Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical information

Easytemp™ TSM470G / TSM470F / TSM470P

Compact RTD Transmitter
4-wire Pt100, class A, PC programmable. The economical and technical alternative to unreliable direct wiring to the control room

Application

The hermetically sealed easytemp™ compact RTD transmitter provide a 4 to 20 mA solution for temperature measurement and is intended for simple measuring tasks from -60 to 320 °F.
The ideal operation location for TSM470G with ½" NPT process fitting is in tanks and pipes that are not exposed to any high pressure or extreme temperature.
Sanitary design of TSM470F and TSM470P with Tri-Clamp connection meets 3-A sanitary standards. TSM470P sensors are electro-polished (R_a = 20 µin, or 240 grit) to meet requirements of the pharmaceutical industry. The TSM470F is polished to a R_a = 32 µin (150 grit) finish.

Features and benefits

- Sensor and electronics potted to protect against condensation
- 4 to 20 mA loop-powered, compact design
- M12 plug-in micro connector for easy start up
- High accuracy all-in-one-system
- Configuration, vizualization and maintenance with PC, using ReadWin® 2000 operating freeware
- Preset measuring range
- Breakdown information in event of sensor break or sensor short-circuit, enables a quick maintenance intervention
- UL recognized component to UL 3111-1
- CSA General purpose
- Electromagnetic compatibility to IEC61326 for use in noisy environments
- Customer specific measurement range setting for high flexibility
- Long term stability: < 0.05% per year
- Reliable measurement during variable ambient temperature
- Compact RTD transmitter completely made of stainless steel, components in contact with the process SST 316L
- Sanitary and threaded process connections and various insertion length for high flexibility
- Pt100, accuracy class A (IEC60751) in 4-wire connection

TI00101R/24/en
51006716

Endress+Hauser
People for Process Automation

Function and system design

Measuring principle

Electronic acquisition and conversion of input signals in industrial temperature measurement.

Measuring system

The compact thermometer consists of a complete sensor with Pt100 (class A, 4-wire connection), process connection and built-in electronics with an M12x1 micro connector and convert the Pt100 input signal into a temperature proportional 4 to 20 mA signal.

Input

Measuring principle

Temperature

Measuring range

Designation	Measuring range limits	Min. span
Pt100 as per IEC 60751	-51 to 160 °C (-60 to 320 °F)	10 °C (18 °F)
■ Connection type: 4-wire connection ■ Sensor current: ≤ 0.6 mA		

Output values

Output signal

analog 4 to 20 mA, 20 to 4 mA

Breakdown information

Breakdown information to NAMUR NE43
Breakdown information is created when the measuring information is invalid or not present anymore and gives a complete listing of all errors occuring in the measuring system.

		Signal (mA)
Under ranging	Standard	3.8
Over ranging	Standard	20.5
Sensor break; sensor short circuit low	To NAMUR NE43	≤ 3.6
Sensor break; sensor short circuit high	To NAMUR NE43	≥ 21

Source impedance

max. ($V_{power\ supply}$ - 10V) / 0.022 A (current output)
e. g. (24 V -10 V) / 0.022 A = 636.4 Ω

Transmission behavior

temperature linear

Min. current consumption

≤ 3.5 mA

Current limit

≤ 23 mA

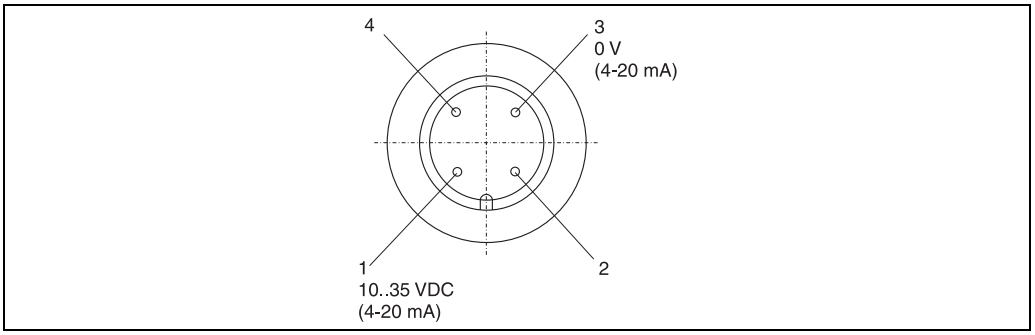
Switch-on delay

2 s (during power up I_a ≤ 3.8 mA)

Wiring

Electrical connection cables must comply with 3-A® standard, must be smooth, corrosion resistant and cleanable.

Electrical connection



Electrical connection of the compact thermometer (viewed 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

The connection cable 5 m is for the 4...20 mA signal and will be connected with pin 1 and 3 as shown in the picture. The pins 2 and 4 are for the communication with the computer. If you look on the communication adapter then you see that there are two male pins that are making connection to the two shortend metal pins 2 and 4. By the way the supply for the TSM470 for the communication is done by the computer interface.

Supply voltage

U_b= 10 to 35 V DC, polarity protected

Residual ripple

Allowable ripple $U_{ss} \leq 3$ V at $U_b \geq 13$ V, $f_{max.} = 1$ kHz

Performance characteristics

Electronics response time

1 s

Response time TSM470

63% response time per ASTM E644

	TSM470G	TSM470F	TSM470P
Tube diameter 1/4" OD, 316L	8 s	4 s	-
Tube diameter 3/8" OD reduced 3/16" OD, 316L	-	3 s	-
Tube diameter 5/32" OD, 316L	-	-	2 s

Reference operating conditions

Calibration temperature: +25 °C ± 5 °C (77 °F ± 9 °F)

Maximum measured error

Electronics

0.1 °C (0.18 °F) or 0.08%.
% refer to the set span. The highest value is valid.

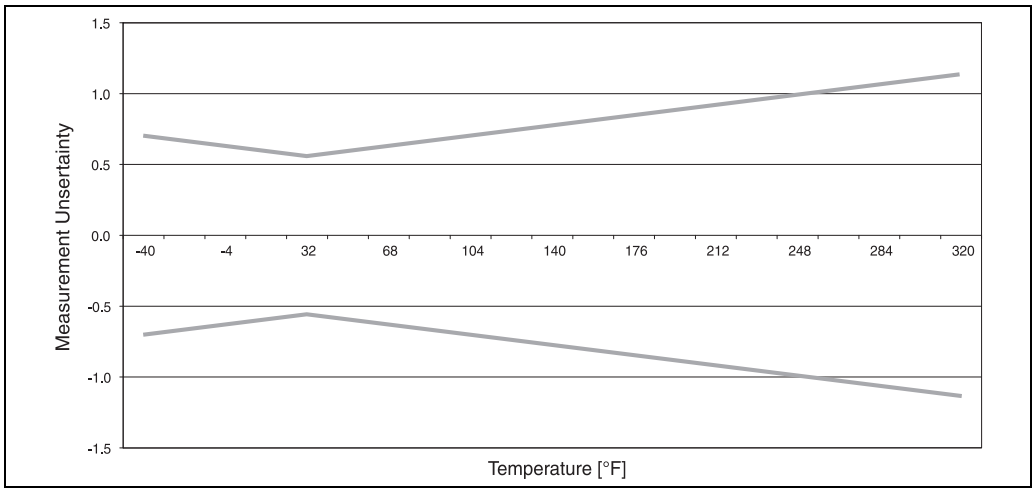
Sensor

- Class A tolerance as per IEC60751, at operating temperature range of –51 to 160 °C (–60 to 320 °F).
- Accuracy = ± 0.15 + 0.002 · ItI [°C]

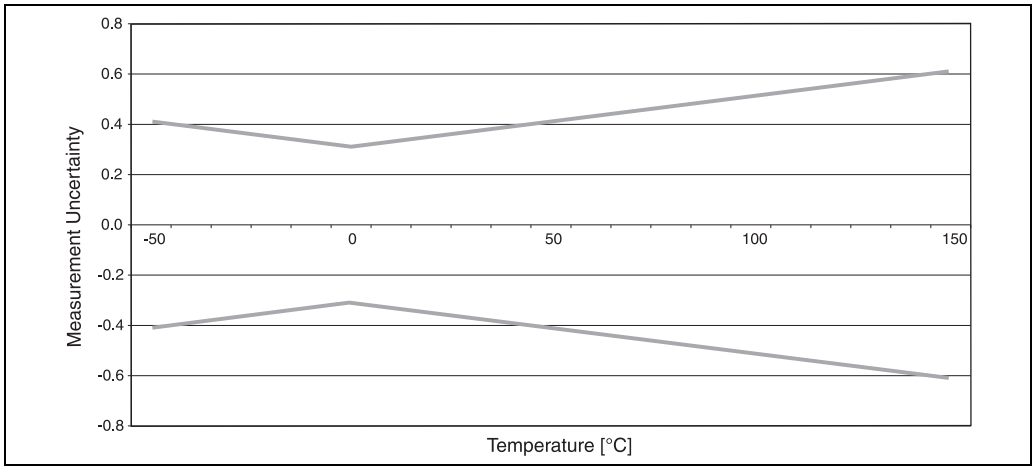
ItI = numerical value of the temperature in °C, unsigned.

Compact RTD transmitter

Initial accuracy:



Transmitter range 360 °F



Transmitter range 200 °C

Influence of power supply

≤ ±0.01%/V deviation from 24 V
Percentages refer to the full scale value.

Long-term stability

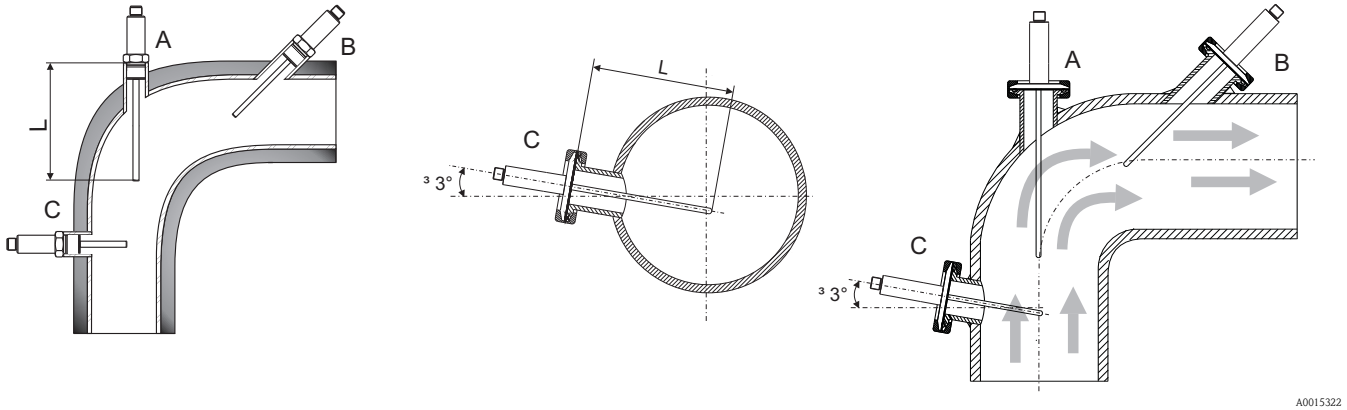
≤ 0.1 °C/year (≤ 0.18 °F/year) or ≤ 0.05%/year
Values under reference operating conditions. % refer to the set span. The highest value is valid.

Influence of ambient temperature (temperature drift)	Pt100 resistance thermometer: T_d= ± (8.3 ppm/°F * (range end value + 328) + 27.8 ppm/°F * preset meas. range) * $\Delta\vartheta$ $\Delta\vartheta$ = deviation of the ambient temperature according to reference condition (73.4 °F ± 9 °F).
Influence of load	± 0.02%/100 Ω Percentages refer to the full scale value.

Installation conditions

Orientation	No restrictions, but self draining. If applicable leak detection hole must be at the lowest point.

Installation instructions



Mounting location

Pipe installation example of TSM470G	Pipe installation example in hygienic applications of TSM470F and TSM470P

A At angle sections, against the direction of flow
B In smaller pipes, turned against the direction of flow
C Perpendicular to the direction of flow. For TSM470F and TSM470P installation with minimal 3° inclination because of self draining.
In pipes with a small cross section the sensor tip should reach or extend slightly past the center line of the pipe (= L).

Care should be taken by the user in the execution of the welding on the process side (suitable weld material, welding radius > 3.2 mm, absence of pits, folds, crevices, …). As a general rule, the thermometers should be installed in such a way that does not adversely affect their cleanability (3-A® requirements must be adhered to).

Environmental conditions

Ambient temperature limits	-40 to +85 °C (-40 to 185 °F)
Storage temperature	-40 to +100 °C (-40 to 212 °F)
Climate class	As per IEC60 654-1, class C
Degree of protection	NEMA Type 6P RATED (IP67)

Shock and vibration resistance

4g / 2 to 150 Hz as per IEC 60 068-2-6

Electromagnetic compatibility (EMC)

CE Electromagnetic Compatibility Compliance
The device meets all requirements listed under IEC61326 Amendment 1, 1998 and NAMUR NE 21.

This recommendation is an uniform and practical way of determining whether the devices used in laboratory and process control are immune to interference with an objective to increase its functional safety.

Discharge of static electricity	IEC61000-4-2	6 kV contact	
Electromagnetic fields	IEC61000-4-3	80 to 2000 Hz	10 V/m
Burst (signal)	IEC61000-4-4	1 kV	
Transient voltage	IEC61000-4-5	1 kV unsym. / 0.5 kV sym.	
HF coupling	IEC61000-4-6	0.15 to 80 MHz	10 V
Line interference	IEC61000-4-16	10 kHz to 150 kHz	10 V

Condensation

allowed

Immersion

Minimum immersion per ASTM E644, $\Delta T \leq 0.05$ °C (0.09 °F)

Version	Minimum Immersion (Inch)
TSM470G	1½ "
TSM470F	¾ "
TSM470P	¾ "

Process

Process temperature limits

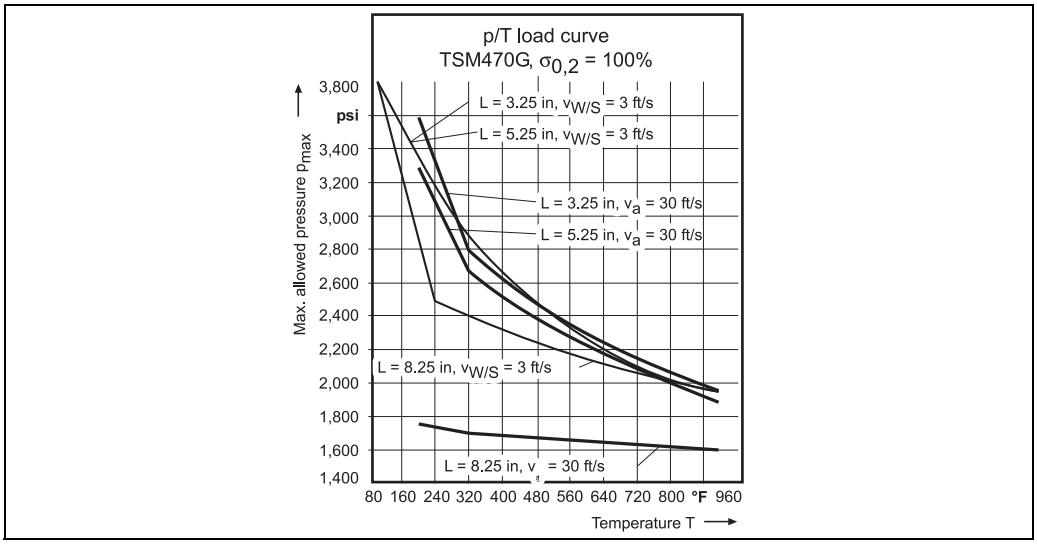
-51 to 160 °C (-60 to 320 °F).

Caution!
Restrictions dependent on the process connection and ambient temperature are possible:

max. ambient temperature	max. process temperature
to 23.9 °C (75 °F)	no restrictions
to 37.8 °C (100 °F)	140.6 °C (285 °F)
to 60 °C (140 °F)	121.1 °C (250 °F)
to 85 °C (185 °F)	101.7 °C (215 °F)

Process pressure limits

p/T load curve according to Dittrich for TSM470G. Maximum static pressure: 4000 PSI (at 25 °C/77 °F).



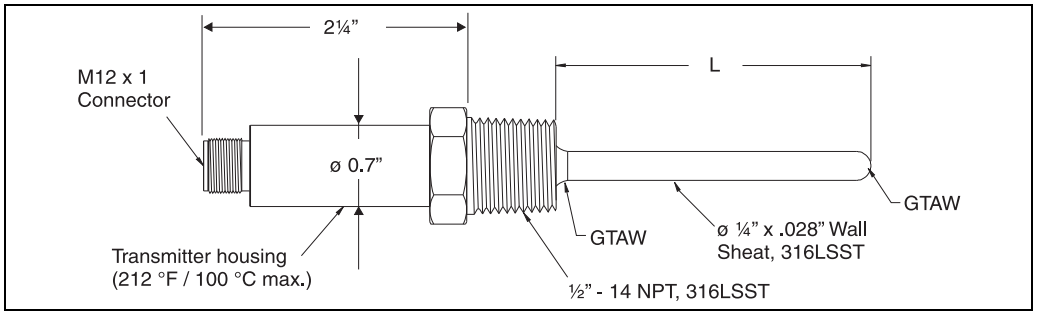
L = insertion length
v_a = flow velocity air
$v_{w/s}$ = flow velocity water or steam

(Avoid resonance frequency as this will cause damage to the probe! Resonance frequency occurs when permanent flow velocity is at 31 ft/s (air) for the 5¼ " and / or 13 ft/s (air) for 8¼ " probe.)

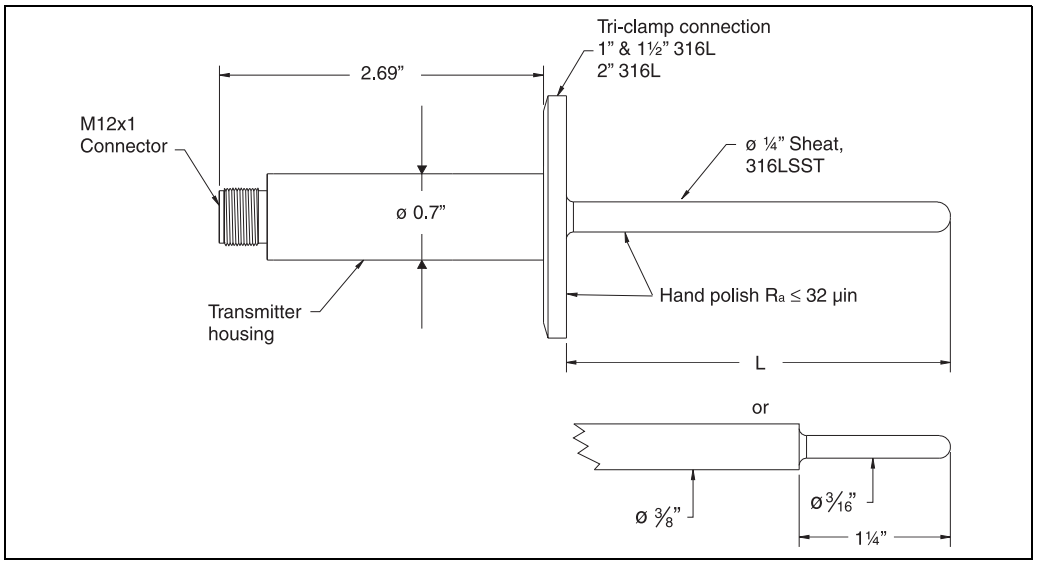
Mechanical construction

Design, dimensions

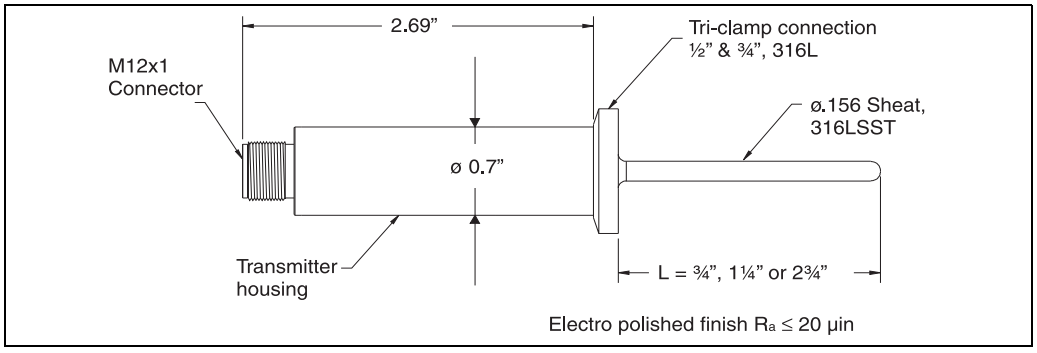
TSM470G



TSM470F



TSM470P



Surface Finish TSM470F & TSM470P

32 micro-inches R_a and 20 micro-inches R_a are the two standard finishes provided for Milk service and Bioprocessing Equipment services respectively. The 32 micro-inch R_a maximum is defined in "3-A Sanitary Standards for Sensors and Sensor Fittings and Connections used on Milk and Milk Products Equipment, Number 74-03". The 20 micro-inch maximum is defined in "ASME BPE-2002, Bioprocessing Equipment".

Polishing Procedures

The wetted surfaces of the sensors and sanitary fittings are mechanically polished to achieve a 32 micro-inch maximum surface finish, in accordance with 3-A Standard Number 74-03. Minimal material has been removed to achieve the indicated surface finish. Residual polishing compounds are removed after polishing operations are completed on all surfaces and sanitary end fittings. The end fitting material and sensor sheath are both composed of 316L stainless steel.
The wetted surfaces of the sensors and sanitary fittings are electropolished to achieve a 20 micro-inch maximum surface finish, in accordance with ASME BPE-2002. All electropolished surfaces have not undergone any passivation. Minimal material has been removed to achieve the indicated surface finish. The end fitting material and sensor sheath are both composed of 316L stainless steel.

Packaging

Sanitary sensors and fittings are individually bagged and sealed to ensure cleanliness upon delivery to the final customer.

Weight

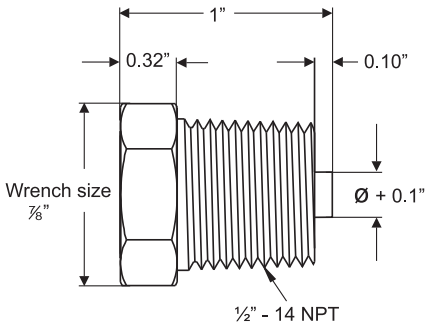
L in Inches (mm)	**3¼" (82.55)**	**5¼" (133.35)**	**8¼" (209.45)**
TSM470G	95 g	103 g	115 g
L in Inches (mm)	**2" (50.8)**	**4" (101.6)**	**6" (152.4)**
TSM470F-_B1	141 g	151 g	161 g
TSM470F-_B2	161 g	188 g	215 g
TSM470F-_C1	198 g	208 g	218 g
TSM470F-_C2	218 g	245 g	272 g
L in Inches (mm)	**¾" (19.05)**	**1¼" (31.75)**	**2¾" (69.85)**
TSM470P	67 g	69 g	72 g

Material

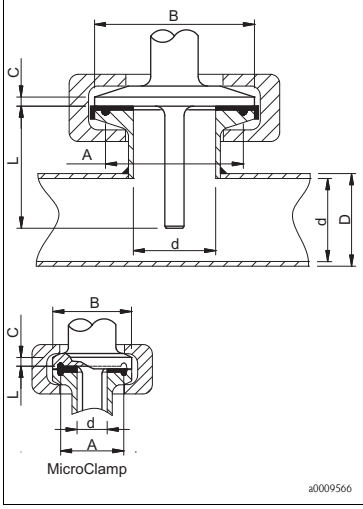
Transmitter housing: stainless steel (SST).
Wetted parts: SS 316L (1.4404).

Process connection

TSM470G



TSM470F and TSM470P, Tri-clamp® connection (3-A® marked)



(*)							(**)
DN	A	B	C	d	D std.	D strong	PNmax (bar)
½"(***)	20,0	25,0	3,6	9,5	-	12,7	-
¾"(***)				15,8	-	19,0	-
1"	43,5	50,5	2,85	22,2	-	29,5	-
					25,4	-	9÷20,7
1½"				34,9	-	42,6	-
					38,1	-	9÷20,7
2"	56,5	64,0		47,6	-	55,7	-
					50,8	-	9÷17,2

(*) Pipes according to ISO 2037 and BS 4825 Part1.
(**) Depends on clamping ring type, at 121°C with suitable gasket.
(***) MicroClamp.

Terminals

M12 plug-in micro connector (see Chap. Wiring).

Human interface

Display elements

No display elements are present directly on the transmitter.
The measured value display, for example, can be called up using the ReadWin® 2000 PC software.

Operating elements

No operating elements are present directly on the transmitter. The temperature transmitter is configured via remote operation with the ReadWin® 2000 PC software.

Remote operation

Configuration
TSM470A configuration kit, can be configured using a PC operating program (ReadWin® 2000).

Interface
PC-interface connecting cable TTL -/- RS232 or USB-port with plug-in connection.

Configurable parameters
Measuring dimension (°C/°F), measuring ranges, failure mode, output signal (4 to 20 / 20 to 4 mA), offset, filter, set tag number (8 characters), output simulation.

Certificates and approvals

3A	A Sanitary Standards for Sensors, Connections and Sensor Fittings used on Milk and Milk Products Equipment, Number 74-03
CE-Mark	This unit complies with the legal requirements laid out within the EU regulations.
Other standards and guidelines	■ IEC60529: Degrees of protection by housing (IP-Code). ■ IEC61010: Safety requirements for electrical measurement, control and laboratory instrumentation. ■ IEC1326: Electromagnetic compatibility (EMC requirements). ■ IEC60751: Industrial platinum resistance thermometer ■ ASTM E644: American society for testing and materials, standard test methods for testing industrial resistance thermometers. ■ NAMUR Standardization association for measurement and control in chemical and pharmaceutical industries. (www.namur.de). ■ NEMA - ANSI / NEMA 250 Standardization association for the electrical industry.
UL	Recognized component to UL 3111-1
CSA GP	CSA General Purpose

Ordering information

Product structure

TSM470F-	**Easytemp® Compact RTD transmitter TSM470F** Compact sanitary Pt100, class A sensor with transmitter, loop powered 4 to 20 mA, M12 quick connector, Sanitary version meets 3-A standard, surface finish R_a min. 32 micro inch (150 grit), UL recognized component, CSA General Purpose

Approval

A	Non hazardous area

Process connection/Material

B	1" + 1 ½" Tri-clamp connection, 316L, 3A
C	2" Tri-clamp connection,316L, 3A
Y	Special version, TSP-no. to be specified

Tube OD diameter; material

1	¼", 316L
2	3/8" reduced 3/16", 316L
9	Special version, TSP-no. to be specified

Immersion length L

A	2 inch
B	4 inch
C	6 inch
X	.... inch (increment 0.25)
Y	Special version, TSP-no. to be specified

Configuration

AA	Range 0 to 100 °F
AB	Range 0 to 200 °F
AC	Range 0 to 300 °F
AD	Range -40 to 140 °F
AE	Range -40 to 200 °F
BB	Range -40 to 60 °C
BC	Range -30 to 60 °C
BD	Range -30 to 150 °C
BE	Range -30 to 70 °C
BG	Range -20 to 20 °C
BH	Range -20 to 60 °C
BI	Range -10 to 40 °C
BK	Range 0 to 50 °C
BL	Range 0 to 100 °C
BM	Range 0 to 150 °C
XX	Customised range (min. span 10 K)
YY	Special version, TSP-no. to be specified

Version

1	Standard
2	with certificate of compliance
3	Cable M12x1, L = 5 m (16.4 ft)
9	Special version, TSP-no. to be specified

Additional option

K	None
L	Material Traceability Certificate
M	Loop Calibration Certificate
Y	Special version, TSP-no. to be specified

TSM470F-	**A**							⇐ **Order code (complete)**

TSM470P-	**Easytemp® Compact RTD transmitter TSM470P** Compact sanitary Pt100, class A sensor with transmitter, loop powered 4 to 20 mA, M12 quick connector, Sanitary version meets 3-A standard, surface finish R_a min. 20 micro inch (240 grit), electro polish, UL recognized component, CSA GP

		Approval
	A	Version for General purpose area

			Process connection
		A	½" + ¾" Tri-clamp, 316L, 3A
		Y	Special version, TSP-no. to be specified

				Tube OD diameter, material
			1	Diameter 5/32" OD, 316L
			9	Special version, TSP-no. to be specified

					Insertion length L
				A	1 ¼ inch
				B	2 ¾ inch
				C	¾ inch
				Y	Special version, TSP-no. to be specified

						Configuration range
					AA	range 0 to 100 °F
					AB	range 0 to 200 °F
					AC	range 0 to 300 °F
					AD	range -40 to 140 °F
					AE	range -40 to 200 °F
					BB	range -40 to 60 °C
					BC	range -30 to 60 °C
					BD	range -30 to 150 °C
					BE	range -30 to 70 °C
					BG	range -20 to 20 °C
					BH	range -20 to 60 °C
					BI	range -10 to 40 °C
					BK	range 0 to 50 °C
					BL	range 0 to 100 °C
					BM	range 0 to 150 °C
					XX	Customised range (min. span 10 K)
					YY	Special version, TSP-no. to be specified

							Version
						1	Standard version
						2	with certificate of compliance
						3	Cable M12x1, L = 5 m (16.4 ft)
						9	Special version, TSP-no. to be specified

								Additional option
							K	None
							L	Material Traceability Certificate
							Y	Special version, TSP-no. to be specified

TSM470P-	**A**							⇐ **Order code (complete)**

TSM470G-	**Easytemp® Compact RTD transmitter TSM470G** Compact Pt100, class A sensor with transmitter, loop powered 4 to 20 mA, M12 quick connector, UL recognized component, CSA General Purpose

	Approval
A	Non-hazardous area

		Process connection/Material
A		½" - 14 NPT, 316L
C		one time compression fitting, 1/8" NPT, 316L
D		re-adjustable compression fitting, 1/8" NPT, 316L
E		one time compression fitting, ¼" NPT, 316L
F		re-adjustable compression fitting, ¼" NPT, 316L
P		Thread G½" BSP, 316L
Q		not selected
Y		Special version, TSP-no. to be specified

			Tube OD diameter/Material per 1 inch
1			Diameter ¼" OD, 316L
9			Special version, TSP-no. to be specified

				Immersion length L
A				3 1/4 inch
B				5 1/4 inches
C				8 1/4 inches
X				..... inch (increment 0.25)
Y				Special version, TSP-no. to be specified

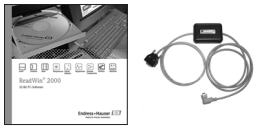
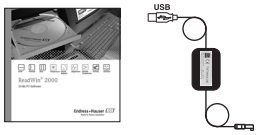
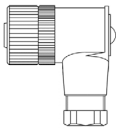
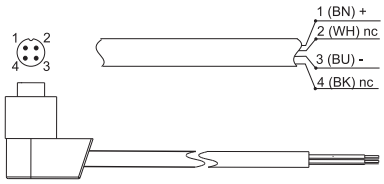
					Configuration range
AA					range 0 to 100 °F
AB					range 0 to 200 °F
AC					range 0 to 300 °F
AD					range -40 to 140 °F
AE					range -40 to 200 °F
BB					range -40 to 60 °C
BC					range -30 to 60 °C
BD					range -30 to 150 °C
BE					range -30 to 70 °C
BG					range -20 to 20 °C
BH					range -20 to 60 °C
BI					range -10 to 40 °C
BK					range 0 to 50 °C
BL					range 0 to 100 °C
BM					range 0 to 150 °C
XX					Customised range (min. span 10 K)
YY					Special version, TSP-no. to be specified

						Version
1						Standard version
3						Cable M12x1, L = 5 m (16.4 ft)
9						Special version, TSP-no. to be specified

							Additional option
K							None
M							Loop calibration certificate
L							Special version, TSP-no. to be specified

TSM470G-	**A**							⇐ **Order code (complete)**

Accessories

Order number	Accessory
TSM470A-VM 	Configuration kit: Setup program (ReadWin® 2000) and PC serial interface connection cable (TTL/RS 232C) for configuration of the TSM470G / TSM470F / TSM470P.
TXU10-BA 	Configuration kit: Setup program (ReadWin® 2000) and PC serial interface connection cable for PC with USB port. Adapter M12 + 4 pin plug
TSM470A-VN 	Connector unshielded, female, angeled, M12 A coded, 4-pos.
SONDTT-AG 	CD-ROM with all operation and instruction manuals, Endress+Hauser data acquisition, system components, temperature measurement.
51005148 	5 m (16.4 ft) PVC connecting cable with M12x1 microconnector
51007657	Adapter Upgrade TXU10 (M12 + 4 pin plug)

Documentation

- Fields of activities (FA) 'Temperature measurement' (FA006T/09/en)
- Compact instructions 'Easytemp™ TSM470' (KA148R/24/ae)
- Operating manual 'Easytemp™ TSM470 compact RTD transmitter' (BA164R/24/ae)

USA	Canada	México	Instruments International
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