Technical Information
iTEMP® TMT121

Temperature transmitter, PC programmable,
for installation on DIN rail according to IEC 60715

Universal input for RTD, thermocouple (TC), resistance and voltage transmitters

Application

- PC programmable (PCP) temperature transmitter for converting various input signals into an scalable 4 to 20 mA analog output signal
- Universal input for resistance thermometer (RTD), thermocouple (TC), resistance transmitter (Ω) and voltage transmitter (mV)
- Online configuration using PC with configuration kit (PC-software ReadWin® 2000 and USB-interface connection)
- DIN rail mounting according to IEC 60715

Your benefits

- Universally PC programmable 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
- Safe operation in hazardous areas
  International approvals such as ATEX Ex ia, NEPSI, FM IS, CSA IS
- Ship building approval GL
- Galvanic isolation
- Output simulation
- Customer-specific linearization, linearization curve match
- Online configuration during measurement

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Function and system design

Measuring principle

Electronic recording and conversion of various input signals in industrial temperature measurement.

Measuring system

The iTEMP® TMT 121 DIN rail temperature transmitter is a 2-wire transmitter with an analog output. It has measurement input for resistance thermometers (RTD) and resistance transmitters in 2-, 3- or 4-wire connection, thermocouples and voltage transmitters. The TMT 121 is set up using a configuration kit (see accessories, → 8) and the free of charge setup software ReadWin® 2000.

Input

Measured variable

Temperature (temperature-linear transmission behavior), resistance and voltage.

Measuring range

Dependent on the sensor connection and input signal the transmitter evaluates a number of different measurement ranges, see 'type of input'.

Type of input

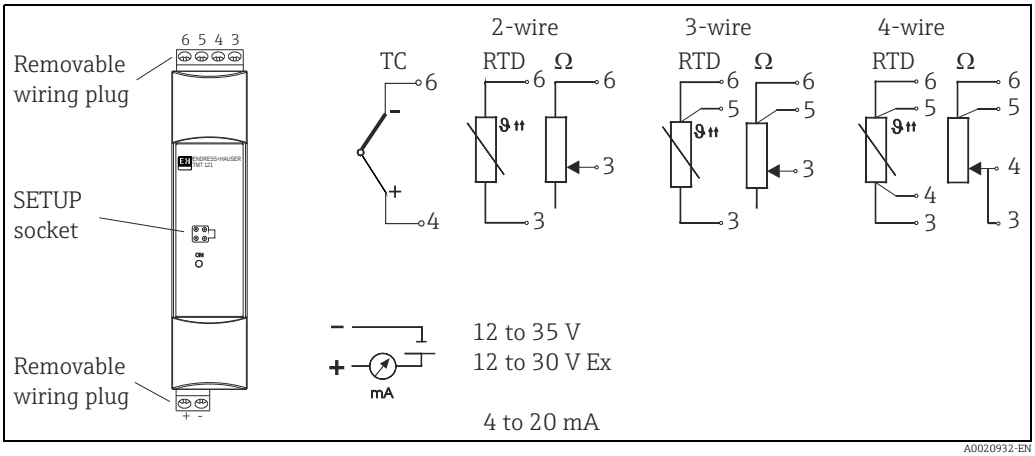
Type of input	Designation	Measuring range limits	Min. span
Resistance thermometer (RTD) as per IEC 60751	Pt100 Pt500 Pt1000	-200...+850 °C (-328...+1562 °F) -200...+250 °C (-328...+482 °F) -200...+250 °C (-328...+482 °F)	10 K
as per DIN 43760	Ni100 Ni120 Ni500 Ni1000	-60...+180 °C (-76...+356 °F) -70...+270 °C (-94...+518 °F) -60...+150 °C (-76...+302 °F) -60...+150 °C (-76...+302 °F)	10 K
	▪ Type of connection: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.6 mA ▪ With 2-wire circuit, compensation of wire resistance possible (0 to 20 Ω) ▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 40 Ω per wire		
Resistance transmitter	Resistance Ω	10 ... 400 Ω 10 ... 2000 Ω	10 Ω 100 Ω
Thermocouple (TC) as per IEC 584, part 1	Type B (PtRh30-PtRh6) Type E (NiCr-CuNi) Type J (Fe-CuNi) Type K (NiCr-Ni) Type N (NiCrSi-NiSi) Type R (PtRh13-Pt) Type S (PtRh10-Pt) Type T (Cu-CuNi)	0...+1820 °C (+32...+3308 °F) -200...+915 °C (-328...+1679 °F) -200...+1200 °C (-328...+2192 °F) -200...+1372 °C (-328...+2372 °F) -270...+1300 °C (-454...+2372 °F) 0...+1768 °C (+32...+3214 °F) 0...+1768 °C (+32...+3214 °F) -200...+400 °C (-328...+752 °F)	500 K 50 K 50 K 50 K 50 K 50 K 50 K 50 K
as per ASTM E988	Type C (W5Re-W26Re) Type D (W3Re-W25Re)	0...+2320 °C (+32...+4208 °F) 0...+2495 °C (+32...+4523 °F)	500 K 500 K
as per DIN 43710	Type L (Fe-CuNi) Type U (Cu-CuNi)	-200...+900 °C (-328...+1652 °F) -200...+600 °C (-328...+1112 °F)	50 K 50 K
	▪ Internal cold junction (Pt100) ▪ External cold junction: configurable value 0 to +85 °C (+32 to +185 °F) ▪ Cold junction accuracy: ± 1 K ▪ Sensor current = typ. 100 nA		
Voltage transmitter (mV)	Millivolt transmitter (mV)	-10 ... 100 mV	5 mV

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[1]: ≤ 3.6 mA or ≥ 21.0 mA
Load	Maximum load = ($V_{Power\ supply}$ - 12 V) / 0.022 A (current output)
Linearization/ transmission behavior	Temperature-linear, resistance-linear, voltage-linear
Filter	Digital filter 1. degree: 0 to 8 s
Galvanic isolation	U = 2 kV AC (Input/output)
Intrinsinc current consumption	≤ 3.5 mA
Current limit	≤ 23 mA
Switch-on delay	4 s (during power up I_a= 3.8 mA)

Power supply

Electrical connection



Assignment of terminal connections

RTD sensor connection									
Type of connection:	2-wire		3-wire			4-wire			
Terminal:	6	3	6	5	3	6	5	3	4
Color:	Red	White	Red	Red	White	Red	Red	White	White

Supply voltage	U_b= 12 to 35 V, protected against polarity reversal

1) Not valid for thermocouple

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)
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment

Maximum measured error

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.

	Designation	Performance characteristics[1]
Resistance thermometers (RTD)	Pt100, Ni100, Ni120 Pt500, Ni500 Pt1000, Ni1000	0.2 K or 0.08% 0.5 K or 0.20% 0.3 K or 0.12%
Thermocouples (TC)	Typ: K, J, T, E, L, U Typ: N, C, D Typ: S, B, R	typ. 0.5 K or 0.08% typ. 1.0 K or 0.08% typ. 2.0 K or 0.08%
	Measuring range	**Performance characteristics**
Resistance transmitters (Ω)	10 to 400 Ω 10 to 2000 Ω	± 0.1 Ω or 0.08% ± 1.5 Ω or 0.12%
Voltage transmitters (mV)	-10 to 100 mV	± 20 µV or 0.08%

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

Influence of power supply

≤ ± 0.01%/V deviation from 24 V in reference operating conditions

Long-term stability

≤ 0.1 °C/year (≤ 0.18 °F/year) in reference operating conditions

Influence of ambient temperature (temperature drift)

Total temperature drift = input temperature drift + output temperature drift

Impact on accuracy when ambient temperature changes by 1 K (1.8 °F):	
Input 10 to 400 Ω	typ. 0.001% of the measured value, min. 1 mΩ
Input 10 to 2000 Ω	typ. 0.001% of the measured value, min. 10 mΩ
Input -10 to 100 mV	typ. 0.001% of the measured value, min. 0.2 µV
Output 4 to 20 mA	typ. 0.0015% of the measuring span

Typical sensitivity of resistance thermometers	
Pt: 0.00385 * R_{nom}/K	Ni: 0.00617 * R_{nom}/K
Example Pt100: 0.00385 x 100 Ω/K = 0.385 Ω/K	

Typical sensitivity of thermocouples					
B: 9 µV/K at 1000 °C (1832 °F)	C: 18 µV/K at 1000 °C (1832 °F)	D: 20 µV/K at 1000 °C (1832 °F)	E: 81 µV/K at 500 °C (932 °F)	J: 56 µV/K at 500 °C (932 °F)	K: 43 µV/K at 500 °C (932 °F)
L: 60 µV/K at 500 °C (932 °F)	N: 38 µV/K at 500 °C (932 °F)	R: 13 µV/K at 1000 °C (1832 °F)	S: 11 µV/K at 1000 °C (1832 °F)	T: 46 µV/K at 100 °C (212 °F)	U: 70 µV/K at 500 °C (932 °F)

Example of calculating the measured error with ambient temperature drift:

- Input temperature drift ϑ = 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 (DIN EN 60751) at maximum process temperature

Typical temperature drift in Ω: (0.001% of 138.5 Ω) * 10 = 0.01385 Ω
Conversion to Kelvin: 0.01385 Ω / 0.385 Ω/K = 0.04 K (0.054 °F)

Influence of load

± 0.02%/100 Ω, related to the adjusted measurement range

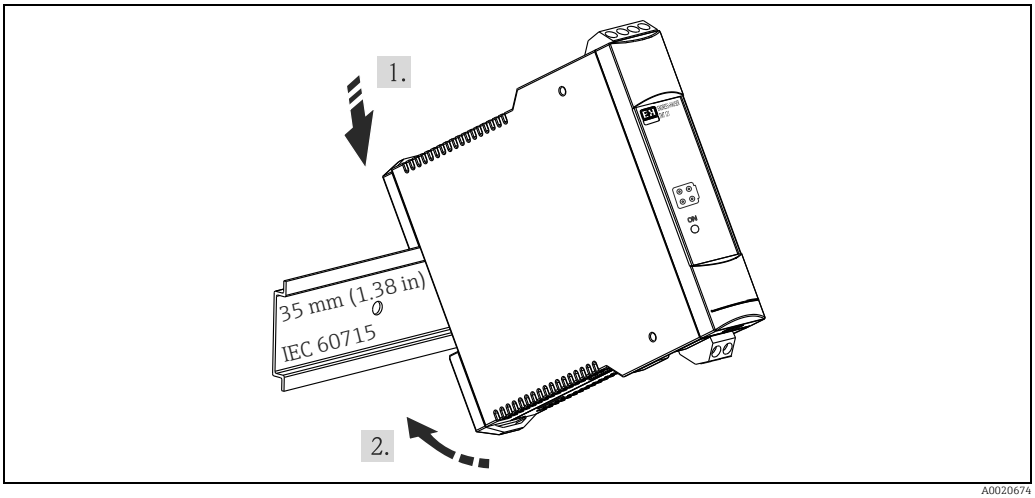
Influence of cold junction

Pt100 DIN EN 60751 Kl. B, internal cold junction with thermocouples TC

Installation conditions

Installation instructions

- Mounting location:



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Installation on DIN rail - follow sequence 1 and 2

- Orientation:
  No restrictions

Environmental conditions

Ambient temperature

-40 to +85 °C (-40 to +185 °F), for hazardous areas see Ex documentation (XA, CD) and section 'Certificates and approvals' → 🖹 7

Storage temperature

-40 to +100 °C (-40 to +212 °F)

Altitude

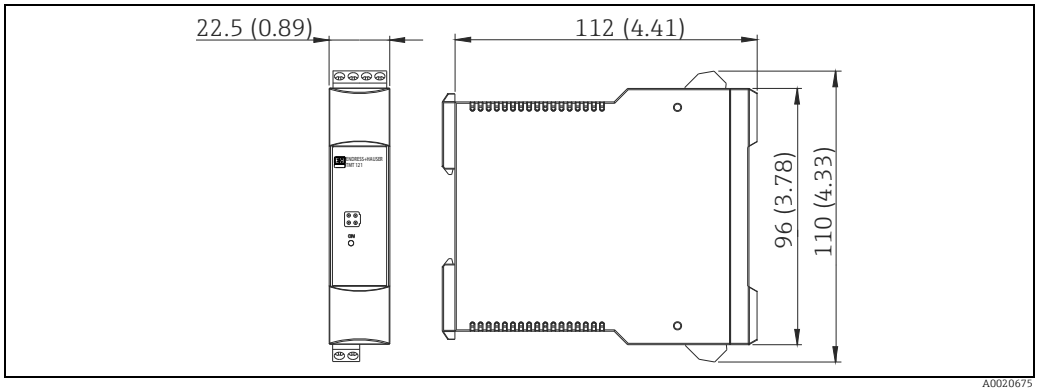
Up to 4000 m (4374.5 yd) above mean sea level in accordance with IEC 61010-1, CSA 1010.1-92

Climate class	According to EN 60654-1, Class C
Humidity	▪ Condensation as per IEC 60068-2-33 permitted ▪ Max. rel. humidity: 95% as per IEC 60068-2-30
Degree of protection	IP 20 (NEMA Type 1 Encl.)
Shock and vibration resistance	4g / 2 to 150 Hz as per IEC 60 068-2-6
Electromagnetic compatibility (EMC)	**CE EMC compliance** Interference immunity and interference emission according to IEC 61326 and NAMUR NE 21.

Mechanical construction

Design, dimensions

Installation on DIN rail according to IEC 60715, TH35



Dimensions in mm (in)

Weight	Approx. 90 g (3.17 oz)
Material	All materials used are RoHS-compliant. 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.
Operating elements	No operating elements are available on the temperature transmitter. The temperature transmitter will be configured by remote operation with the PC software ReadWin® 2000.
Remote operation	Online configuration via PC with configuration kit (PC-Software ReadWin® 2000 and USB interface cable), see 'Acessories', → 🖹 8

Menu	Configurable parameters
Standard settings	▪ Selection sensor type ▪ Connection (2-, 3- or 4-wire connection) ▪ Selection unit: °C, °F ▪ Measurement range limits (depends on selected sensor type)
Expanded settings	▪ Cold junction compensation internal/external (only on TC connection) ▪ Temperature external (only on TC connection) ▪ Compensation resistance (0 to 20 Ω on RTD 2-wire connection) ▪ Fault condition reaction: ≤ 3.6 mA or ≥ 21.0 mA, for configuration ≥ 21.0 mA an output current ≥ 21.5 mA is guaranteed ▪ Analog output: 4 to 20 mA (standard) or 20 to 4 mA (inverse) ▪ Filter, optional from 0 to 8 s ▪ Zero point, offset: -9.9 to +9.9 K (-18 to +18 °F) ▪ TAG (Measurement point description)
Service functions	▪ Simulation analog output: on/off ▪ Password assignment

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

ATEX approval

TMT121		ATEX II 2(1)G	Ex ia [ia Ga] IIC T4...T6 Gb
Power supply (Terminals + and -)		$U_i \leq 30$ V $_{DC}$ $I_i \leq 100$ mA $P_i \leq 750$ mW C_i = negligibly small L_i = negligibly small	
Sensor circuit (Terminals 3 to 6)		$U_0 \leq 4.4$ V DC $I_0 \leq 9.6$ mA $P_0 \leq 10.6$ mW	
Maximum connection data	Ex ia IIC Ex ia IIB Ex ia IIA	L_0 = 100 mH L_0 = 100 mH L_0 = 100 mH	C_0 = 2.4 µF C_0 = 12 µF C_0 = 18 µF
Temperature range	T6 T5 T4	Ta = -40 °C to +50 °C Ta = -40 °C to +65 °C Ta = -40 °C to +85 °C	

TMT121		ATEX II 3G Ex nA II T6/T5/T4
Power supply (Terminals + and -)		U ≤ 35 V DC
Output		4...20 mA Current consumption ≤ 23 mA
Temperature range	T6 T5 T4	Ta = -40 °C to + 45 °C Ta = -40 °C to + 55 °C Ta = -40 °C to + 85 °C

FM approval

Labeling:
IS / Class I / Division 1 / Groups ABCD / T4/T5/T6
Class I / Zone 0 / AEx ia IIC / T4/T5/T6
NI / Class I / Division 2 / Groups ABCD / T4/T5/T6

For connection data see table on ATEX approval ATEX II 2(1)G

CSA approval (Canadian Standard Association)

Labeling:
INTRINSICALLY SAFE Class I / Div. 1 / Groups ABCD / T4/T5/T6
NONINCENDIVE, FIELD WIRING Class I / Div. 2 / Groups ABCD / T4/T5/T6
For connection data see table on ATEX approval ATEX II 2(1)G

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.

Other standards and guidelines

- IEC 60529: Degrees of protection through housing (IP code)
- IEC 61326: Electromagnetic compatibility (EMC requirements)
- IEC 61010: Safety requirements for electrical measurement, control and laboratory instrumentation
- NAMUR: International user association of automation technology in process industries

UL

Recognized component to UL3111-1

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website:
  www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center:
  www.endress.com/worldwide

Product Configurator - the tool for individual product configuration:
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Optional accessories

Type	Order code
Configuration kit: Setup-program ReadWin® 2000 and PC-interface cable with 4-pin USB-plug	TXU10-AA

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.

Konfigurator$^{+temperature}$	Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools: ▪ For temperature competence ▪ Quick and easy design and sizing of temperature measuring points ▪ Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries The Konfigurator is available: On request from your Endress+Hauser sales office on a CD-ROM for local PC installation.

W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.

Documentation

- Operating instructions: KA00126R/09/c4
- Ex supplementary documentation:
  ATEX II 2(1)G Ex ia IIC: XA013R/09/a3
  ATEX II 3G Ex nA II: XA018R/09/a3

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