Technical Information
iTEMP TMT111, DIN rail

Universal temperature transmitter for resistance thermometers (RTD), thermocouples, resistance and voltage transmitters, PC programmable, for installation on DIN rail according to IEC 60715

Application
- PC programmable (PCP) DIN rail temperature transmitter for converting various input signals into a scalable 4 to 20 mA analog output signal
- Usable for resistance thermometer (RTD), thermocouple (TC), resistance transmitter (Ω), voltage transmitter (mV)
- Device configuration using PC with configuration kit and PC-Software ReadWin® 2000
- Installation on DIN rail according to IEC 60715, TH35

Your benefits
- 2-wire technology, 4 to 20 mA analog output
- Fault signal on sensor break or short circuit, presettable to NAMUR NE 43
- UL recognized component to UL 3111-1
- CSA General Purpose
- Meets the EMC requirements as per NAMUR NE21
- Ex-Certification:
  - ATEX Ex ia
  - CSA IS
  - FM IS
- Galvanic isolation 2 kV (input/output)
- Output simulation for quick and easy testing of the measurement loop

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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 TMT111, DIN rail temperature transmitter is a 2-wire transmitter with an analog output. It has a measurement input for resistance thermometers (RTD) and resistance transmitters in 2-, 3- or 4-wire connection, thermocouples and voltage transmitters. Setting up of the TMT111 is done using a configuration kit (see chapter “Accessories” on page 9 and the free of charge configuration software ReadWin® 2000.

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.

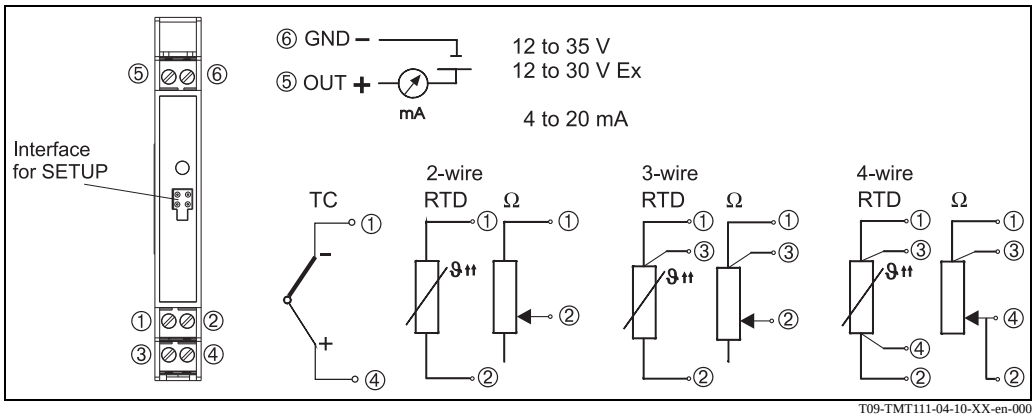
Type of input	Designation	Measurement range limits	Minimum measurement range
Resistance thermometer (RTD) as per IEC 60751 (a = 0.00385)	Pt100 Pt500 Pt1000	-200 to 850 °C (-328 to 1562 °F) -200 to 250 °C (-328 to 482 °F) -200 to 250 °C (-328 to 482 °F)	10 K 10 K 10 K
as per DIN 43760 (a = 0.006180)	Ni100 Ni500 Ni1000	-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 10 K 10 K
as per Edison Curve (a = 0.006720)	Ni120	-70 to 270 °C (-94 to 518 °F)	10 K
	▪ Connection type: 2-wire, 3-wire or 4-wire connection ▪ For 2-wire circuit, compensation for wire resistance possible (0 to 20 Ω) ▪ Sensor cable resistance max. 40 Ω per cable ▪ Sensor current: ≤ 0.6 mA		
Resistance transmitter	Resistance Ω	10 to 400 Ω 10 to 2000 Ω	10 Ω 100 Ω
Thermocouples (TC) as per IEC 584 part 1	B (PtRh30-PtRh6) E (NiCr-CuNi) J (Fe-CuNi) K (NiCr-Ni) N (NiCrSi-NiSi) R (PtRh13-Pt) S (PtRh10-Pt) T (Cu-CuNi)	0 to +1820 °C (32 to 3308 °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) -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)	500 K 50 K 50 K 50 K 50 K 500 K 500 K 50 K
as per ASTM E988	C (W5Re-W26Re) D (W3Re-W25Re)	0 to +2320 °C (32 to 4208 °F) 0 to +2495 °C (32 to 4523 °F)	500 K 500 K
as per DIN 43710	L (Fe-CuNi) U (Cu-CuNi)	-200 to +900 °C (-328 to 1652 °F) -200 to +600 °C (-328 to 1112 °F)	50 K 50 K
	▪ Internal cold junction (Pt100) or external 0 °C to +80 °C (32 to 176 °F) ▪ Cold junction accuracy: ± 1 K		
Voltage transmitters (mV)	Millivolt transmitter (mV)	-10 to 100 mV	5 mV

Output

Output signal	Analog 4 to 20 mA, 20 to 4 mA
Signal on alarm	▪ Underranging: Linear drop to 3.8 mA ▪ Overranging: Linear rise to 20.5 mA ▪ Sensor breakage; Sensor short circuit[1]: ≤ 3.6 mA or ³ 21.0 mA (for configuration ³ 21.0 mA, output ³ 21.5 mA is guaranteed)
Load	Max. ($V_{Power\ supply}$ - 12 V) / 0.022 A (Current output)
Linearization / transmission behavior	Temperature linear, resistance linear, voltage linear
Filter	Digital filter 1st degree: 0 to 8 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 ≈ 3.8 mA)

Power supply

Electrical connection



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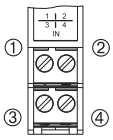
Connection terminal	Sensor-connection cable	
	Option 1	**Option 2**
	m Red, n White o Red, p White	m White, n Red o White, p Red

Temperature transmitter terminal connections

Supply voltage

U_β = 12 to 35 V, polarity protected

1) Not 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.

	Type	Measurement accuracy
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 S, B, R	typ. 0.5 K or 0.08% typ. 1.0 K or 0.08% typ. 2.0 K or 0.08%

	Measurement range	Measurement accuracy
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 100 mV	± 20 mV or 0.08%

Influence of power supply

≤ ± 0.01%/V deviation from 24 V[1]

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 mV
Output 4 to 20 mA	Typ. 0.0015% of the span

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

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

Example of calculating the measured error with ambient temperature drift:
Input temperature drift ΔT = 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: (0.001% of 138.5 Ω) * 10 = 0.01385 Ω
Conversion to Kelvin: 0.01385 Ω / 0.385 Ω/K = 0.04 K (0.054 °F)

Long-term stability	≤ 0.1K/year or ≤ 0.05%/year[1 2]
Influence of load	≤ ± 0.02%/100 Ω[1]
Influence of cold junction	Pt100 DIN IEC 60751 Cl. B (internal cold junction with thermocouples TC)

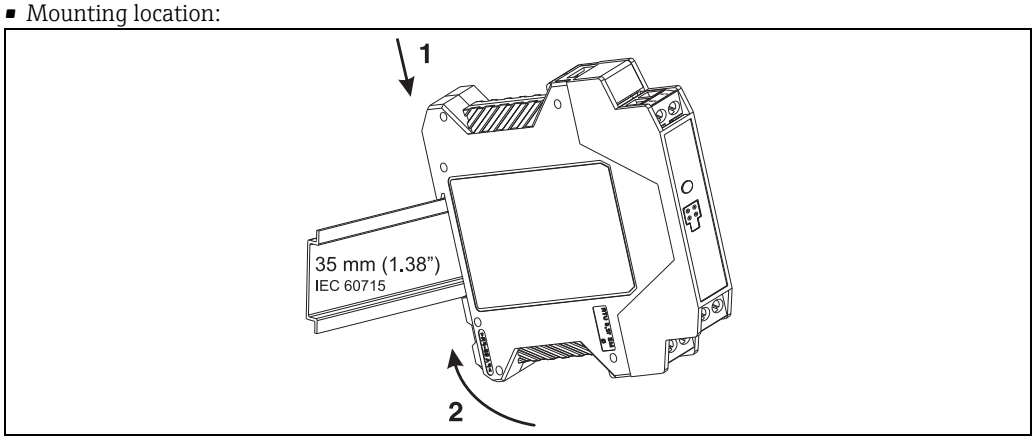
1) according to reference conditions

2) % is related to the adjusted measurement range (the value to be applied is the greater one)

Installation conditions

Installation instructions

- Mounting location:



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Installation on DIN rail according to IEC 60715, TH35 - follow sequence 1 and 2

- Orientation: No restrictions

Environmental conditions

Ambient temperature	-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
Degree of protection	IP20 (NEMA Type 1 Encl.)
Electromagnetic compatibility (EMC)	CE conformity EMC to all relevant requirements of the IEC/EN 61326-series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity. Maximum fluctuations during EMC-tests: < 1% of measuring span. Interference immunity to IEC/EN 61326-series, requirements for industrial areas Interference emission to IEC/EN 61326-series, electrical equipment Class B

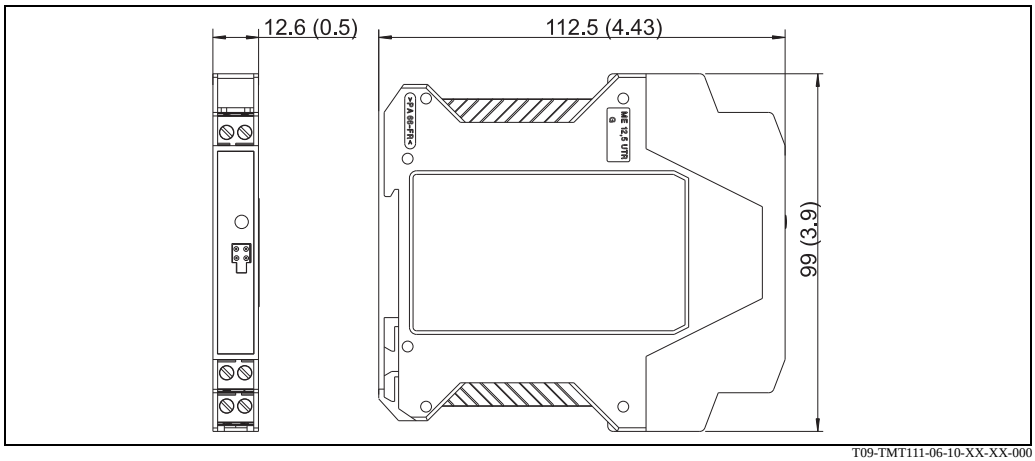
Humidity

- Condensation as per IEC 60 068-2-33 permitted
- Max. rel. humidity: 95% as per IEC 60068-2-30

Mechanical construction

Design, dimensions

Installation on DIN rail according to IEC 60715, TH35



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Dimensions in mm (in)

Weight

Approx. 90 g (3.17 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.

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.
Available configuration kits see chapter 'accessories'on page 9.

Operation via PC

Menu	Configurable parameters
Standard settings	▪ Sensor type ▪ Connection (2-, 3- or 4-wire connection) ▪ Units °C, °F ▪ Measurements range limits (depends on selected sensor type)
Expanded settings	▪ Cold junction compensation (internal/external on TC connection) ▪ Temperature external (on TC with cold junction compensation external) ▪ Compensation resistance (0 to 20 Ω) on RTD 2-wire connection ▪ Fault condition reaction (≤ 3.6 mA or [3] 21.0 mA), for configuration [3] 21.0 mA, output [3] 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 approval

The measurement system fulfils the requirements demanded by the EU regulations. Endress+Hauser acknowledges successful unit testing by adding the CE mark.

Hazardous area approvals

ATEX approval

TMT111		ATEX II 2(1)G EEx ia IIC T6/T5/T4	
Power supply (Terminals 5 and 6)		$U_i \leq 30$ V DC $I_i \leq 100$ mA $P_i \leq 750$ mΩ C_i = negligibly small L_i = negligibly small	
Sensor circuit (Terminals 1 to 4)		$U_0 \leq 4.4$ V DC $I_0 \leq 9.6$ mA $P_0 \leq 10.6$ mΩ	
Max. connection data	EEx ia IIC EEx ia IIB	L_0 = 100 mH L_0 = 100 mH	C_0 = 2.4 mF C_0 = 12 mF
Temperature range	T6 T5 T4	Ta = -40 °C ... +50 °C Ta = -40 °C ... +65 °C Ta = -40 °C ... +85 °C	

Application:
- Equipment Category: Explosive gas-air mixtures (G)
- Category 1 Zone 1 or 2, Apparatus with external circuits for connection to equipment in category 1

For Zone 0: This apparatus may be installed in Zones 1, 2 and the sensor circuit can be fed into Zone 0.

FM approval

TMT111			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	
Supply circuit (Terminals 5 and 6)			$U_i \leq 30$ V DC $I_i \leq 100$ mA $P_i \leq 750$ mΩ C_i = negligible small L_i = negligible small	
Sensor circuit (Terminals 1 to 4)			$U_0 \leq 2.5$ V DC $I_0 \leq 2.2$ mA $P_0 \leq 1.4$ mΩ	
Max. connecting values	Group A, B Group C Group D	IIC IIB IIA	$L_a = L_0$ = 1000 mH $L_a = L_0$ = 1000 mH $L_a = L_0$ = 1000 mH	$C_a = C_0$ = 100 mF $C_a = C_0$ = 1000 mF $C_a = C_0$ = 1000 mF
Temperature range	T6 T5 T4		T_a = -40 °C ... +50 °C T_a = -40 °C ... +65 °C T_a = -40 °C ... +85 °C	

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

Application:
- Intrinsic Safety
- Non-Incendive

CSA (Canadian Standard Association)

TMT111			IS / Class I / Division 1 / Groups ABCD / T4/T5/T6 Ex ia IIC / T4/T5/T6 NI / Class I / Division 2 / Groups ABCD / T4/T5/T6	
Supply circuit (Terminals 5+ and 6-)			$U_i \leq 30$ V DC $I_i \leq 100$ mA $P_i \leq 750$ mΩ C_i = negligible small L_i = negligible small	
Sensor circuit (Terminals 1 to 4)			$U_0 \leq 4.4$ V DC $I_0 \leq 9.6$ mA $P_0 \leq 10.2$ mΩ	
Max. connecting values	Group A, B Group C Group D	IIC IIB IIA	$L_a = L_0 = 100$ mH $L_a = L_0 = 100$ mH $L_a = L_0 = 100$ mH	$C_a = C_0 = 100$ mF $C_a = C_0 = 1000$ mF $C_a = C_0 = 1000$ mF
Temperature range	T6 T5 T4		T_a = -40 °C ... +50 °C T_a = -40 °C ... +65 °C T_a = -40 °C ... +85 °C	

Labeling:
- Class I / Div. 1 / Groups ABCD / T4/T5/T6
- Class I / Div. 2 / Groups ABCD / T4/T5/T6

Application:
- Intrinsically safe
- Non-Incendive

For further details on the available Ex versions (ATEX, CSA, FM, etc.), please contact your nearest Endress+Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation. If required, please request copies from your Endress+Hauser sales organization.

UL approval

UL recognized component (see www.ul.com/database, search for Keyword "E225237")

CSA GP

CSA General Purpose according to C22.2 No. 1010.1-92

Other standards and guidelines

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

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the configuration
- 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

Configuration kits for PC programmable transmitters

- FXA291 Commubox: PC-interface cable with 4-pin USB-plug;
  Order-Code: 51516983
- TMT121A-VK: Setup-program ReadWin® 2000 and PC-interface cable (TTL/RS232C);
  Order-Code: TMT121A-VK
- TXU10-AA: Setup-program ReadWin® 2000 and PC-interface cable with 4-pin USB-plug;
  Order-Code: TXU10-AA

The operating software ReadWin® 2000 can be downloaded free of charge from the Internet from the following address: **www.endress.com/readwin**

Documentation

- Operating Instructions iTEMP TMT111 DIN rail (BA159R/09/c4)
- Ex supplementary documentation: ATEX II 2(1) G EEx ia IIC (XA021R/09/a3)

www.addresses.endress.com

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