developing solutions

FISCHER MESS- UND REGELTECHNIK

Data sheet

TE45

Digital temperature transmitter

09015415 • DB_EN_TE45 • Rev. ST4-B • 09/24

1 Product and functional description

1.1 Performance characteristics

Typical applications

- Food industry
- Heating, air conditioning and ventilation engineering
- Environmental technology
- Procedural technology
- Petrochemical industry

Main features

- 2-wire technology 4-20 mA
- Application range for all common thermocouples according to
  - IEC 60584
  - DIN 43710
  - ASTM E988
- Resistance thermometer according to
  - IEC 60751
  - DIN 43760
- HF-insensitive
- EMC-resistant
- High measuring accuracy
- Very low temperature drift
- Programmable via PC
- With moisture protection
- Notification of sensor errors
- Galvanically isolated

1.2 Intended use

The TE45 is a universal and configurable temperature transmitter with a sensor input for resistance thermometers and thermocouples and a 4 to 20 mA analogue output. It can be used for temperature detection in liquid and gaseous media.

The device is designed for mounting in various connection heads of the B, BUS, BUSH, S79 and BBK types.

The device may only be used for the purpose stipulated by the manufacturer. The manufacturer will not be liable for damage arising from incorrect or improper use.

1.2.1 Use in areas at risk of explosion

Devices with the mark TE45 11 ##### 9 can be supplied as "electrical equipment for use in potentially explosive atmospheres" Zone 0 - gases and vapours.

Designation as per guideline 2014/34/EU


II 1G Ex ia IIC T6 ... T4 Ga

⚠ DANGER

Operation in areas at risk of explosion

If operated in explosive areas, the electrical data of the unit and the valid local regulations and guidelines for the installation and operation of electrical systems in explosive areas must be observed.

Technical data (ATEX)

Supply voltage	U_i	≤ 30 V DC
	I_i	≤ 100 mA
	P_i	800 mW
	C_i	negligibly small
	L_i	negligibly small
Sensor circuit	U_o	≤ 4.3 V DC
	I_o	≤ 4.8 mA
	P_o	≤ 5.2 mW

Max. connected loads	Ex iA IIC	L_o	= 50 mH	C_o	=3 µF
	Ex iA IIB	L_o	= 100 mH	C_o	= 18 µF
	Ex ia II A	L_o	= 100 mH	C_o	= 48 µF

Max. ambient temperature	Class	EPL Gb Zone 1	EPL Ga Zone 0
	T6	+ 55 °C	+ 40 °C
	T5	+ 70 °C	+ 60 °C
	T4	+ 85 °C	+ 60 °C

1.3 Function diagram

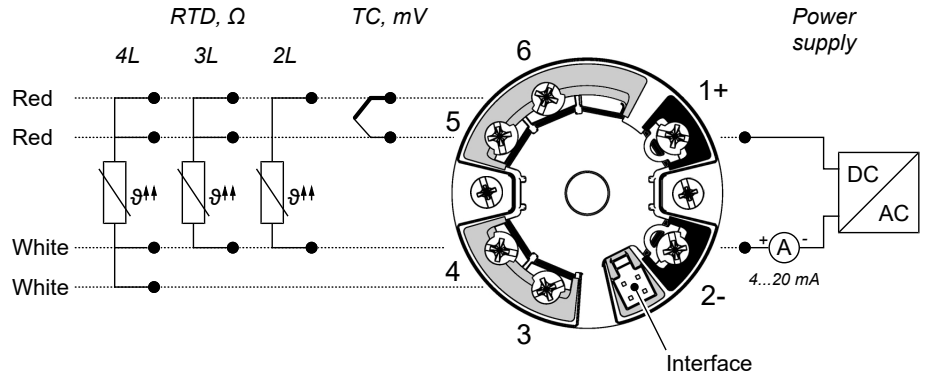


Fig. 1: Function and connection diagram

1.4 Design and mode of operation

The temperature transmitter is a 2-wire device with one measuring input and one analogue output. The device transmits signals from resistance thermometers and thermocouples via a 4...20 mA current signal.

Resistor input

Can be used for Pt100/200/500/1000 with temperature ranges according to IEC 60751 and Ni100/120 according to DIN 43760, as well as linear resistances up to max. 2 kΩ Measuring lead compensation up to max. 50Ω.

Thermocouple input

For standard thermocouples in accordance with IEC 60584/DIN 43710 and ASTM E688. You can select the internal Pt100 as reference junction compensation or specify a constant external temperature

Power supply/analogue output

The 4 ... 20 mA output signal can be inverted to a 20 ... 4 mA signal. The signal limits can be configured in accordance with NAMUR recommendation NE43 for failure detection.

The device has reverse polarity protection for the power supply.

Interface

The TZ45 configuration kit is connected to this interface. The configuration set consists of the programming software, the adapter and the serial connection cable. The adapter has galvanic isolation.

Data is exchanged between the transmitter and PC in both directions, so that the configuration and serial number of the transmitter can be accessed from any PC with the configuration set.

2 Technical data

2.1 General

General information	
Type designation	TE45
Measuring variable	Temperature (temperature-linear transfer behaviour), resistance and voltage
Type of protection	IP00
Weight	45 g

Reference conditions	
Calibration temperature	+25 °C ±3 K
Supply voltage	24 V DC
Resistance calibration	4-conductor circuit

2.2 Input variables

2.2.1 Resistance thermometer (RTD)

Measuring current at the sensor	< 0.3 mA
Max. sensor cable resistance	50 Ω per conductor
Line compensation (2-wire)	0 ... 30 Ω

			Measuring range limits		
No.	**Standard**	**Type**	**Measuring range**	**Min. range**	**Max. measurement deviation**
1	IEC 60751	Pt100	-200 … 850 °C	10 K	≤ 0.33 °C
3		Pt200	-200 … 850 °C	10 K	≤ 0.37 °C
4		Pt500	-200 … 500 °C	10 K	≤ 0.23 °C
5		Pt1000	-200 … 250 °C	10 K	≤ 0.15 °C
2	DIN43760	Ni100	-60 … 250 °C	10 K	≤ 0.10 °C
6		Ni120	-60 … 250 °C	10 K	≤ 0.10 °C
7	Lin. Resistance transmitter		10 ... 2000 Ω	10 Ω	≤ 623.4 mΩ

Calculation of the measurement deviation (MD) at reference condition

A difference from the maximum measurement deviation due to rounding is possible.

No.	Measured value specific
1	$MD = \pm \sqrt{[\ (0.05\ °C + (MV - SMR) \cdot 0.006\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
2	$MD = \pm \sqrt{[\ (0.08\ °C + (MV - SMR) \cdot 0.011\%)^2 + (EM \cdot 0.03\%)^2\ ]}$
3	$MD = \pm \sqrt{[\ (0.035\ °C + (MV - SMR) \cdot 0.008\%)^2 + (EM \cdot 0.03\%)^2\ ]}$
4	$MD = \pm \sqrt{[\ (0.02\ °C + (MV - SMR) \cdot 0.007\%)^2 + (EM \cdot 0.03\%)^2\ ]}$
5	$MD = \pm \sqrt{[\ (0.04\ °C + (MV - SMR) \cdot 0.004\%)^2 + (EM \cdot 0.03\%)^2\ ]}$
6	$MD = \pm \sqrt{[\ (0.04\ °C + (MV - SMR) \cdot 0.004\%)^2 + (EM \cdot 0.03\%)^2\ ]}$
7	$MD = \pm [\ 60\ m\Omega + 0.006\% \cdot (MV^2 + (0.03\% \cdot EM)^2)]$

MV = Measured value
SMR = Start of measuring range
EM= End of measuring range - start of measuring range

2.2.2 Thermocouple (TC)

Reference junction (internal)	Pt100 Fixed default value: adjustable -40 ... +85 °C
Reference junction accuracy	± 0.5 K

			Measuring range limits		
No.	**Standard**	**Type**	**Measuring range**	**Min. range**	**Max. measurement deviation**
1	IEC 60584	A	0 … 2500 °C	50 K	≤ 1.81 °C
2		B	+40 … 1820 °C	50 K	≤ 2.14 °C
3		E	-250 … 1000 °C	50 K	≤ 0.46 °C
4		J	-210 … 1200 °C	50 K	≤ 0.54 °C
5		K	-270 … 1372 °C	50 K	≤ 0.64 °C
6		N	-270 … 1300 °C	50 K	≤ 0.82 °C
7		R	-50 … 1768 °C	50 K	≤ 1.68 °C
8		S	-50 … 1768 °C	50 K	≤ 1.68 °C
9		D	-200 … 400 °C	50 K	≤ 0.53 °C
10	IEC 60854 ASTME988	C	0° … 2315 °C	50 K	≤ 1.05 °C
11	ASTM E988	E	0° … 2315 °C	50 K	≤ 1.25 °C
12	DIN 43710	L	-200 … 900 °C	50 K	≤ 0.5 °C
13		U	-200 … 600 °C	50 K	≤ 0.5 °C
14	Voltage transmitter		-20 ... 100 mV	5 mV	≤ 37.36 µV

Calculation of the measurement deviation (MD) at reference condition

A difference from the maximum measurement deviation due to rounding is possible.

No.	Measured value specific
1	$MD = \pm \sqrt{[\ (1.0\ °C + (MV - SMR) \cdot 0.026\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
2	$MD = \pm \sqrt{[\ (2.1\ °C + (MV - SMR) \cdot 0.09\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
3	$MD = \pm \sqrt{[\ (0.3\ °C + (MV - SMR) \cdot 0.012\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
4	$MD = \pm \sqrt{[\ (0.36\ °C + (MV - SMR) \cdot 0.01\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
5	$MD = \pm \sqrt{[\ (0.5\ °C + (MV - SMR) \cdot 0.01\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
6	$MD = \pm \sqrt{[\ (0.7\ °C + (MV - SMR) \cdot 0.025\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
7	$MD = \pm \sqrt{[\ (1.6\ °C + (MV - SMR) \cdot 0.04\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
8	$MD = \pm \sqrt{[\ (1.6\ °C + (MV - SMR) \cdot 0.03\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
9	$MD = \pm \sqrt{[\ (0.5\ °C + (MV - SMR) \cdot 0.05\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
10	$MD = \pm \sqrt{[\ (0.75\ °C + (MV - SMR) \cdot 0.0055\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
11	$MD = \pm \sqrt{[\ (1.1\ °C + (MV - SMR) \cdot 0.016\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
12	$MD = \pm \sqrt{[\ (0.39\ °C + (MV - SMR) \cdot 0.016\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
13	$MD = \pm \sqrt{[\ (0.45\ °C + (MV - SMR) \cdot 0.04\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$
14	$MD = \pm \sqrt{[\ (10\ µV + (MV - SMR) - 0.0018\%)^2 + (EM \cdot 0.03\ \%)^2\ ]}$

MV = Measured value
SMR = Start of measuring range
EM= End of measuring range - start of measuring range

2.3 Output variables

Analogue output	4 ... 20 mA 20 ... 4 mA (inverted)
Linearisation/ Transmission behaviour	temperature linear, resistance linear, voltage linear
Start delay	≤ 7 s (during which I_a ≤ 3.8 mA)
Jump response	≤ 1 s
Filter (1st order digital filter)	0 … 120 s
Galvanic isolation	U = 2 kV AC for 1 minute (input/output)

Failure information according to NAMUR NE43:

Under measured value range	Linear drop from 4.0 ... 3.8 mA
Measuring range exceeded	Linear increase from 20.0 ... 20.5 mA
Failure (sensor break, short circuit)	≤ 3.6 mA (low) ≥ 21 mA (high) adjustable 21.5 ... 23 mA

2.4 Measuring accuracy

Measurement deviation	See table of input variables The information includes non-linearities and repeatability.
Long-term stability	
● *Temperature range*	0.02 K / 1 year or 0.03 K / 5 years (for Pt100/ Pt1000)
● *Resistance range*	≤ 20 mΩ / K
● *Voltage range*	≤ 1.5 µV / K
Impact of ambient temperature	≤ 0.017 °C / K (depending on sensor)
Impact of the supply voltage	negligible

2.5 Auxiliary energy

Rated voltage	24 V DC
Permitted op. voltage	10 V ≤ U_b ≤ 36 V
Power consumption	3.6 to 23 mA
Current limitation	≤ 23 mA

2.6 Operating conditions

Ambient temperature range	-40...+85 °C
Storage temperature range	-50 … +100 °C
IP protection class	IP 00 (when installed, depends on the connection head or field housing used).
Humidity (according to IEC 60068-2-30)	Max. rel. humidity: 95 % Condensation permitted
Climate class (according to EN 60654-1)	C1
Shock and vibration resistance (in accordance with DIN EN 60068-2-27)	2 ... 100 Hz at 4g

Conformity

Guideline	Applied standard
ATEX Directive 2014/34/EU	EN IEC 60079-0 EN 60079-11
Low-Voltage Directive 2014/35/EU	EN 61010-1
EMC Directive 2014/30/EU	IEC/EN 61326 Namur (NE21)
RoHS Directive 2011/65/EU	EN IEC 63000
REACH Regulation (EC) No 1907/2006	The article TE45 does not contain any SVHC substances.

2.7 Construction design

Electrical connection	Screw terminals
Cable design	Rigid or flexible
Cable cross-section	≤ 2.5 mm² (14 AWG)
Installation position	User-defined
Dimensions	Ø 44 x 24.1 mm
Weight	45 g

2.7.1 Materials

Casing	Polycarbonate
Connection terminals	Nickel-plated brass Gold-plated contact
Casting compound	QSIL 553

2.7.2 Dimension drawings

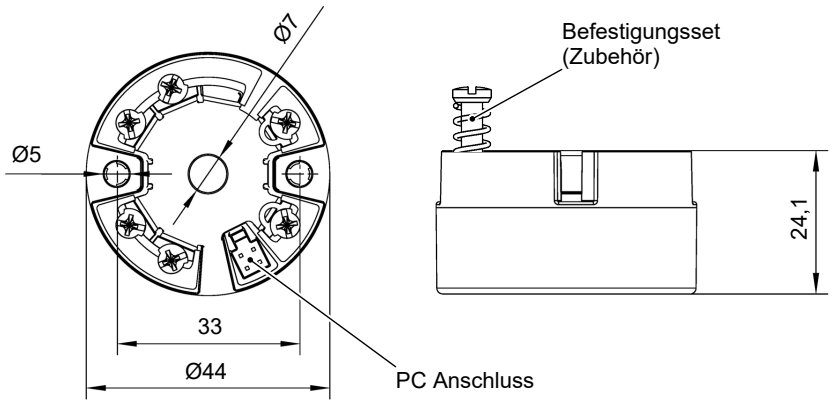
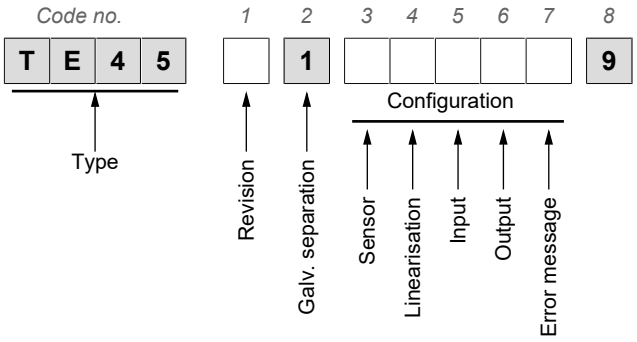


Fig. 2: Dimension drawing

3 Order codes

Please specify the desired measuring range with every order.



[1]	Revision
0	Standard
1	ATEX version (II 1G Ex ia IIC T6 ... T4 Ga)

[2]	Galvanic isolation
1	yes

	Configuration	3	4	5	6	7
	None	**0**	**0**	**0**	**0**	**0**

[3]	Sensor
	Resistance thermometer (RTD)
1	Pt100
2	Ni100
3	Pt200
4	Pt500
5	Pt1000
6	Ni120
7	Resistance transmitter
	Thermocouple (TC)
8	Voltage transmitter
A	Type A thermocouple
B	Type B thermocouple
C	Type C thermocouple
E	Type D thermocouple
E	Type E thermocouple
J	Type J thermocouple
K	Type K thermocouple
L	Type L thermocouple
N	Type N thermocouple
R	Type R thermocouple
S	Type S thermocouple
D	Type T thermocouple

U	Type U thermocouple

[4]	**Linearisation**
1	With linearisation

[5]	**Input**	
	For resistance thermometers (RTD)	
1	R, Pt100,PT200,Pt500,Pt100,Ni100,Ni120	2-conductor *)
2	R, Pt100,PT200,Pt500,Pt100,Ni100,Ni120	3-conductor
3	R, Pt100,PT200,Pt500,Pt100,Ni100,Ni120	4-conductor

*) please specify cable resistance (max. 30Ω)

	For thermocouples (TC)
4	Internal reference junction
8	External reference junction (constant reference temperature -40 ... 80°C)

[6]	**Output**
1	4 … 20 mA
2	20 to 4 mA

[7]	**Error message (NAMUR)**	
2	Low	≤ 3.6 mA
3	High	≥ 21 mA

Add as plain text

Measuring range			
	Start	to *End*	☐ [°C] ☐ [Ω] ☐ [mV]

3.1 Accessories

Order No.	Designation	
TZ45	Configuration set incl. USB interface cable	
04002156	Top-hat rail adapter	
06402741	Fastening set	
	2	Screws with spring
	4	Lock washers
	1	Cover cap for the PC connection

3.2 Information about the document

This document contains all technical data about the device. Great care was taken when compiling the texts and illustrations. nevertheless, errors cannot be ruled out.

Subject to technical amendments.

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