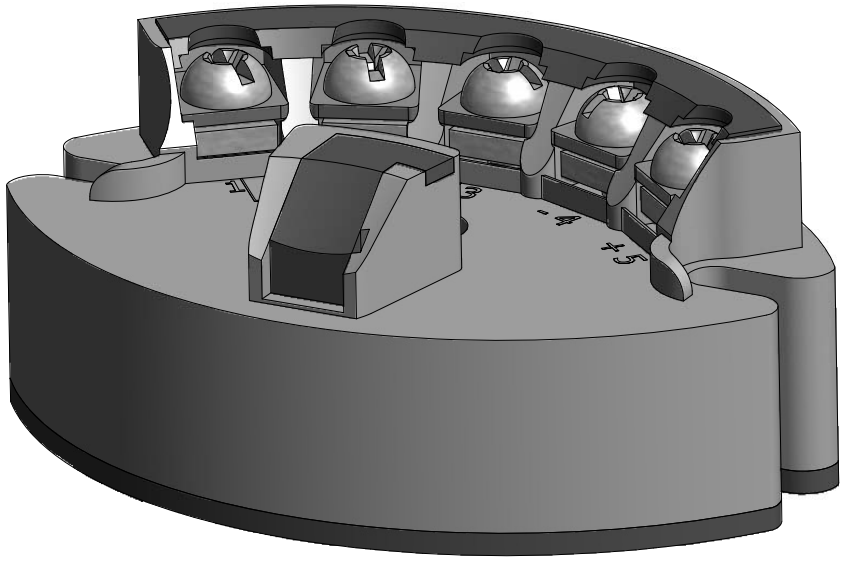
Transmitter

Configuration Code TM01
Series 440 Programmable
RTD Temperature Transmitter

The Series 440 programmable RTD temperature transmitter is a 2-wire transmitter with an analog output. It has measurement input for Pt100 resistance thermometers (RTD) in 2- or 3-wire connections. Setting up of the transmitter is done using the communication cable. These small units can be mounted in Pyromation connection heads or they can be used for surface mounting by using a 35 mm DIN-rail mounting clip.

TEMPERATURE HEAD TRANSMITTER

Universal head transmitter for Pt100 resistance thermometers (RTD), programmable using a PC, for installation in a sensor head.



Patent #D350, 596

Application Areas

- PC programmable temperature head transmitter for converting Pt100 input signal into an scaleable (4 to 20) mA analog output signal
- Platinum resistance thermometer (RTD)
- Online configuration using PC with SETUP connector.

Features and Benefits

- Universally PC programmable for Pt100 signals
- 2-wire technology, (4 to 20) mA analog output
- High accuracy in total ambient temperature range
- Fault signal on sensor break or short circuit
- RFI/EMI Protected, CE marked
- c UL us UL Recognized Component
- FM CSA General Purpose and non-incendive for use in hazardous locations
- Online configuration during measurement using SETUP connector
- Output simulation

ORDER CODES

Unconfigured Order Number: **440-00[1]**

Example Configured Order Number:

1	2	3		4	5
4 4 0	-	3	85 U	-	S (50-300)	F

1

CODE	DESCRIPTION
2	RTD (2-wire)
3	RTD (3-wire)

2

CODE	DESCRIPTION
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)

[1] Default setting for unconfigured transmitter is 3-wire Pt100 (0 -100)°C.

3

CODE	DESCRIPTION
U	Upscale Burnout ≥ 21.0 mA
D	Downscale Burnout ≤ 3.6 mA

4

RANGE
S (lower limit – upper limit)

5

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit

Accessories

CODE	DESCRIPTION
10303	Communication Cable and Software (USB)
10307	35 mm DIN-rail mounting clip

Resistance Thermometer Input (RTD)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Pt100 (α = 0.003 85 °C^{-1})	(-200 to 650) °C [-328 to 1202] °F	10 ˚C [18 ˚F]
Connection Type	2- or 3-wire connection cable resistance compensation possible in the 2-wire system (0 to 20) Ω	
Sensor cable resistance	maximum 11 Ω per cable	
Sensor current	≤ 0.6 mA	

Output (Analog)

Output signal	(4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear
Maximum load	($V_{power\ supply}$ - 10 V) / 0.023 A (current output)
Digital filter 1st degree	(0 to 8) s
Induced current required	≤ 3.5 mA
Current limit	≤ 23 mA
Switch on delay	4 s (during power 1_a = 3.8 mA)
Electronic response time	1 s

Failure Mode

Undershooting measurement range	Decrease to 3.8 mA
Exceeding measurement range	Increase to 20.5 mA
Sensor breakage/short circuit	≤ 3.6 mA or ≥ 21.0 mA

Electronic Connection

Power supply	U_b = (10 to 30) V dc, polarity protected
Allowable ripple	U_{ss} ≤ 5 V at U_b ≥ 13 V, f_{max} = 1 kHz

Resistance Thermometer Accuracy (RTD)

TYPE	MEASUREMENT ACCURACY
Pt100	± 0.2 °C or 0.08% [1]
Reference conditions	Calibration temperature (23 ± 5) °C [73 ± 9] °F

General Accuracy

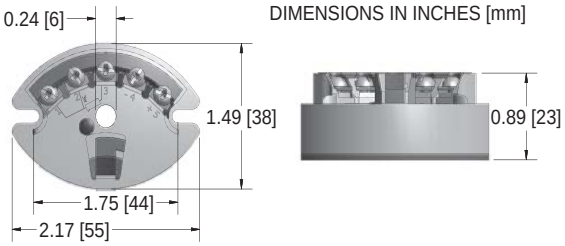
Influence of power supply	± 0.01%/V deviation from 24 V [2]
Load influence	± 0.02%/100 Ω [2]
Temperature drift	T_d = ± (15 ppm/°C × (range end value + 200) + 50 ppm/°C × measurement range) × $\Delta\vartheta$ $\Delta\vartheta$ = deviation of the ambient temperature according to the reference condition
Long term stability	≤ 0.1 °C/year [3] or ≤ 0.05%/year [1][3]

[1] % is related to the adjusted measurement range (the value to be applied is the greater)
[2] All data is related to a measurement end value of 20 mA
[3] Under reference conditions

Ambient Conditions

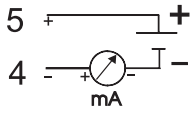
Ambient temperature	(-40 to 85) °C [-40 to 185] °F
Storage temperature	(-40 to 100) °C [-40 to 212] °F
Climatic class	EN 60 654-1, Class C
Condensation	Permitted
Shock resistance	4 g / (2 to 150) Hz according to IEC 60 068-2-6
EMC immunity	Interference immunity and interference emission according to EN 61 326-1 (1EC 1326)

Mechanical Construction

Dimensions	
Weight	Approximately 44 g
Materials	Housing: Polycarbonate • Potting: Polyurethane
Terminals	15 AWG (maximum)

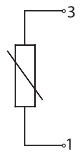
Terminal Connections

Power supply and current output

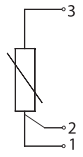


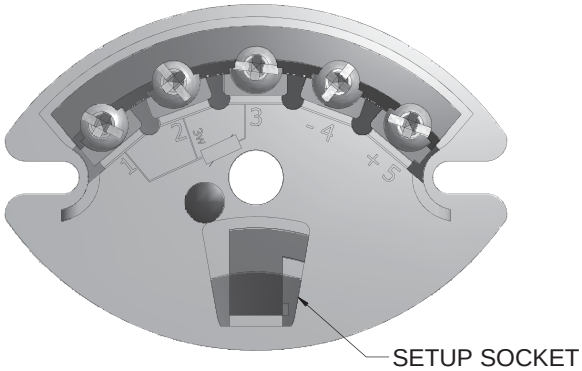
(10 to 30) V dc
(4 to 20) mA

2-Wire



3-Wire





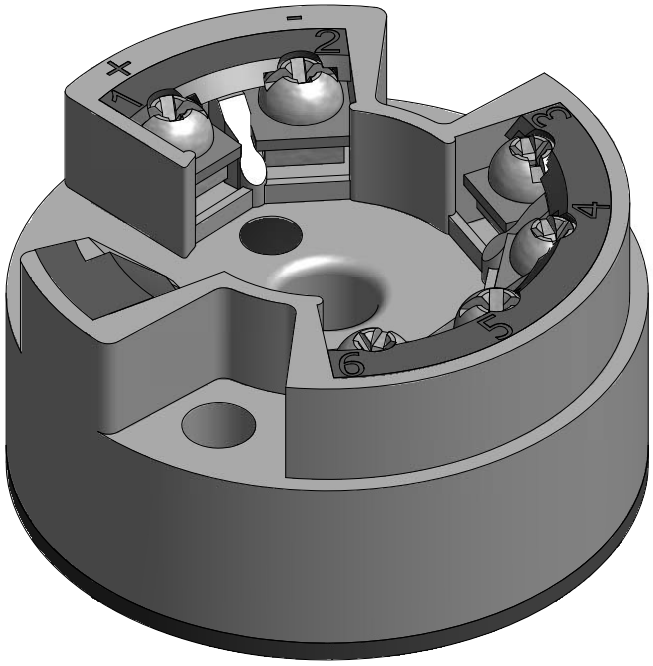
Approvals

CE marked	Unit complies with the legal requirements set forth by the EU regulations.
c UL us	UL Recognized Component
FM APPROVED CSA	General Purpose and non-incendive for use in hazardous locations Class I, Division 2 Groups A, B, C and D

The Series 441 programmable temperature transmitter is a 2-wire transmitter with an analog output. It has measurement input for resistance thermometers (RTD) in 2-, 3- or 4-wire connections, thermocouples, resistance and voltage inputs. Setting up of the transmitter is done using the communication cable. These small units can be mounted in Pyromation DIN (Form B) connection heads or they can be used for surface mounting by using a 35 mm DIN-rail mounting clip.

TEMPERATURE HEAD TRANSMITTER

Universal head transmitter for resistance thermometers (RTD), thermocouples, resistance and voltage inputs, programmable using a PC, for installation in a sensor head (Form B)



Application Areas

- PC programmable temperature head transmitter for converting various input signals into an scalable (4 to 20) mA analog output signal
- Input:
  Resistance thermometer (RTD)
  Thermocouple (TC)
  Resistance (Ω)
  Voltage (mV)
- Online configuration using PC with SETUP connector

Features and Benefits

- Universally PC programmable for various signals
- Galvanic isolation
- 2-wire technology, (4 to 20) mA analog output
- High accuracy in total ambient temperature range
- Fault signal on sensor break or short circuit
- RFI/EMI Protected, CE marked
- c UL us UL Recognized Component
- CSA Intrinsically safe and non-incendive for hazardous locations
- FM Intrinsically safe and non-incendive for hazardous locations
- Online configuration during measurement using SETUP connector
- Output simulation

ORDER CODES

Unconfigured Order Number: **441-00[1]**

Example Configured Order Number:

1	2	3		4	5
4 4 1	-	1	J	U	-	S (50-300)	F

1

CODE	DESCRIPTION
1	Thermocouple (TC)
2	RTD (2-wire)
3	RTD (3-wire)
4	RTD (4-wire)

2

CODE	DESCRIPTION
J	Type J thermocouple
K	Type K thermocouple
T	Type T thermocouple
N	Type N thermocouple
E	Type E thermocouple
R	Type R thermocouple
S	Type S thermocouple
B	Type B thermocouple
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
55	500 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
95	1000 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
MV	Millivolts
W	Resistance

[1] Default setting for unconfigured transmitter is 3-wire Pt100 (0 - 100) °C.

3

CODE	DESCRIPTION
U	Upscale Burnout ≥ 21.0 mA
D	Downscale Burnout ≤ 3.5 mA

4

RANGE
S (lower limit – upper limit)

5

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit

Accessories

CODE	DESCRIPTION
10303	Communication cable and software (USB)
10307	35 mm DIN-rail mounting clip

INPUT

Resistance Thermometer (RTD)

TYPE	MEASUREMENT RANGE		MINIMUM RANGE
Pt100 (α = 0.003 85 $^{o}C^{-1}$)	(-200 to 850) °C	[-328 to 1562] °F	10° C [18 °F]
Pt500	(-200 to 250) °C	[-328 to 482] °F	10° C [18 °F]
Pt1000	(-200 to 250) °C	[-328 to 482] °F	10° C [18 °F]
Ni100 (α = 0.006 18 $^{o}C^{-1}$)	(-60 to 180) °C	[-76 to 356] °F	10° C [18 °F]
Ni500	(-60 to 150) °C	[-76 to 302] °F	10° C [18 °F]
Ni1000	(-60 to 150) °C	[-76 to 302] °F	10° C [18 °F]
Connection type	2-, 3- or 4-wire connection cable. Resistance compensation possible in the 2-wire system (0 to 20) Ω		
Sensor cable resistance	maximum 11 Ω per cable		
Sensor current	≤ 0.6 mA		

Resistance (Ω)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Resistance (Ω)	(10 to 400) Ω	10 Ω
	(10 to 2000) Ω	100 Ω

Thermocouples (TC)

TYPE	MEASUREMENT RANGE		MINIMUM RANGE
B (PtRh30-PtRh6)	(0 to 1820) °C	[32 to 3308] °F	500 °C [900 °F]
C (W5Re-W26Re)	(0 to 2320) °C	[32 to 4208] °F	500 °C [900 °F]
D (W3Re-W25Re) [3]	(0 to 2495) °C	[32 to 4523] °F	500 °C [900 °F]
E (NiCr-CuNi)	(-200 to 915) °C	[-328 to 1679] °F	50 °C [90 °F]
J (Fe-CuNi)	(-200 to 1200) °C	[-328 to 2192] °F	50 °C [90 °F]
K (NiCr-Ni)	(-200 to 1372) °C	[-328 to 2501] °F	50 °C [90 °F]
L (Fe-CuNi) [2]	(-200 to 900) °C	[-328 to 1652] °F	50 °C [90 °F]
N (NiCrSi-NiSi)	(-270 to 1300) °C	[-454 to 2372] °F	50 °C [90 °F]
R (PtRh13-Pt)	(0 to 1768) °C	[32 to 3214] °F	500 °C [900 °F]
S (PtRh10-Pt)	(0 to 1768) °C	[32 to 3214] °F	500 °C [900 °F]
T (Cu-CuNi)	(-200 to 400) °C	[-328 to 752] °F	50 °C [90 °F]
U (Cu-CuNi) [2]	(-200 to 600) °C	[-328 to 1112] °F	50 °C [90 °F]
MoRe5-MoRe41 [1]	(0 to 2000) °C	[32 to 3632] °F	500 °C [900 °F]
Cold junction	internal (Pt100) or external (0 to 80) °C [32 to 176] °F		
Cold junction accuracy	± 1 °C		

[1] no reference
[2] according to DIN 43710
[3] according to ASTM E988

Voltage (mV)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Millivolt (mV)	(-10 to 100) mV	5 mV

OUTPUT

Output (Analog)

Output signal	(4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear, resistance linear, voltage linear
Maximum load	($V_{power\ supply}$ - 8 V) / 0.025 A (current output)
Digital filter 1st degree	(0 to 8) s
Induced current required	≤ 3.5 mA
Current limit	≤ 25 mA
Switch on delay	4 s (during power up I_a = 3.8 mA)
Electronic response time	1 s

Failure Mode

Undershooting measurement range	Decrease to 3.8 mA
Exceeding measurement range	Increase to 20.5 mA
Sensor breakage/short circuit [1]	≤ 3.5 mA or ≥ 21.0 mA

Electrical Connection

Power supply	U_b = (8 to 30) V dc, polarity protected
Galvanic isolation (In/out)	$\hat{U}$ = 3.75 kV ac
Allowable ripple	U_{ss} ≤ 5 V at U_b ≥ 13 V, f_{max} = 1 kHz

ACCURACY

Reference conditions	Calibration temperature (23 ± 5) °C [73 ± 9] °F

Resistance Thermometer (RTD)

TYPE	MEASUREMENT ACCURACY
Pt100, Ni100 Pt500, Ni500 Pt1000, Ni1000	± 0.2 °C or 0.08% [2] ± 0.5 °C or 0.20% [2] ± 0.3 °C or 0.12% [2]

Resistance (Ω)

TYPE	MEASUREMENT ACCURACY	MEASUREMENT RANGE
Resistance	± 0.1 Ω or 0.08% [2]	(10 to 400) Ω
	± 1.5 Ω or 0.12% [2]	(10 to 2000) Ω

[1] Not for thermocouple
[2] % is related to the adjusted measurement range (the value to be applied is the greater)

ACCURACY (continued)

Thermocouple (TC)

TYPE	MEASUREMENT ACCURACY
K, J, T, E, L, U N, C, D S, B, R MoRe5-MoRe41	± 0.5 °C or 0.08% [1] ± 1.0 °C or 0.08% [1] ± 2.0 °C or 0.08% [1]
Influence of the internal reference junction	Pt100 ± (0.30 + 0.005 |t|) °C |t| = value of temperature without regard to sign °C

Voltage (mV)

TYPE	MEASUREMENT ACCURACY	MEASUREMENT RANGE
Millivolt (mV)	± 20 µV or 0.08% [1]	(-10 to 100) mV

General Accuracy

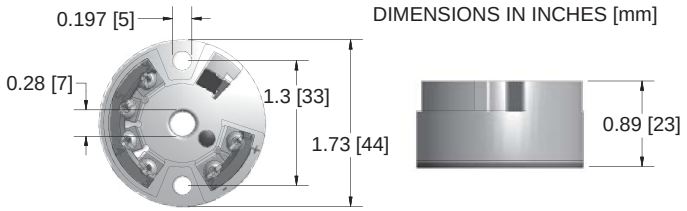
Influence of power supply	± 0.01%/V deviation from 24 V [2]
Load influence	± 0.02%/100 Ω [2]
Temperature drift	Resistive thermometer (RTD): T_d = ± (15 ppm/°C × range end value + 50 ppm/°C × measurement range) × $\Delta\vartheta$ Resistive thermometer Pt100: T_d = ± (15 ppm/°C × (range end value + 200) + 50 ppm/°C × measurement range) × $\Delta\vartheta$ Thermocouple (TC): T_d = ± (50 ppm/°C × range end value + 50 ppm/°C × measurement range) × $\Delta\vartheta$ $\Delta\vartheta$ = Deviation of the ambient temperature according to the reference condition
Long term stability	≤ 0.1 °C/year [3] or ≤ 0.05%/year [1][3]
[1] % is related to the adjusted measurement range (the value to be applied is the greater) [2] All data is related to a measurement end value of 20 mA [3] Under reference conditions	

INSTALLATION CONDITIONS

Ambient Conditons

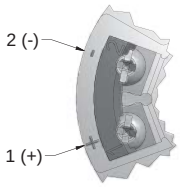
Ambient temperature	(-40 to 85) °C [-40 to 185] °F
Storage temperature	(-40 to 100) °C [-40 to 212] °F
Climatic class	To EN 60 654-1, Class C
Moisture condensation	Allowable
Vibration protection	4 g / (2 to 150) Hz according to IEC 60 068-2-6
EMC immunity	Interference immunity and interference emission as per EN 61 326-1 (IEC 1326)

MECHANICAL CONSTRUCTION

Dimensions	
Weight	approximately 40 g
Materials	Housing: Polycarbonate • Potting: Polyurethane
Terminals	15 AWG (maximum)

Terminal Connections

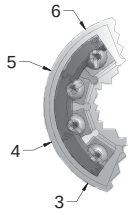
Power supply and current output

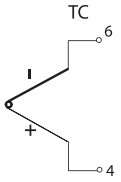


(8 to 30) V dc
(4 to 20) mA

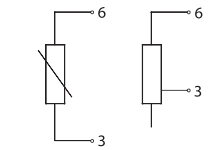
SETUP socket

Sensor Connection

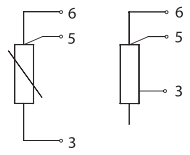




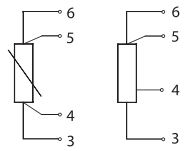
2-Wire



3-Wire



4-Wire



Remote Operation

Configurable parameters	Sensor type and connection type, engineering units (°C/°F), measurement range, internal/external cold junction compensation, cable resistance compensation on 2 wire connection, fault conditioning, output signal (4 to 20) mA or (20 to 4) mA, digital filter (damping), offset, measurement point identification (8 characters), output simulation

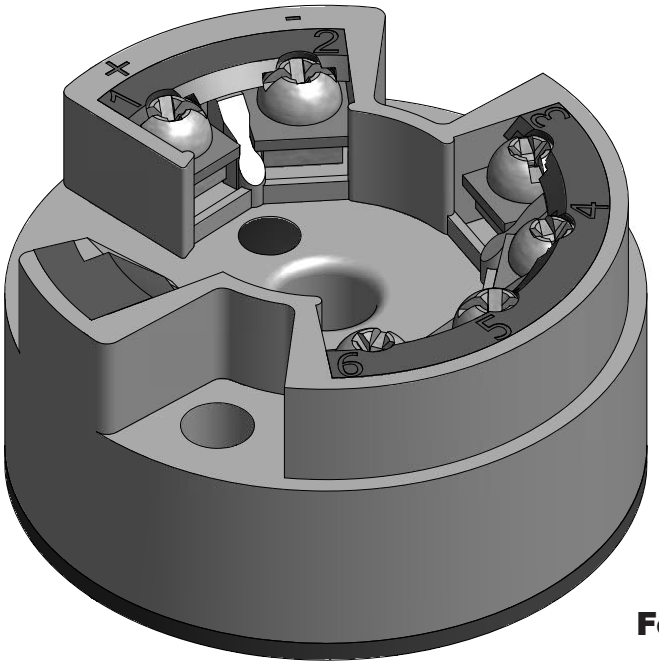
Approvals

CE marked	Unit complies with the legal requirements set forth by the EU regulations.
c UL us	UL Recognized Component
FM APPROVED CSA	General Purpose and non-incendive for use in hazardous locations Class I, Division 2 Groups A, B, C and D

The Series 442 programmable HART® temperature transmitter is a 2-wire transmitter with an analog output. It has measurement input for resistance thermometers (RTD) in 2-, 3- or 4-wire connections, thermocouples, resistance and voltage inputs. The transmitter can be programmed with a PC or HART® protocol hand-held terminal. These small units can be mounted in Pyromation DIN (Form B) connection heads, or they can be used for surface mounting by using a 35 mm DIN-rail mounting clip.

TEMPERATURE HEAD TRANSMITTER

Intrinsically safe universal head transmitter for resistance thermometers (RTD), thermocouples, resistance and voltage inputs, programmable using HART® protocol, for installation in a sensor head (Form B).



HART COMMUNICATION PROTOCOL

Features and Benefits

- Universal settings with HART® protocol for various signals.
- Galvanic isolation
- 2-wire technology, (4 to 20) mA analog output
- High accuracy in total ambient temperature range
- Fault signal on sensor break or short circuit
- RFI/EMI Protected, CE marked
- c UL us UL Recognized Component
- CSA Intrinsically safe and non-incendive for hazardous locations
- FM Intrinsically safe and non-incendive for hazardous locations
- Output simulation

HART® is a registered trademark of HART Communication Foundation

ORDER CODES

Unconfigured Order Number: 442-00[1]

Example Configured Order Number:

4 4 2	-	1	J	U	-	S (50-300)	F
		1	2	3		4	5

1

CODE	DESCRIPTION
1	Thermocouple (TC)
2	RTD (2-wire)
3	RTD (3-wire)
4	RTD (4-wire)

2

CODE	DESCRIPTION
J	Type J thermocouple
K	Type K thermocouple
T	Type T thermocouple
N	Type N thermocouple
E	Type E thermocouple
R	Type R thermocouple
S	Type S thermocouple
B	Type B thermocouple
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
55	500 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
95	1000 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
MV	Millivolts
W	Resistance

3

CODE	DESCRIPTION
U	Upscale Burnout ≥ 21.0 mA
D	Downscale Burnout ≤ 3.6 mA

4

RANGE
S (lower limit – upper limit)

5

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit

Accessories

CODE	DESCRIPTION
10307	35 mm DIN rail mounting clip

[1] Default setting for unconfigured transmitters is 3-wire Pt100 (0 - 100) °C.

INPUT

Resistance Thermometer (RTD)

TYPE	MEASUREMENT RANGE		MINIMUM RANGE
Pt100 (α = 0.003 85 $^{o}C^{-1}$)	(-200 to 850) °C	[-328 to 1562] °F	10° C [18 °F]
Pt500	(-200 to 250) °C	[-328 to 482] °F	10° C [18 °F]
Pt1000	(-200 to 250) °C	[-328 to 482] °F	10° C [18 °F]
Ni100 (α = 0.006 18 $^{o}C^{-1}$)	(-60 to 250) °C	[-76 to 356] °F	10° C [18 °F]
Ni500	(-60 to 150) °C	[-76 to 302] °F	10° C [18 °F]
Ni1000	(-60 to 150) °C	[-76 to 302] °F	10° C [18 °F]
Connection Type	2-, 3- or 4-wire connection cable. Resistance compensation possible in the 2 wire system (0 to 30) Ω		
Sensor cable resistance	maximum 11 Ω per cable		
Sensor current	≤ 0.2 mA		

Resistance (Ω)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Resistance (Ω)	(10 to 400) Ω (10 to 2000) Ω	10 Ω 100 Ω

Thermocouples (TC)

TYPE	MEASUREMENT RANGE		MINIMUM RANGE
B (PtRh30-PtRh6)	(0 to 1820) °C	[32 to 3308] °F	500 °C [900 °F]
C (W5Re-W26Re)	(0 to 2320) °C	[32 to 4208] °F	500 °C [900 °F]
D (W3Re-W25Re) [3]	(0 to 2495) °C	[32 to 4523] °F	500 °C [900 °F]
E (NiCr-CuNi)	(-270 to 1000) °C	[-454 to 1832] °F	50 °C [90 °F]
J (Fe-CuNi)	(-210 to 1200) °C	[-346 to 2192] °F	50 °C [90 °F]
K (NiCr-Ni)	(-270 to 1372) °C	[-454 to 2501] °F	50 °C [90 °F]
L (Fe-CuNi) [2]	(-200 to 900) °C	[-328 to 1652] °F	50 °C [90 °F]
N (NiCrSi-NiSi)	(-270 to 1300) °C	[-454 to 2372] °F	50 °C [90 °F]
R (PtRh13-Pt)	(-50 to 1768) °C	[-58 to 3214] °F	500 °C [900 °F]
S (PtRh10-Pt)	(-50 to 1768) °C	[-58 to 3214] °F	500 °C [900 °F]
T (Cu-CuNi)	(-270 to 400) °C	[-454 to 752] °F	50 °C [90 °F]
U (Cu-CuNi) [2]	(-200 to 600) °C	[-328 to 1112] °F	50 °C [90 °F]
MoRe5-MoRe41 [1]	(0 to 2000) °C	[32 to 3632] °F	500 °C [900 °F]
Cold junction	internal (Pt100) or external (0 to 80) °C [32 to 176] °F		
Cold junction accuracy	± 1 °C		
[1] no reference [2] according to DIN 43710 [3] according to ASTM E988			

Voltage (mV)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Millivolt (mV)	(-10 to 75) mV	5 mV

HART® is a registered trademark of HART Communication Foundation

OUTPUT

Output (Analog)

Output signal	(4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear, resistance linear, voltage linear
Maximum load	($V_{power\ supply}$ - 11.5V) / 0.022 A current output)
Digital filter 1st degree	(0 to 60) s
Induced current required	≤ 3.5 mA
Current limit	≤ 25 mA
Switch on delay	4 s (during power up I_a = 3.8 mA)
Electronic response time	1 s

Failure Mode

Undershooting measurement range	Decrease to 3.8 mA
Exceeding measurement range	Increase to 20.5 mA
Sensor breakage/short circuit [1]	≤ 3.6 mA or ≥ 21.0 mA
[1] Not for thermocouple	

Electrical Connection

Power supply	U_b = (11.5 to 30) V dc, polarity protected
Galvanic isolation (In/out)	Û = 2 kV ac
Allowable ripple	U_{ss} ≤ 3 V at U_b ≥ 13 V, f_{max} = 1 kHz

ACCURACY

Reference conditions	Calibration temperature (23 ± 5) °C [73 ± 9] °F

Resistance Thermometer (RTD)

TYPE	MEASUREMENT ACCURACY
Pt100, Ni100 Pt500, Ni500 Pt1000, Ni1000	± 0.2 °C or 0.08% [2] ± 0.5 °C or 0.20% [2] ± 0.3 °C or 0.12% [2]

Resistance (Ω)

TYPE	MEASUREMENT ACCURACY	MEASUREMENT RANGE
Resistance	± 0.1 Ω or 0.08% [2]	(10 to 400) Ω
	± 1.5 Ω or 0.12% [2]	(10 to 2000) Ω
[2] % is related to the adjusted measurement range (the value to be applied is the greater)		

HART® is a registered trademark of HART Communication Foundation

ACCURACY (continued)

Thermocouple (TC)

TYPE	MEASUREMENT ACCURACY [1]
K, J, T, E, L, U N, C, D S, B, R MoRe5-MoRe41	± 0.5 °C or 0.08% ± 1.0 °C or 0.08% ± 2.0 °C or 0.08%
Influence of the internal reference junction	Pt100 ± (0.30 + 0.005 |t|) °C |t| = value of temperature without regard to sign °C

Voltage (mV)

TYPE	MEASUREMENT ACCURACY	MEASUREMENT RANGE
Millivolt (mV)	± 20 µV or 0.08% [1]	(-10 to 100) mV

General Accuracy

Influence of power supply	± 0.01%/V deviation from 24 V [2]
Load influence	± 0.02%/100 Ω [2]
Temperature drift	Resistive thermometer (RTD): T_d = ± (15 ppm/°C × range end value + 50 ppm/°C measurement range) × $\Delta\vartheta$ Resistive thermometer Pt100: T_d = ± (15 ppm/°C × (range end value + 200) + 50 ppm/°C × measurement range) × $\Delta\vartheta$ Thermocouple (TC): T_d = ± (50 ppm/°C × range end value + 50 ppm/°C measurement range) × $\Delta\vartheta$ $\Delta\vartheta$ = Deviation of the ambient temperature according to the reference condition
Long term stability	≤ 0.1 °C/year [3] or ≤ 0.05%/year [1][3]

[1] % is related to the adjusted measurement range (the value to be applied is the greater)
[2] All data is related to a measurement end value of 20 mA
[3] Under reference conditions

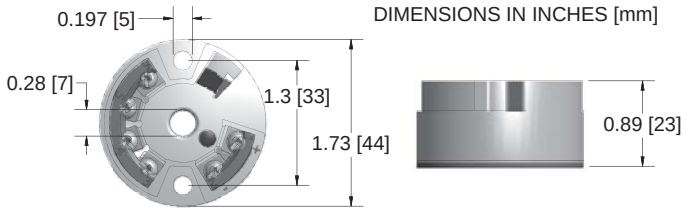
INSTALLATION CONDITIONS

Ambient Conditions

Ambient temperature	(-40 to 85) °C [-40 to 185] °F
Storage temperature	(-40 to 100) °C [-40 to 212] °F
Climatic class	To EN 60 654-1, Class C
Moisture condensation	Allowable
Vibration protection	4 g / (2 to 150) Hz according to IEC 60 068-2-6
EMC immunity	Interference immunity and interference emission as per EN 61 326-1 (IEC 1326)

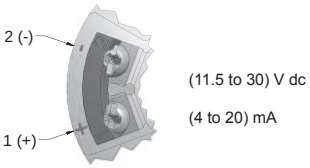
HART® is a registered trademark of HART Communication Foundation

MECHANICAL CONSTRUCTION

Dimensions	
Weight	approximately 40 g
Materials	Housing: Polycarbonate • Potting: Polyurethane
Terminals	15 AWG (maximum)

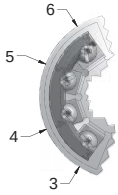
Terminal Connections

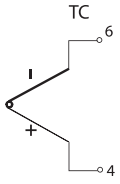
Power supply and current output



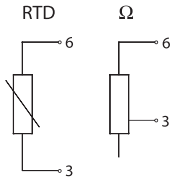
HART® Communication on (4 to 20) mA

Sensor Connection

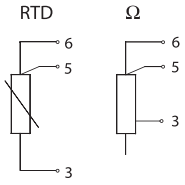




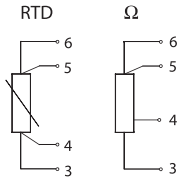
2-Wire



3-Wire



4-Wire



Remote Operation

Configurable parameters	Sensor type and connection type, engineering units (°C/°F), measurement range, internal/external cold junction compensation, cable resistance compensation on 2-wire connection, fault conditioning, output signal (4 to 20) mA or (20 to 4) mA, digital filter (damping), offset, measurement point identification (8 characters), output simulation

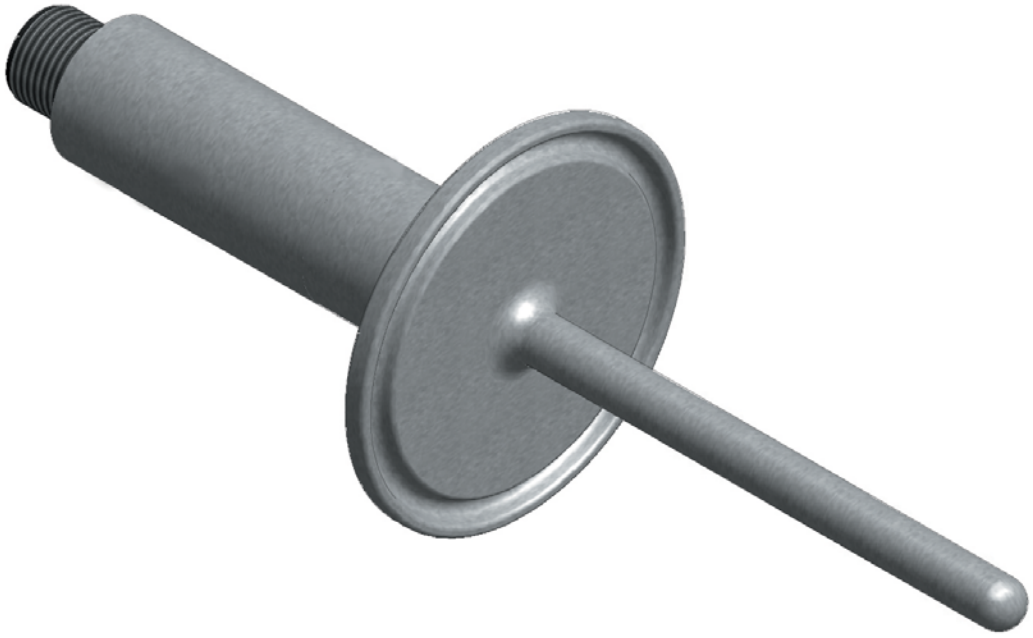
Approvals

CE marked	Unit complies with the legal requirements set forth by the EU regulations.
c UL us	UL Recognized Component
FM APPROVED CSA	General Purpose and non-incendive for use in hazardous locations Class I, Division 2 Groups A, B, C and D

HART® is a registered trademark of HART Communication Foundation

The Series 450 Programmable Integral Temperature Transmitter is ideal for monitoring temperature in highly moist or corrosive environments and in small areas such as pipes and tanks. The unit consists of a 4-wire Pt100 RTD sensor, built-in (4 to 20) mA transmitter, and process connection. The integral design eliminates all external screw connections, simplifying the electrical installation process and solving the problems caused by moisture, loose connections, and corrosion. A "quick disconnect" M12 plug adapter connects the transmitter to a PC for ease of calibration, re-programming, and wiring accuracy.

SERIES 450 PROGRAMMABLE INTEGRAL TEMPERATURE TRANSMITTER



c UL us

Application Areas

- PC programmable temperature transmitter for converting Pt100 input signal into a scaleable (4 to 20) mA analog output signal
- Platinum Resistance Thermometer (RTD)
- Ideal for use in applications where sanitary wash-down procedures are required
- Compact design is well suited for use in small areas such as tanks and pipes
- Used for measuring temperatures from (-51 to 160) °C [-60 to 320] °F

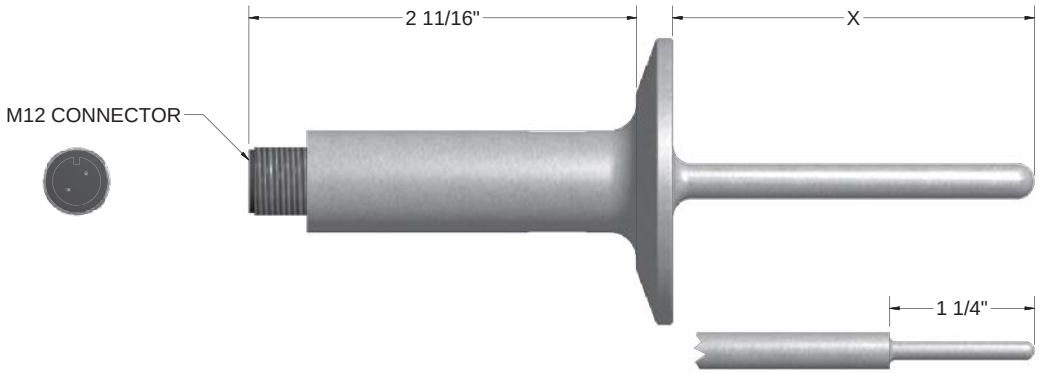
Features and Benefits

- PC programmable transmitter with (4 to 20) mA output
- Reliable measurements despite fluctuations in ambient temperature
- Available in threaded and Clean-In-Place (CIP) connections
- RFI/EMI Protected
- c UL us UL Recognized Component

MINIATURE CIP RTD ASSEMBLY

See Food & Dairy Section For Ordering Information

CIP RTD ASSEMBLY

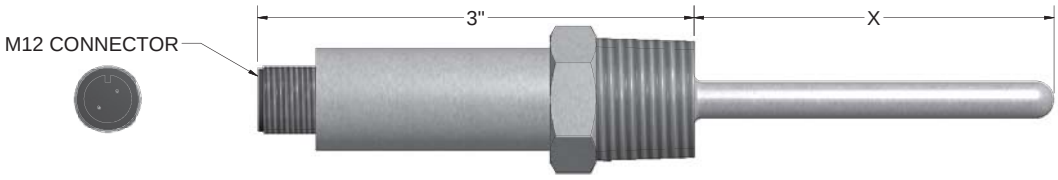


See Food & Dairy Section For Ordering Information

RTD ASSEMBLY WITH NO PROCESS FITTING

See RTD Section For Ordering Information

RTD ASSEMBLY WITH THREADED CONNECTION



See RTD Section For Ordering Information

INPUT

Resistance Thermometer Input (RTD)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Pt100 (α = 0.003 85)	(-51 to 160) °C [-60 to 320] °F	10 ˚C [18 ˚F]
Connection Type	4 wire connection (standard)	
Sensor current	≤ 0.6 mA	

OUTPUT

Output (Analog)

Output signal	(4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear
Maximum load	($V_{power\ supply}$ - 10 V) / 0.023 A (current output)
Induced current required	≤ 3.5 mA
Current limit	≤ 23 mA
Switch on delay	2 s
Electronic response time	1 s

Failure Mode

Undershooting measurement range	Decreases to 3.8 mA
Exceeding measurement range	Increases to 20.5 mA
Sensor breakage/short circuit	≤ 3.6 mA or ≥ 21.0 mA

ACCURACY

Accuracy

Electronics measurement error	0.1 °C or 0.08% [1]
Reference conditions	Calibration temperature (23 ± 5) °C [73 ± 9] °F
Sensor measurement error	Class A ± (0.15 + 0.002 |t|) °C Class B ± (0.3 + 0.005 |t|) °C Grade B ± (0.25 + 0.0042 |t|) °C Class AA ± (0.01 + 0.0017 |t|) °C 1/5 Class B ± (0.06 + 0.0017 |t|) °C |t| = value of temperature without regard to sign, °C
Influence of power supply	± 0.01%/V deviation from 24 V [2]
Load influence	± 0.02%/100 Ω [2]
Temperature drift	T_d = ± (15 ppm/°C × (full scale value + 200) + 50 ppm/°C of set measuring range) × Δ^o Δ^o = deviation of ambient temperature from the reference operation condition
Electronics long term stability	≤ 0.1 °C/year [3] or ≤ 0.05%/year [1][3]

[1] % is related to the adjusted measurement range (the value to be applied is the greater)
[2] All data is related to a measurement and value of 20 mA
[3] Under reference conditions

Electrical Connection

Electrical connection	 Electrical connection of the compact thermometer (view from above) - M12 plug, 4-pin Pin 1: Power supply (10 to 35) V dc; Current output (4 to 20) mA Pin 2: PC configuration cable connection Pin 3: Power supply 0 V dc; current output (4 to 20) mA Pin 4: PC configuration cable connection
Power supply	U_b = (10 to 35) V dc, polarity protected
Allowable ripple	$U_{ss} \leq 3V$ at $U_b \geq 13V$, f_{max} = 1 kHz

Environmental Conditions

Ambient Temperature	(-40 to 85) ˚C [-40 to 185] ˚F
Storage Temperature	(-40 to 100) ˚C [-40 to 212] ˚F
Climatic Class	EN 60 654-1, class C
Condensation	Permitted
Ingress protection	IP 67
Shock resistance	4g / (2 to 150) Hz as per IEC 60 068-2-6
EMC immunity	Interference immunity and interference emission as per EN 61 326-1 (IEC 1326)

Process

	MAXIMUM AMBIENT	MAXIMUM PROCESS
Process temperature limit	to 25 °C [77 °F] to 40 °C [104 °F] to 60 °C [140 °F] to 85 °C [185 °F]	160 °C [320 °F] 135 °C [275 °F] 120 °C [248 °F] 100 °C [212 °F]

Approvals

c UL us	UL Recognized Component
3A AUTHORIZED 74-	3-A Sanitary Council Standard 74- (CIP sensors only)

Transmitter

Configuration Code TM01
Series 642 Programmable HART®
Field Temperature Transmitter

The Series 642 programmable HART® field temperature transmitter is a 2-wire unit with analog output. It includes input for RTDs; resistance inputs in 2-wire, 3-wire, and 4-wire connections; thermocouples and voltage signals. The transmitter can be supplied with or without a digital display, in either a general-purpose aluminum housing, or explosion-proof aluminum housing. The Series 642 can be programmed with a PC or a HART® protocol handheld terminal. When supplied with a digital display, the LC screen shows the current measured value and a bar graph with limit value violation indicator.

PROGRAMMABLE FIELD TEMPERATURE TRANSMITTER

Programmable temperature transmitter for resistance thermometers (RTDs), thermocouples, resistance inputs and voltage inputs: adjustable via HART® protocol.

HART COMMUNICATION PROTOCOL

Application Areas

- Temperature field transmitter with HART® protocol for converting various input signals to an analog, scaleable (4 to 20) mA output signal
- Input:
  Resistance thermometer (RTD)
  Thermocouples (TC)
  Resistance input (Ohm)
  Voltage input (mV)
- HART® protocol for operating the device on site using a handheld communicator or remotely via the PC

Features and Benefits

- Universally programmable with HART® protocol for various input signals
- Illuminated display, rotatable
- Operation, visualization and maintenance with PC; e.g. using TransComm Light operating software
- 2-wire technology, analog output (4 to 20) mA
- Undervoltage detection
- Highly accurate in entire operating temperature range
- Approvals:
  FM and CSA (IS, NI, XP and DIP)
- Galvanic isolation
- Output simulation
- Min./max. process values recorded
- Customized measuring range setup or expanded SETUP; see questionnaire

FM APPROVED CE marked

HART® is a registered trademark of HART Communication Foundation

pyromation inc.

ORDER CODES

Example Order Number:

1-0		1-1		1-2	1-3	1-4		1-5	1-6
642A	-	D	-	3	85	U	-	S(0-200)	C

1-0 Transmitter Type

CODE	DESCRIPTION
642A	(4 to 20) mA HART® Field Transmitter with general-purpose aluminum housing
642C	(4 to 20) mA HART® Field Transmitter with explosion-proof aluminum housing FM/CSA / XP Class I / Div 1/ Groups A,B,C,D / DIP Class II / Div 1 / Groups E,F,G / Class III / NI Class I / Div 2 / Groups A,B,C,D
642F	(4 to 20) mA HART® Field Transmitter with general-purpose aluminum housing FM/CSA IS Class I / Div 1 / Groups A,B,C,D / NI Class I / Div 2 / Groups A,B,C,D

1-1 Options

CODE	DESCRIPTION
T	Solid cover
D	Glass cover with digital display

1-2 Input Type

CODE	DESCRIPTION
00	Unconfigured[1]
1	Thermocouple (TC) or millivolt
2	RTD (2-wire) or resistance
3	RTD (3-wire) or resistance
4	RTD (4-wire) or resistance

[1] Default setting for unconfigured transmitter is 3-wire Pt100 (0 - 100) °C

Accessories

CODE	DESCRIPTION
10321	Pipe mounting bracket for use on pipes with a diameter between 1.5" to 3.3"

1-3 Sensor Type

CODE	DESCRIPTION
J	Type J thermocouple
K	Type K thermocouple
T	Type T thermocouple
N	Type N thermocouple
E	Type E thermocouple
R	Type R thermocouple
S	Type S thermocouple
B	Type B thermocouple
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
55	500 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
95	1000 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
MV	Millivolts
W	Resistance
Other types available. Consult factory.	

1-4 Failure Mode

CODE	DESCRIPTION
U	Upscale Burnout ≥ 23 mA
D	Downscale Burnout ≤ 3 mA

1-5 Range

CODE	DESCRIPTION
S	(lower limit – upper limit)

1-6 Unit of Measure

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit
K	Kelvin

HART® is a registered trademark of HART Communication Foundation

INPUT

Resistance Thermometer (RTD)

TYPE	STANDARDS	MEASUREMENT RANGE		MINIMUM RANGE
Pt100 (α = 0.003 85 °C^{-1}) Pt200 Pt500 Pt1000	ASTM E1137 IEC 60 751	(-200 to 850) °C (-200 to 850) °C (-200 to 250) °C (-200 to 250) °C	[-328 to 1562] °F [-328 to 1562] °F [-328 to 482] °F [-328 to 482] °F	10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F]
Pt100 (α = 0.003 916)	JIS C1604	(-200 to 649) °C	[-328 to 1200] °F	10 °C [18 °F]
Pt100 (α = 0.003 923)	SAMA	(-100 to 700) °C	[-148 to 1292] °F	10 °C [18 °F]
Ni100 (α = 0.006 180) Ni1000 (α = 0.006 180)	DIN 43 760	(-60 to 250) °C (-60 to 150) °C	[-76 to 482] °F [-76 to 302] °F	10 °C [18 °F] 10 °C [18 °F]
Ni120 (α = 0.006 720) Cu10 (α = 0.004 274)	Edison Curve	(-70 to 270) °C (-100 to 260) °C	[-94 to 518] °F [-148 to 500] °F	10 °C [18 °F] 10 °C [18 °F]
Pt50 (α = 0.003 911) Pt100 (α = 0.003 911) Cu50 (α = 0.004 278) Cu100 (α = 0.004 278)	GOST	(-200 to 1100) °C (-200 to 850) °C (-200 to 200) °C (-200 to 200) °C	[-328 to 2012] °F [-328 to 1562] °F [-328 to 392] °F [-328 to 392] °F	10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F]
Polynomial RTD Pt100 (Callendar - van Dusen)		(-200 to 850) °C (-200 to 850) °C	[-328 to 1562] °F [-328 to 1562] °F	10 °C [18 °F] 10 °C [18 °F]
Connection type		2-, 3- or 4-wire connection cable resistance compensation possible in the 2 wire system (0 to 30) Ω		
Sensor cable resistance		3-wire and 4-wire connection, sensor wire resistance to maximum 50 Ω per wire		
Sensor current		≤ 0.3 mA		

Resistance (Ω)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Resistance (Ω)	(10 to 400) Ω (10 to 2000) Ω	10 Ω 100 Ω

Thermocouples (TC) (ASTM E230)

TYPE	MEASUREMENT RANGE		MINIMUM RANGE
B (PtRh30-PtRh6)	(0 to 1820) °C	[32 to 3308] °F	500 °C [900 °F]
C (W5Re-W26Re)	(0 to 2320) °C	[32 to 4208] °F	500 °C [900 °F]
D (W3Re-W25Re) [1]	(0 to 2495) °C	[32 to 4523] °F	500 °C [900 °F]
E (NiCr-CuNi)	(-270 to 1000) °C	[-454 to 1832] °F	50 °C [90 °F]
J (Fe-CuNi)	(-210 to 1200) °C	[-346 to 2192] °F	50 °C [90 °F]
K (NiCr-Ni)	(-270 to 1372) °C	[-454 to 2501] °F	50 °C [90 °F]
L (Fe-CuNi) [2]	(-200 to 900) °C	[-328 to 1652] °F	50 °C [90 °F]
N (NiCrSi-NiSi)	(-270 to 1300) °C	[-454 to 2372] °F	50 °C [90 °F]
R (PtRh13-Pt)	(-50 to 1768) °C	[-58 to 3214] °F	500 °C [900 °F]
S (PtRh10-Pt)	(-50 to 1768) °C	[-58 to 3214] °F	500 °C [900 °F]
T (Cu-CuNi)	(-270 to 400) °C	[-454 to 752] °F	50 °C [90 °F]
U (Cu-CuNi) [2]	(-200 to 600) °C	[-328 to 1112] °F	50 °C [90 °F]
Cold junction	internal (Pt100) or external (0 to 80) °C [32 to 176] °F		
Cold junction accuracy	± 1 °C		
Max. sensor resistance	10 kΩ		
[1] no reference [2] according to DIN 43 710			

Voltage (mV)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Millivolt (mV)	(-20 to 100) mV	5 mV

HART® is a registered trademark of HART Communication Foundation

OUTPUT

Output (Analog)

Output signal	Analog (4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear, resistance linear, voltage linear
Maximum load	($V_{power\ supply}$ - 11V) / 0.022 A (current output)
Digital filter 1st degree	(0 to 60) s
Induced current required	≤ 3.5 mA
Current limit	≤ 23 mA
Switch on delay	4 s (during switch-on operation I_a = 4 mA)
Response time	1 s

Failure Mode

Undershooting measurement range	Decrease to 3.8 mA
Exceeding measurement range	Increase to 20.5 mA
Sensor breakage/short circuit	≤ 3.6 mA or ≥ 21.0 mA (configurable 21.6 mA to 23 mA)

Electrical Connection

Power supply	U_b = 11 to 40 V (8 to 40 without display), reverse polarity protected
Cable entry	Three 1/2" NPT openings
Allowable ripple	U_{ss} ≤ 3 V at U_b ≥ 13.5 V, f_{max} = 1 kHz

ACCURACY

Reference conditions	Calibration temperature (23 ± 5) °C [73.4 ± 9] °F

Resistance Thermometer (RTD)

TYPE	MEASUREMENT ACCURACY - DIGITAL	MEASUREMENT ACCURACY - D/A[1]
Cu100, Pt100, Ni100, Ni120	± 0.2 °C [0.36 °F]	± 0.02%
Pt500	± 0.6 °C [1.08 °F]	± 0.02%
Cu50, Pt50, Pt1000, Ni1000	± 0.4 °C [0.72 °F]	± 0.02%
Cu10, Pt200	± 2 °C [3.6 °F]	± 0.02%

Thermocouple (TC)

TYPE	MEASUREMENT ACCURACY - DIGITAL	MEASUREMENT ACCURACY - D/A[1]
K, J, T, E, L, U	Typical ± 0.5 °C [0.9 °F]	± 0.02%
N, C, D	Typical ± 1 °C [0.18 °F]	± 0.02%
S, B, R	Typical ± 2 °C [3.6 °F]	± 0.02%

Resistance (Ω)

TYPE	MEASUREMENT ACCURACY - DIGITAL	MEASUREMENT ACCURACY - D/A[1]	MEASUREMENT RANGE
Resistance	± 0.08 Ω	± 0.02%	(10 to 400) Ω
	± 1.6 Ω	± 0.02%	(10 to 2000) Ω

Voltage (mV)

TYPE	MEASUREMENT ACCURACY - DIGITAL	MEASUREMENT ACCURACY - D/A[1]	MEASUREMENT RANGE
Voltage	± 20 µV	± 0.02%	(20 to 100) mV

[1] % relates to the set span. Accuracy = digital + D/A accuracy

HART® is a registered trademark of HART Communication Foundation

ACCURACY (continued)

Physical input range of the sensors

TYPE	MEASUREMENT ACCURACY[1]
(10 to 400) Ω	Cu10, Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120
(10 to 2000) Ω	Pt200, Pt500, Pt1000, Ni1000
(-20 to 100) mV	Thermocouple type: C, D, E, J, K, L, N
(-5 to 30) mV	Thermocouple type: B, R, S, T, U

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

General

Repeatability	0.03% of the physical input range (15 Bit) Resolution A/D conversion: 18 Bit
Load influence	≤ ± 0.005%/V deviation from 24 V, related to the full-scale value
Long term stability	≤ 0.1 °C [0.18 °F] / year or ≤ 0.05%/year Date under reference conditions. % relates to the set span. The larger value applies.

Temperature Drift

Total temperature drift = input temperature drift + output temperature drift	Effect on the accuracy when ambient temperature changes by 1 °C [1.8 °F]	
	Input (10 to 400) Ω	0.002% of measured value
	Input (10 to 2000) Ω	0.002% of measured value
	Input (-20 to 100) mV	typ. 0.002% of measured value (maximum value = 1.5 x typical)
	Input (5 to 30) mV	typ. 0.002% of measured value (maximum value = 1.5 x typical)
	Output (4 to 20) mA	typ. 0.002% of measured value (maximum value = 1.5 x typical)

INSTALLATION CONDITIONS

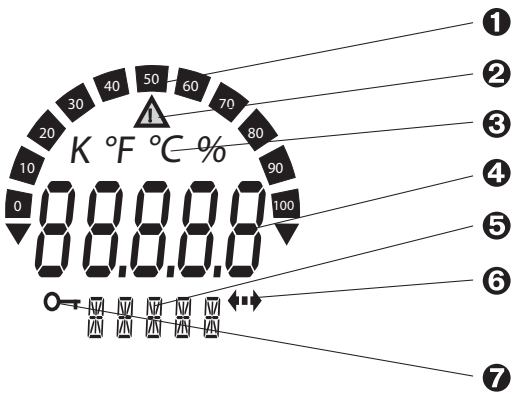
Ambient Conditions

Ambient temperature	Without display: (-40 to 85) °C [-40 to 185] °F With display: (-40 to 70) °C [-40 to 158] °F NOTE: The display can react slowly for temperature < -20 °C [< -4 °F]
Storage temperature	Without display: (-40 to 100) °C [-40 to 212] °F With display: (-40 to 85) °C [-40 to 185] °F
Allowable Altitude	6500 ft. above sea level
Climatic class	As per EN 60 654-1, Class C
Moisture condensation	Allowable
Shock and vibration protection	3 g / (2 to 150) Hz according to IEC 60 068-2-6
EMC immunity	Interference immunity and interference emission as per EN 61 326-1 (IEC 1326) (0.08 to 2) GHz 10 V/m; (1.4 to 2) GHz 30 V/m to EN 61 000-4-3
Protection	IP67, NEMA 4X, Class 1, Division 1, Group A, B, C; Class II Division I, Groups E, F, G and Class III, Division I (when specified)

HART® is a registered trademark of HART Communication Foundation

INTERFACE

Display Elements



LC display of the field transmitter (illuminated, can be rotated in 90° increments)

Item 1: Bar graph display in 10% increments with indicators for overranging / underranging

Item 2: 'Caution' display

Item 3: Unit display K, °F, or °C or %

Item 4: Measured value display (digit height 20.5 mm / 0.81 ")

Item 5: Status and information display

Item 6: 'Communication' display

Item 7: 'Programming disabled' display

Operating Elements

No operating elements are present directly on the display. The device parameters of the field transmitter are configured using the handheld communicator or a PC with HART® Modem and operating software TransComm Light.

Remote Operation

Interface	HART® communication via transmitter power supply
Configurable device parameters	Sensor type and connection type, engineering units (°C/°F), measurement ranges, internal/external cold junction compensation of wire resistance with 2-wire connection, failure mode, output signal (4 to 20) mA (20 to 4) mA, digital filter (damping), offset, TAG+descriptor (8+16 characters), output simulation, customized linearization, recording of min./max process value, analog output: Option: customized linearization

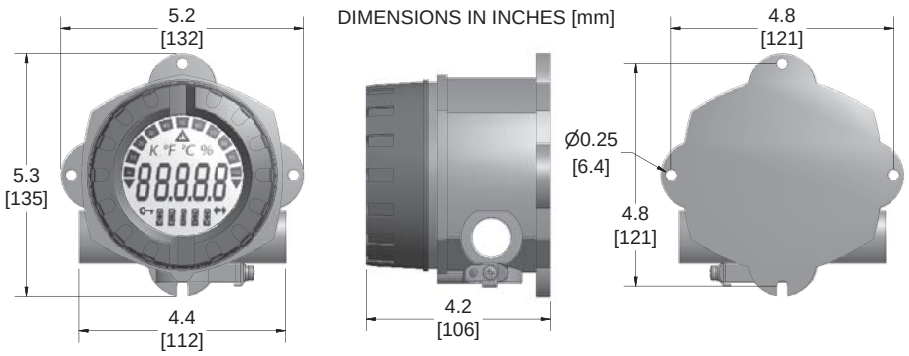
STANDARDS

Approvals

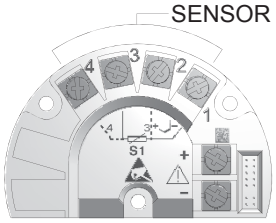
CE marked	Unit complies with the legal requirements set forth by the EU regulations.
FM APPROVED CSA	Intrinsically safe and non-incendive or explosion proof for hazardous locations Class I, Division 1 and 2, Groups A, B, C and D
Other standards and guidelines	IEC 60 529: Degrees of protection through housing (IP code) IEC 61 010: Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures IEC1326: Electromagnetic compatibility (EMC requirements)

HART® is a registered trademark of HART Communication Foundation

MECHANICAL CONSTRUCTION

Dimensions	 Display rotatable in 90° increments
Weight	approximately 1.6 kg [3.53 lb]
Materials	Housing: die-cast aluminum with powder coating
Terminals	Cables / wires up to max. 2.5 mm² (AWG 13)

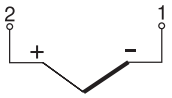
Terminal Connections



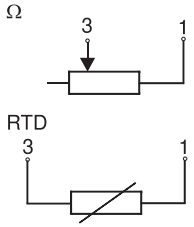
HART® Communication on (4 to 20) mA

Sensor

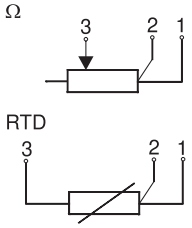
TC



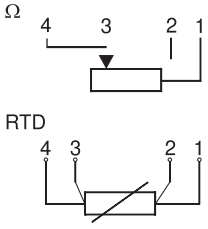
2-wire



3-wire



4-wire



Optional Mounting Bracket

Part Number: 10321

Designed for use on pipes with a diameter between 1.5" to 3.3".

The additonal mounting plate must be used for pipes with a diameter of 1.5" to 2.2". No plate is required for pipes with a diameter of 2.2" to 3.3".

Assembly includes bracket, screws, and mounting plate.

HART® is a registered trademark of HART Communication Foundation

Configuration sheet for Series 642 temperature transmitter
For customer specific setup

Sensor

TC ( ) B ( ) C ( ) D ( ) E ( ) J
( ) K ( ) L ( ) N ( ) R ( ) S
( ) T ( ) U

RTD ( ) Pt100 ( ) Pt500 ( ) Pt1000
( ) Ni100 ( ) Ni500 ( ) Ni1000

( ) mV ( ) (10 to 400) Ohm ( ) (10 to 2000) Ohm

( ) 2-wire ( ) 3-wire ( ) 4-wire

Unit ( ) °C ( ) °F ( ) K ( ) mV ( ) Ohm

Range Lower limit [ ][ ][ ][ ][ ].[ ]

Upper limit [ ][ ][ ][ ][ ].[ ]

Note:
Must meet minimum space requirements

Expanded setup

Reference junction/TC only ( ) internal ( ) external [ ][ ][ ] (0 to 80) ºC (32 to 17) ºF

Compensation wire resistance S1 [ ][ ] (0 to 30) Ohm

Failure mode ( ) ≤ 3.6 mA ( ) ≥ 21.0 mA

Output ( ) (4 to 20) mA ( ) (20 to 4) mA

Filter [ ][ ] (0 to 60) s

Offset S1 [ ][ ].[ ] (-10 to 10) ºC [-18 to 18] ºF

Line voltage filter ( ) 50 Hz ( ) 60 Hz

TAG [ ][ ][ ][ ][ ][ ][ ][ ]

DESCRIPTION
16 characters max. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

The T82 programmable HART® field temperature transmitter is a 2-wire unit with analog output. It includes input for RTDs: resistance inputs in 2-wire, 3-wire, and 4-wire connections; thermocouples and voltage signals. The transmitter can be supplied with or without a digital display, in a general-purpose aluminum screw-cover housing. The T82 can be programmed using a HART® protocol handheld terminal. When supplied with a digital display, the LCD display shows the current measured value.

PROGRAMMABLE DUAL INPUT TEMPERATURE TRANSMITTER

Programmable temperature transmitter for resistance thermometers (RTDs), thermocouples, resistance inputs and voltage inputs: adjustable via HART® protocol.

HART COMMUNICATION PROTOCOL

Application Areas

- Temperature transmitter with 2 input channels and HART® protocol for converting various input signals to an analog, scaleable (4 to 20) mA output signal
- Input:
  Resistance thermometer (RTD)
  Thermocouples (TC)
  Resistance input (Ohm)
  Voltage input (mV)
- HART® protocol for operating the device on site using a handheld communicator

Features and Benefits

- Universally programmable with HART® protocol for various input signals
- 2-wire, single, analog output (4 to 20) mA
- Undervoltage detection
- Highly accurate in entire operating temperature range
- Approvals: FM and CSA (IS, NI)
- Galvanic isolation
- Output simulation
- Customized measuring range setup or expanded SETUP; see manual

ORDER CODES

Example Order Number:

1-0		1-1		1-2		1-3		1-4		1-5		1-6	1-7
36T82-D10	-	33	-	85	-	85	-	E	-	U	-	S(0-200)	C

1-0 Transmitter Type

CODE	DESCRIPTION
T82-00	No display (transmitter only)
T82-D10	Transmitter with digital display
36T82-D10	Transmitter with digital display and general purpose screw-cover housing

1-1 Configuration Input

CODE	DESCRIPTION
00	Unconfigured
2I	Ch1: RTD 2-wire, Ch2: inactive
22	Ch1: RTD 2-wire, Ch2: RTD 2-wire
23	Ch1: RTD 2-wire, Ch2: RTD 3-wire
2T	Ch1: RTD 2-wire, Ch2: Thermocouple
3I	Ch1: RTD 3-wire, Ch2: inactive
32	Ch1: RTD 3-wire, Ch2: RTD 2-wire
33	Ch1: RTD 3-wire, Ch2: RTD 3-wire
3T	Ch1: RTD 3-wire, Ch2: Thermocouple
4I	Ch1: RTD 4-wire, Ch2: inactive
4T	Ch1: RTD 4-wire, Ch2: Thermocouple
TI	Ch1: Thermocouple, Ch2: inactive
TT	Ch1: Thermocouple, Ch2: Thermocouple

1-2 Sensor Input Channel 1

CODE	DESCRIPTION
J	Type J thermocouple
K	Type K thermocouple
T	Type T thermocouple
N	Type N thermocouple
E	Type E thermocouple
R	Type R thermocouple
S	Type S thermocouple
B	Type B thermocouple
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
55	500 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
95	1000 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)

HART® is a registered trademark of HART Communication Foundation

1-3 Sensor Input Channel 2

CODE	DESCRIPTION
00	No second channel
J	Type J thermocouple
K	Type K thermocouple
T	Type T thermocouple
N	Type N thermocouple
E	Type E thermocouple
R	Type R thermocouple
S	Type S thermocouple
B	Type B thermocouple
85	100 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
55	500 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)
95	1000 ohm platinum (α = 0.003 85 $^{\circ}C^{-1}$)

1-4 Input Set-ups

CODE	DESCRIPTION
A	Process variable = Ch1; Ch2 = inactive
B	Process variable = Ch1; Secondary value = Ch2
C	Process variable = the difference between Ch1 and Ch2
D	Process variable = average of Ch1 and Ch2
E	Sensor backup; Process variable = Ch1 and Ch2

1-5 Failure Mode

CODE	DESCRIPTION
U	Upscale Burnout ≥ 23 mA
D	Downscale Burnout ≤ 3 mA

1-6 Range

CODE	DESCRIPTION
S	(lower limit – upper limit)

1-7 Unit of Measure

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit

INPUT

Resistance Thermometer (RTD)

TYPE	STANDARD	MEASUREMENT RANGE		MINIMUM RANGE
Pt100 (α = 0.003 85 °C^{-1}) Pt200 Pt500 Pt1000	ASTM E1137 IEC 60 751	(-200 to 850) °C (-200 to 850) °C (-200 to 500) °C (-200 to 250) °C	[-328 to 1562] °F [-328 to 1562] °F [-328 to 932] °F [-328 to 482] °F	10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F] 10 °C [18 °F]
Pt100 (α = 0.003 916)	JIS C1604:1984	(-200 to 510) °C	[-328 to 950] °F	10 °C [18 °F]
Ni100 (α = 0.006 18) Ni120 (α = 0.006 18)	DIN 43 760 IPTS-68	(-60 to 250) °C (-60 to 250) °C	[-76 to 482] °F [-76 to 482] °F	10 °C [18 °F] 10 °C [18 °F]
Pt50 (α = 0.003 91) Pt100 (α = 0.003 91) Cu50 (α = 0.004 28)	GOST 6651-94	(-185 to 1100) °C (-200 to 850) °C (-175 to 200) °C	[-301 to 2012] °F [-328 to 1562] °F [-283 to 392] °F	10 °C [18 °F] 10 °C [18 °F] 10 °C [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 R_O.		10 °C [18 °F]
Type of connection: 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 (Ω)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Resistance (Ω)	(10 to 400) Ω (10 to 2000) Ω	10 Ω 100 Ω

Thermocouples (TC)

TYPE	STANDARD	MEASUREMENT RANGE		RECOMMENDED TEMPERATURE RANGE		MINIMUM RANGE
B (PtRh30-PtRh6)	IEC 584 part 1	(40 to 1820) °C	[104 to 3308] °F	(100 to 1500) °C	[212 to 2732] °F	50 °C [90 °F]
E (NiCr-CuNi)	ASTM E230	(-270 to 1000) °C	[-454 to 1832] °F	(0 to 750) °C	[32 to 1382] °F	50 °C [90 °F]
J (Fe-CuNi)		(-210 to 1200) °C	[-346 to 2192] °F	(20 to 700) °C	[68 to 1292] °F	50 °C [90 °F]
K (NiCr-Ni)		(-270 to 1372) °C	[-454 to 2501] °F	(0 to 1100) °C	[32 to 2012] °F	50 °C [90 °F]
N (NiCrSi-NiSi)		(-270 to 1300) °C	[-454 to 2372] °F	(0 to 1100) °C	[32 to 2012] °F	50 °C [90 °F]
R (PtRh13-Pt)		(-50 to 1768) °C	[-58 to 3214] °F	(0 to 1400) °C	[32 to 2552] °F	50 °C [90 °F]
S (PtRh10-Pt)		(-50 to 1768) °C	[-58 to 3214] °F	(0 to 1400) °C	[32 to 2552] °F	50 °C [90 °F]
T (Cu-CuNi)		(-260 to 400) °C	[-436 to 752] °F	(-185 to 350) °C	[-301 to 662] °F	50 °C [90 °F]
C (W5Re-W26Re)	ASTM E230	(0 to 2315) °C	[32 to 4199] °F	(0 to 2000) °C	[32 to 3632] °F	50 °C [90 °F]
D (W3Re-W25Re)	ASTM E1751	(0 to 2315) °C	[32 to 4199] °F	(0 to 2000) °C	[32 to 3632] °F	50 °C [90 °F]
L (Fe-CuNi)	DIN 43 710	(-200 to 900) °C	[-328 to 1652] °F	(0 to 750) °C	[32 to 1382] °F	50 °C [90 °F]
U (Cu-CuNi)		(-200 to 600) °C	[-328 to 1112] °F	(-185 to 400) °C	[-301 to 752] °F	50 °C [90 °F]
Cold junction		internal (Pt100) or external (-40 to 85) °C [-40 to 185] °F				
Max. sensor resistance		10 kΩ				

Voltage (mV)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Millivolt (mV)	(-20 to 100) mV	5 mV

HART® is a registered trademark of HART Communication Foundation

T82 Programmable HART® Temperature Transmitter Specifications

OUTPUT

Output (Analog)

Output signal	Analog (4 to 20) mA or (20 to 4) mA	
Transmission as	Temperature linear, resistance linear, voltage linear	
Maximum load	($U_{b\ max}$ - 11V) / 0.023 A (current output)	
Digital filter 1st degree	(0 to 120) s	
Minimum current required	3.5 mA, multidrop mode 4 mA	
Current limit	≤ 23 mA	
Switch on delay	10 s (during switch-on operation I_a ≤ 3.8 mA)	
Response time	Resistance thermometer (RTD)	0.9 to 1.2 s (depends on the connection method 2/3/4-wire)
	Thermocouples (TC)	0.7 s
	Reference temperature	0.5 s

Failure Mode

Underranging	Linear drop from 4.0 mA to 3.8 mA
Overranging	Linear increase from 20.0 mA to 20.5 mA
Failure, e.g. sensor breakage; sensor short circuit	≤ 3.6 mA or ≥ 21 mA (configurable 21.5 mA to 23 mA)

Electrical Connection

Supply Voltage	11V ≤ Vcc ≤ 42 V non-hazardous area, reverse polarity protected, see XP documentation for hazardous locations
Entry	3/4 inch NPT conduit connection x 1/2 inch NPT process connection
Residual	U_{ss} ≤ 3 V at U_b ≥ 13.5 V, f_{max} = 1 kHz

ACCURACY

Reference conditions	Calibration temperature (25 ± 5) °C [77 ± 9] °F Supply voltage: 24 V dc 4-wire circuit for resistance adjustment

Resistance Thermometer (RTD)

TYPE	MEASUREMENT ACCURACY - DIGITAL[1]	MEASUREMENT ACCURACY - D/A[2]
Pt100, Ni100, Ni120	0.1 °C [0.18 °F]	0.03%
Pt500	0.3 °C [0.54 °F]	0.03%
Cu50, Pt50, Pt1000	0.2 °C [0.36 °F]	0.03%
Pt200	1.0 °C [1.8 °F]	0.03%

Thermocouple (TC)

TYPE	MEASUREMENT ACCURACY - DIGITAL[1]	MEASUREMENT ACCURACY - D/A[2]
K, J, T, E, L, U	0.25 °C [0.45 °F]	0.03%
N, C, D	0.5 °C [0.9 °F]	0.03%
S, B, R	1.0 °C [1.8 °F]	0.03%

Resistance (Ω)

TYPE	MEASUREMENT ACCURACY - DIGITAL[1]	MEASUREMENT ACCURACY - D/A[2]	MEASUREMENT RANGE
Resistance	± 0.04 Ω	0.03%	(10 to 400) Ω
	± 0.8 Ω	0.03%	(10 to 2000) Ω

Voltage (mV)

TYPE	MEASUREMENT ACCURACY - DIGITAL[1]	MEASUREMENT ACCURACY - D/A[2]	MEASUREMENT RANGE
Voltage	± 10 µV	0.03%	(-20 to 100) mV

[1] Using HART® transmitted measured value
[2] % refers to the set span. Accuracy of current output = digital + D/A accuracy

HART® is a registered trademark of HART Communication Foundation

ACCURACY (continued)

Physical input range of the sensors

(10 to 400) Ω	Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120
(10 to 2000) Ω	Pt200, Pt500, Pt1000
(-20 to 100) mV	Thermocouple type: B, C, D, E, J, K, L, N, R, S, T, U

General

Load influence	≤ ± 0.0025%/V with reference to the span
Long term stability	≤ 0.1 °C [0.18 °F] / year or ≤ 0.05%/year Date under reference conditions. % relates to the set span. The larger value is valid.

Influence of ambient temperaure (temperature drift)

Total temperature drift = input temperature drift + output temperature drift	Impact on the accuracy when ambient temperature changes by 1 °C [1.8 °F]	
	Input (10 to 400) Ω	typ. 0.001% of measured value, min. 1 mΩ
	Input (10 to 2000) Ω	typ. 0.001% of measured value, min. 10 mΩ
	Input (-20 to 100) mV	typ. 0.001% of measured value, min. 0.2 µV
	Output (4 to 20) mA	typ. 0.0015% of the span

INSTALLATION CONDITIONS

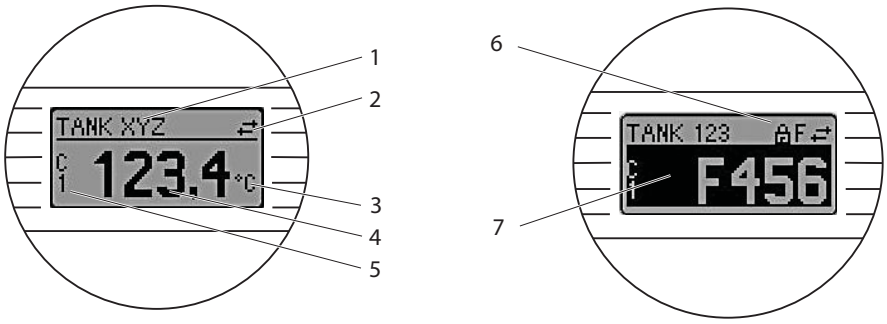
Ambient Conditions

Ambient temperature	Without display: (-40 to 85) °C [-40 to 185] °F non-hazardous location (for hazardous locations, see XP documentation)			
Storage temperature	Without display: (-50 to 100) °C [-58 to 212] °F			
Altitude	Up to 4000 m (4374.5 yeards) above mean sea level per IEC 61010-1, CAN/CSA C22.2 No. 61010-1			
Climatic class	As per EN 60 654-1, Class C			
Humidity	Condensation permitted per IEC 60 068-2-33/Max. rel. humidity: 95% per IEC 60068-2-30			
Shock and vibration protection	(25 to 100) Hz for 4g			
Electromagnetic compatibility (EMC)	Electromagnetic compatibility in accordance with all the relevant requirements of the EN 61326 series and NAMUR Recommendation EMC (NE21),			
	ESD (electrostatic discharge)	EN/IEC 61000-4-2		6 kV cont., 8 kV air
	Electromagnetic fields	EN/IEC 61000-4-3	0.08 to 2.7 GHz	10 V/m
	Burst (fast transients)	EN/IEC 61000-4-4		2 kV
	Surge (surge voltage)	EN/IEC 61000-4-5		0.5 kV sym./1 kV assym.
	Conducted RF	EN/IEC 61000-4-6	0.01 to 80 MHz	10 V
Protection	IP 20 with screw terminals in the installed state. NEMA 4X, IP 66/67 when installed in field housing option 36.			

HART® is a registered trademark of HART Communication Foundation

INTERFACE

Display Elements



Item 1: Displays the TAG
Item 2: 'Communication' symbol
Item 3: Unit display
Item 4: Measured value display
Item 5: Value/channel display S1, S2, DT, PV, I, %
Item 6: 'Configuration locked' symbol
Item 7: Status signals

Remote Operation

Interface	HART® (Version 6) communication via transmitter power supply
Configurable device parameters	Sensor type and connection type, engineering units (°C/°F), measurement ranges, internal/external cold junction compensation of wire resistance with 2-wire connection, failure mode, output signal (4 to 20) mA (20 to 4) mA, digital filter (damping), offset, TAG+descriptor (8+16 characters), output simulation, analog output: option: customized linearization

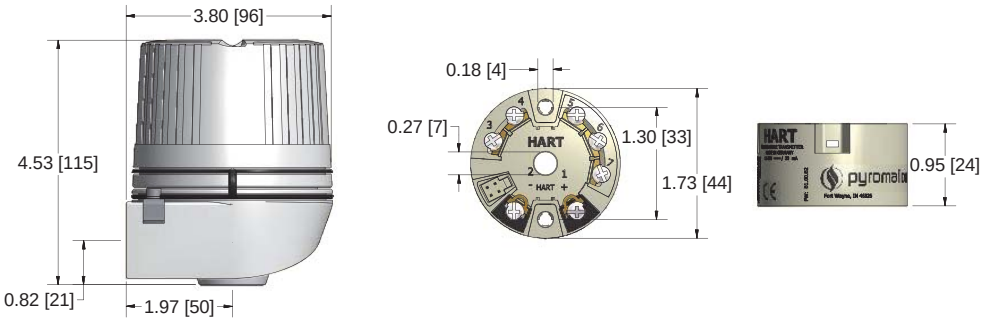
APPROVALS

Approvals

CE marked	Unit complies with the legal requirements set forth by the EU regulations.
FM APPROVED, CSA	Intrinsically safe and non-incendive Class I, Division 1 and 2, Groups A, B, C and D

HART® is a registered trademark of HART Communication Foundation

MECHANICAL CONSTRUCTION

Dimensions	
Weight	Housing, transmitter, and display: approximately 970 g (2 1/4 lbs)
	Transmitter only: approximately 50 g (1/4 lb)
Materials	Housing: die-cast aluminum with powder coating
Terminals	15 AWG Maximum

Terminal Connections