storage temperature

-40 to +100 °C (-40 to 212 °F)

Climate class

According to IEC 60654-1, Class C

Condensation

Permitted

Degree of protection

IP 20 (NEMA 1)

Shock and vibration resistance

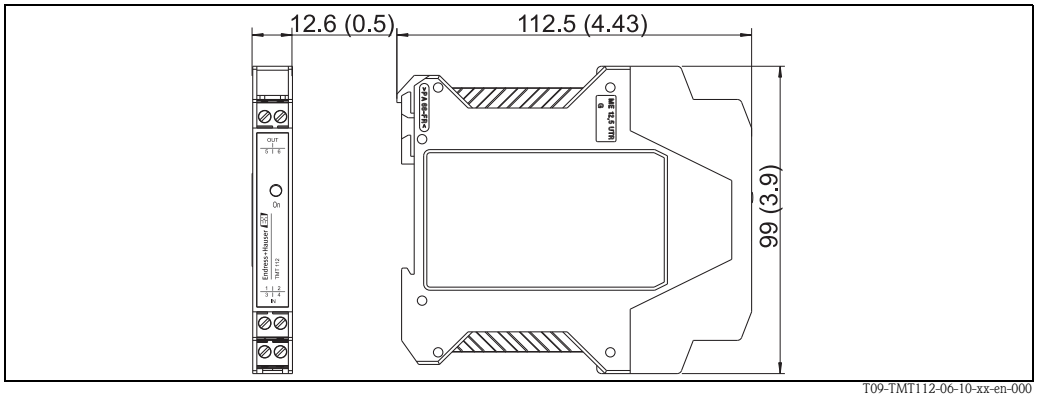
4g / 2 to 150 Hz as per IEC 60 068-2-6

Electromagnetic compatibility (EMC)

Interference immunity and interference emission according to IEC 61326 and NAMUR NE 21

Mechanical construction

Design, dimensions



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

Weight	Approx. 90 g (3.2 oz)
Material	Housing: Plastic PC/ABS, UL 94V0
Terminals	Keyed plug-in screw terminals, core size max. 2.5 mm² (16 AWG) solid, or strands with ferrules

Human interface

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

CE-Mark	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.
Hazardous area approvals	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.
UL	Recognized component to UL 3111-1
Other standards and guidelines	■ IEC 60529: Degree of protection by housing (IP code) ■ IEC 61010: Safety requirements for electrical measurement, control and laboratory use. ■ IEC 61326: Electromagnetic compatibility (EMC requirements) ■ NAMUR Standards working group for measurement and control technology in the chemical industry. (www.namur.de).
CSA GP	CSA General Purpose

Ordering information

Questionnaire

Questionnaire Endress+Hauser iTEMP temperature transmitter
Customer specific setup / Kundenspezifische Einstellung

Standard setup / Standardeinstellung

Sensor
TC: ( ) B ( ) C ( ) D ( ) E ( ) J ( ) K ( ) L ( ) N ( ) R ( ) S ( ) T ( ) U
RTD: **( ) Pt100** ( ) Pt500 ( ) Pt1000 ( ) Ni100 ( ) Ni500 ( ) Ni1000
( ) 2 wire **( ) 3 wire** ( ) 4 wire

Unit / Einheit: **( ) °C** ( ) °F

Range / Messbereich (not / nicht PROFIBUS-PA)
Low scale / Anfang [.]
High scale / Ende [.]
Bitte beachten!: Messbereich und min. Spanne (s. Techn. Daten)
Note!: Range and min. span (s. Techn. data)

Bus address / Busadresse (only / nur PROFIBUS-PA) [ ] **[0...126]**

Expanded setup / Erweiterte Einstellung

Reference junction / Vergleichsstelle: **( ) intern** ( ) extern [ ] [0...80°C; 32...176°F] (only / nur TC)

Compensation wire resistance / Kompensation Leitungswiderstand: [ ] [**0**...20 Ohm] (only / nur RTD 2 wire) [**0**...30 Ohm] (only / nur HART, PA RTD 2 wire)

Failure mode / Fehlerverhalten: ( ) ≤ 3.6 mA **( ) ≥ 21.0 mA** (not / nicht PROFIBUS-PA)

Output / Ausgang: **( ) 4...20 mA** ( ) 20...4 mA (not / nicht PROFIBUS-PA)

Filter: [ ] [**0**, 1, 2,..., 8s] (only / nur PCP) [**0**, 1, 2,..., 100s]

Offset: [.] [-9.9... **0**...+9.9K]

TAG PCP [ ]
HART (HART: 8 char. TAG + 16 char. Descriptor , PROFIBUS-PA: 32 char.)
PROFIBUS-PA [ ]

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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							
	A	Non-hazardous area						
	B	ATEX II 2(1) G EEx ia IIC T4/T5/T6						
	C	FM IS, Class I, Div. 1+2, Group A, B, C, D						
	D	CSA IS, Class I, Div. 1+2, Group A, B, C, D						
	E	ATEX II3G Ex nA IIC T4/T5/T6						
	J	CSA General Purpose						
		Configuration connection						
		A	Factory setup Pt100 3-wire 0...100 °C					
		1	Thermocouple TC					
		2	RTD, 2-wire					
		3	RTD, 3-wire					
		4	RTD, 4-wire					
			Configuration sensor type					
			A	Factory setup Pt100 3-wire 0...100 °C				
			B	Type B	0 to 1820 °C	min. span 500 K		
			C	Type C	0 to 2320 °C	min. span 500 K		
			D	Type D	0 to 2495 °C	min. span 500 K		
			E	Type E	-200 to 1000 °C	min. span 50 K		
			J	Type J	-200 to 1200 °C	min. span 50 K		
			K	Type K	-200 to 1372 °C	min. span 50 K		
			L	Type L	-200 to 900 °C	min. span 50 K		
			N	Type N	-270 to 1300 °C	min. span 50 K		
			R	Type R	-50 to 1768 °C	min. span 500 K		
			S	Type S	-50 to 1768°C	min. span 500 K		
			T	Type T	-200 to 400 °C	min. span 50 K		
			U	Type U	-200 to 600 °C	min. span 50 K		
			V	Voltage transmitter -10... 75 mV, Min. span 5 mV				
			W	Pt100 acc. to JIS C1604-81	-200 to 649 °C	min. span 10 K		
			1	Pt100 acc. to IEC 60751	-200 to 850 °C	min. span 10 K		
			2	Ni100	-60 to 250 °C	min. span 10 K		
			3	Pt500	-200 to 250 °C	min. span 10 K		
			4	Ni500	-60 to 150 °C	min. span 10 K		
			5	Pt1000	-200 to 250 °C	min. span 10 K		
			6	Ni100	-60 to 150 °C	min. span 10 K		
			7	Resistance transmitter 10... 400 Ohm, Min. span 10 Ohm				
			8	Resistance transmitter 10...2000 Ohm, Min. span 100 Ohm				
				Configuration				
				A	Factory setup Pt100 3-wire 0 to 100 °C			
				B	Measuring range, see additional specification			
				C	TC configuration range, see questionnaire			
				D	RTD configuration range, see questionnaire			
					Additional option			
					A	Basic version		
					B	Works calibration certificate 6-point		
TMT112-						⇐ Order code		

Accessories

- 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

- 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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