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

Technical Information

Temperature Switch Thermophant T TTR 31, TTR 35

Temperature switch for the safe measurement, monitoring and control of process temperatures

Application

Temperature switch for the monitoring, display and control of process temperatures in a range from -58 to +302°F (-50 to 150°C):

Thermophant T TTR 31
– with threaded connections or couplings
Thermophant T TTR 35
– for sanitary/hygienic applications

- Versions for use in sanitary/hygienic applications
- Electronic versions
  – one PNP switch output
  – two PNP switch outputs
  – 2 x PNP switch outputs or one PNP switch output and 4 to 20 mA output (active)

Benefits at a glance

This compact temperature switch is designed with the latest technology:

- Integrated switching electronics for distributed and economic process monitoring and control
- Quick and flexible process integration due to modular connections
- High reproducibility and long-term stability
- Functional safety SIL 2 (optional)
- Function check and information available with LEDs and digital display
- Long-term stable temperature sensor made of platinum (Pt100 class A as per IEC 751)
- High accuracy across the entire ambient temperature range and short response time
- Operation and visualization using personal computer and ReadWin® 2000 configuration software
- Upper part of housing can be rotated by 310°

TI105R/09/ae
No. 51007865

Endress+Hauser
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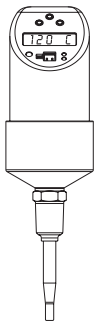
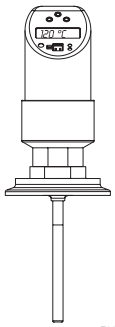
Function and system design

Measuring principle

Electronic recording and conversion of input signals in industrial temperature measurement. A platinum sensor located at the measuring tip changes its resistance value depending on the temperature. This resistance value is recorded electronically. The conversion of the resistance value into a temperature measurement signal is defined by the international standard IEC 751.

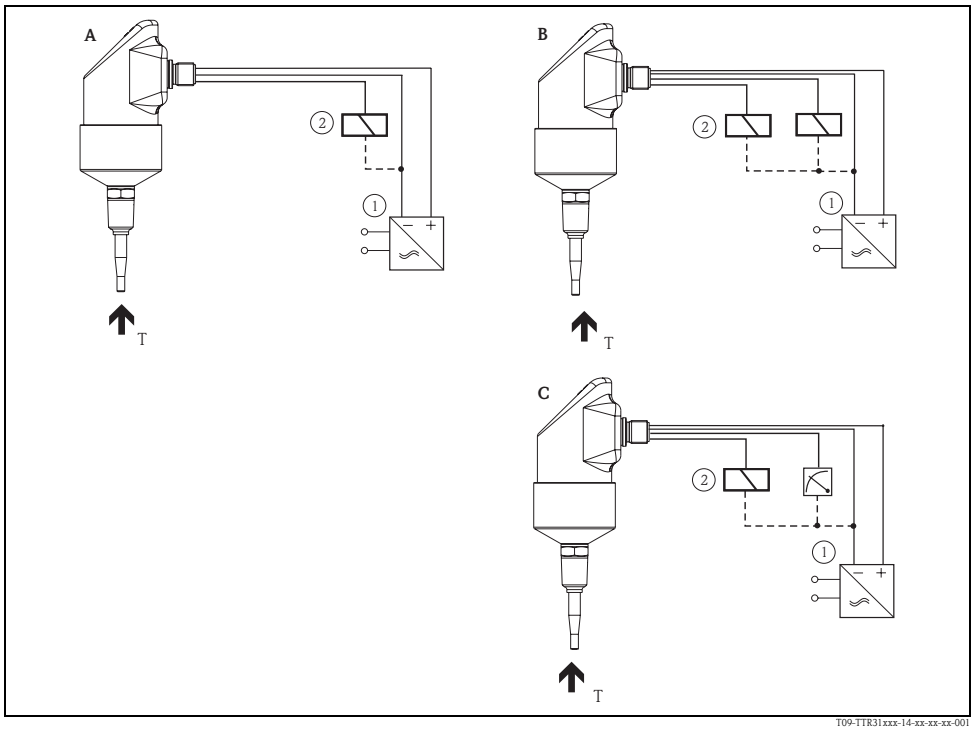
Measuring system

Overview

Thermophant product family	**TTR 31**	**TTR 35**
	 T09-TTR31xxx-14-xx-xx-xx-000	 T09-TTR35xxx-14-xx-xx-xx-000
Measurement probe	Pt100	Pt100
Field of application	Measurement and monitoring and control of process temperatures.	Measurement and monitoring and control of process temperatures in hygienic processes.
Process connection	Coupling (sensor length ≥ 100 mm) Thread – G ½A and G ¼A – ANSI ¼" NPT and ½" NPT	Hygiene – Tri-clamp 1" - 1½", 2" – Varivent F, N – DIN 11851 – APV inline
Measuring range (process temperature range)	-58 to 302°F (-50 to 150°C)	-58 to 302°F (-50 to 150°C) in hygienic processes

DC voltage version

PNP switch output of electronics.
Power supply e.g. with a power supply unit.
Preferably in conjunction with programmable logic controllers (PLC) or for controlling a relay.



A: 1x PNP switch output
B: 2x PNP switch output
C: PNP switch output with additional analog output, 4 to 20 mA
Power supply unit
Load (e.g. programmable logic controller, process control system, relay)

Functional safety (SIL)

The Thermophant T temperature switches were developed according to the standards IEC 61508 and IEC 61511-1 (FDIS). The device version with PNP switch output and additional analog output is equipped with fault detection and fault prevention facilities within the electronics and software. It can, therefore, be used to monitor limit temperature up to SIL 2 (Safety Integrity Level).
The attainable SIL value is determined by the safety technical characteristics of probability of failure, hardware fault tolerance and the safe failure fraction. Details on this may be found in the Functional Safety Manual (in development).

Input

Measuring principle

Temperature (temperature-linear transmission behaviour)

Measuring range

Designation	Measuring range limits	Min. span
Pt100 as per IEC 751	-58 to 302°F (-50 to 150°C)	10 K
▪ Sensor current: ≤ 0.6 mA		

Output

Output signal

DC voltage version: (short-circuit proof version)

- 1x PNP switch output
- 2x PNP switch outputs
- 2 x PNP switch outputs or one PNP switch output and 4 to 20 mA output (active)

Switching capacity

DC voltage version:

- Switch status ON: $I_a \leq 250$ mA
- Switch status OFF: $I_a \leq 1$ mA
- Switching cycles: > 10,000,000
- Voltage drop PNP: ≤ 2 V
- Overload protection
  Automatic testing of switching current; output is switched off in case of overcurrent, the switching current is tested again every 0.4 s; max. capacitance load: 14 µF for max. supply voltage (without resistive load)

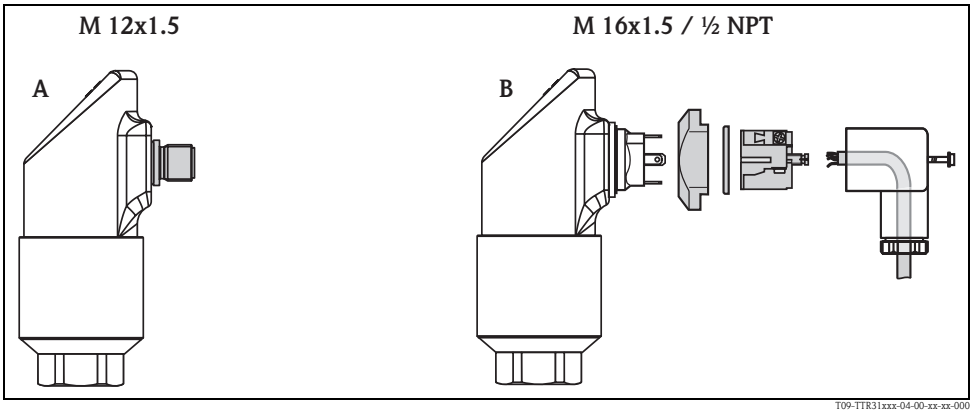
Inductive load

To prevent electrical interference, only operate an inductive load (relays, contactors, solenoid valves) when directly connected to a protective circuit (free-wheeling diode or capacitor).

Power supply

Electrical connection

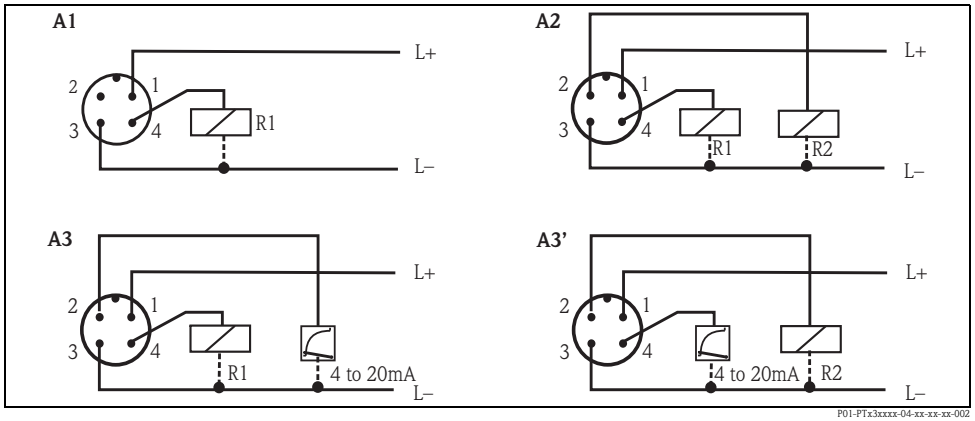
Plug connection



A: M 12x1.5 connector
B: M 16x1.5 or ½ NPT valve plug

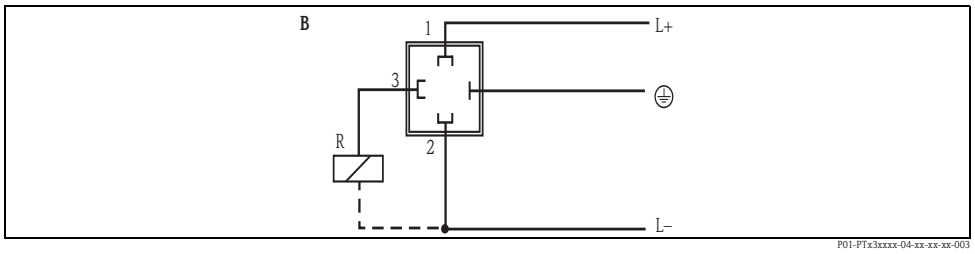
Device connection

- DC voltage version with M 12x1.5 connector



A1: 1x PNP switch output
A2: 2x PNP switch output
A3: PNP switch output with additional analog output
A3': PNP switch output with additional analog output, DESINA-compliant (adjustable).

- DC voltage version with M 16x1.5 or ½ NPT valve plug



B: 1 x PNP switch output

Supply voltage

- DC voltage version
  12 to 30 V DC (reverse polarity protection)

Current consumption

Without load < 60 mA

Power supply failure

- Behavior in case of overvoltage (> 30 V)
  The device works continuously up to 34 V DC without any damage.
  No damage is caused to the device in case of a short-term overvoltage up to 1 kV (as per EN 61000-4-5).
  The specific properties are no longer guaranteed if the supply voltage is exceeded.
- Behavior in case of undervoltage
  If the supply voltage drops below the minimum value, the device switches off (status as if not supplied with power = switch open).

Performance characteristics

The percentage information in the "Performance characteristics" section refers to the sensor nominal value.

Reference operating conditions

As per DIN IEC 60770 or DIN IEC 61003
T = 77°F (25°C), relative humidity 45 to 75 %, ambient air pressure 12.4 to 15.4 psi (860 to 1060 kPa)
Supply voltage U = 24 V DC

Maximum measured error
Switch point and display

Electronics

0.2 K

Sensor

- Tolerance class A as per IEC 751, -58 to +302°F (-50 to 150°C)
- Maximum measured error in °C = 0.15 + 0.002 · ItI

ItI = Process temperature in °C without taking sign into account.

Total error

Total error = electronics error + sensor error,
e.g. for process temperatures:
-50 to 75°C ≤ 0.5 K
75 to 150 °C ≤ 0.65 K

Non-repeatability
Switch point

0.1 K as per EN 61298-2 (without ambient temperature influence)

Sensor response time

≤ 10 s (t_{90})

Long-term drift

≤ 0.1 K per year under reference operating conditions

Long-term reliability

Mean time between failure (MTBF) > 100 years
(calculated according to "British Telecom Handbook of Reliability Data No. 5")

Influence of ambient temperature

- Switch output and display: ≤ 30 ppm/K
- Analog output: ≤ 50 ppm/K + influence of switch output and display

Switch output response time

100 ms

Analog output

- Maximum measured error = switch point error and display error + 0.1%
- Rise time T_{90}: ≤ 200 ms
- Settling time T_{99}: ≤ 500 ms

Operating conditions: Installation instructions

Installation instructions

- Any orientation
- Any position-dependent zero shift can be corrected.
  Position factor (offset): ±10 % of the sensor nominal value

Operating conditions: Environment

Ambient temperature range

-40 to 185°F (–40 to +85°C)

Storage temperature

-40 to 185°F (–40 to +85°C)

Climate class

4K4H as per DIN EN 60721-3-4

Degree of protection

- With M 16x1.5 or ½" NPT valve plug: NEMA 4 (IP 65)
- With M 12x1.5 connector: NEMA 4X / NEMA 6P (IP 66 / IP 68), 3 ftH_2O for max. 1 hour (1 mH_2O)

Shock resistance

50 g as per DIN IEC 68-2-27 (11 ms)

Vibration resistance

- 20 g as per DIN IEC 68-2-6 (10-2000Hz)
- 4 g as per German Lloyd GL Guidelines

Electromagnetic compatibility

- Interference emission as per EN 61326, class B electrical equipment
- Interference immunity as per EN 61326, appendix A (industrial use) and NAMUR Recommendation NE 21

EMC influence: ≤ 0.5 %

Operating conditions: Process

Process temperature limits

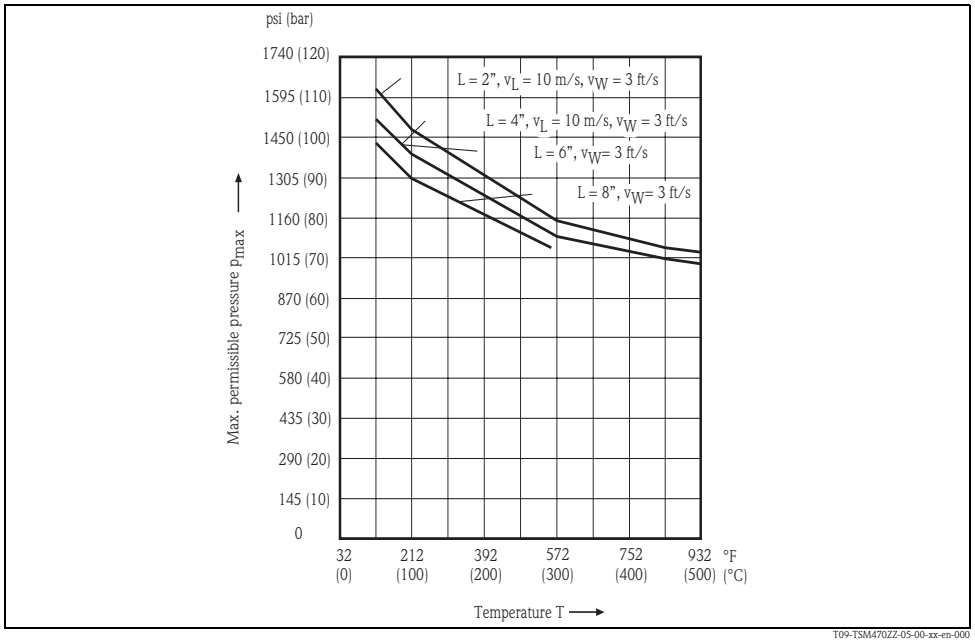
-58 to 302°F (-50 to 150 °C)
Restrictions depending on process connection and ambient temperature:

- No restriction with coupling (see Accessories, order no. **51004751**, **51004753**) and neck tube length min. 20 mm
- with process connection:

max. ambient temperature	max. process temperature
up to 77°F (25°C)	no restriction
up to 104°F (40°C)	275°F (135°C)
up to 140°F (60°C)	248°F (120°C)
up to 185°F (85°C)	212°F (100°C)

Process pressure limits

p/T load diagram as per DIN 43763 or Dittrich



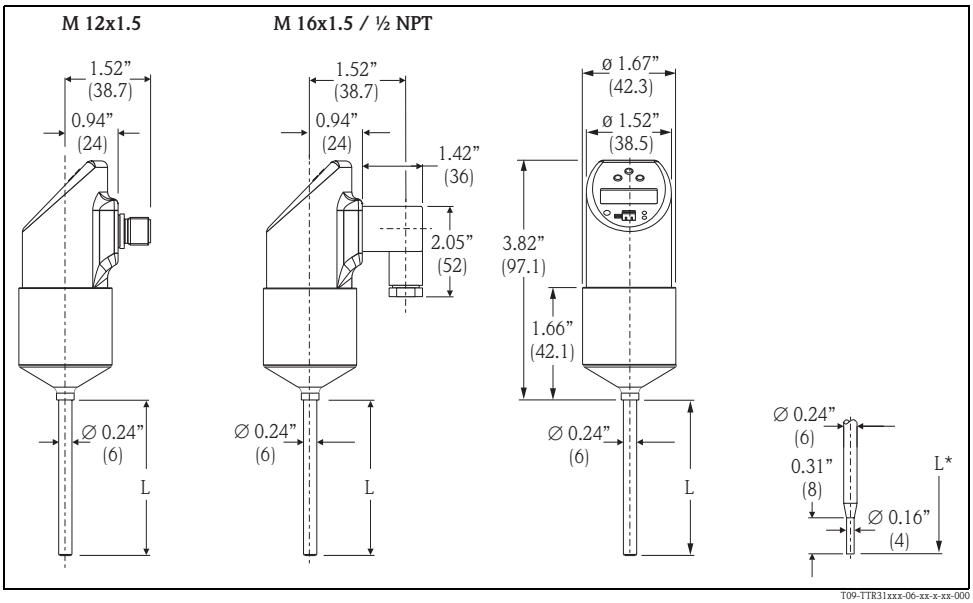
p/T load diagram

L = insertion length
v_L = medium velocity air
v_W = medium velocity water

Mechanical construction

Design, dimensions

Dimensions



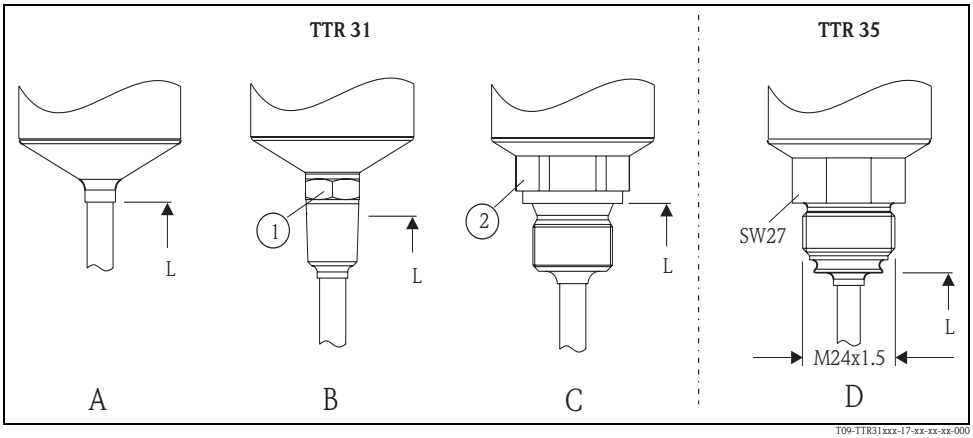
All dimensions in inches (mm)

Length L in 4" and 8" (100 and 200 mm)
Length L* = 2" (50 mm) with reduced sensor tip

M 12x1.5 connector as per IEC 60947-5-2

M 16x1.5 or ½ NPT valve plug as per DIN 43650A/ISO 4400

Process connection



Pos. A: Version without process connection (’w’). For suitable welding boss and coupling see ’Accessories’.

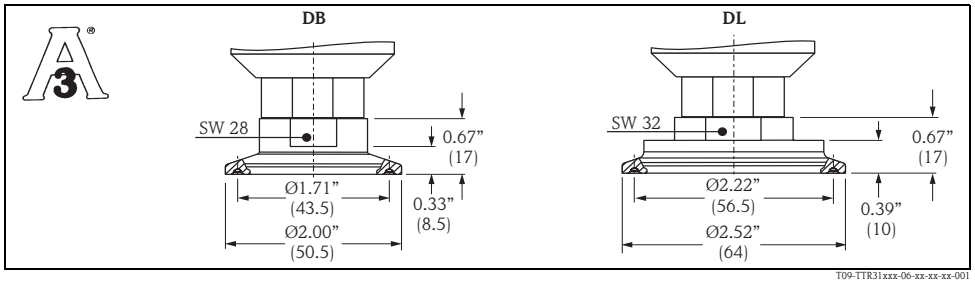
Pos. B: Version with thread process connection ANSI ¼" NPT (1 = AF14) and ½" NPT (2 = AF27).

Pos. C: Version with thread process connection G ¼A (1 = AF14) and G ½A (2 = AF27) as per ISO 228.

Pos. D: Adapter concept - version with M24x1.5 thread for adapters with process connection for hygienic processes.

Length L in 4" and 8" (100 and 200 mm), Length L = 2" (50 mm) with reduced sensor tip

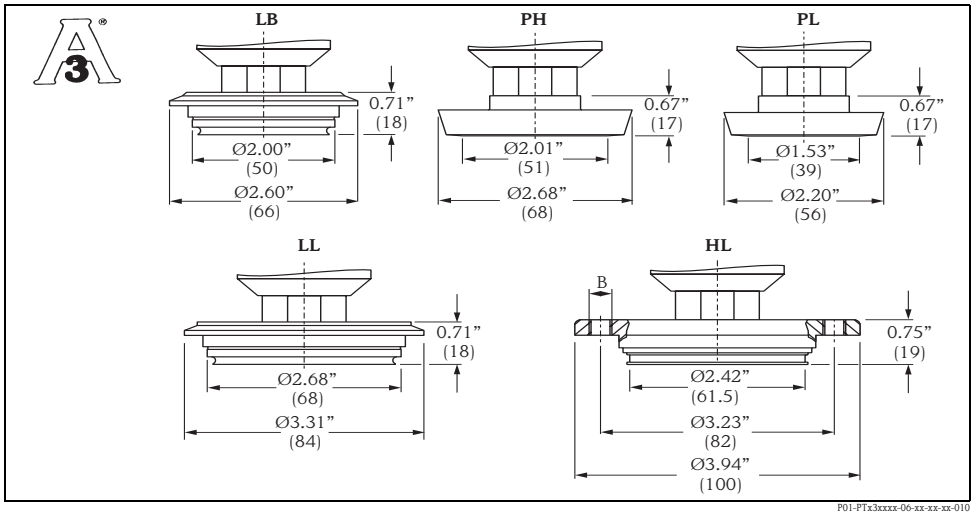
TTR 35 Adapter
Clamp connections



Process connection versions (adapters)
DB: clamp 1" to 1½" (ISO 2852) or DN 25 to DN 40 (DIN 32676)
DL: clamp 2" (ISO 2852) or DN 50 (DIN 32676)

See also "Ordering information" section
All dimensions in inches (mm)

TTR 35 Adapter
Hygiene connections



Process connection versions (adapters)
LB: Varivent F pipe DN 25-32, PN 40
LL: Varivent N pipe DN 40-162, PN 40
PH: DIN 11851, DN 40, PN 40 (including coupling nut)
PL: DIN 11851, DN 50, PN 40 (including coupling nut)
HL: APV inline, DN 50, PN 40, 316L, 3A (B = 6 x Ø8.6 bores + 2 x M8 thread)

See also "Ordering information" section
All dimensions in inches (mm)

Weight

Approx. 300 g (depends on sensor length and process connection)

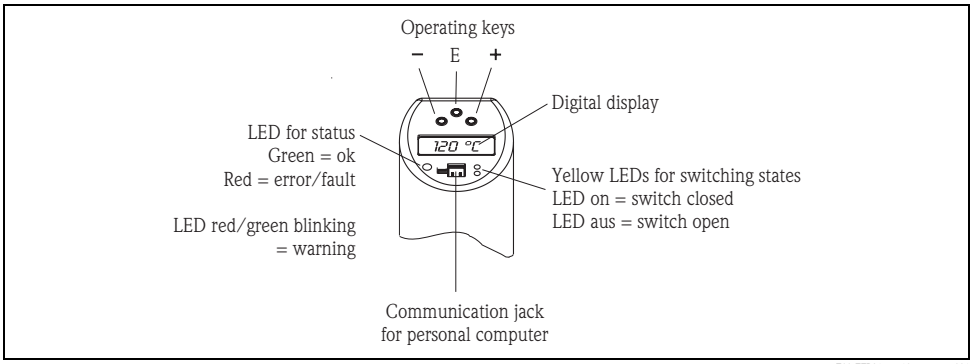
Material

- Process connection: AISI 316L SS
  Surfaces in contact with process in TTR 35 with surface quality $R_a \leq 0.8$ µm
  Coupling nut: AISI 304 SS
- Seals:
  FKM Viton
  EPDM, FDA number 21–CFR 177.2600
- Housing: AISI 316L SS, with surface quality $R_a \leq 0.8$ µm
- Valve plug: polyamide (PA)
  M12 connector: exterior 316L
  Cable outer covering: polyurethane (PUR)
- Display: Lexan®
- Keys: polycarbonate PC-FR, Lexan®

Human interface

Operating elements

Position of display and operating elements



On-site operation

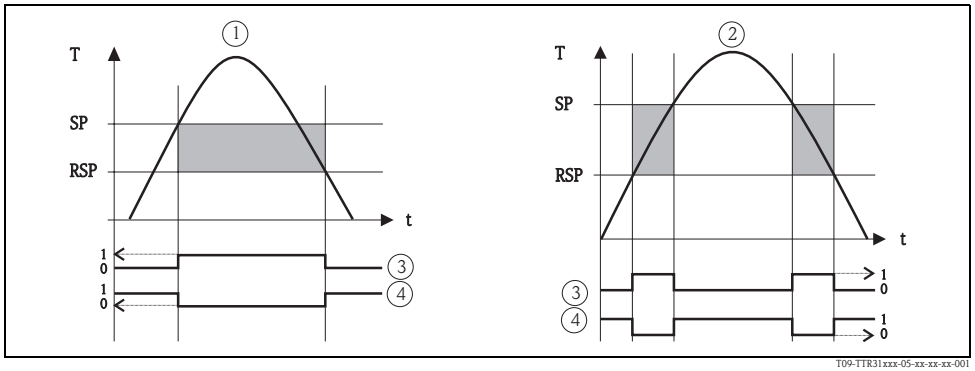
Menu-guided operation using operating keys.

Function group	Operating options
BASE (basic functions)	Unit selection: °C, °F, K
	Zero point, offset (automatic and manual)
	Display: –Display of measured value or of configured switch point (switch 1) – Rotation of display by 180° – Switching off of display
	Damping 0 to 40 s: display value, switch points, display
	– Behavior as per DESINA: The PIN of the M12 connector is assigned in accordance with the guidelines of DESINA. – SIL mode: (only for devices with corresponding electronics) Details on this may be found in the Functional Safety Manual (in development).
OUT and OUT 2 (optional)	Switch output function: – Hysteresis or window function – NC contact or NO contact – Analog output (optional) See next diagram
	Switch point: – Input value
	Switch-back point: – Input value
	Delay of switch point and switch-back point: can be set anywhere between 0 to 99 s
	Analog output (optional): Lower Range Value / Upper Range Value – Input lower range value (LRV) or upper range value (URV) – Acceptance of applied value for lower range value (LRV) or upper range value (URV) Setting of error current: choice of 3.5 mA / 21.7 mA / last current value

Function group	Operating options
SERV (service functions)	Resetting of all settings to factory settings
	Setting of locking code
	Security locking
	Static Revision Counter, incremented each time the configuration is changed
	Display of last error to occur
	Switch output 1, switch output 2 and analog output simulation
	Display of max. measured temperature value
	Display of min. measured temperature value

Switch point functions

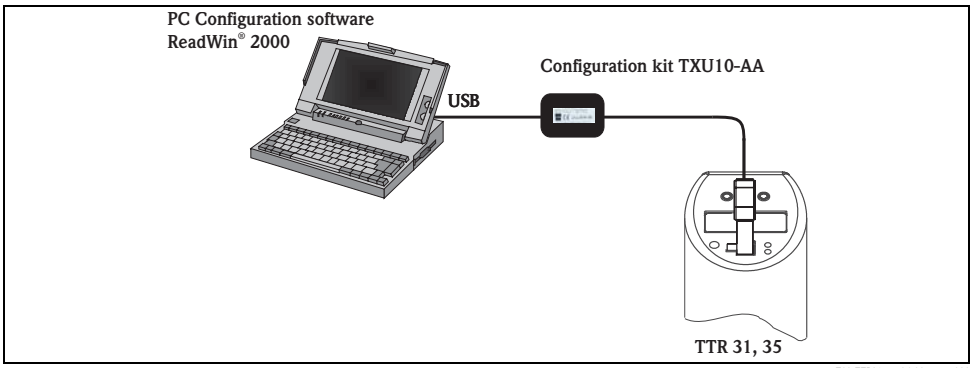
- Hysteresis function
  The hysteresis function enables two-point control via a hysteresis. Depending on the temperature T, the hysteresis can be set via the switch point SP and the switch-back point RSP.
- Window function
  The window function enables the setting of a process window.
- NO contact or NC contact
  This switch function is freely selectable.



1 Hysteresis function, 2 Window function, 3 NO contact, 4 NC contact, SP switch point, RSP switch-back point

Operation with ReadWin® 2000

Operation, visualisation and maintenance with PC and ReadWin® 2000 PC configuration software.



In addition to the operating options listed in the previous "On-site operation" section, the ReadWin® 2000 configuration software provides further information on the Thermophant T:

Function group	Description
INFO	Tag number
	Order code
	Limit switch serial number
	Electronics serial number
	Hardware version
	Software version
	Device version

Certificates and approvals

CE-Mark

The device meets the legal requirements of the EC diectives. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Other standards and guidelines

- IEC 60529:
  Degree of protection provided by housing (IP-Code)
- IEC 61010:
  Safety requirements for electrical measurement, control and laboratory use.
- IEC 1326:
  Electromagnetic compatibility (EMC requirements)
- NAMUR
  Standards working group for measurement and control technology in the chemical industry.
  (www.namur.de)

Functional safety

The device meets the functional safety requirements in accordance with IEC 61508 / IEC 61511-1 (FDIS). This device can, therefore, be used to monitor temperature up to SIL 2.

Hygiene standard

The TTR35 temperature switch meets the requirements of Sanitary Standard no. 74-2. Endress+Hauser confirms this by applying the 3–A symbol.

UL listed for Canada and USA

The device was examined by Underwriters Laboratories Inc. (UL) in accordance with the standards UL 61010B-1 and CSA C22.2 No. 1010.1-92 and listed under the number E225237 UL.

Ordering information

Questionnaire

Questionnaire Endress+Hauser Thermophant TTR31/TTR35
Customer specific setup

Units **( ) °C** ( ) °F

Output 1

Type:
( ) 1=Hysteresis normally open
( ) 2=Hysteresis normally closed
( ) 3=Window normally open
( ) 4=Window normally closed

SP: [ ][ ][ ].[ ] (-57.1 to 302 °F; -49.5 to 150 °C)

RSP: [ ][ ][ ].[ ] (RSP ≤ (SP -0.8 °F); RSP ≤ (SP -0.5 °C))

Output 2 (only if available)

Type:
( ) 1 = Hysteresis normally open
( ) 2 = Hysteresis normally closed
( ) 3 = Window normally open
( ) 4 = Window normally closed
( ) 5 = 4 to 20 mA (only if available)

SP: [ ][ ][ ].[ ] (-57.1 to 302 °F; -49.5 to 150 °C)

RSP: [ ][ ][ ].[ ] (RSP ≤ (SP -0.8 °F); RSP ≤ (SP -0.5 °C))

Analog output (only if output 2 = 4 to 20 mA)

Range low scale: [ ][ ][ ].[ ] (-58 to 284 °F; -50 to 140 °C)
(min. span: 10 K)

Range high scale: [ ][ ][ ].[ ] (-40 to 302 °F; -40 to 150 °C;)

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

(Connection conform to DESINA)**: ( ) NO** ( ) YES

TAG (2 x 18 characters)

[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

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R09-TTR31xxxx-16-06-xx-a2-001

Thermophant-T TTR31
Product structure

Thermophant T TTR31
Temperature switch, intelligent, programmable. Sensor: Pt100, long-term stable.

Approval:												
A	For non-hazardous areas											
Y	Special version to be specified											
		Electrical connection:										
		1	Plug M12, IP66/68									
		2	Valve plug M16x1.5, ISO4400, NMEMA 4 (IP65)									
		3	Valve plug NPT1/2, ISO4400, NEMA 4 (IP65)									
		9	Special version to be specified									
				Power supply; Output signal:								
				A	12 to 30 V DC; switch PNP							
				B	12 to 30 V DC; 2x switch PNP							
				C	12 to 30 V DC; switch PNP + 4 to 20 mA Functional safety SIL2, IEC61508							
				Y	Special version to be specified							
					Display:							
					1	Digital						
						Sensing element:						
						1	Pt100, class A, -58 to 302°F (-50°C to 150°C)					
							Adjustment; Unit:					
							1	Unit °C				
							2	Unit °F				
							S	Switch output 1,see additional spec.				
							T	Switch output 1+2, see additional spec.				
							U	Switch output + analog output, see additional spec.				
							Y	Special version to be specified				
								Process connection; Material:				
								AA	without (insertion length L ≥ 4" / 100 mm), 316L SS, couplings			
								AB	Thread ISO228 G¼A, 316L SS			
								DA	Thread ANSI ¼ NPT, 316L SS			
								AE	Thread ISO 228 G½A, 316L SS			
								DE	Thread ANSI ½ NPT, 316L SS			
								YY	Special version to be specified			
									Insertion length L; Probe diameter D:			
									1B	L = 2" (50 mm); D = 0.24" (6 mm); reduced tip, 0.16" (4 mm)		
									2C	L = 4" (100 mm); D = 0.24" (6 mm)		
									2E	L = 8" (200 mm); D = 0.24" (6 mm)		
										Additional option:		
										A	none	
										Y	Special version to be specified	
											Version:	
											A	Standard, documentation german
											B	Standard, documentation english
											C	Standard, documentation french
											Y	Special version to be specified
TTR31-				**1**	**1**							⇒ **Order code**

Thermophant-T TTR35
Product structure

Thermophant T TTR35
Temperature switch, intelligent, programmable. Sensor: Pt100, long-term stable. hygienic applications. FDA-compliant.

Approval:	
A	For non-hazardous areas
Y	Special version to be specified
Electrical connection:	
1	Plug M12, IP66
2	Valve plug M16x1.5, ISO4400, NEMA 4 (IP65)
3	Valve plug NPT1/2, ISO4400, NEMA 4 (IP65)
9	Special version to be specified
Power supply; Output signal:	
A	12 to 30 V DC; switch PNP
B	12 to 30 V DC; 2x switch PNP
C	12 to 30 V DC; switch PNP + 4 to 20 mA; Functional safety SIL2, IEC61508
Y	Special version to be specified
Display:	
1	Digital
Sensing element:	
1	Pt100, class A, -58 to 302°F (-50°C to 150°C)
Adjustment; Unit:	
1	Unit °C
2	Unit °F
S	Switch output 1,see additional spec.
T	Switch output 1+2, see additional spec.
U	Switch output + analog output, see additional spec.
Y	Special version to be specified
Process connection; Material:	
	Tri-Clamp connections
DB	ISO2852 DN25-38, 1-1½ inch, 316L SS, 3-A, DIN32676 DN25-40
DL	ISO2852 DN40-51, 2 inch, 316L SS, 3-A, DIN32676 DN50
HL	APV inline DN50 PN40, 316L SS, 3A
LB	Varivent F pipe DN25-32, PN40, 316L SS, 3-A
LL	Varivent N pipe DN40-162, PN40, 316L SS, 3-A
PH	DIN11851, DN40 PN40, 316L SS, 3-A
PL	DIN11851, DN50 PN40, 316L SS, 3-A
YY	Special version to be specified
Insertion length L; Probe diameter D:	
1B	L = 2" (50 mm); D = 0.24" (6 mm); reduced tip, 0.16" (4 mm)
2C	L = 4" (100 mm); D = 0.24" (6 mm)
2E	L = 8" (200 mm); D = 0.24" (6 mm)
Additional option:	
A	none
Y	Special version to be specified
Version:	
A	Standard, documentation german
B	Standard, documentation english
C	Standard, documentation french
Y	Special version to be specified

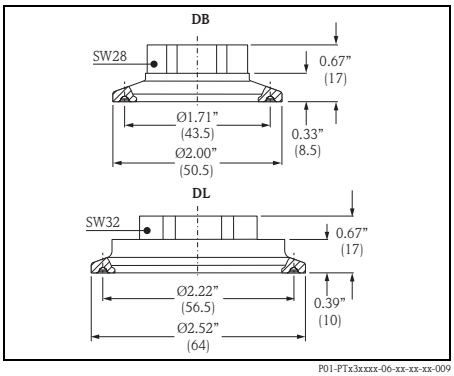
TTR35-				**1**	**1**							⇒ **Order code**

Accessories

All dimensions in mm.

Clamp adapter

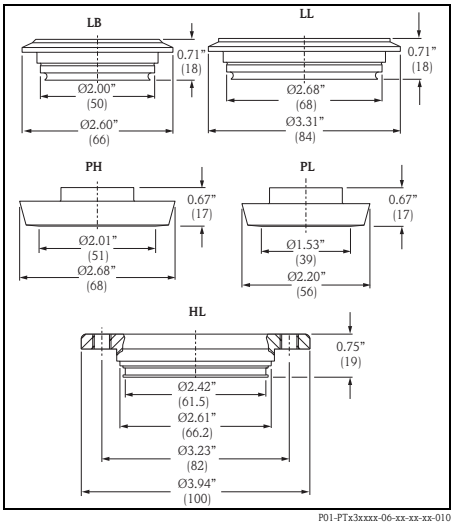
- TTR 35: order numbers for clamp adapter versions.
  DB version: order no. 52023994
  DL version: order no. 52023995



P01-PTx3xxxx-06-xx-xx-xx-009

Hygiene adapter

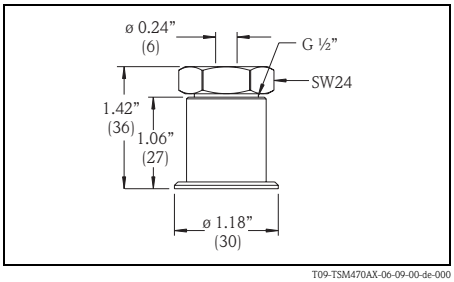
- TTR 35: order numbers for hygiene adapter versions.
  LB version: order no. 52023996
  LL version: order no. 52023997
  PH version: order no. 52023999
  PL version: order no. 52023998
  HL version: order no. 52024000



P01-PTx3xxxx-06-xx-xx-xx-010

Welding boss with sealing taper

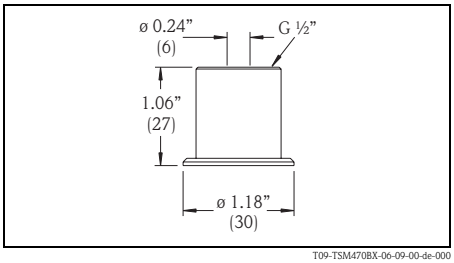
Collar welding boss
Seal, moveable coupling, material of parts in contact with process: 316L SS, PEEK
Order no. 51004751



T09-TSM470AX-06-09-00-de-000

Collar welding boss

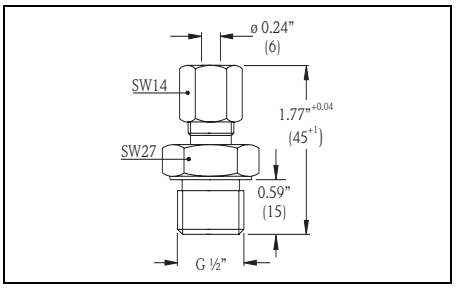
Material of parts in contact with process: 316L SS
Order no. 51004752



T09-TSM470BX-06-09-00-de-000

Coupling with sealing taper

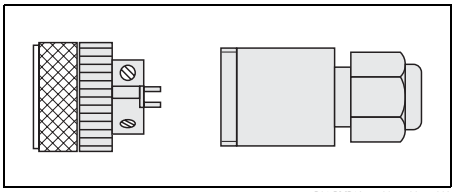
G ½" process connection
Seal, moveable coupling, material of parts in contact with process: 316L SS
Order no. 51004753



T09-TSM470AX-06-09-00-de-001

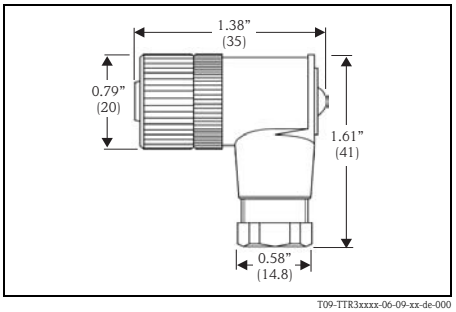
Plug-in jack

- M 12x1.5 plug-in jack
  Self-made connection to M 12x1.5 housing connector
  Order number: 52006263


P01-PMP13xxx-00-xx-00-xx-003

Elbow plug

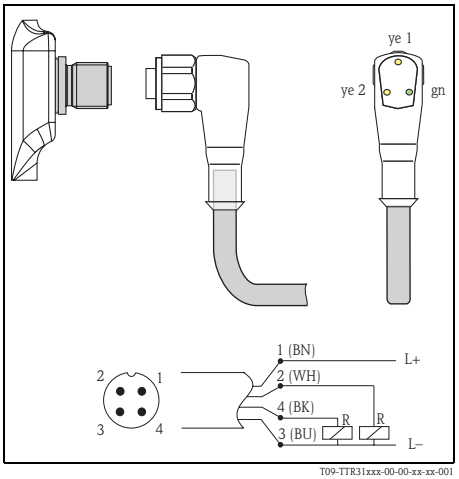
- Elbow plug
  4-pole M12 connector for customised cable construction, elbowed, NEMA 4X (IP67), PG7
  Order number: 51006327



T09-TTR3xxxx-06-09-xx-de-000

Connecting cable

- Cable, 4 x 0.34 mm² with M12 socket, elbowed, screw plug, length 5 m, sprayed PVC cable
  Order number: 52010285
- Cable, 4 x 0.34 mm² with M12 socket, with LED, elbowed, 316L SSscrew plug, length 5 m, sprayed PVC cable, specially for hygiene applications,
  Order number: 52018763
  Display:
  –gn: device operational
  –ye1: switch status 1
  –ye2: switch status 2



T09-TTR31xxx-00-00-xx-xx-001

Core colours:
– 1 = BN brown
– 2 = WH white
– 3 = BU blue
– 4 = BK black

Configuration kit

- Configuration kit for PC-programmable transmitters – ReadWin® 2000 setup program and interface cable for PCs with USB port; Adapter for transmitters with 4-pole post connector
  Order code: TXU10-AA
- ReadWin® 2000 can be downloaded free of charge directly from the internet at the following address:
  www.endress.com/readwin

T09-TTR31xxx-00-00-xx-xx-000

Documentation

Field of activities brochure	Temperature measuring technology, sensors and transmitters for the process industry; FA006t/09/en
Technical information	Process pressure switch Ceraphant T PTC31, PTP31, PTP35 TI384P/24/ae
Operating Instructions	■ Thermophant T TTR 31 / TTR 35 temperature switch; KA 174r/09 ■ Configuration software ReadWin® 2000 BA137R/09/en
Safety instructions	■ ATEX Safety instructions for electrical equipment for use in hazardous locations (in development). ■ Functional Safety Manual SIL (in development).

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