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Technical Information
iTEMP TMT182B

Temperature transmitter

With HART® protocol for universal use

Application

- Universal temperature transmitter with HART® communication for the conversion of various input signals into a scalable, analog 4-20 mA output signal
- The iTEMP TMT182B is characterized by its reliability, long-term stability, high precision and advanced diagnostic function (important in critical processes)
- For the highest level of safety, reliability and risk reduction
- Universal input for resistance thermometers (RTD), thermocouples (TC), resistance transmitters (Ω), voltage transmitters (mV)
- Installation in terminal head, form B (flat face)

Your benefits

- Safe operation in hazardous areas thanks to international approvals
- Reliable operation thanks to sensor and device monitoring
- Diagnostics information according to NAMUR NE107
- Ready to use: pre-programmed ex works if required
- Easy configuration thanks to free software

Endress+Hauser
People for Process Automation

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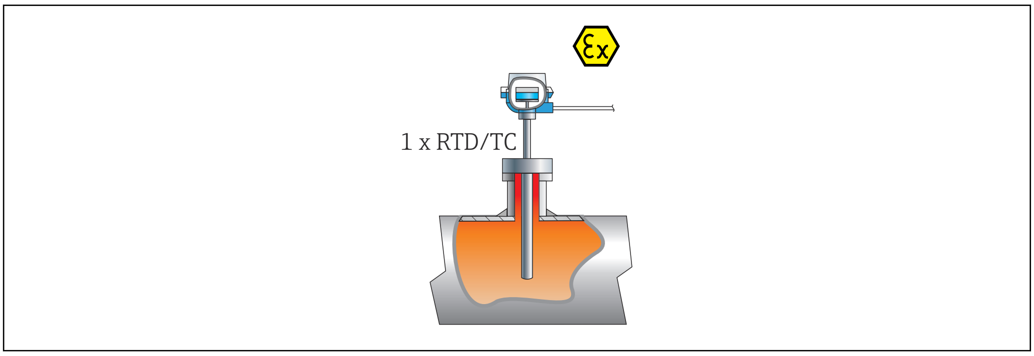
Function and system design

Measuring principle

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

Measuring system

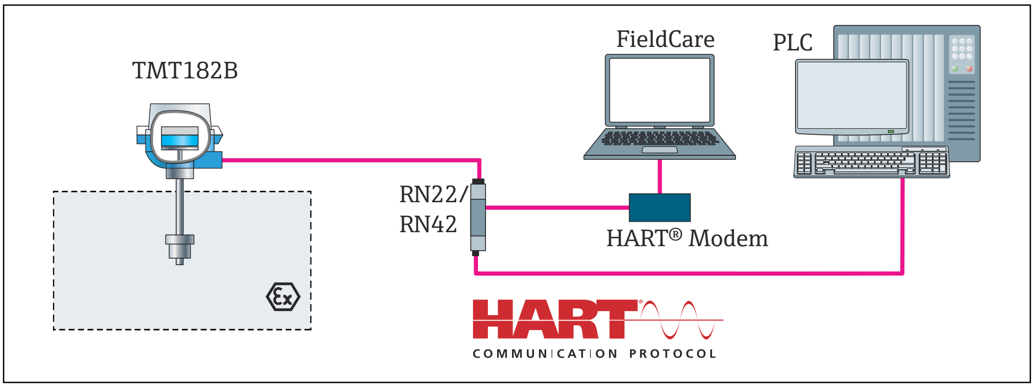


1 *Application example: installed head transmitter - 1 x RTD/TC, directly wired*

Endress+Hauser offers a comprehensive range of industrial thermometers with resistance sensors or thermocouples.

When combined with the temperature transmitter, these components form a complete measuring point for a wide range of applications in the industrial sector.

The temperature transmitter is a 2-wire device with one measuring input and one analog output. The device not only transmits converted signals from resistance thermometers and thermocouples, it also transmits resistance and voltage signals using HART® communication and as a 4 to 20 mA current signal. It can be installed as an intrinsically safe electrical apparatus in hazardous areas and is used for instrumentation in a form B (flat face) terminal head as per DIN EN 50446.



2 *Device architecture for HART® communication*

Standard diagnostic functions

- Cable open-circuit, short-circuit of sensor wires
- Incorrect wiring
- Internal device errors
- Overrange/underrange detection
- Device temperature overrange/underrange detection

Low voltage detection

The low voltage detection function prevents the device from continuously transmitting an incorrect analog output value (caused by an incorrect or damaged power supply system or a damaged signal cable). If the supply voltage drops below the required value, the analog output value drops to < 3.6 mA for approx. 5 s. The device then tries to output the normal analog output value again. If the supply voltage is still too low, this process is repeated cyclically.

Input

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

Resistance thermometer (RTD) as per standard	Designation	α	Measuring range limits	Min. span
IEC 60751:2022	Pt100 (1) Pt200 (2) Pt500 (3) Pt1000 (4)	0.003851	−200 to +850 °C (−328 to +1 562 °F) −200 to +850 °C (−328 to +1 562 °F) −200 to +500 °C (−328 to +932 °F) −200 to +250 °C (−328 to +482 °F)	10 K (18 °F)
JIS C1604:1984	Pt100 (5)	0.003916	−200 to +510 °C (−328 to +950 °F)	10 K (18 °F)
DIN 43760 IPTS-68	Ni100 (6) Ni120 (7)	0.006180	−60 to +250 °C (−76 to +482 °F) −60 to +250 °C (−76 to +482 °F)	10 K (18 °F)
GOST 6651-94	Pt50 (8) Pt100 (9)	0.003910	−185 to +1 100 °C (−301 to +2 012 °F) −200 to +850 °C (−328 to +1 562 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-2009	Cu50 (10) Cu100 (11)	0.004280	−180 to +200 °C (−292 to +392 °F) −180 to +200 °C (−292 to +392 °F)	10 K (18 °F)
	Ni100 (12) Ni120 (13)	0.006170	−60 to +180 °C (−76 to +356 °F) −60 to +180 °C (−76 to +356 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-94	Cu50 (14)	0.004260	−50 to +200 °C (−58 to +392 °F)	10 K (18 °F)
-	Pt100 (Callendar van Dusen) Nickel polynomial Copper polynomial	-	The measuring range limits are specified by entering the limit values that depend on the coefficients A to C and R0.	10 K (18 °F)
	▪ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ▪ With 2-wire circuit, compensation of wire resistance possible (0 to 30 Ω) ▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire			
Resistance transmitter	Resistance Ω		10 to 400 Ω 10 to 2 000 Ω	10 Ω 10 Ω

Thermocouples as per standard	Designation	Measuring range limits		Min. span
IEC 60584, Part 1 ASTM E230-3	Type A (W5Re-W20Re) (30) Type B (PtRh30-PtRh6) (31) Type E (NiCr-CuNi) (34) Type J (Fe-CuNi) (35) Type K (NiCr-Ni) (36) Type N (NiCrSi-NiSi) (37) Type R (PtRh13-Pt) (38) Type S (PtRh10-Pt) (39) Type T (Cu-CuNi) (40)	0 to +2 500 °C (+32 to +4 532 °F) +40 to +1 820 °C (+104 to +3 308 °F) −250 to +1 000 °C (−482 to +1 832 °F) −210 to +1 200 °C (−346 to +2 192 °F) −270 to +1 372 °C (−454 to +2 501 °F) −270 to +1 300 °C (−454 to +2 372 °F) −50 to +1 768 °C (−58 to +3 214 °F) −50 to +1 768 °C (−58 to +3 214 °F) −200 to +400 °C (−328 to +752 °F)	Recommended temperature range: 0 to +2 500 °C (+32 to +4 532 °F) +500 to +1 820 °C (+932 to +3 308 °F) −150 to +1 000 °C (−238 to +1 832 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 300 °C (−238 to +2 372 °F) +200 to +1 768 °C (+392 to +3 214 °F) +200 to +1 768 °C (+392 to +3 214 °F) −150 to +400 °C (−238 to +752 °F)	50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F)
IEC 60584, Part 1 ASTM E230-3 ASTM E988-96	Type C (W5Re-W26Re) (32)	0 to +2 315 °C (+32 to +4 199 °F)	0 to +2 000 °C (+32 to +3 632 °F)	50 K (90 °F)
ASTM E988-96	Type D (W3Re-W25Re) (33)	0 to +2 315 °C (+32 to +4 199 °F)	0 to +2 000 °C (+32 to +3 632 °F)	50 K (90 °F)
DIN 43710	Type L (Fe-CuNi) (41) Type U (Cu-CuNi) (42)	−200 to +900 °C (−328 to +1 652 °F) −200 to +600 °C (−328 to +1 112 °F)	−150 to +900 °C (−238 to +1 652 °F) −150 to +600 °C (−238 to +1 112 °F)	50 K (90 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)	−200 to +800 °C (−328 to +1 472 °F)	−200 to +800 °C (+328 to +1 472 °F)	50 K (90 °F)
	▪ Internal reference junction (Pt100) ▪ External preset value: configurable value −40 to +85 °C (−40 to +185 °F) ▪ Maximum sensor wire resistance 10 kΩ			
Voltage transmitter (mV)	Millivolt transmitter (mV)	−20 to 100 mV		5 mV

Output

Output signal

Analog output	4 to 20 mA, 20 to 4 mA (can be inverted)
Signal encoding	FSK ±0.5 mA via current signal
Data transmission rate	1200 baud
Galvanic isolation	U = 2 kV AC for 1 minute (input/output)

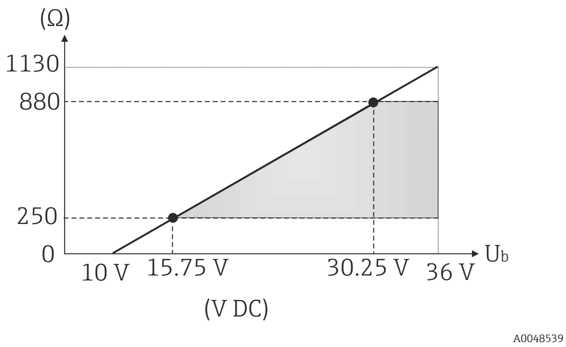
Failure information

Failure information as per NAMUR NE43:

Failure information is created if the measuring information is missing or not valid. A complete list of all the errors occurring in the measuring system is created.

Underranging	Linear decrease from 4.0 to 3.8 mA
Overranging	Linear increase from 20.0 to 20.5 mA
Failure e.g. sensor failure; sensor short-circuit	≤ 3.6 mA ("low") or ≥ 21 mA ("high"), can be selected

Load

$R_{b\ max.}$= ($U_{b\ max.}$ - 10 V) / 0.023 A (current output). Valid for head transmitter Load in Ohm U_b = supply voltage in V DC	

Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Filter

1st order digital filter: 0 to 120 s

Protocol-specific data

Manufacturer ID	17 (0x11)
Device type ID	0x11D2
HART® specification	7
Device address in multi-drop mode	Software setting addresses 0 to 63
Device description files (DTM, DD)	Information and files available at: www.endress.com www.fieldcommgroup.org
HART load	Min. 250 Ω
HART device variables	**Measured value for primary value (PV)** Sensor (measured value) **Measured values for SV, TV, QV (secondary, tertiary and quaternary variable)** ▪ SV: device temperature ▪ TV: sensor (measured value) ▪ QV: sensor (measured value)
Supported functions	Condensed status

Wireless HART data

Minimum starting voltage	10 V_{DC}
Start-up current	3.58 mA

Start-up time	7 s
Minimum operating voltage	10 V_{DC}
Multidrop current	4.0 mA
Time for connection setup	9 s

Write protection for device parameters

Software: user role-based concept (password assignment)

Switch-on delay

≤ 7 s until the first valid measured value signal is present at the current output and until the start of HART® communication. While switch-on delay = $I_a \leq 3.8$ mA

Power supply

Supply voltage

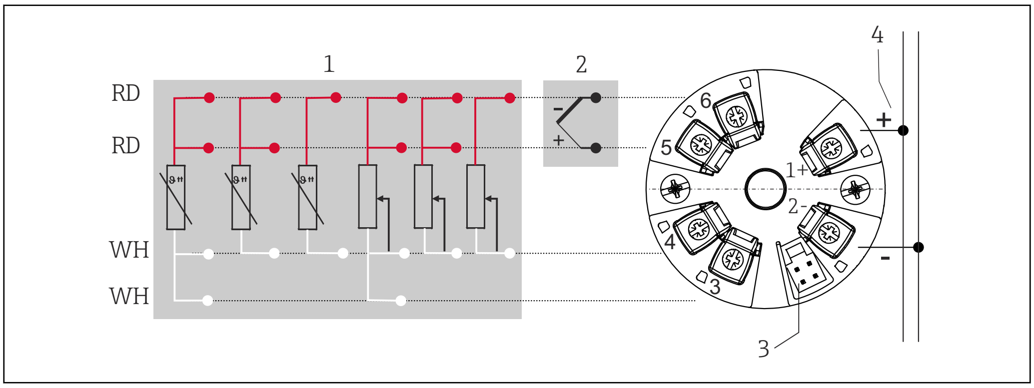
Values for non-hazardous areas, protected against polarity reversal:
U = 10 to 36 V_{DC}

Values for hazardous area, see Ex documentation.

Current consumption

- 3.6 to 23 mA
- Minimum current consumption 3.5 mA
- Current limit ≤ 23 mA

Electrical connection



3 *Assignment of terminal connections for head transmitter*

1 *Sensor input, RTD and Ω, 4-, 3- and 2-wire*
2 *Sensor input, TC and mV*
3 *CDI interface*
4 *Bus terminator and power supply*

Terminals

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	≤ 1.5 mm² (16 AWG)

Performance characteristics

Response time

Resistance thermometer (RTD) and resistance transmitter (Ω measurement)	≤1 s
Thermocouples (TC) and voltage transmitters (mV)	≤ 1 s
Reference temperature	≤ 1 s

When recording step responses, it must be taken into account that the times of the internal reference measuring point are added to the specified times where applicable.

Refresh time

Approx. 100 ms

Reference operating conditions

- Calibration temperature: +25 °C ±3 K (77 °F ±5.4 °F)
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment

Maximum measured error

In accordance with DIN EN 60770 and the reference conditions specified above. The measured error data correspond to ±2 σ (Gaussian distribution). The data include non-linearities and repeatability.

MV = Measured value

LRV = Lower range value of relevant sensor

Typical

Standard	Designation	Measuring range	Typical measured error (±)	
Resistance thermometer (RTD) as per standard			Digital value 1)	Value at current output
IEC 60751:2008	Pt100 (1)	0 to +200 °C (32 to +392 °F)	0.12 °C (0.22 °F)	0.14 °C (0.25 °F)
IEC 60751:2008	Pt1000 (4)		0.09 °C (0.16 °F)	0.11 °C (0.20 °F)
GOST 6651-94	Pt100 (9)		0.10 °C (0.18 °F)	0.12 °C (0.22 °F)
Thermocouples (TC) as per standard			Digital value 1)	Value at current output
IEC 60584, Part 1	Type K (NiCr-Ni) (36)	0 to +800 °C (32 to +1 472 °F)	0.65 °C (1.17 °F)	0.69 °C (1.24 °F)
IEC 60584, Part 1	Type S (PtRh10-Pt) (39)		1.50 °C (2.70 °F)	1.52 °C (2.74 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.60 °C (4.68 °F)	2.61 °C (4.70 °F)

1) Measured value transmitted via HART®.

Measured error for resistance thermometers (RTD) and resistance transmitters

Standard	Designation	Measuring range	Measured error (±)	
			Digital 1)	**D/A 2)**
			Based on measured value 3)	
IEC 60751:2008	Pt100 (1)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (0.1 °C (0.18 °F) + 0.006% * (MV - LRV))	0.03 % (≙ 4.8 μA)
	Pt200 (2)		ME = ± (0.2 °C (0.36 °F) + 0.011% * (MV - LRV))	
	Pt500 (3)	−200 to +510 °C (−328 to +950 °F)	ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))	
	Pt1000 (4)	−200 to +250 °C (−328 to +482 °F)	ME = ± (0.06 °C (0.11 °F) + 0.007% * (MV - LRV))	
JIS C1604:1984	Pt100 (5)	−200 to +510 °C (−328 to +950 °F)	ME = ± (0.08 °C (0.14 °F) + 0.006% * (MV - LRV))	
GOST 6651-94	Pt50 (8)	−185 to +1 100 °C (−301 to +2 012 °F)	ME = ± (0.13 °C (0.23 °F) + 0.008% * (MV - LRV))	
	Pt100 (9)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (0.08 °C (0.14 °F) + 0.0055% * (MV - LRV))	0.03 % (≙ 4.8 μA)

Standard	Designation	Measuring range	Measured error (±)	
			Digital [1]	D/A [2]
DIN 43760 IPTS-68	Ni100 (6)	−60 to +250 °C (−76 to +482 °F)	ME = ± (0.08 °C (0.14 °F) - 0.004% * (MV - LRV))	
	Ni120 (7)			
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.12 °C (0.22 °F) + 0.006% * (MV - LRV))	
	Cu100 (11)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.08 °C (0.14 °F) + 0.003% * (MV - LRV))	
	Ni100 (12)	−60 to +180 °C (−76 to +356 °F)	ME = ± (0.08 °C (0.14 °F) - 0.004% * (MV - LRV))	
	Ni120 (13)			
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to +200 °C (−58 to +392 °F)	ME = ± (0.12 °C (0.22 °F) + 0.004% * (MV - LRV))	
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± 25 mΩ + 0.0032 % * MV	0.03 % (≙ 4.8 µA)
		10 to 2 850 Ω	ME = ± 120 mΩ + 0.006 % * MV	

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal.
3) Deviations from maximum measured error possible due to rounding.

Measured error for thermocouples (TC) and voltage transmitters

Standard	Designation	Measuring range	Measured error (±)	
			Digital [1]	D/A [2]
			Based on measured value [3]	
IEC 60584-1 ASTM E230-3	Type A (30)	0 to +2 500 °C (+32 to +4 532 °F)	ME = ± (1.25 °C (2.25 °F) + 0.026% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Type B (31)	+500 to +1 820 °C (+932 to +3 308 °F)	ME = ± (2.25 °C (4.05 °F) - 0.09% * (MV - LRV))	
IEC 60584-1 ASTM E230-3 ASTM E988-96	Type C (32)	0 to +2 000 °C (+32 to +3 632 °F)	ME = ± (1.15 °C (2.07 °F) + 0.0055% * (MV - LRV))	
ASTM E988-96	Type D (33)		ME = ± (1.25 °C (2.25 °F) - 0.016% * (MV - LRV))	
IEC 60584-1 ASTM E230-3	Type E (34)	−150 to +1 000 °C (−238 to +1 832 °F)	ME = ± (0.4 °C (0.72 °F) - 0.008% * (MV - LRV))	
	Type J (35)	−150 to +1 200 °C (−238 to +2 192 °F)	ME = ± (0.45 °C (0.81 °F) - 0.007% * (MV - LRV))	
	Type K (36)		ME = ± (0.6 °C (1.08 °F) - 0.01% * (MV - LRV))	
	Type N (37)	−150 to +1 300 °C (−238 to +2 372 °F)	ME = ± (0.8 °C (1.44 °F) - 0.025% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Type R (38)	+200 to +1 768 °C (+392 to +3 214 °F)	ME = ± (1.6 °C (2.88 °F) - 0.025% * (MV - LRV))	
	Type S (39)		ME = ± (1.6 °C (2.88 °F) - 0.025% * (MV - LRV))	
	Type T (40)	−150 to +400 °C (−238 to +752 °F)	ME = ± (0.5 °C (0.9 °F) - 0.05% * (MV - LRV))	
DIN 43710	Type L (41)	−150 to +900 °C (−238 to +1 652 °F)	ME = ± (0.5 °C (0.9 °F) - 0.016% * (MV - LRV))	
	Type U (42)	−150 to +600 °C (−238 to +1 112 °F)	ME = ± (0.55 °C (0.99 °F) - 0.04% * (MV - LRV))	
GOST R8.585-2001	Type L (43)	−200 to +800 °C (−328 to +1 472 °F)	ME = ± (2.45 °C (4.41 °F) - 0.015% * (MV - LRV))	
Voltage transmitter (mV)		−20 to +100 mV	ME = ± 10.0 µV	4.8 µA

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal.
3) Deviations from maximum measured error possible due to rounding.

Total measured error of transmitter at current output = √(Measured error digital² + Measured error D/A²)

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), ambient temperature +25 °C (+77 °F), supply voltage 24 V:

Measured error digital = 0.1 °C + 0.006% x (200 °C - (-200 °C)):	0.12 °C (0.22 °F)
Measured error D/A = 0.003 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Measured error digital value (HART):	0.12 °C (0.22 °F)
Measured error analog value (current output): √(Measured error digital² + Measured error D/A²)	0.14 °C (0.25 °F)

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:

Measured error digital = 0.1 °C + 0.006% x (200 °C - (-200 °C)):	0.12 °C (0.22 °F)
Measured error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.108 °F)
Influence of ambient temperature (digital) = (35 - 25) x (0.0017 % x 200 °C - (-200 °C)), min. 0.003 °C	0.07 °C (0.13 °F)
Influence of ambient temperature (D/A) = (35 - 25) x (0.003% x 200 °C)	0.06 °C (0.108 °F)
Influence of supply voltage (digital) = (30 - 24) x (0.01% x 200 °C - (-200 °C)), min. 0.005 °C	0.02 °C (0.036 °F)
Influence of supply voltage (D/A) = (30 - 24) x (0.003% x 200 °C)	0.04 °C (0.72 °F)
Measured error digital value (HART): √(Measured error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.14 °C (0.25 °F)**
Measured error analog value (current output): √(Measured error digital² + Measured error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + Influence of supply voltage (D/A)²	**0.17 °C (0.31 °F)**

Sensor adjustment

Sensor-transmitter matching

RTD sensors are one of the most linear temperature measuring elements. Nevertheless, the output must be linearized. To significantly improve temperature measurement accuracy, the device allows the use of two methods:

- Callendar van Dusen coefficients (Pt100 resistance thermometer)
  The Callendar van Dusen equation is described as:
  $R_T = R_0[1+AT+BT^2+C(T-100)T^3]$

  The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically with the aid of sensor calibration.

- Linearization for copper/nickel resistance thermometers (RTD)
  The polynomial equation for copper/nickel is as follows:
  $R_T = R_0(1+AT+BT^2)$

  The coefficients A and B are used for the linearization of nickel or copper resistance thermometers (RTD). The exact values of the coefficients derive from the calibration data and are specific to each sensor. The sensor-specific coefficients are then sent to the transmitter.

Sensor-transmitter matching using one of the methods mentioned above significantly improves the temperature measurement accuracy of the entire system. This is because the transmitter uses the specific data pertaining to the connected sensor to calculate the measured temperature, instead of using the standardized sensor curve data.

1-point adjustment (offset)

Shifts the sensor value

Current output adjustment Correction of the 4 or 20 mA current output value.

Operating influences The measured error data correspond to 2 σ (Gaussian distribution).

Influence of ambient temperature and supply voltage on operation for resistance thermometers (RTD) and resistance transmitters

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change	
		Digital [1]	D/A [2]	Digital [1]	D/A [2]
		Based on measured value		Based on measured value	
Pt100 (1)	IEC 60751:2008	0.0015% * (MV - LRV), at least 0.003 °C (0.005 °F)	0.003 %	0.001% * (MV - LRV), at least 0.002 °C (0.004 °F)	0.003 %
Pt200 (2)		at least 0.014 °C (0.025 °F)		at least 0.008 °C (0.014 °F)	
Pt500 (3)		0.0015% * (MV - LRV), at least 0.006 °C (0.011 °F)		0.0009% * (MV - LRV), at least 0.003 °C (0.005 °F)	
Pt1000 (4)		at least 0.003 °C (0.005 °F)		at least 0.002 °C (0.004 °F)	
Pt100 (5)	JIS C1604:1984	0.0017% * (MV - LRV), at least 0.003 °C (0.005 °F)		0.0009% * (MV - LRV), at least 0.002 °C (0.004 °F)	
Pt50 (8)	GOST 6651-94	0.0017% * (MV - LRV), at least 0.006 °C (0.011 °F)		0.0011% * (MV - LRV), at least 0.003 °C (0.005 °F)	
Pt100 (9)		0.0015% * (MV - LRV), at least 0.003 °C (0.005 °F)		0.0009% * (MV - LRV), at least 0.002 °C (0.004 °F)	
Ni100 (6)	DIN 43760 IPTS-68	at least 0.002 °C (0.004 °F)	0.003 %	at least 0.001 °C (0.002 °F)	0.003 %
Ni120 (7)					
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	at least 0.005 °C (0.009 °F)		at least 0.003 °C (0.005 °F)	
Cu100 (11)		at least 0.003 °C (0.005 °F)		at least 0.002 °C (0.004 °F)	
Ni100 (12)					
Ni120 (13)		at least 0.002 °C (0.004 °F)		at least 0.001 °C (0.002 °F)	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	at least 0.006 °C (0.011 °F)		at least 0.003 °C (0.005 °F)	
Resistance transmitter (Ω)					
10 to 400 Ω		0.0012% * MV, at least 1 mΩ	0.003 %	0.0007% * MV, at least 1 mΩ	0.003 %
10 to 2 000 Ω		0.0013% * MV, at least 12 mΩ		0.0008% * MV, at least 7 mΩ	

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal

Influence of ambient temperature and supply voltage on operation for thermocouples (TC) and voltage transmitters

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change	
		Digital [1]	D/A [2]	Digital	D/A [2]
		Based on measured value		Based on measured value	
Type A (30)	IEC 60584-1 ASTM E230-3	0.0032% * (MV - LRV), at least 0.010 °C (0.018 °F)	0.003 %	0.0017% * (MV - LRV), at least 0.010 °C (0.018 °F)	0.003 %
Type B (31)		at least 0.020 °C (0.036 °F)		at least 0.010 °C (0.018 °F)	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change	
		Digital [1]	D/A [2]	Digital	D/A [2]
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	0.0025% * (MV - LRV), at least 0.010 °C (0.018 °F)		0.0015% * (MV - LRV), at least 0.010 °C (0.018 °F)	
Type D (33)	ASTM E988-96	0.0023% * (MV - LRV), at least 0.010 °C (0.018 °F)		0.0013% * (MV - LRV)	
Type E (34)	IEC 60584-1 ASTM E230-3	0.0016% * (MV - LRV)		0.001% * (MV - LRV)	
Type J (35)		0.0018% * (MV - LRV)			
Type K (36)		0.0018% * (MV - LRV), at least 0.010 °C (0.018 °F)			
Type N (37)			0.003 %		0.003 %
Type R (38)		at least 0.020 °C (0.036 °F)		at least 0.010 °C (0.018 °F)	
Type S (39)					
Type T (40)		≤ 0.01 °C (0.018 °F)		≤ 0.01 °C (0.018 °F)	
Type L (41)	DIN 43710				
Type U (42)					
Type L (43)	GOST R8.585-2001				
Voltage transmitter (mV)			0.003 %		0.003 %
−20 to 100 mV	-	0.002% * MV		0.0008% * MV	

1) Measured value transmitted via HART®.
2) Percentages based on the configured span of the analog output signal

MV = Measured value

LRV = Lower range value of relevant sensor

Total measured error of transmitter at current output = √(Measured error digital² + Measured error D/A²)

Long-term drift, resistance thermometers (RTD) and resistance transmitters

Designation	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Pt100 (1)	IEC 60751:2008	≤ 0.009% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0103% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0122% * (MV - LRV) or 0.04 °C (0.06 °F)
Pt200 (2)		0.10 °C (0.19 °F)	0.13 °C (0.24 °F)	0.15 °C (0.26 °F)
Pt500 (3)		≤ 0.0095% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.0121% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.0136% * (MV - LRV) or 0.04 °C (0.06 °F)
Pt1000 (4)		≤ 0.0096% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0125% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0143% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.0077% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0102% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0112% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt50 (8)	GOST 6651-94	≤ 0.0076% * (MV - LRV) or 0.05 °C (0.09 °F)	≤ 0.01% * (MV - LRV) or 0.06 °C (0.11 °F)	≤ 0.011% * (MV - LRV) or 0.07 °C (0.12 °F)
Pt100 (9)		≤ 0.008% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0114% * (MV - LRV) or 0.03 °C (0.05 °F)
Ni100 (6)	DIN 43760 IPTS-68	0.02 °C (0.04 °F)	0.02 °C (0.04 °F)	0.03 °C (0.05 °F)
Ni120 (7)				

Designation	Standard	Long-term drift (±) [1]		
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.04 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.11 °F)
Cu100 (11)		0.03 °C (0.05 °F)	0.04 °C (0.06 °F)	0.04 °C (0.06 °F)
Ni100 (12)		0.02 °C (0.04 °F)	0.02 °C (0.04 °F)	0.03 °C (0.05 °F)
Ni120 (13)				
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.04 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.11 °F)
Resistance transmitter				
10 to 400 Ω		≤ 0.0055% * MV or 7 mΩ	≤ 0.0073% * MV or 10 mΩ	≤ 0.008% * (MV - LRV) or 11 mΩ
10 to 2 000 Ω		≤ 0.007% * (MV - LRV) or 47 mΩ	≤ 0.009% * (MV - LRV) or 60 mΩ	≤ 0.0067% * (MV - LRV) or 67 mΩ

1) Whichever is greater

Long-term drift, thermocouples (TC) and voltage transmitters

Designation	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 0.049% * (MV - LRV) or 0.75 °C (1.35 °F)	≤ 0.063% * (MV - LRV) or 0.98 °C (1.76 °F)	≤ 0.068% * (MV - LRV) or 1.06 °C (1.91 °F)
Type B (31)		1.75 °C (3.15 °F)	2.30 °C (4.14 °F)	2.50 °C (4.50 °F)
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	0.80 °C (1.44 °F)	1.02 °C (1.84 °F)	1.10 °C (1.98 °F)
Type D (33)	ASTM E988-96	0.97 °C (1.75 °F)	1.25 °C (2.25 °F)	1.36 °C (2.45 °F)
Type E (34)	IEC 60584-1 ASTM E230-3	0.28 °C (0.50 °F)	0.36 °C (0.65 °F)	0.39 °C (0.70 °F)
Type J (35)		0.34 °C (0.61 °F)	0.44 °C (0.79 °F)	0.48 °C (0.86 °F)
Type K (36)		0.40 °C (0.72 °F)	0.51 °C (0.92 °F)	0.56 °C (1.01 °F)
Type N (37)		0.57 °C (1.03 °F)	0.676 °C (1.37 °F)	0.82 °C (1.48 °F)
Type R (38)		1.28 °C (2.30 °F)	1.69 °C (3.04 °F)	1.85 °C (3.33 °F)
Type S (39)		1.29 °C (2.32 °F)	1.70 °C (3.06 °F)	
Type T (40)		0.42 °C (0.76 °F)	0.55 °C (0.99 °F)	0.60 °C (1.08 °F)
Type L (41)	DIN 43710	0.28 °C (0.50 °F)	0.36 °C (0.65 °F)	0.40 °C (0.72 °F)
Type U (42)		0.41 °C (0.74 °F)	0.54 °C (0.97 °F)	0.58 °C (1.04 °F)
Type L (43)	GOST R8.585-2001	0.34 °C (0.61 °F)	0.45 °C (0.81 °F)	0.48 °C (0.86 °F)
Voltage transmitter (mV)				
−20 to 100 mV		≤ 0.027% * MV or 9 µV	≤ 0.035% * MV or 12 µV	≤ 0.038% * MV or 13 µV

1) Whichever is greater

Analog output long-term drift

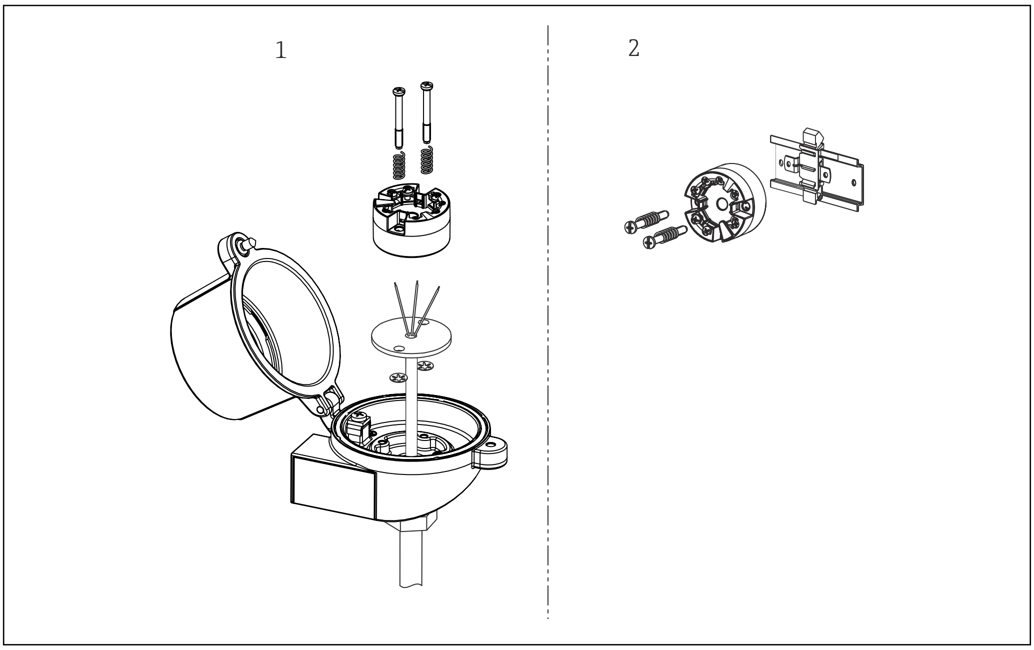
Long-term drift D/A [1] (±)		
after 1 year	after 3 years	after 5 years
0.030%	0.036%	0.038%

1) Percentages based on the configured span of the analog output signal.

Influence of the reference junction	Pt100 DIN IEC 60751 Cl. B (internal reference junction with thermocouples TC)

Installation

Mounting location



4 *Mounting location options for the transmitter*

1 *Terminal head, form B (flat face) as per DIN EN 50446, direct installation on insert with cable entry (middle hole 7 mm (0.28 in))*
2 *With DIN rail clip on DIN rail as per IEC 60715 (TH35)*

When installing the head transmitter in a terminal head form B (flat face), make sure there is sufficient space in the terminal head!

Orientation	No restrictions.

Environment

Ambient temperature	−40 to +85 °C (−40 to +185 °F), for hazardous areas see Ex documentation.
Storage temperature	−50 to +100 °C (−58 to +212 °F)
Operating altitude	Up to 4 000 m (4 374.5 yard) above sea level.
Humidity	Condensation: ▪ Permitted ▪ Max. rel. humidity: 95 % as per IEC 60068-2-30
Climate class	Climate class C1 as per IEC 60654-1
Degree of protection	With screw terminals: IP 20. In the installed state, it depends on the terminal head or field housing used.

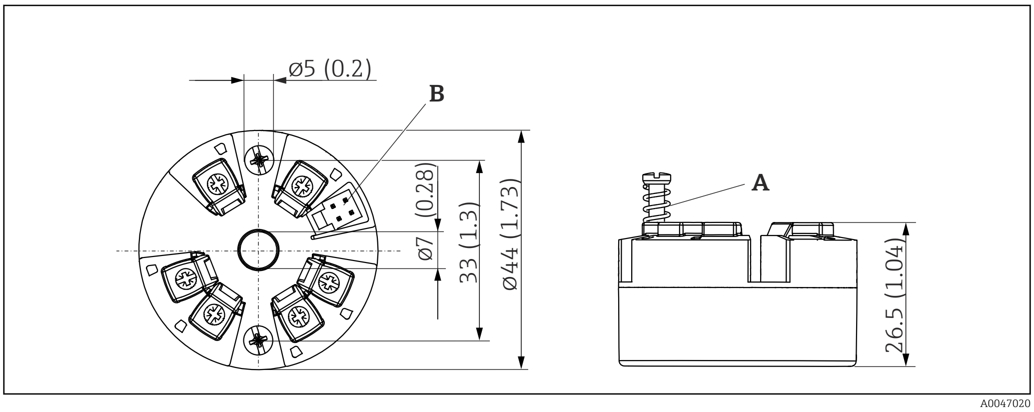
Shock and vibration resistance	Vibration resistance according to DNVGL-CG-0339 : 2015 and DIN EN 60068-2-27 2 to 100 Hz at 4g (increased vibration stress) Shock resistance as per KTA 3505 (section 5.8.4 Shock test)
Electromagnetic compatibility (EMC)	**CE conformity** Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity. All tests were passed both with and without ongoing digital HART® communication. To ensure interference-free HART® communication with EMC influence, a shielded cable must be used, with the shield connected to ground on both sides. Maximum measured error <1% of measuring range. Interference immunity as per IEC/EN 61326 series, industrial requirements Interference emission as per IEC/EN 61326 series, Class B equipment
Insulation class	Class III
Overvoltage category	Overvoltage category II
Pollution degree	Pollution degree 2

Mechanical construction

Design, dimensions

Dimensions in mm (in)

Head transmitter



5 *Version with screw terminals*

A *Spring travel L ≥ 5 mm (not for US - M4 securing screws)*
B *CDI interface for connecting a configuration tool*

Weight	40 to 50 g (1.4 to 1.8 oz)
Materials	All the materials used are RoHS-compliant. ▪ Housing: polycarbonate (PC) ▪ Terminals: screw terminals, nickel-plated brass and gold-plated or tin-plated contacts ▪ Potting: QSIL 553

Operability

Remote operation

The configuration of HART® functions and device-specific parameters takes place via HART®communication or the CDI interface (service interface) of the device. There are special configuration tools from different manufacturers available for this purpose. For more information, contact your Endress+Hauser sales representative.

Certificates and approvals

Current certificates and approvals that are available for the product can be selected via the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

HART® certification

The temperature transmitter is registered by the FieldComm Group™. The device meets the requirements of the HART® Communication Protocol Specifications, Revision 7.

MTTF

168 years

The mean time to failure (MTTF) denotes the theoretically expected time until the device fails during normal operation. The term MTTF is used for systems that cannot be repaired, e.g. temperature transmitters.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

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.

Accessories included in the scope of delivery:
- Printed version of Brief Operating Instructions in English
- ATEX supplementary documentation: ATEX Safety instructions (XA), **C**ontrol **D**rawings (CD)
- Mounting material for head transmitter

Device-specific accessories

Accessories for the head transmitter
Field housing TA30x for Endress+Hauser head transmitter
Adapter for DIN rail mounting, clip as per IEC 60715 (TH35) without securing screws
Standard - DIN mounting set (2 screws + springs, 4 lock washers and 1 CDI interface cover)
US - M4 securing screws (2 M4 screws and 1 CDI interface cover)

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART® communication with FieldCare via the USB interface. For details, see Technical Information TI404F/00
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see Technical Information TI405C/07
WirelessHART adapter	Is used for the wireless connection of field devices. The WirelessHART® adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks. For details, see Operating Instructions BA061S/04
Field Xpert SMT70	Universal, high-performance tablet PC for device configuration The tablet PC enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as a comprehensive, all-in-one solution. With a pre-installed driver library, it is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. For details, see Technical Information TI01342S/04

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://portal.endress.com/webapp/applicator

Accessories	Description
Configurator	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 The Configurator is available on the Endress+Hauser website at: 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.

DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. For details, see Operating Instructions BA00027S

FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00065S

System components

Accessories	Description
RN22	Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART® transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively. The RN22 requires a supply voltage of 24 V_{DC}. For details, see Technical Information TI01515K
RN42	Single-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART® transmission. The device has one active and one passive current input; the outputs can be operated actively or passively. The RN42 can be powered with a wide range voltage of 24 to 230 $V_{AC/DC}$. For details, see Technical Information TI01584K
RIA15	Process display, digital loop-powered display for 4 to 20 mA circuit, panel mounting, with optional HART® communication. Displays 4 to 20 mA or up to 4 HART® process variables For details, see Technical Information TI01043K

Supplementary documentation

The following types of documentation are available on the product pages and in the Download Area of the Endress+Hauser website (www.endress.com/downloads) (depending on the selected device version):

Document	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

Document	Purpose and content of the document
Safety Instructions (XA)	Depending on the approval, Safety Instructions (XA) are supplied with the device. The Safety Instructions are an integral part of the Operating Instructions. ℹ Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

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