Technical Information
iTEMP TMT82

Temperature transmitter



HART® temperature transmitter as head, field or DIN rail device with two universal sensor inputs suitable for use in hazardous areas and SIL 2

Application

- Safe operation in hazardous areas thanks to international approvals such as FM, CSA, ATEX, EAC, NEPSI, IECEx, DNV GL
- 2-channel universal signal inputs: RTD, thermocouple, resistance (Ω) and voltage transmitters (mV), HART® 7 protocol
- HART® 7 communication
- Suited for use in marine applications
- Installation in field housings for remote installation in a harsh environment; Ex d environment; Up to IP 68
- Installation in terminal head form B (flat face) as per DIN EN 50446
- DIN rail housing for installation in cabinets; width 17.5 mm

Benefits

- Robust temperature transmitter delivering precise, long-term stable measurements for high plant availability
- SIL certification up to SIL 2, SC3 according to IEC 61508:2010
- Sensor-transmitter-matching for highest measurement accuracy
- Sensor and hardware failure detection; diagnostic status information according to NAMUR NE 107
- Push-in terminals for fast, tool-free wiring during installation or maintenance

Endress+Hauser
People for Process Automation

Table of contents

Function and system design 3
Measuring principle 3
Measuring system 3

Input 4
Measured variable 4
Measuring range 4
Type of input 5

Output 6
Output signal 6
Failure signal 6
Load 6
Linearization/transmission behavior 7
Mains filter 7
Filter 7
Protocol-specific data 7
Write protection for device parameters 7
Switch-on delay 7

Electrical connection 7
Supply voltage 7
Current consumption 7
Electrical connection 8
Terminals 9

Performance characteristics 10
Response time 10
Update time 10
Reference conditions 10
Maximum measurement error 10
Sensor adjustment 13
Current output adjustment 13
Operating influences 13
Influence of the reference junction 17

Installation 18
Installation location 18
Orientation 19

Environment 19
Ambient temperature range 19
Storage temperature 20
Relative humidity 20
Operating altitude 20
Climate class 20
Degree of protection 20
Shock and vibration resistance 20
Electromagnetic compatibility (EMC) 20
Overvoltage category 20
Pollution degree 20
Protection class 20

Mechanical construction 21
Design and dimensions 21
Weight 25
Materials 25

Operability 26
Local operation 26
Remote operation 26

Certificates and Approvals 27
Functional safety 27
HART certification 27
Test certificate 27

Ordering information 27

Accessories 27
Device-specific accessories 27
Communication-specific accessories 29
Service-specific accessories 29
Online tools 29
System components 30

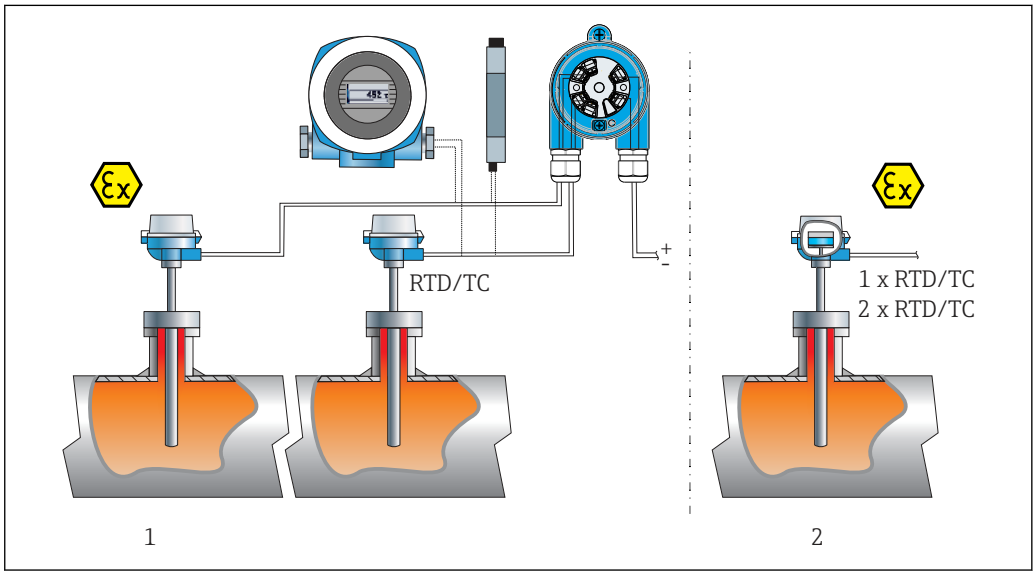
Documentation 30

Function and system design

Measuring principle

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

Measuring system



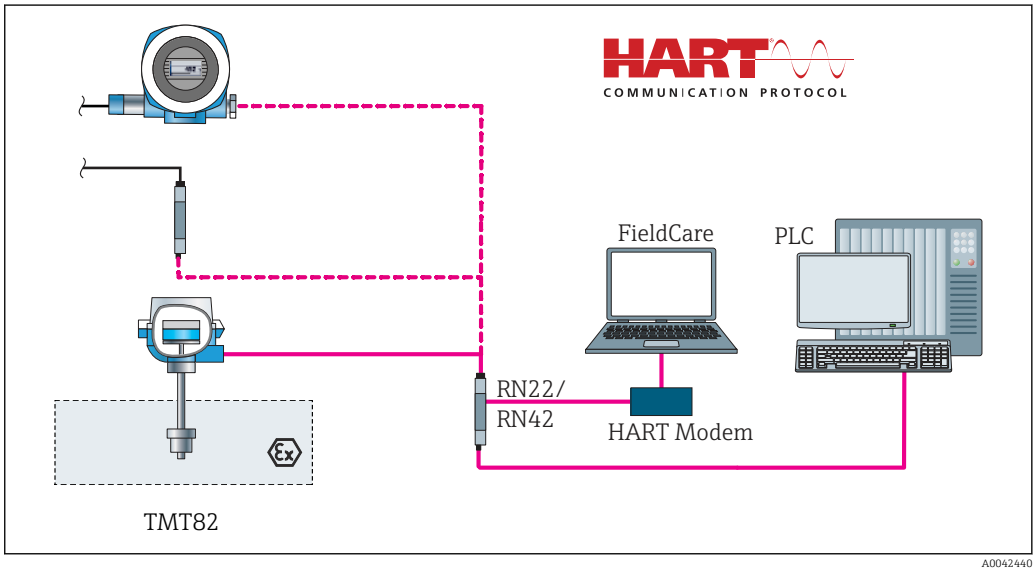
1 *Application examples*

1 *Two sensors with measuring input (RTD or TC) in remote installation with the following advantages: drift warning, sensor backup function and temperature-dependent sensor switching*
2 *Integrated transmitter - 1 x RTD/TC or 2 x RTD/TC for redundancy*

The manufacturer 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 two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART communication and as a 4 to 20 mA current signal. It can be installed as an intrinsically safe apparatus in hazardous areas. It is used for instrumentation in the terminal head (flat face) as per DIN EN 50446, for installation in the cabinet on a TH35 mounting rail as per EN 60715 or mounted in a 2-compartment field mount housing with glass window and included plug-on display.



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
- Ambient temperature out-of-range detection

Corrosion detection as per NAMUR NE 89

Corrosion of the sensor connection cables can cause incorrect measured value readings. The transmitter offers the possibility of detecting any corrosion of the thermocouples, voltage transmitters (mV) and resistance thermometers, resistance transmitters (Ohm) with 4-wire connection before a measured value is corrupted. The transmitter prevents incorrect measured values from being exported and can issue a warning via the HART protocol if conductor resistance values exceed plausible limits.

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 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.

2-channel functions

These functions increase the reliability and availability of the process values:
- Sensor backup switches to the second sensor if the primary sensor fails
- Drift warning or alarm if the deviation between sensor 1 and sensor 2 is less than or greater than a predefined limit value
- Temperature-dependent switching between sensors which are used in different measuring ranges
- Mean value or differential measurement from two sensors
- Mean value measurement with sensor redundancy

Not all modes are available in the SIL mode, see the 'Functional Safety Manual'.

Functional Safety Manual for temperature field transmitter TMT82: FY01105T

Input

Measured variable

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

Measuring range

It is possible to connect two sensors that are independent of one another [1]. The measuring inputs are not galvanically isolated from each other.

Resistance thermometer (RTD) as per standard	Description	α	Measuring range limits	Min. measuring span
IEC 60751:2008	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)

1) In the case of 2-channel measurement the same measuring unit must be configured for the two channels (e.g. both °C or F or K). Independent 2-channel measurement of a resistance transmitter (Ohm) and voltage transmitter (mV) is not possible.

Resistance thermometer (RTD) as per standard	Description	α	Measuring range limits	Min. measuring span
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 the 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	Description	Measuring range limits		Min. measuring 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 (−418 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 reference junction: configurable value −40 to 85 °C (−40 to 185 °F) ▪ Maximum sensor wire resistance 10 kΩ (If the sensor wire resistance is greater than 10 kΩ, an error message is output in accordance with NAMUR NE 89)			
Voltage transmitter (mV)	Millivolt transmitter (mV)	−20 to 100 mV		5 mV

Type of input

The following connection combinations are possible when both sensor inputs are assigned:

		Sensor input 1			
Sensor input 2		**RTD or resistance transmitter, 2-wire**	**RTD or resistance transmitter, 3-wire**	**RTD or resistance transmitter, 4-wire**	**Thermocouple (TC), voltage transmitter**
	RTD or resistance transmitter, 2-wire	☑	☑	-	☑
	RTD or resistance transmitter, 3-wire	☑	☑	-	☑

		Sensor input 1			
	RTD or resistance transmitter, 4-wire	-	-	-	-
	Thermocouple (TC), voltage transmitter	☑	☑	☑	☑
	For field mount housing with a thermocouple on sensor input 1: It is not possible to connect a second thermocouple (TC), resistance thermometer, resistance transmitter or voltage transmitter on sensor input 2 as this input is needed for the external reference junction.				

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)

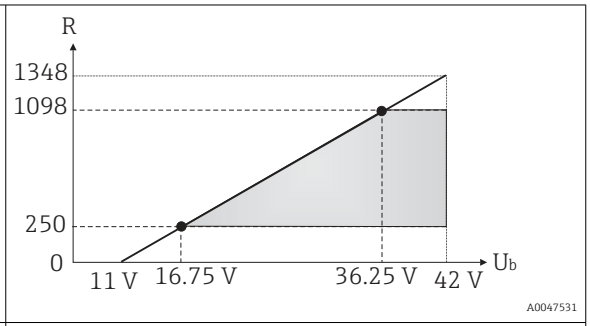
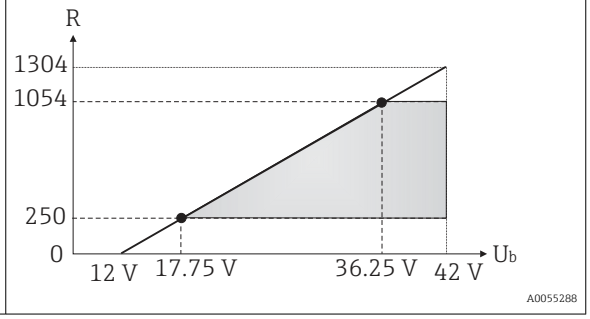
Failure signal

Failure information as per NAMUR NE43:

The 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 or sensor short-circuit	≤ 3.6 mA ("low") or ≥ 21 mA ("high"), can be selected The "high" alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

Load

Head transmitter: $R_{b\,max.} = (U_{b\,max.} - 11\ V) / 0.023\ A$ (current output).	
DIN rail transmitter: $R_{b\,max.} = (U_{b\,max.} - 12\ V) / 0.023\ A$ (current output).	

Load in Ω. U_b = supply voltage in V DC

Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Mains filter

$^{50}/_{60}$ Hz

Filter

1st order digital filter: 0 to 120 s

Protocol-specific data

HART version	7
Device address in the multi-drop mode [1]	Software setting addresses 0 to 63
Device description files (DD)	Information and files are available free of charge at: www.endress.com www.fieldcommgroup.org
Load (communication resistor)	Min. 250 Ω

1) Not possible in SIL mode, see Functional Safety Manual FY01105T

Write protection for device parameters

- Hardware: Write protection for head transmitter on optional display using DIP switch
- Software: Write protection using password

Switch-on delay

- Until the start of HART communication, approx. 6 s [2], while switch-on delay = I_a ≤3.8 mA
- Until the first valid measured value signal is present for HART communication and at the current output, approx. 15 s, while switch-on delay = I_a ≤ 3.8 mA

Electrical connection

Supply voltage

Values for non-hazardous areas, protected against polarity reversal:

- Head transmitter
  - 11 V ≤ Vcc ≤ 42 V (standard)
  - 11 V ≤ Vcc ≤ 32 V (SIL mode)
  - I: ≤ 23 mA
- DIN rail transmitter
  - 12 V ≤ Vcc ≤ 42 V (standard)
  - 12 V ≤ Vcc ≤ 32 V (SIL mode)
  - I: ≤ 23 mA

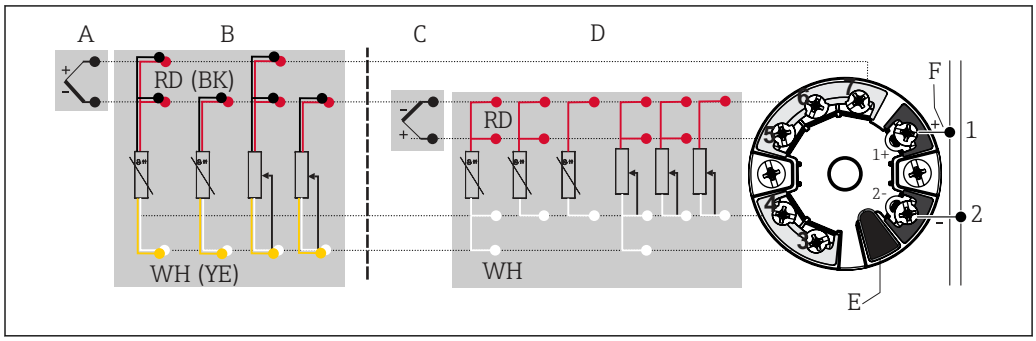
Values for hazardous area, see Ex documentation.

Current consumption

Current consumption ≤ 23 mA

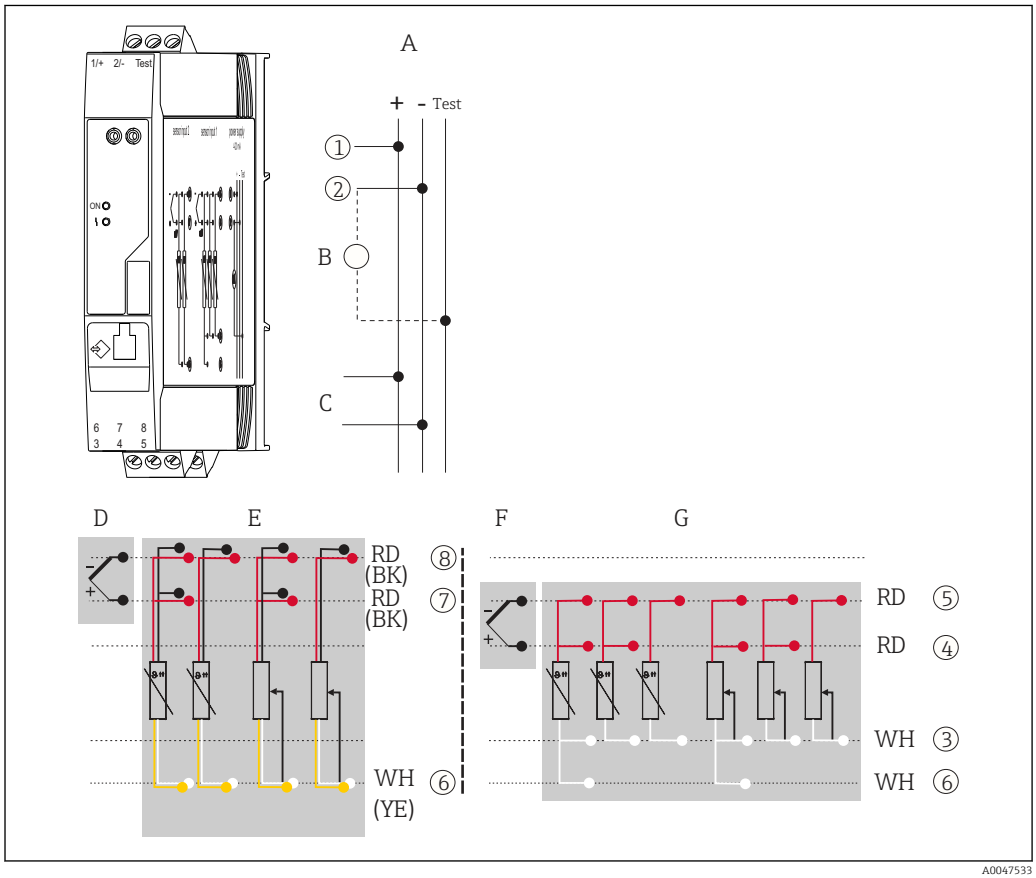
2) Does not apply to SIL mode

Electrical connection



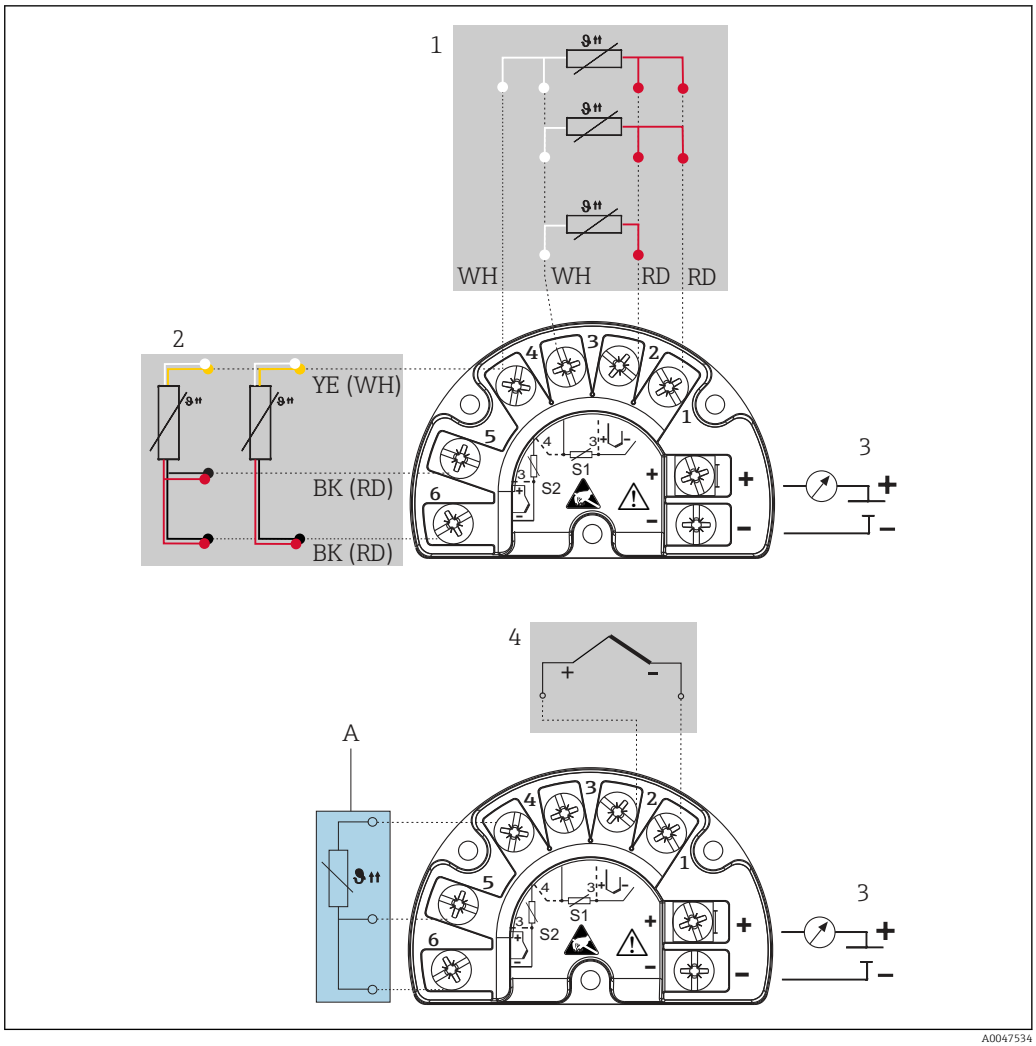
3 *Assignment of terminal connections for head transmitter*

A Sensor input 2, TC and mV, external cold junction (CJ) Pt1000
B Sensor input 2, TC and mV, internal cold junction (CJ)
C Sensor input 2, RTD and Ω, 2- and 3-wire
D Sensor input 1, TC and mV, external cold junction (CJ) Pt1000
E Sensor input 1, TC and mV, internal cold junction (CJ)
F Sensor input 1, RTD and Ω, 2-, 3- and 4-wire
G Display connection, service interface
H Bus connection and power supply



4 *Assignment of terminal connections for DIN rail transmitter*

A Bus connection and power supply
B To check the output current, an ammeter (DC measurement) can be connected between the "Test" and "-" terminals.
C HART connection
D Sensor input 2, TC and mV
E Sensor input 2, RTD and Ω, 3- and 2-wire
F Sensor input 1, TC and mV
G Sensor input 1, RTD and Ω, 4-, 3- and 2-wire



5 *Terminal assignment of the field mount housing with separate terminal compartment*

1 *Sensor input 1, RTD, : 2-, 3- and 4-wire*
2 *Sensor input 2, RTD: 2-, 3-wire*
3 *Bus connection and power supply*
4 *Sensor input 1, thermocouple (TC)*
A *If sensor input thermocouple (TC) is selected: permanent connection of the external reference junction, terminals 4, 5 and 6 (Pt100, IEC 60751, class B, 3-wire). It is not possible to connect a second thermocouple (TC) on sensor 2.*

An unshielded installation cable is sufficient if only the analog signal is used. The use of shielded cables is recommended in the event of increased EMC interference. As of a sensor cable length of 30 m (98.4 ft)30 m (98.4 ft), a shielded cable must be used for a head transmitter in the field mount housing with a separate terminal compartment and for the DIN rail transmitter.

A shielded cable is recommended for HART communication. Observe grounding concept of the plant. A minimum load of 250 Ω is required in the signal circuit in order to operate the HART transmitter via the HART protocol (terminals 1 and 2).

Terminals

Choice of screw terminals or push-in terminals for sensor and power supply cables:

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	≤ 2.5 mm² (14 AWG)
		Field mount housing: 2.5 mm² (12 AWG) plus ferrule

Terminal design	Cable design	Cable cross-section
Push-in terminals (cable version, stripping length = min. 10 mm (0.39 in)	Rigid or flexible	0.2 to 1.5 mm² (24 to 16 AWG)
	Flexible with ferrules (with or without plastic ferrule)	0.25 to 1.5 mm² (24 to 16 AWG)

Ferrules must be used with push-in terminals and when using flexible cables with a cable cross-section of ≤ 0.3 mm². Otherwise, the use of ferrules when connecting flexible cables to push-in terminals is not recommended.

Performance characteristics

Response time

The measured value update depends on the sensor type and connection type. It falls within the following ranges:

Resistance thermometers (RTD)	0.9 to 1.5 s (depends on the connection type 2/3/4-wire)
Thermocouples (TC)	1.1 s
Reference junction	1.1 s

When recording step responses, it must be taken into account that the times for measuring the second channel and the internal reference junction may be added to the specified times.

Update time

≤ 100 ms

Reference conditions

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

Maximum measurement error

In accordance with EN IEC 62828 and the reference operating conditions specified above. The measurement error data correspond to ±2 σ (Gaussian distribution). The data include non-linearities and repeatability.

Typically

Standard	Description	Measuring range	Typical measurement 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)	0.07 °C (0.13 °F)	0.09 °C (0.16 °F)
IEC 60751:2008	Pt1000 (4)		0.05 °C (0.09 °F)	0.08 °C (0.14 °F)
GOST 6651-94	Pt100 (9)		0.06 °C (0.11 °F)	0.08 °C (0.14 °F)
Thermocouples (TC) as per standard			Digital value	Value at current output
IEC 60584, Part 1 ASTM E230-3	Type K (NiCr-Ni) (36)	0 to 800 °C (32 to 1 472 °F)	0.25 °C (0.45 °F)	0.35 °C (0.63 °F)
	Type R (PtRh13-Pt) (38)		0.59 °C (1.06 °F)	0.64 °C (1.15 °F)
	Type S (PtRh10-Pt) (39)		0.67 °C (1.21 °F)	0.71 °C (1.28 °F)

1) Measured value transmitted via HART.

Measurement error for resistance thermometers (RTD) and resistance transmitters

Standard	Description	Measuring range	Measurement 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 = ± (0.05 °C (0.09 °F) + 0.0039% * (MV - LRL))	0.03 % (≙ 4.8 µA)
	Pt200 (2)		ME = ± (0.04 °C (0.07 °F) + 0.01% * (MV - LRL))	
	Pt500 (3)	−200 to 500 °C (−328 to 932 °F)	ME = ± (0.02 °C (0.04 °F) + 0.01% * (MV - LRL))	
	Pt1000 (4)	−200 to 250 °C (−328 to 482 °F)	ME = ± (0.01 °C (0.02 °F) + 0.009% * (MV - LRL))	
JIS C1604:1984	Pt100 (5)	−200 to 510 °C (−328 to 950 °F)	ME = ± (0.04 °C (0.07 °F) + 0.005% * (MV - LRL))	
GOST 6651-94	Pt50 (8)	−185 to 1 100 °C (−301 to 2 012 °F)	ME = ± (0.08 °C (0.14 °F) + 0.007% * (MV - LRL))	
	Pt100 (9)	−200 to 850 °C (−328 to 1 562 °F)	ME = ± (0.04 °C (0.07 °F) + 0.005% * (MV - LRL))	
DIN 43760 IPTS-68	Ni100 (6)	−60 to 250 °C (−76 to 482 °F)	ME = ± (0.042 °C (0.076 °F) - 0.005% * (MV - LRL))	
	Ni120 (7)		ME = ± (0.035 °C (0.063 °F) - 0.004% * (MV - LRL))	
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−180 to 200 °C (−292 to 392 °F)	ME = ± (0.09 °C (0.16 °F) + 0.006% * (MV - LRL))	
	Cu100 (11)	−180 to 200 °C (−292 to 392 °F)	ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRL))	
	Ni100 (12)	−60 to 180 °C (−76 to 356 °F)	ME = ± (0.05 °C (0.09 °F) - 0.005% * (MV - LRL))	
	Ni120 (13)		ME = ± (0.05 °C (0.09 °F) - 0.005% * (MV - LRL))	
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to 200 °C (−58 to 392 °F)	ME = ± (0.10 °C (0.18 °F) + 0.004% * (MV - LRL))	
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± (16 Ω + 0.0025% * (MV - LRL))	0.03 % (≙ 4.8 µA)
		10 to 2 000 Ω	ME = ± (30 Ω + 0.007% * (MV - LRL))	

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

Measurement error for thermocouples (TC) and voltage transmitters

Standard	Description	Measuring range	Measurement 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 = ± (0.7 °C (1.26 °F) + 0.019% * (MV - LRL))	0.03 % (≙ 4.8 µA)
	Type B (31)	500 to 1 820 °C (932 to 3 308 °F)	ME = ± (1.15 °C (2.07 °F) - 0.04% * (MV - LRL))	
IEC 60584-1 ASTM E230-3 ASTM E988-96	Type C (32)	0 to 2 000 °C (32 to 3 632 °F)	ME = ± (0.4 °C (0.72 °F) + 0.0065% * (MV - LRL))	
ASTM E988-96	Type D (33)	0 to 2 000 °C (32 to 3 632 °F)	ME = ± (0.55 °C (0.99 °F) - 0.005% * (MV - LRL))	
IEC 60584-1 ASTM E230-3	Type E (34)	−150 to 1 000 °C (−238 to 1 832 °F)	ME = ± (0.16 °C (0.29 °F) - 0.001% * (MV - LRL))	
	Type J (35)	−150 to 1 200 °C (−238 to 2 192 °F)	ME = ± (0.22 °C (0.4 °F) - 0.0045% * (MV - LRL))	
	Type K (36)		ME = ± (0.28 °C (0.5 °F) - 0.003% * (MV - LRL))	
	Type N (37)	−150 to 1 300 °C (−238 to 2 372 °F)	ME = ± (0.37 °C (0.67 °F) - 0.01% * (MV - LRL))	
	Type R (38)	200 to 1 768 °C (392 to 3 214 °F)	ME = ± (0.65 °C (1.17 °F) - 0.01% * (MV - LRL))	
	Type S (39)		ME = ± (0.7 °C (1.26 °F) - 0.005% * (MV - LRL))	
	Type T (40)	−150 to 400 °C (−238 to 752 °F)	ME = ± (0.3 °C (0.54 °F) - 0.027% * (MV - LRL))	
DIN 43710	Type L (41)	−150 to 900 °C (−238 to 1 652 °F)	ME = ± (0.24 °C (0.43 °F) - 0.0055% * (MV - LRL))	
	Type U (42)	−150 to 600 °C (−238 to 1 112 °F)	ME = ± (0.33 °C (0.59 °F) - 0.028% * (MV - LRL))	
GOST R8.585-2001	Type L (43)	−200 to 800 °C (−328 to 1 472 °F)	ME = ± (2.2 °C (3.96 °F) - 0.015% * (MV - LRL))	

Standard	Description	Measuring range	Measurement error (±)	
Voltage transmitter (mV)		−20 to 100 mV	ME = ± 10 µV	4.8 µA

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

MV = measured value

LRL = lower range limit of the sensor in question

Total measurement error of transmitter at current output = √(Measurement error digital² + Measurement 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:

Measurement error digital = 0.05 °C+ 0.0039% x (200 °C - (-200 °C)):	0.07 °C (0.13 °F)
Measurement error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Measurement error digital value (HART):	0.07 °C (0.13 °F)
Measurement error analog value (current output): √(measurement error digital² + measurement error D/A²)	0.09 °C (0.16 °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:

Measurement error digital = 0.05 °C+ 0.0039% x (200 °C - (-200 °C)):	0.07 °C (0.13 °F)
Measurement error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Influence of ambient temperature (digital) = (35 - 25) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) x (0.001% x 200 °C)	0.02 °C (0.04 °F)
Influence of supply voltage (digital) = (30 - 24) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) x (0.001% x 200 °C)	0.01 °C (0.02 °F)
Measurement error digital value (HART): √(Measurement error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.12 °C (0.22 °F)**
Measurement error analog value (current output): √(Measurement error digital² + Measurement 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	**0.13 °C (0.23 °F)**

The measurement error data correspond to ±2 σ(Gaussian distribution).

MV = measured value

LRL = lower range limit of the sensor in question

Physical input measuring range of sensors	
10 to 400 Ω	Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120

10 to 2 000 Ω	Pt200, Pt500, Pt1000
–20 to 100 mV	Thermocouples type: A, B, C, D, E, J, K, L, N, R, S, T, U

Other measurement errors apply in SIL mode.

For more information, please refer to Functional Safety Manual FY01105T.

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

2-point adjustment (sensor trimming)

Correction (slope and offset) of the measured sensor value at transmitter input

Current output adjustment

Correction of 4 or 20 mA current output value (not possible in SIL mode)

Operating influences

The measurement error data correspond to ±2 σ (Gaussian distribution).

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

Description	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
		Maximum	Based on measured value		Maximum	Based on measured value	
Pt100 (1)	IEC 60751:2008	≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)	0.001 %	≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)	0.001 %
Pt200 (2)		≤ 0.026 °C (0.047 °F)	-		≤ 0.026 °C (0.047 °F)	-	
Pt500 (3)		≤ 0.014 °C (0.025 °F)	0.002% * (MV - LRL), at least 0.009 °C (0.016 °F)		≤ 0.014 °C (0.025 °F)	0.002% * (MV - LRL), at least 0.009 °C (0.016 °F)	
Pt1000 (4)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRL), at least 0.004 °C (0.007 °F)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRL), at least 0.004 °C (0.007 °F)	

Description	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Pt100 (5)	JIS C1604:1984		0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)			0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)	
Pt50 (8)	GOST 6651-94	≤ 0.03 °C (0.054 °F)	0.002% * (MV - LRL), at least 0.01 °C (0.018 °F)		≤ 0.03 °C (0.054 °F)	0.002% * (MV - LRL), at least 0.01 °C (0.018 °F)	
Pt100 (9)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRL), at least 0.005 °C (0.009 °F)	
Ni100 (6)	DIN 43760 IPTS-68	≤ 0.005 °C (0.009 °F)	-		≤ 0.005 °C (0.009 °F)	-	
Ni120 (7)			-			-	
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.008 °C (0.014 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Cu100 (11)			0.002% * (MV - LRL), at least 0.004 °C (0.007 °F)			0.002% * (MV - LRL), at least 0.004 °C (0.007 °F)	
Ni100 (12)		≤ 0.004 °C (0.007 °F)	-		≤ 0.004 °C (0.007 °F)	-	
Ni120 (13)			-			-	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.008 °C (0.014 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Resistance transmitter (Ω)							
10 to 400 Ω		≤ 6 mΩ	0.0015% * (MV - LRL), at least 1.5 mΩ	0.001 %	≤ 6 mΩ	0.0015% * (MV - LRL), at least 1.5 mΩ	0.001 %
10 to 2 000 Ω		≤ 30 mΩ	0.0015% * (MV - LRL), at least 15 mΩ		≤ 30 mΩ	0.0015% * (MV - LRL), at least 15 mΩ	

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

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

Description	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
		Maximum	Based on measured value		Maximum	Based on measured value	
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 0.14 °C (0.25 °F)	0.0055% * (MV - LRL), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.14 °C (0.25 °F)	0.0055% * (MV - LRL), at least 0.03 °C (0.054 °F)	0.001 %
Type B (31)		≤ 0.06 °C (0.11 °F)	-		≤ 0.06 °C (0.11 °F)	-	
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	≤ 0.09 °C (0.16 °F)	0.0045% * (MV - LRL), at least 0.03 °C (0.054 °F)		≤ 0.09 °C (0.16 °F)	0.0045% * (MV - LRL), at least 0.03 °C (0.054 °F)	
Type D (33)	ASTM E988-96	≤ 0.08 °C (0.14 °F)	0.004% * (MV - LRL), at least 0.035 °C (0.063 °F)		≤ 0.08 °C (0.14 °F)	0.004% * (MV - LRL), at least 0.035 °C (0.063 °F)	
Type E (34)	IEC 60584-1 ASTM E230-3	≤ 0.03 °C (0.05 °F)	0.003% * (MV - LRL), at least 0.016 °C (0.029 °F)		≤ 0.03 °C (0.05 °F)	0.003% * (MV - LRL), at least 0.016 °C (0.029 °F)	
Type J (35)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV - LRL), at least 0.02 °C (0.036 °F)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV - LRL), at least 0.02 °C (0.036 °F)	
Type K (36)		≤ 0.04 °C (0.07 °F)	0.003% * (MV - LRL), at least 0.013 °C (0.023 °F)		≤ 0.04 °C (0.07 °F)	0.003% * (MV - LRL), at least 0.013 °C (0.023 °F)	
Type N (37)			0.0028% * (MV - LRL), at least 0.020 °C (0.036 °F)			0.0028% * (MV - LRL), at least 0.020 °C (0.036 °F)	
Type R (38)		≤ 0.06 °C (0.11 °F)	0.0035% * (MV - LRL), at least 0.047 °C (0.085 °F)		≤ 0.06 °C (0.11 °F)	0.0035% * (MV - LRL), at least 0.047 °C (0.085 °F)	

Description	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Type S (39)		≤ 0.05 °C (0.09 °F)	-		≤ 0.05 °C (0.09 °F)	-	
Type T (40)		≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °F)	-	
Type L (41)	DIN 43710	≤ 0.02 °C (0.04 °F)	-		≤ 0.02 °C (0.04 °F)	-	
Type U (42)		≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °F)	-	
Type L (43)	GOST R8.585-2001	≤ 0.01 °C (0.02 °F)	-		≤ 0.01 °C (0.02 °F)	-	
Voltage transmitter (mV)				0.001 %			0.001 %
−20 to 100 mV	-	≤ 3 µV	-		≤ 3 µV	-	

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

MV = measured value

LRL = lower range limit of the sensor in question

Total measurement error of transmitter at current output = $\sqrt{}$(Measurement error digital^2 + Measurement error D/A^2)

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

Description	Standard	Long-term drift (±) [1]				
		after 1 year	after 3 years	after 5 years	after 10 years	after 20 years
		Based on measured value				
Pt100 (1)	IEC 60751:2008	≤ 0.016% * (MV - LRL) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRL) or 0.05 °C (0.09 °F)	≤ 0.028% * (MV - LRL) or 0.06 °C (0.10 °F)	≤ 0.03% * (MV - LRL) or 0.065 °C (0.12 °F)	≤ 0.03% * (MV - LRL) or 0.07 °C (0.13 °F)
Pt200 (2)		0.25 °C (0.44 °F)	0.41 °C (0.73 °F)	0.50 °C (0.91 °F)	0.58 °C (1.04 °F)	0.58 °C (1.04 °F)
Pt500 (3)		≤ 0.018% * (MV - LRL) or 0.08 °C (0.14 °F)	≤ 0.03% * (MV - LRL) or 0.14 °C (0.25 °F)	≤ 0.036% * (MV - LRL) or 0.17 °C (0.31 °F)	≤ 0.05% * (MV - LRL) or 0.2 °C (0.36 °F)	≤ 0.05% * (MV - LRL) or 0.2 °C (0.36 °F)
Pt1000 (4)		≤ 0.0185% * (MV - LRL) or 0.04 °C (0.07 °F)	≤ 0.031% * (MV - LRL) or 0.07 °C (0.12 °F)	≤ 0.038% * (MV - LRL) or 0.08 °C (0.14 °F)	≤ 0.05% * (MV - LRL) or 0.1 °C (0.18 °F)	≤ 0.05% * (MV - LRL) or 0.1 °C (0.18 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.015% * (MV - LRL) or 0.04 °C (0.07 °F)	≤ 0.024% * (MV - LRL) or 0.07 °C (0.12 °F)	≤ 0.027% * (MV - LRL) or 0.08 °C (0.14 °F)	≤ 0.027% * (MV - LRL) or 0.085 °C (0.153 °F)	≤ 0.027% * (MV - LRL) or 0.085 °C (0.153 °F)
Pt50 (8)	GOST 6651-94	≤ 0.017% * (MV - LRL) or 0.07 °C (0.13 °F)	≤ 0.027% * (MV - LRL) or 0.12 °C (0.22 °F)	≤ 0.03% * (MV - LRL) or 0.14 °C (0.25 °F)	≤ 0.03% * (MV - LRL) or 0.12 °C (0.22 °F)	≤ 0.03% * (MV - LRL) or 0.12 °C (0.22 °F)
Pt100 (9)		≤ 0.016% * (MV - LRL) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRL) or 0.07 °C (0.12 °F)	≤ 0.028% * (MV - LRL) or 0.07 °C (0.13 °F)	≤ 0.03% * (MV - LRL) or 0.06 °C (0.11 °F)	≤ 0.03% * (MV - LRL) or 0.06 °C (0.11 °F)
Ni100 (6)	DIN 43760 IPTS-68	0.04 °C (0.06 °F)	0.05 °C (0.10 °F)	0.061 °C (0.11 °F)	0.065 °C (0.12 °F)	0.065 °C (0.12 °F)
Ni120 (7)					0.061 °C (0.11 °F)	0.061 °C (0.11 °F)
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.11 °C (0.20 °F)	0.11 °C (0.198 °F)	0.11 °C (0.198 °F)
Cu100 (11)		≤ 0.015% * (MV - LRL) or 0.04 °C (0.06 °F)	≤ 0.024% * (MV - LRL) or 0.06 °C (0.10 °F)	≤ 0.027% * (MV - LRL) or 0.06 °C (0.11 °F)		
Ni100 (12)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)	0.058 °C (0.104 °F)	0.058 °C (0.104 °F)

Description	Standard	Long-term drift (±) [1]				
Ni120 (13)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)		
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.10 °C (0.18 °F)	0.11 °C (0.198 °F)	0.11 °C (0.198 °F)
Resistance transmitter						
10 to 400 Ω		≤ 0.0122% * (MV - LRL) or 12 mΩ	≤ 0.02% * (MV - LRL) or 20 mΩ	≤ 0.022% * (MV - LRL) or 22 mΩ	≤ 0.025% * (MV - LRL) or 30 mΩ	≤ 0.025% * (MV - LRL) or 250 mΩ
10 to 2 000 Ω		≤ 0.015% * (MV - LRL) or 144 mΩ	≤ 0.024% * (MV - LRL) or 240 mΩ	≤ 0.03% * (MV - LRL) or 295 mΩ	≤ 0.16% * (MV - LRL) or 350 mΩ	≤ 0.16% * (MV - LRL) or 1 600 mΩ

1) Whichever is greater

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

Description	Standard	Long-term drift (±) [1]				
		after 1 year	after 3 years	after 5 years	after 10 years	after 20 years
		Based on measured value				
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 0.048% * (MV - LRL) or 0.46 °C (0.83 °F)	≤ 0.072% * (MV - LRL) or 0.69 °C (1.24 °F)	≤ 0.1% * (MV - LRL) or 0.94 °C (1.69 °F)	≤ 0.11% * (MV - LRL) or 1 °C (1.8 °F)	≤ 0.11% * (MV - LRL) or 1.1 °C (1.98 °F)
Type B (31)		1.08 °C (1.94 °F)	1.63 °C (2.93 °F)	2.23 °C (4.01 °F)	2.5 °C (4.5 °F)	2.5 °C (4.5 °F)
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	≤ 0.038% * (MV - LRL) or 0.41 °C (0.74 °F)	≤ 0.057% * (MV - LRL) or 0.62 °C (1.12 °F)	≤ 0.078% * (MV - LRL) or 0.85 °C (1.53 °F)	≤ 0.085% * (MV - LRL) or 1.0 °C (1.8 °F)	≤ 0.085% * (MV - LRL) or 1.0 °C (1.8 °F)
Type D (33)	ASTM E988-96	≤ 0.035% * (MV - LRL) or 0.57 °C (1.03 °F)	≤ 0.052% * (MV - LRL) or 0.86 °C (1.55 °F)	≤ 0.071% * (MV - LRL) or 1.17 °C (2.11 °F)	≤ 0.08% * (MV - LRL) or 1.3 °C (2.34 °F)	≤ 0.08% * (MV - LRL) or 1.3 °C (2.34 °F)
Type E (34)	IEC 60584-1 ASTM E230-3	≤ 0.024% * (MV - LRL) or 0.15 °C (0.27 °F)	≤ 0.037% * (MV - LRL) or 0.23 °C (0.41 °F)	≤ 0.05% * (MV - LRL) or 0.31 °C (0.56 °F)	≤ 0.06% * (MV - LRL) or 0.4 °C (0.72 °F)	≤ 0.06% * (MV - LRL) or 0.4 °C (0.72 °F)
Type J (35)		≤ 0.025% * (MV - LRL) or 0.17 °C (0.31 °F)	≤ 0.037% * (MV - LRL) or 0.25 °C (0.45 °F)	≤ 0.051% * (MV - LRL) or 0.34 °C (0.61 °F)	≤ 0.06% * (MV - LRL) or 0.4 °C (0.72 °F)	≤ 0.06% * (MV - LRL) or 0.4 °C (0.72 °F)
Type K (36)		≤ 0.027% * (MV - LRL) or 0.23 °C (0.41 °F)	≤ 0.041% * (MV - LRL) or 0.35 °C (0.63 °F)	≤ 0.056% * (MV - LRL) or 0.48 °C (0.86 °F)	≤ 0.06% * (MV - LRL) or 0.55 °C (0.99 °F)	≤ 0.06% * (MV - LRL) or 0.55 °C (0.99 °F)
Type N (37)		0.36 °C (0.65 °F)	0.55 °C (0.99 °F)	0.75 °C (1.35 °F)	0.8 °C (1.44 °F)	0.8 °C (1.44 °F)
Type R (38)		0.83 °C (1.49 °F)	1.26 °C (2.27 °F)	1.72 °C (3.10 °F)	1.9 °C (3.42 °F)	1.9 °C (3.42 °F)
Type S (39)		0.84 °C (1.51 °F)	1.27 °C (2.29 °F)	1.73 °C (3.11 °F)	1.9 °C (3.42 °F)	1.9 °C (3.42 °F)
Type T (40)		0.25 °C (0.45 °F)	0.37 °C (0.67 °F)	0.51 °C (0.92 °F)	0.6 °C (1.08 °F)	0.6 °C (1.08 °F)
Type L (41)	DIN 43710	0.20 °C (0.36 °F)	0.31 °C (0.56 °F)	0.42 °C (0.76 °F)	≤ 0.05% * (MV - LRL) or 0.4 °C (0.72 °F)	≤ 0.05% * (MV - LRL) or 0.4 °C (0.72 °F)
Type U (42)		0.24 °C (0.43 °F)	0.37 °C (0.67 °F)	0.50 °C (0.90 °F)	0.6 °C (1.08 °F)	0.6 °C (1.08 °F)
Type L (43)	GOST R8.585-2001	0.22 °C (0.40 °F)	0.33 °C (0.59 °F)	0.45 °C (0.81 °F)	0.5 °C (0.9 °F)	0.5 °C (0.9 °F)
Voltage transmitter (mV)						
– 20 to 100 mV		≤ 0.027% * (MV - LRL) or 5.5 µV	≤ 0.041% * (MV - LRL) or 8.2 µV	≤ 0.056% * (MV - LRL) or 11.2 µV	≤ 0.07% * (MV - LRL) or 12 µV	≤ 0.07% * (MV - LRL) or 12 µV

1) Whichever is greater

Long-term drift analog output

Long-term drift D/A [1] (±)				
after 1 year	after 3 years	after 5 years	after 10 years	after 20 years
0.021%	0.029%	0.031%	0.031%	0.031%

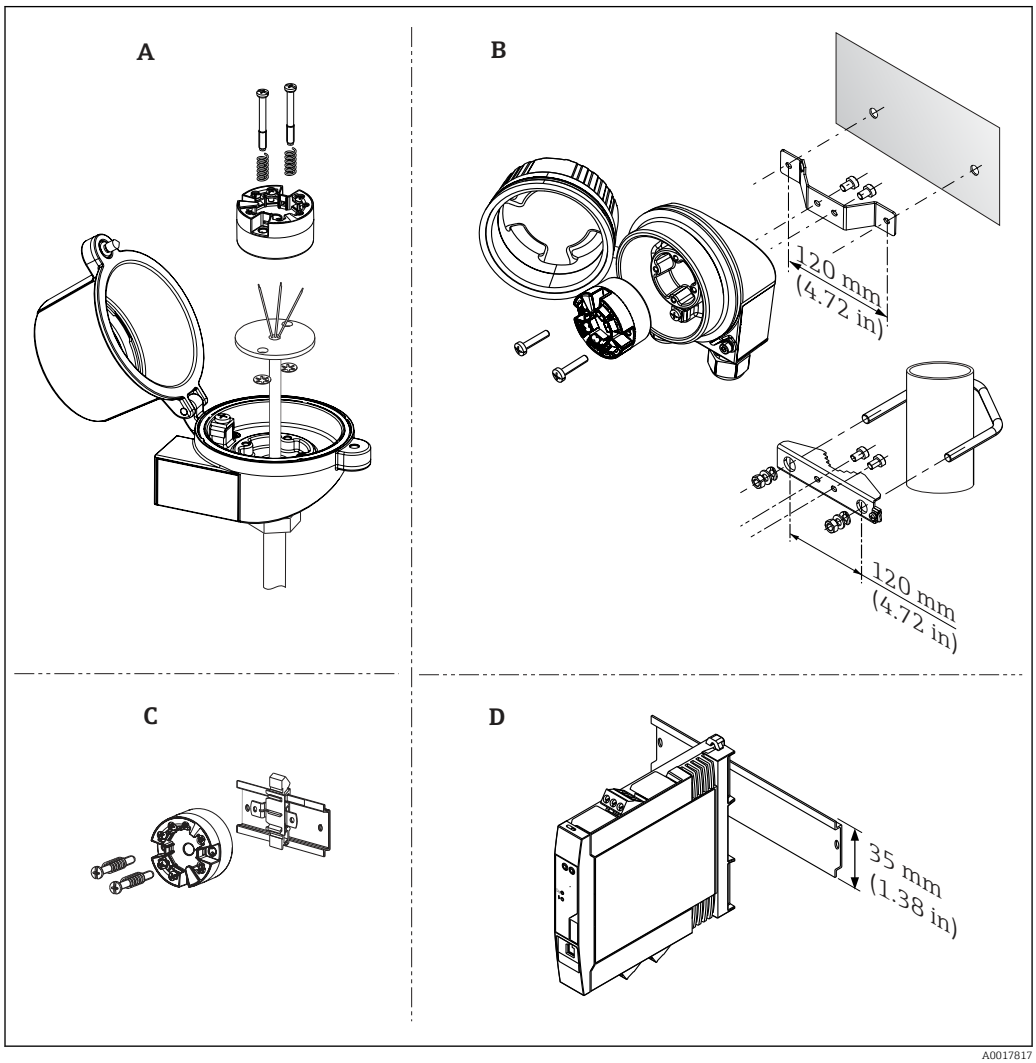
1) Percentages based on the configured measuring span of the analog output signal.

Influence of the reference junction

- Pt100 DIN IEC 60751 Cl. B (internal reference junction with thermocouples TC)
- Field mount housing with separate terminal compartment: Pt100 DIN IEC 60751 Cl. B (external reference junction with thermocouples TC)

Installation

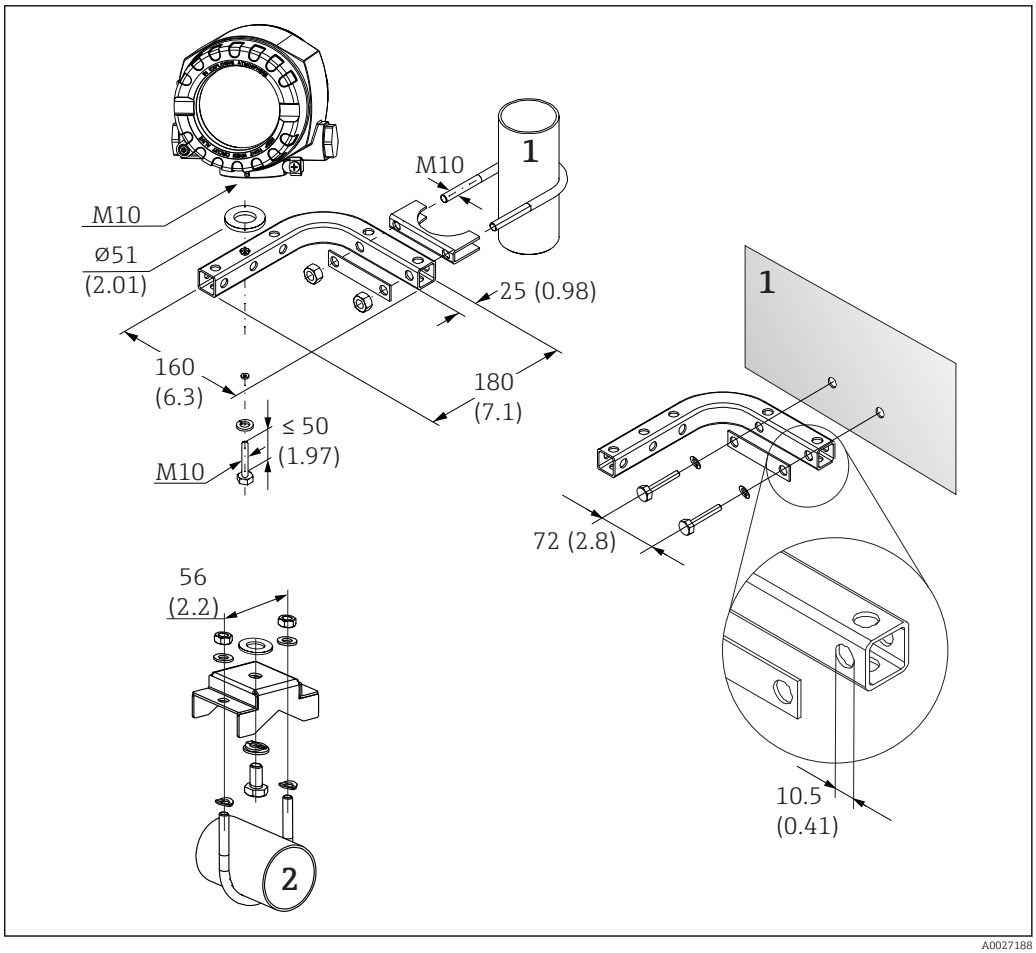
Installation location



6 Mounting location options for the transmitter

A Terminal head form B in accordance with DIN EN 50446, direct installation onto insert with cable entry (middle hole 7 mm (0.28 in))
B Separated from process in field housing, wall or pipe mounting
C With DIN rail clip on DIN rail as per IEC 60715 (TH35)
D DIN rail transmitter for mounting on DIN rail as per IEC 60715 (TH35)

- In SIL mode: The head transmitter must not be operated using the DIN rail clip and remote sensors as a substitute for a DIN rail transmitter in a cabinet.
- When installing the head transmitter in a terminal head form B (flat face), make sure there is sufficient space in the terminal head.



7 *Mounting the field mount housing using special mounting bracket. Dimensions in mm (in)*

1 Mounting with combined wall/pipe mounting bracket
2 Mounting with pipe mounting bracket 2"/V4A

Orientation

- Head transmitter: No restrictions.
- DIN rail transmitter: When a DIN rail transmitter is used with a thermocouple/mV measurement, increased measurement deviation may occur depending on the installation situation and ambient conditions. If the DIN rail transmitter is mounted in series between other DIN rail devices (reference operating condition: 24 V, 12 mA), deviations of max. ±1.5 °C may occur.

To avoid additionally higher measured value deviations, mount the DIN rail transmitter vertically and ensure that it is aligned correctly (sensor connection at bottom/power supply at top).

Environment

Ambient temperature range

Head transmitter/DIN rail transmitter	–40 to 85 °C (–40 to 185 °F); for hazardous areas, see Ex documentation.
Optional	–50 to 85 °C (–58 to 185 °F), for hazardous areas, see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JM". [1]
Optional	–52 to 85 °C (–62 to 185 °F), for hazardous areas, see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JN". [1]

Head transmitter, field mount housing with separate terminal compartment incl. display	−30 to 85 °C (−22 to 185 °F). At temperatures < −20 °C (−4 °F) the display may react slowly, Product Configurator order code: "Field housing", option "R" and "S".
SIL mode	−40 to 70 °C (−40 to 158 °F)

1) If the temperature is below −40 °C (−40 °F), increased failure rates are likely.

Storage temperature

Head transmitter	−50 to +100 °C (−58 to +212 °F)
Optional	−52 to 85 °C (−62 to 185 °F) Product Configurator order code for "Test, certificate, declaration", option "JN" 1)
Head transmitter, field mount housing with separate terminal compartment incl. display	−35 to +85 °C (−31 to +185 °F). At temperatures < −20 °C (−4 °F) the display may react slowly, Product Configurator order code: "Field housing", option "R" and "S".
DIN rail transmitter	−40 to +100 °C (−40 to +212 °F)

1) If the temperature is below −50 °C (−58 °F), increased failure rates are likely.

Relative humidity

- Condensation:
  - Head transmitter permitted
  - DIN rail transmitter not permitted
- Max. rel. humidity: 95% as per IEC 60068-2-30

Operating altitude

Up to 4 000 m (13 123 ft) above sea level.

Climate class

- Head transmitter: climate class C1 as per EN 60654-1
- DIN rail transmitter: climate class B2 as per IEC 60654-1
- Head transmitter, field mount housing with separate terminal compartment including display: climate Class Dx as per IEC 60654-1

Degree of protection

- Head transmitter with screw or push-in terminals: IP 20. In the installed state, it depends on the terminal head or field housing used.
- When installed in field mount housing with separate terminal compartment: IP 67, NEMA Type 4x
- DIN rail transmitter: IP 20

Shock and vibration resistance

Vibration resistance as per DNVGL-CG-0339: 2015 and DIN EN 60068-2-27
- Head transmitter: 2 to 100 Hz at 4g (increased vibration stress)
- DIN rail transmitter: 2 to 100 Hz at 0.7 g (general 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 HARTcommunication.

Maximum measurement 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

Overvoltage category

Overvoltage category II

Pollution degree

Pollution degree 2

Protection class

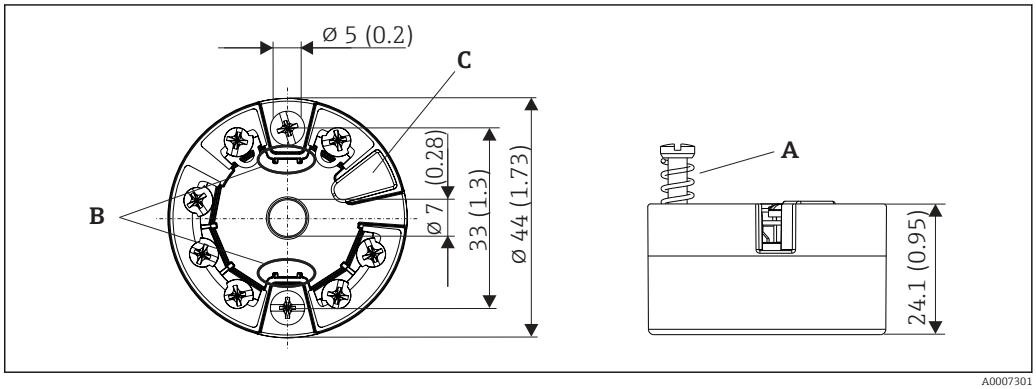
Protection class III

Mechanical construction

Design and dimensions

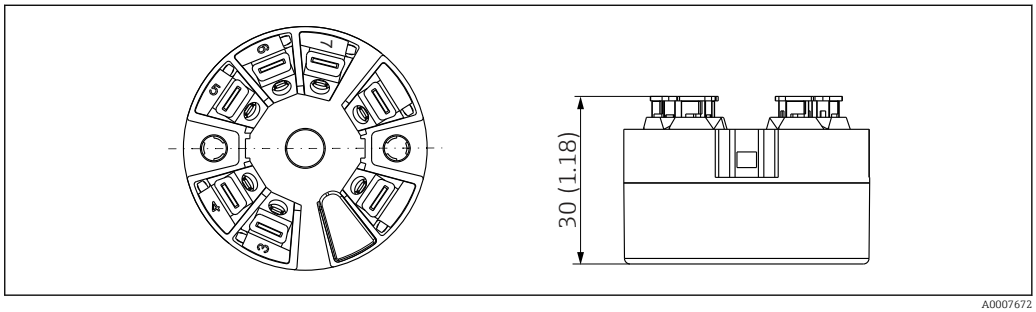
Dimensions in mm (in)

Head transmitter



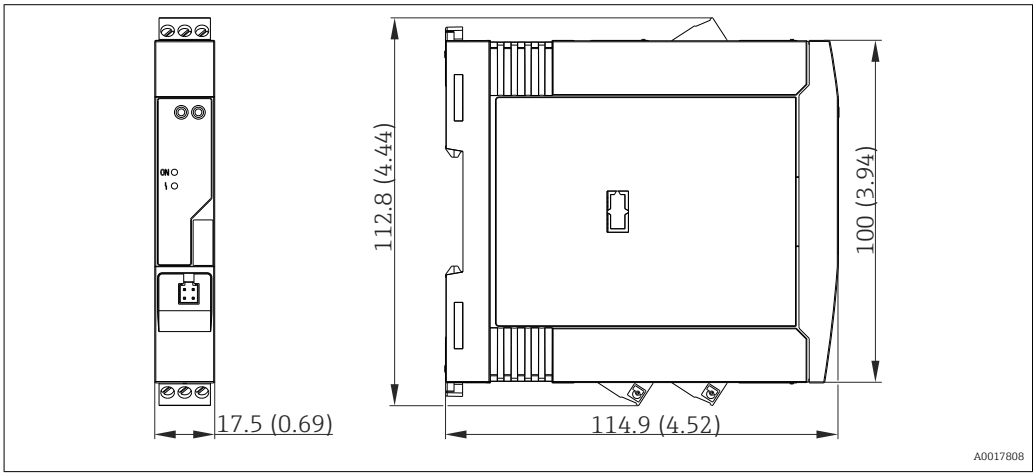
8 Version with screw terminals

A Spring travel L ≥ 5 mm (not for US - M4 securing screws)
B Mounting elements for attachable measured value display TID10
C Service interface for connecting measured value display or configuration tool



9 Version with push-in terminals. Dimensions are identical to the version with screw terminals, apart from housing height.

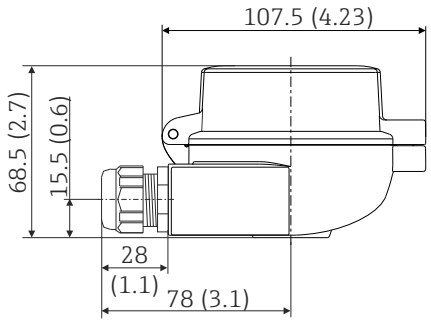
DIN rail transmitter

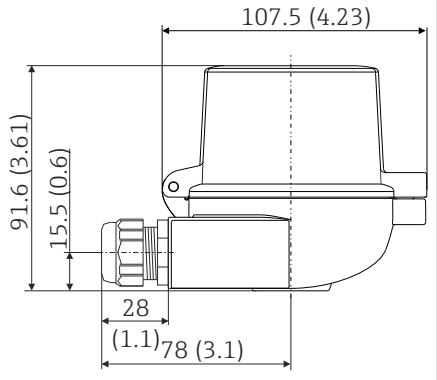


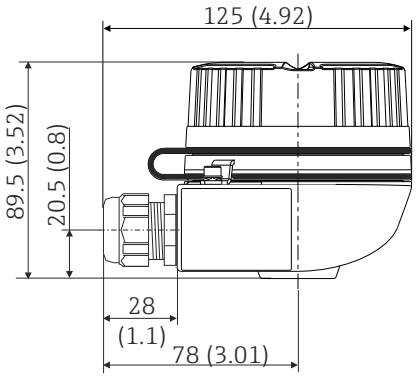
Field housing

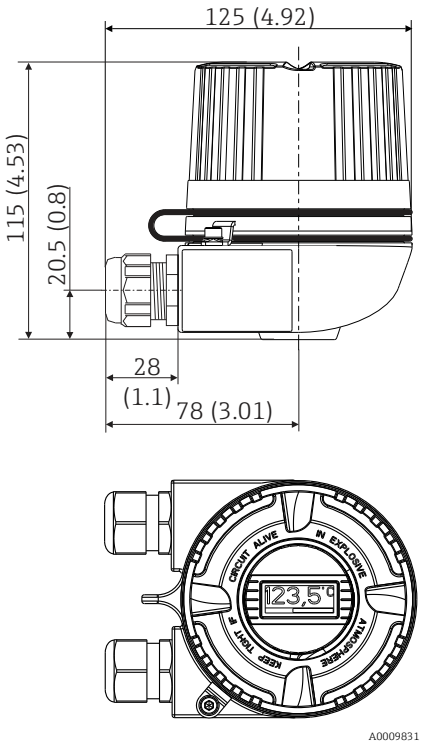
All field housings have an internal geometry in accordance with DIN EN 50446, form B (flat face).
Cable glands in the diagrams: M20x1.5

Maximum ambient temperatures for cable glands	
Type	**Temperature range**
Polyamide cable gland ½" NPT, M20x1.5 (non-Ex)	−40 to 100 °C (−40 to 212 °F)
Polyamide cable gland M20x1.5 (for dust ignition-proof area)	−20 to 95 °C (−4 to 203 °F)
Brass cable gland ½" NPT, M20x1.5 (for dust ignition-proof area)	−20 to 130 °C (−4 to 266 °F)

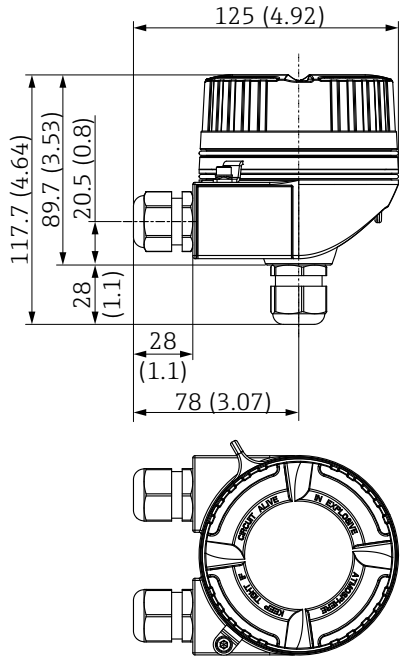
TA30A	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz)

TA30A with display window in cover	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Display window in cover for head transmitter with TID10 display

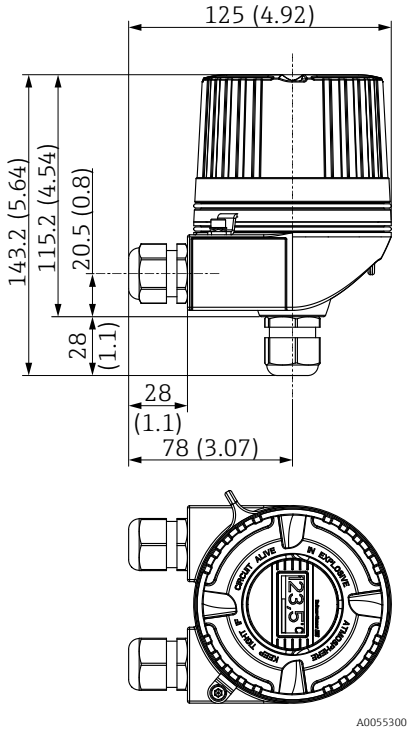
TA30H	Specification
	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Material: ▪ Aluminum, with polyester powder coating ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Cable entry glands: NPT ½", M20x1.5 ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum approx. 640 g (22.6 oz) ▪ Stainless steel approx. 2 400 g (84.7 oz) When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).

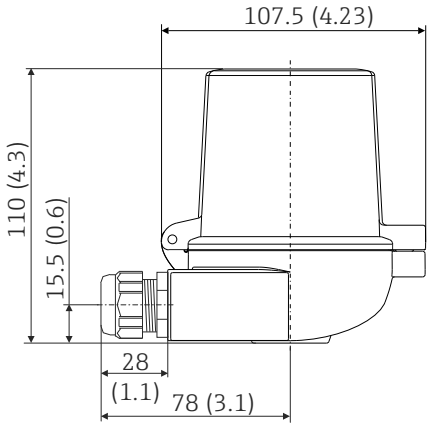
TA30H with display window in cover	Specification
	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Material: ▪ Aluminum with polyester powder coating ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Cable entry glands: NPT ½", M20x1.5 ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum approx. 860 g (30.33 oz) ▪ Stainless steel approx. 2 900 g (102.3 oz) ▪ For display TID10 When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).

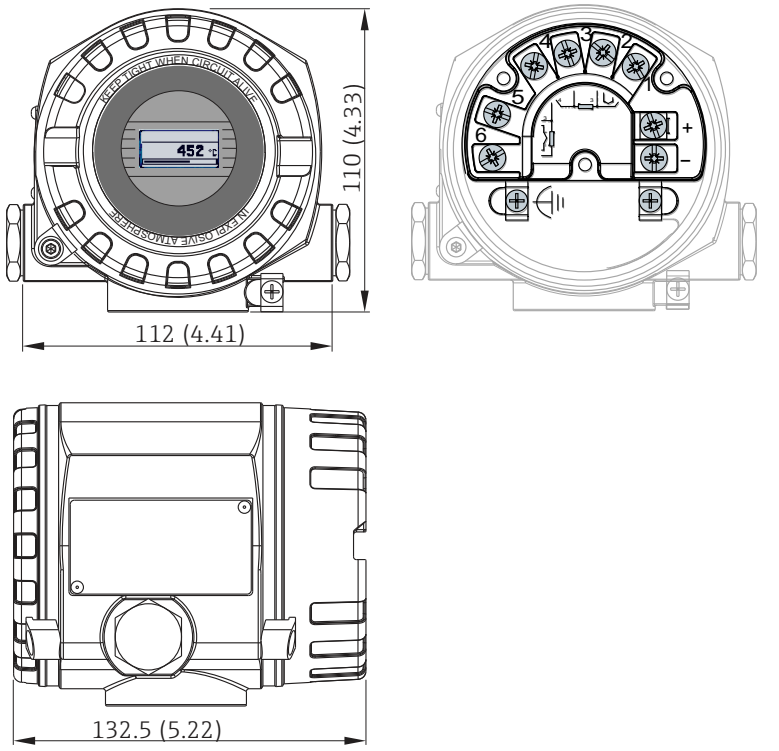
TA30H with three cable entries	Specification

	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with three cable entries (two at the front, one at the bottom) with grounding screw
	▪ Protection class: NEMA Type 4x Encl.
	▪ Material:
	  ▪ Aluminum, with polyester powder coating
	  ▪ Dry lubricant Klüber Syntheso Glep 1
	▪ Cable entry glands: ½" NPT
	▪ Color of head: blue, RAL 5012
	▪ Color of cap: gray, RAL 7035
	▪ Weight: approx. 640 g (22.6 oz)
	When the housing cover is unscrewed: Before screwing it on, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).

TA30H with three cable entries and display window in cover	Specification

	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with three cable entries (two at the front, one at the bottom), with grounding screw
	▪ Protection class: NEMA Type 4x Encl.
	▪ Material:
	  ▪ Aluminum with polyester powder coating
	  ▪ Stainless steel 316L without coating
	  ▪ Dry lubricant Klüber Syntheso Glep 1
	▪ Display window: single-pane safety glass according to DIN 8902
	▪ Cable entry glands: ½" NPT
	▪ Color of aluminum head: blue, RAL 5012
	▪ Color of aluminum cap: gray, RAL 7035
	▪ Weight:
	  ▪ Aluminum approx. 860 g (30.33 oz)
	  ▪ Stainless steel approx. 2 900 g (102.3 oz)
	▪ For display TID10
	When the housing cover is unscrewed: Before screwing it on, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).

TA30D	Specification
	▪ 2 cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ Two head transmitters can be mounted. In the standard configuration one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz)

Field mount housing with separate terminal compartment	Specification
	▪ Separate electronics compartment and terminal compartment ▪ Display rotatable in 90° increments ▪ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base ▪ Cable entry: 2x ½" NPT, 2x M20x1.5 ▪ Protection class: IP67, NEMA type 4x ▪ Color: blue, RAL 5012 ▪ Weight: approx. 1.4 kg (3 lb)

Weight

- Head transmitter: approx. 40 to 50 g (1.4 to 1.8 oz)
- Field housing: see specifications
- DIN rail transmitter: Approx. 100 g (3.53 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
  - Push-in terminals: tin-plated brass, contact springs 1.4310, 301 (AISI)
- Potting compound:
  - Head transmitter: QSIL 553
  - DIN rail housing: Silgel612EH

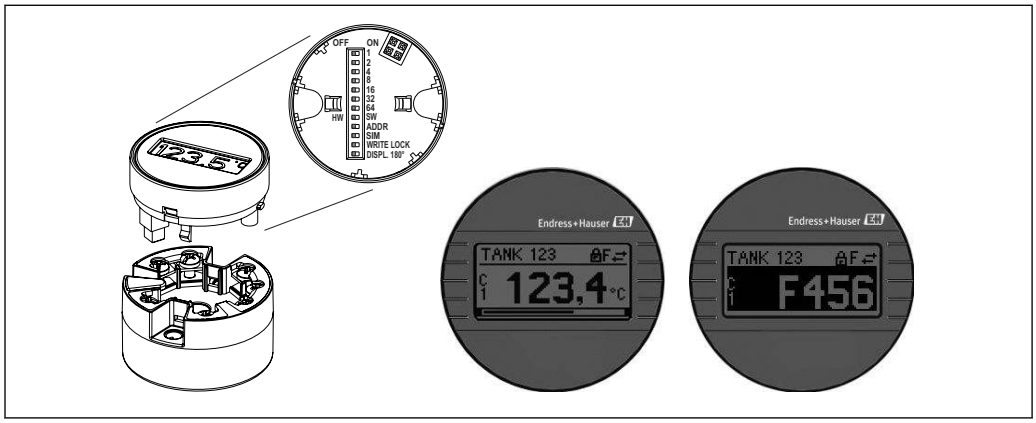
Field housing: see specifications

Operability

Local operation

Head transmitter

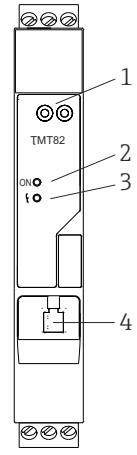
The head transmitter has no display or operating elements. There is the option of using the attachable measured value display TID10 together with the head transmitter. When the head transmitter will be ordered with the field mount housing with separate terminal compartment, the display is already included. The display provides plain-text information on the current measured value and the measuring point identification. An optional bar graph is also used. In the event of a fault in the measuring chain, this will be displayed in inverse color showing the channel ident and diagnostic number. DIP switches can be found on the rear of the display. These enable hardware settings to be made, such as write protection.



10 *Attachable measured value display TID10 with bar graph indicator (optional)*

If the head transmitter is installed in a field housing and used with a display, an enclosure with a glass window in the cover must be used.

DIN rail transmitter



1:	HART communication jacks (2 mm) for commissioning and configuration	
2:	Power LED	A green LED indicates that the voltage supply is correct
3:	Status LED	Off: No diagnostic message
		Red: Category F diagnostic message
		Red flashing: Category C, S or M diagnostic message
4:	Service interface	For connecting a configuration tool (not in SIL mode)

Remote operation

HART functions and device-specific parameters are configured via HART Communication or the CDI interface (service interface) of the device. There are special configuration tools from different manufacturers available for this purpose. Contact the manufacturer or sales department for further information.

Certificates and Approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

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

Functional safety

SIL 2/3 (hardware/software) certified to:
- IEC 61508-1:2010 (Management)
- IEC 61508-2:2010 (Hardware)
- IEC 61508-3:2010 (Software)

HART certification

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

Test certificate

Complies with:
- WELMEC 8.8, only in SIL mode: "Guide on the General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring Instruments".
- OIML R117-1 Edition 2007 (E) "Dynamic measuring systems for liquids other than water".
- EN 12405-1/A2 Edition 2010 "Gas meters – Conversion devices – Part 1: Volume conversion".
- OIML R140-1 Edition 2007 (E) "Measuring systems for gaseous fuel"

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**.

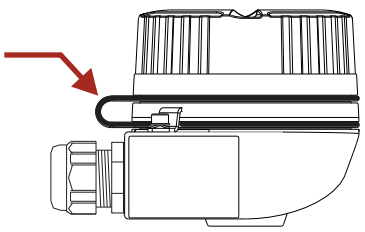
Accessories

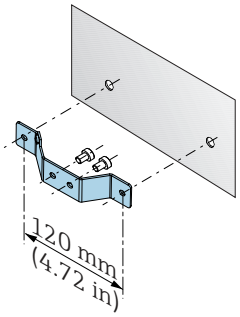
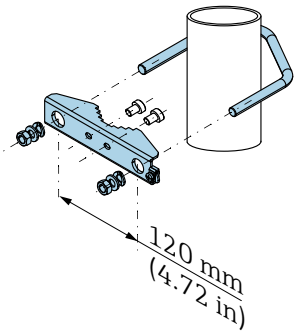
The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessories

Accessories for the head transmitter
Display unit TID10 for Endress+Hauser head transmitter iTEMP TMT8x or TMT7x, attachable
Field housing TA30x for Endress+Hauser head transmitter
Adapter for DIN rail mounting, DIN rail clip as per IEC 60715 (TH35) without securing screws
Standard – DIN terminal head mounting set (2 screws + springs, 4 securing disks and 1 display connector cover)
US mounting set – M4 screws (2 M4 screws and 1 display connector cover)

Accessory mounted	
Captive screw for field housing TA30H	 A0053779

Accessory enclosed	
Wall mounting bracket, 316 L	 A0061686
Pipe mounting bracket, 316 L	 A0061687

Accessories for field mount housing with separate terminal compartment
Cover locking
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket
Cable glands M20x1.5 and NPT ½"
Adapter M20x1.5 outside/M24x1.5 inside
Dummy plugs M20x1.5 and NPT ½"

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see the Technical Information
WirelessHART adapter SWA70	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 the Technical Information
Field Xpert SMT70B	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. Field Xpert also uses the most secure Bluetooth® interface available for its wireless connections. 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 the Technical Information

Service-specific accessories

Configurator
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the 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 at www.endress.com on the relevant product page:

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

DeviceCare SFE100
DeviceCare is an Endress+Hauser configuration tool for field devices using the following communication protocols: HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, IO/Link, Modbus, CDI and Endress+Hauser Common Data Interfaces.

www.endress.com/sfe100

FieldCare SFE500
FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.
The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.

www.endress.com/sfe500

Netilion
With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.

www.netilion.endress.com

Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

System components

RN series active barrier

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.

For more information, please refer to: www.endress.com

Process indicators from the RIA product family

Easily readable process indicators with various functions: loop-powered indicators for displaying 4-20 mA values, display of up to four HART variables, process indicators with control units, limit value monitoring, sensor power supply, and galvanic isolation.

Universal application thanks to international hazardous area approvals, suitable for panel mounting or field installation..

For more information, please refer to: www.endress.com

Data Manager of the RSG product family

Data Managers are flexible and powerful systems to organize process values. Up to 20 universal inputs and up to 14 digital inputs for direct connection of sensors, optionally with HART, are available as an option. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. The values can be forwarded via common communication protocols to higher-level systems and connected to one another via individual plant modules.

For more information, please refer to: www.endress.com

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the product configuration:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid** This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	**Quick guide to obtaining the first measured value** The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Reference** The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: 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 parameters** The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions. The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
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 product documentation.



www.addresses.endress.com

Endress+Hauser

People for Process Automation