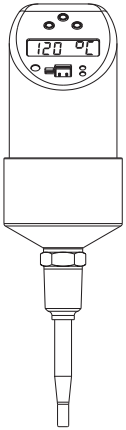
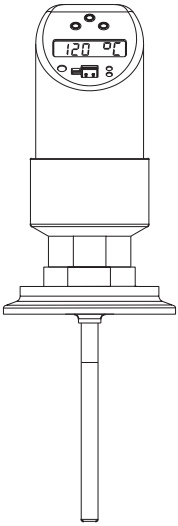
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating manual

Thermophant T TTR31, TTR35

Temperature switch





BA201R/09/en/02.05
51009833
Release 01.01.00

Endress+Hauser

People for Process Automation

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1 Safety instructions

1. 1 Designated use

The Thermophant T is a temperature switch for monitoring, displaying and regulating process temperatures. The device has been safely built with state-of-the-art technology and meets the applicable requirements and EC Directives. It can, however, be a source of danger if used incorrectly or for anything other than the designated use.

1. 2 Installation, commissioning and operation

Installation, electrical connection, commissioning, operation and maintenance of the measuring system must be carried out by trained, qualified specialists authorised to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain. The device may only be modified and repair work carried out if this is explicitly permitted in the Operating Instructions. Damaged devices which could be a source of danger may not be commissioned and must be labelled and identified as defective.

1. 3 Operational safety

- Functional safety
  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. This device version can therefore be used to monitor 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).
- Ex-area
  The Thermophant T is not approved for use in Ex-areas.

1. 4 Return

The following procedures must be carried out before a device is returned to Endress+Hauser:

- Always enclose a fully completed “Declaration of Contamination” form with the device. Only then can Endress+Hauser transport and examine a returned device. A copy of the “Declaration of Contamination” can be found on the second last page of these Operating Instructions.
- Remove all fluid residues. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

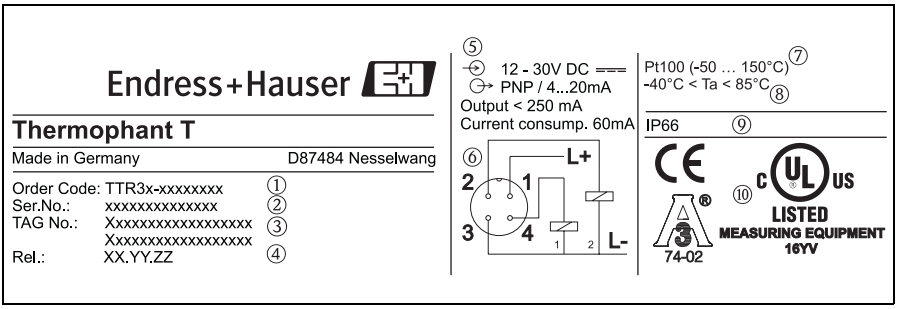


Warning!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.

2 Device identification

2. 1 Nameplate

To identify your device, compare the complete order code and the version information on the delivery papers with the data on the nameplate.



T09-TTR31xxx-18-xx-xx-xx-000

Fig. 1: Nameplate for device identification (as example)

①	Order code	⑥	Connection diagram
②	Serial number	⑦	Measuring range
③	TAG number	⑧	Ambient temperature
④	Release number (change status)	⑨	Degree of protection
⑤	Connection values	⑩	Approvals

Note!
The release number indicates the change status of the device. A change in the last two figures does not have any affect on the compatibility - see also → Chap. 7.

3 Installation

3. 1 Incoming acceptance, storage

- Incoming acceptance:
  Check the packaging and the device for damage. Check that the goods delivered are complete and nothing is missing.
- Storage:
  Storage temperature –40 °C to +85 °C (-40 °F to +185 °F).

3. 2 Dimensions

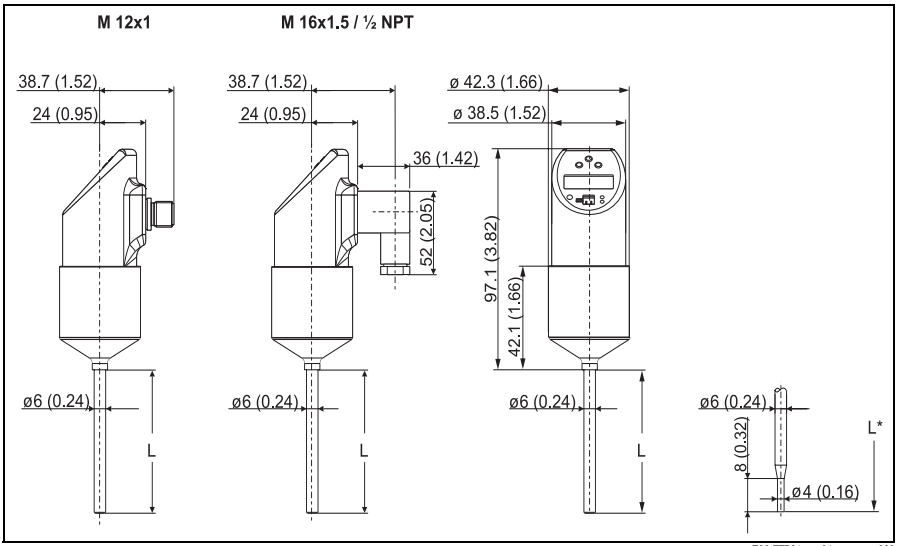
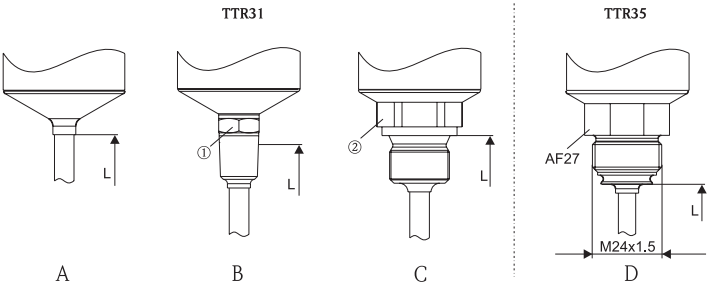


Fig. 2: Dimensions in mm (inches)

Version L in 100 and 200 mm (3.94 and 7.87"), version L = 50 mm (1.97") with reduced sensor tip*
M 12x1 connector as per IEC 60947-5-2
M 16x1.5 or ½ NPT valve plug as per DIN 43650A/ISO 4400

3. 3 Process connection

The following table illustrates the versions of Thermophant T.

	TTR31			TTR35
	 T09-TTR31xxx-17-xx-xx-en-000			
Field of application	Monitoring, display and control of process temperatures			Monitoring, display and control of process temperatures in hygienic processes
Process connection	**Item A** Version without process connection ('w'). Suitable welding bosses and coupling (see Section 6)	**Item B** Version with thread process connection ANSI ¼" NPT (① = AF14) and ½" NPT (① = AF27)	**Item C** Version with thread process connection G ¼A (② = AF14) and G ½A (② = AF27) as per ISO 228	**Item D** Adapter concept – version with M24x1.5 thread for adapters with process connection for hygienic processes (see Section 6.1.2)
Sensor length L	Version L in 100 and 200 mm (3.94 and 7.87"), version L = 50 mm (1.97") only with reduced sensor tip			
Measuring range	-50 °C to +150 °C (-58 °F to 302 °F)			

3. 4 Installation instructions

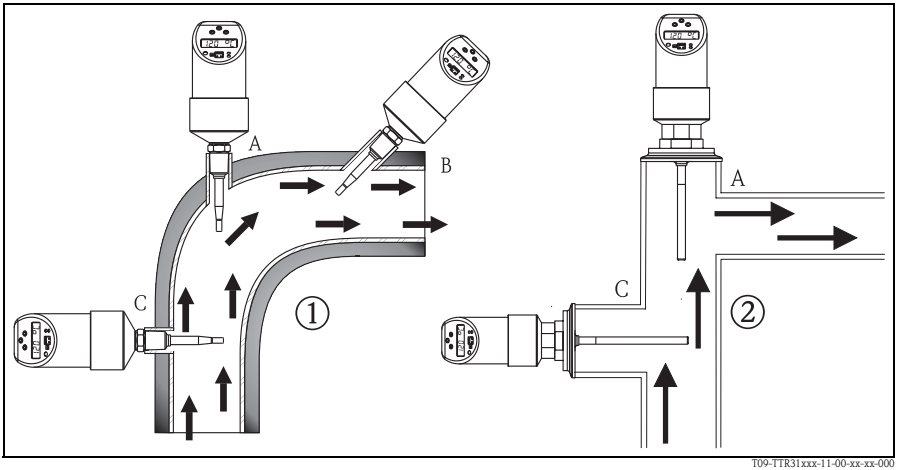


Fig. 3: Possible installation options for temperature monitoring in pipes

① *TTR31*
② *TTR35 for use in hygienic processes*

Mounting instructions:

- Installation at angle pieces, against the direction of flow (Fig. 3, Item A)
- Installation in smaller pipes, inclined against the direction of flow (Fig. 3, Item B)
- Installation vertical to the direction of flow (Fig. 3, Item C)
- The on-site display can be rotated electronically 180° – see Section 5. 1 "On-site operation"
- The housing can be rotated up to 310°

4 Wiring

4. 1 DC voltage version with M12 connector

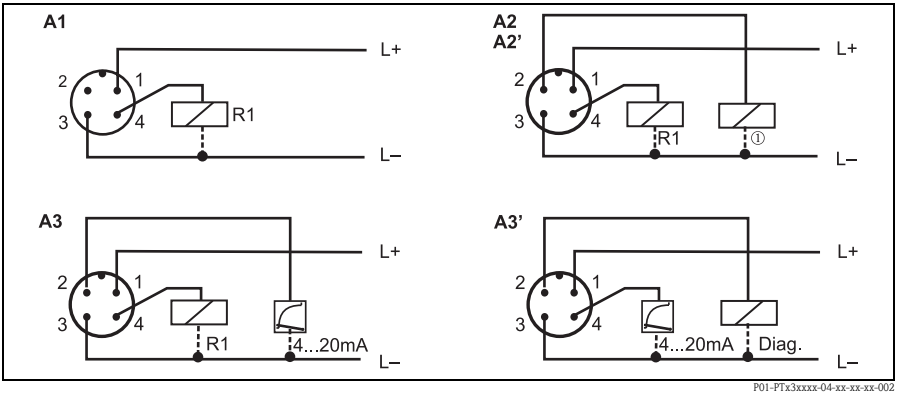


Fig. 4: Thermophant T with M12x1 connector

A1: 1x PNP switch output
A2: PNP switch outputs R1 and ①(R2)
A2': PNP switch outputs R1 and ① (diagnosis/break contact with adjustment "DESINA")
A3: PNP switch output with additional analog output
A3': PNP switch output with additional analog output (PIN assignment with "DESINA" setting)

Note!
DESINA (→ Chap. 5.1.3 Basic settings):
R2 = Diagnosis/break contact (more informations about DESINA see www.desina.de)

4. 2 DC voltage version with valve connector

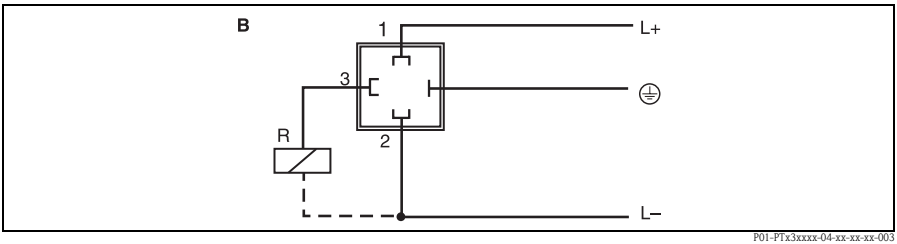


Fig. 5: Thermophant T with M 16x1.5 or ½ NPT valve plug

B: 1x PNP switch output

5 Operation

5. 1 On-site operation

The Thermophant T is operated by means of three keys. The digital display and the light emitting diodes (LED) support navigation in the operating menu.

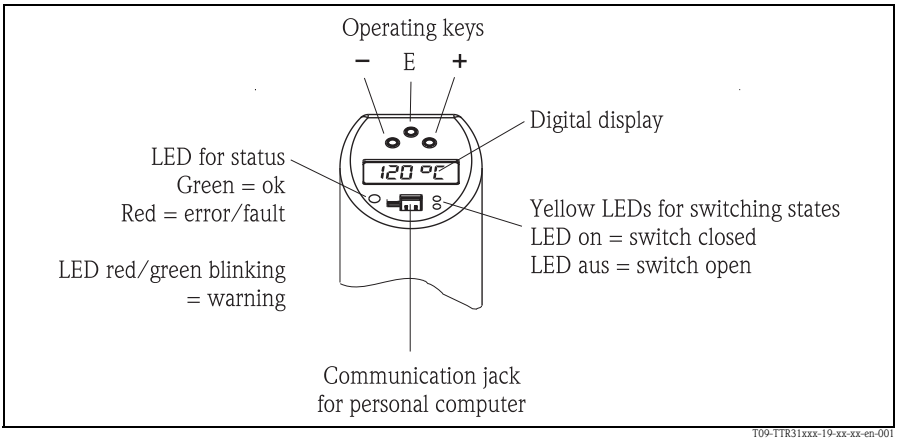


Fig. 6: Position of operating elements and possibilities for display

Background illumination of the digital display:
- *White = OK status*
- *Red = error status*

5.1.1 Navigating in the operating menu

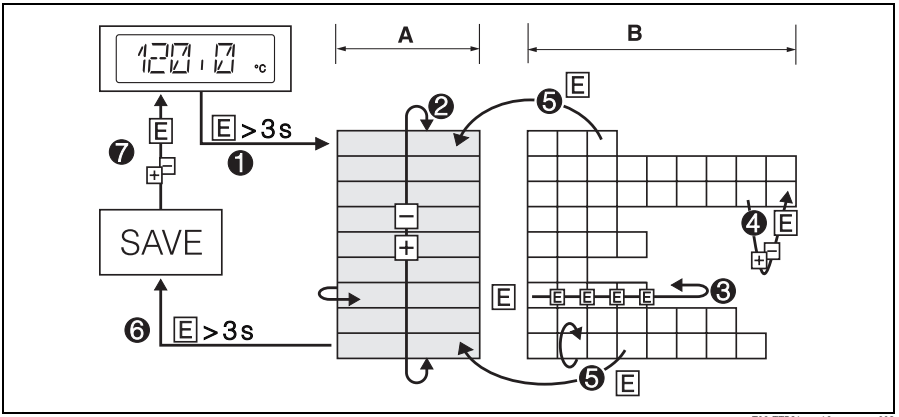


Fig. 7: Navigating in the operating menu

A Function group selection

B Function selection

① *Enter the operating menu*
– *Press the E key for longer than 3 s*

② *Select the "Function group" with the + or – key*

③ *Select the "Function" with the E key*

④ *Enter or change parameters with the + or – key*
– *Then return to "Function" with the E key Note: If software locking is enabled, it must be disabled before making entries or changes*

⑤ *Press the E key several times to return to the "Function group"*

⑥ *Jump back to the measuring position (Home position)*
– *Press the E key for longer than 3 s*

⑦ *Query to save data (select "YES" or "NO" with the + or – key)*
– *Confirm with the E key*

Note!
Changes to the parameter settings only become effective if you choose ⑦ 'YES' when asked to save data.

5.1.2 Structure of the operating menu

The structure below shows all the possible fields of the operating menu.

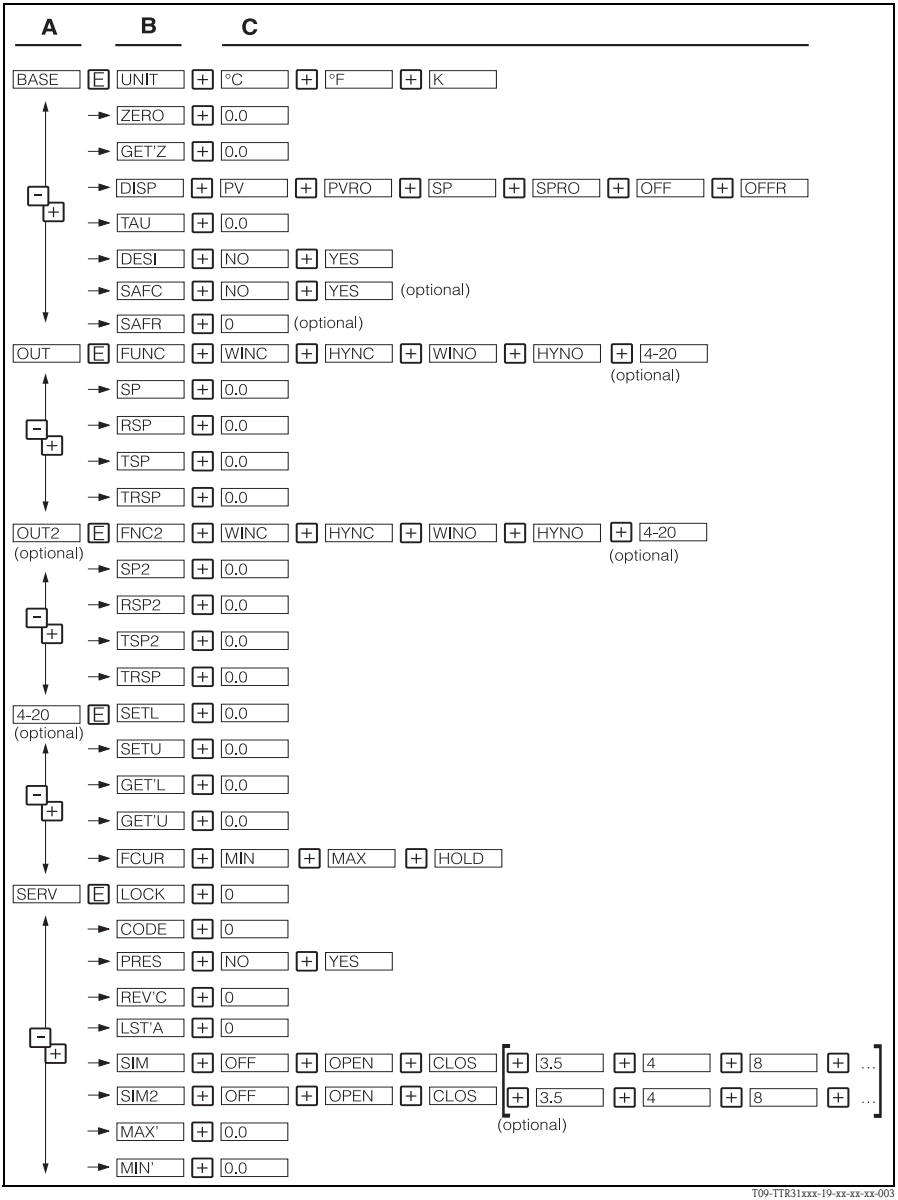


Fig. 8: Operating menu: A function groups, B functions, C settings

5.1.3 Basic settings

Base	Basic settings			
BASE	UNIT	Technical unit	°C °F K	Select technical unit: °C °F K
	ZERO	Configure zero point	0.0	Position adjustment: within ±10 °C/K (±19 °F) of the upper range limit
	GET'Z	Accept zero point	0.0	No settings possible (not available in PC software)
	DISP	Display	PV PVRO SP SPRO OFF OFFR	PV: measured value display PVRO: measured value display rotated 180° SP: set switch point display SPRO: set switch point display rotated 180° OFF: display off OFFR: display off rotated 180°
	TAU	Damping: display value, output signal	0.0	0...40 s
	DESI	DESINA	NO YES	Connection in accordance with DESINA guidelines
	SAFC	Safety confirmation	NO YES	Operation with increased functional safety (in development). Factory setting NO should not be changed
	SAFR	Safety release code	0	Enter the calculated safety code of the PC Software

5.1.4 Output setting

- 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 monitoring of a process temperature range.
- NO contact or NC contact
  This switch function is freely selectable.
- Factory setting (if no customer-specific settings have been ordered):
  Switch point SP 1: 45 %; Switch-back point RSP 1: 44.5 %
  Switch point SP 2: 55 %; Switch-back point RSP 2: 54.5 %
- Range of adjustment
  LRL = Lower Range Limit
  URL = Upper Range Limit
  LRV = Lower Range Value
  URV = Upper Range Value

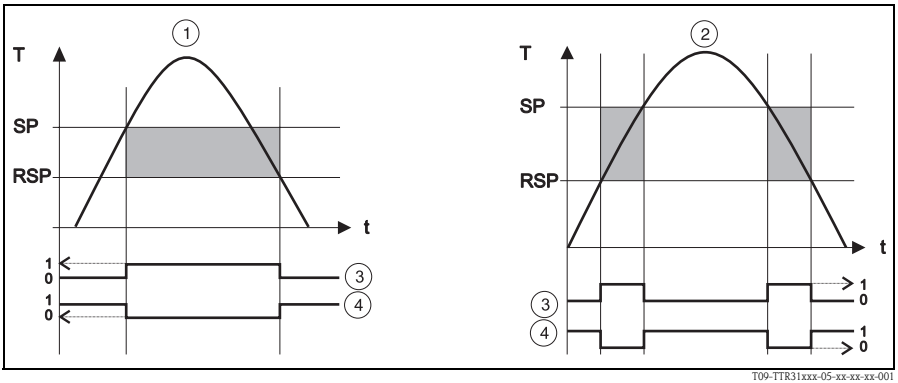


Fig. 9: ① Hysteresis function, ② Window function, ③ NO contact switch status , ④ NC contact switch status SP Switch point; RSP Switch-back point

OUT/ OUT2	Output/output 2 (optional)			
OUT OUT2	FUNC FNC2	Switching characteristic	WINC HYNC WINO HYNO 4--20	WINC: window/NC contact HYNC: hysteresis/NC contact WINO: window/NO contact HYNO: hysteresis/NO contact 4 - 20: Analog output (only if available)
	SP SP2	Switch point value	0.0	Switch point -49.5 to 150 °C (-57.1 to 302 °F) in increments of 0.1 °C (0.18 °F)
	RSP RSP2	Switch-back point value	0.0	Switch-back point -50 to 149 °C (-58 to 300.2 °F) in increments of 0.1 °C (0.18 °F)
	TSP TSP2	Switch point delay	0.0	Delay time 0...99 s in increments of 0.1 s
	TRSP TRS2	Switch-back point delay	0.0	Delay time 0...99 s in increments of 0.1 s
Min. distance between SP and RSP: 0.5 °C/K (0.9 °F)				

OUT/ OUT2	Output/output 2 (optional)			
4--20	SETL	Value for 4 mA (LRV)	0.0	-50 to 130 °C (-58 to 266 °F) Lower range value in increments of 0.1 °C (0.18 °F)
	SETU	Value for 20 mA (URV)	0.0	-30 to 150 °C (-22 to 302 °F) Enter upper range value in increments of 0.1 °C (0.18 °F)
	GET'L	Temperature applied for 4 mA (LRV)	0.0	Take temperature value as lower range value (not via PC software)
	GET'U	Temperature applied for 20 mA (URV)	0.0	Take temperature value as upper range value (not vial PC software)
	FCUR	Error current	MIN MAX HOLD	Current value in event of error: MIN = ≤ 3.6 mA MAX = ≥ 21.0 mA HOLD = last value
Min. distance between SETL and SETU: 20 °C/K (36 °F)				

5.1.5 Service function setting

SERV	Service functions			
SERV	LOCK	Locking code	0	Enter the locking code for enabling the device.
	CODE	Change locking code	0	Freely selectable code 1...9999. 0 = no locking; A locking code already assigned can only be changed by first entering the old code for enabling the device.
	PRES	Reset	NO YES	Reset all entries to the factory setting
	REV'C	Revision counter	0	Increases by 1 with each configuration
	LST'A	Last device status	0	Displays the last device status to occur ≠ 0
	SIM SIM2 (if output 2 available)	Simulation output 1 or 2	OFF OPEN CLOS 3.5 (if analog output available)	OFF: No simulation OPEN: Switch output open CLOS: Switch output closed 3.5: Simulation values for analog output in mA (3.5/4.0/8.0/12.0/16.0/20.0/21.7)
	MAX'	Max. indicator	0.0	Display of max. measured process value
	MIN'	Min. indicator	0.0	Display of min. measured process value

5. 2 Operation with PC and Readwin® 2000

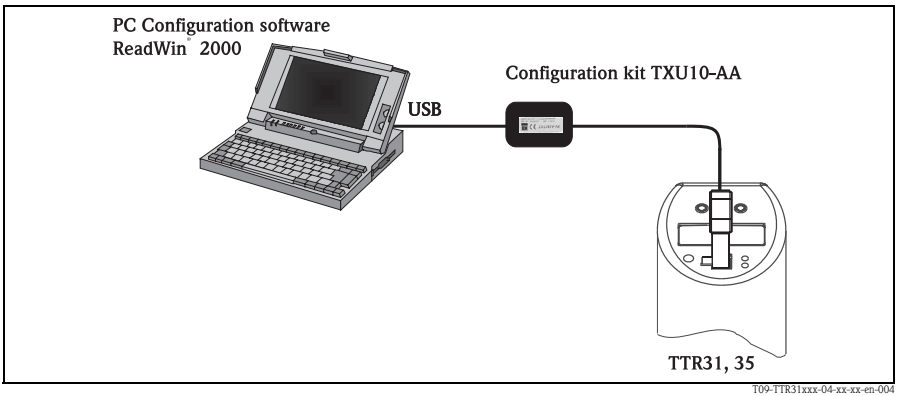


Fig. 10: Operation with PC

5.2.1 Additional operating options

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

Function group	Description
SERV	Number of switch changes for output 1
	Number of switch changes for output 2
	Device status
INFO	Tag number
	Order code
	Limit switch serial number
	Sensor serial number
	Electronics serial number
	Device release (change status)
	Hardware version

Function group	Description
INFO	Software version

5.2.2 Operating Instructions for Readwin® 2000

Comprehensive information on the ReadWin ® 2000 configuration software may be found in the Operating Instructions BA 137R/09/en.

6 Accessories

All dimensions in the drawings are given in mm (inches).

6. 1 Adapter concept for TTR35

The process connection is an adapter and the sensor module has an adapter thread (see Section 3. 3, process connection). As a result, the process connection can easily be changed at a later stage.

6.1.1 Adapter change

The adapter can be changed on TTR35.

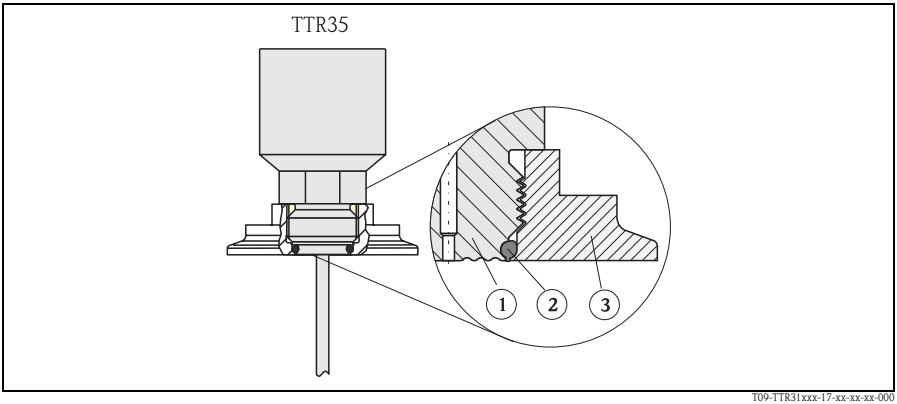


Fig. 11: Changing the adapter

① *Sensor module with adapter thread*
② *Standard O-ring*
③ *Adapter*

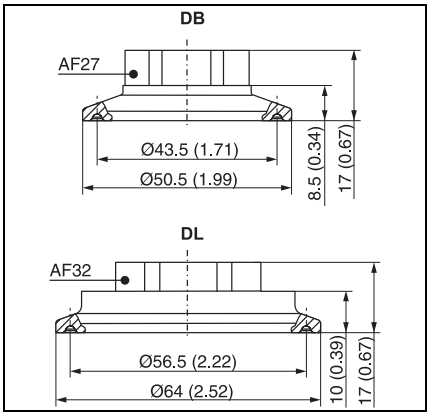
Please note the following when changing the adapter:

- Use a new O-ring. Diameter 15.54 x 2.62 mm (0.612" x 0.103").
  EPDM 70 Shore FDA 3-A approved.
- The device (sensor module) can be fixed in place with an open-ended wrench AF 27.
- The adapter can be screwed on with an open-ended wrench AF 27 or AF 32 (depending on the process connection, (see Section 6.1.2 adapter versions)).
  The maximum torque is 80 Nm. The thread can become loose if exposed to severe strain through pressure and temperature. For this reason, the air-tightness must be checked regularly and the thread tightened if necessary.
- When changing the adapter, make sure that the sensor tube of the sensor is not damaged.

Note!
We recommend to change the O-ring in the same time frame as of all other sealings in your process.

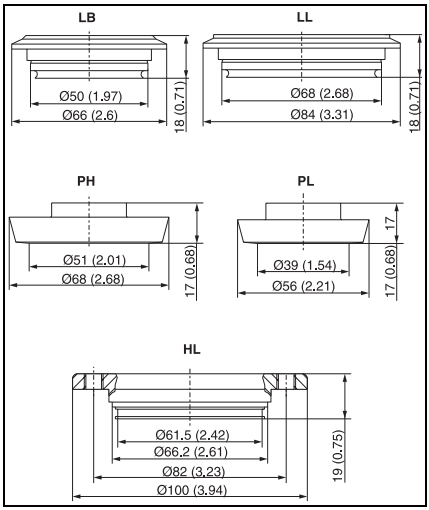
6.1.2 Adapter versions

TTR35: order numbers for clamp adapter versions.
Version DB: order no. 52023994
Version DL: order no. 52023995



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

TTR35: order numbers for hygiene adapter versions.
Version LB: order no. 52023996
Version LL: order no. 52023997
Version PH: order no. 52023999
Version PL: order no. 52023998
Version HL: order no. 52024000



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

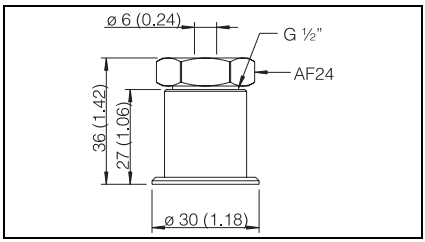
6.1.3 O-ring for adapter change

O-ring 15.54 x 2.62 mm (0.612" x 0.103"), EPDM 70 Shore FDA, order number 52024267

6. 2 Welding bosses and coupling

6.2.1 Welding boss with sealing taper

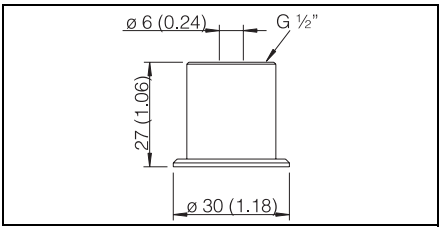
Collar welding boss
Seal, moveable coupling, material of parts in contact with process: 316L, PEEK
Order number: 51004751



T09-TSM470AX-06-09-00-en-000

6.2.2 Collar welding boss

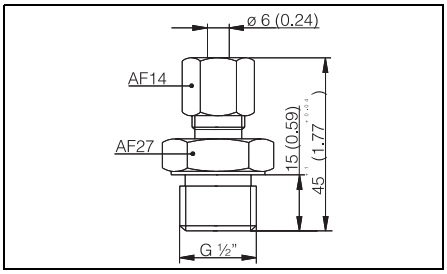
Material of parts in contact with process: 316L
Order no. 51004752



T09-TSM470BX-06-09-00-en-000

6.2.3 Coupling with sealing taper

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

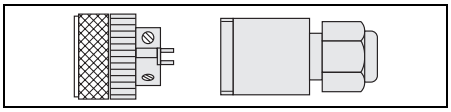


T09-TSM470AX-06-09-00-en-001

6. 3 Electrical connection

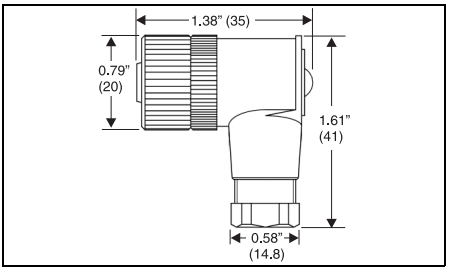
6.3.1 Plug-in jack

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


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

6.3.2 Elbow plug

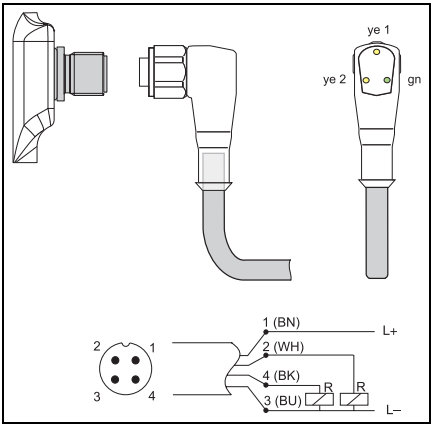
Elbow plug
4-pole M12 connector for customised cable construction, elbowed, IP67, PG7
Order number: 51006327



T09-TTR3xxxx-06-09-xx-en-000

6.3.3 Connecting cable

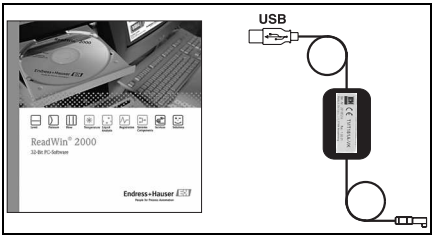
- Cable, 4 x 0.34 mm² (22 AWG) with M12 socket, elbowed, screw plug, length 5 m (16.4 ft), PVC cable – Order number: 52010285
- Cable, 4 x 0.34 mm² (22 AWG) with M12 socket, with LED, elbowed, 316L screw plug, length 5 m (16.4 ft), PVC cable, special for hygiene applications,
  order number: 52018763
  Display:
  – gn: device operational
  – ye1: switch status 1
  – ye2: switch status 2
  Core colours:
  – 1 = BN brown
  – 2 = WH white
  – 3 = BU blue
  – 4 = BK black



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

6. 4 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

7 Trouble-shooting

7. 1 Errors and warnings

If an error in the device occurs, the colour of the status LED changes from green to red and the background illumination of the digital display changes from white to red. The display shows:

- E-code for errors
  In the event of an error message, the measured value is uncertain.
- W-code for warnings
  In the event of a warning, the measured value is reliable.

Code	Explanation
E011	Device configuration faulty
E012	Error in measurement or underreach/overreach in SIL mode
E015	Error in EEPROM
E019	Power supply has undervoltage/overvoltage
E020	Error in Flash
E021	Error in RAM
E022	USB supply voltage
E025	Switching contact 1 is not open although it should be
E026	Switching contact 2 is not open although it should be
E040	VCC (Controller voltage) is out of working area
E042	Output current cannot be generated
E044	Output current drifts too much (± 0.5 mA)

Code	Explanation
W107	Simulation active
W202	Temperature outside the sensor range (not SIL mode)

Code	Explanation
W209	Device starts
W210	Configuration modified
W212	Sensor signal outside the permitted range (not SIL mode)
W250	Number of switch cycles exceeded
W270	Short-circuit and overload at output 1
W280	Short-circuit and overload at output 2

7. 2 Repair

A repair is not planned.

7. 3 Disposal

When disposing, ensure that the materials of the device components are separated and processed accordingly.

7. 4 Change status (release)

The release number on the nameplate and in the Operating Instructions indicates the change status of the device: XX.YY.ZZ (example 01.02.01).

XX	Change in the main version. Compatibility no longer provided. Device and Operating Instructions change.
YY	Change in functionality and operation. Compatibility provided. Operating Instructions change.
ZZ	Trouble-shooting and internal modifications. Operating Instructions do not change.

7. 5 Release history

Date	Release no. device	Device and software-No. (Firmware/Software)	Changes	Operating manual
06.2004	1.00.00	1.00.00		KA174r/09/en (51008032)
12.2004	1.01.00	1.00.00	New analog electronics	BA201r/09/en (51009833)

8 The most important technical data

8. 1 Power supply

Supply voltage
- DC voltage version 12...30 V DC

Current consumption
- Without load < 60 mA, with reverse polarity protection

Power supply failure
- Behaviour 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 IEC 61000-4-5). If the supply voltage is exceeded, the properties specified are no longer guaranteed.
- Behaviour 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).

8. 2 Output

Switching capacity
- 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 load testing of switching current; output is switched off in case of overcurrent, the switching current is tested again every 0.5 s; max. capacitance load: 14 µF for max. supply voltage (without resistive load).

Load (analog output)
- Max. (V_{supply} – 6.5 V) / 0.022 A

Signal on alarm
- Analog output: ≤ 3.6 mA or ≥ 21.0 mA adjustable
  (if setting ≥ 21.0 mA the output is ≥ 21.5 mA)
- Switch outputs: in safe state (switch normally open)

8. 3 Operating conditions

- Any orientation
- Any position-dependent zero shift can be corrected
  Offset: ±20 % URL

Operating conditions: Environment
- Ambient temperature range
  –40...+85 °C (-40...+ 185 °F)
- Storage temperature
  –40...+85 °C (-40...+ 185 °F)

Operating conditions: Process

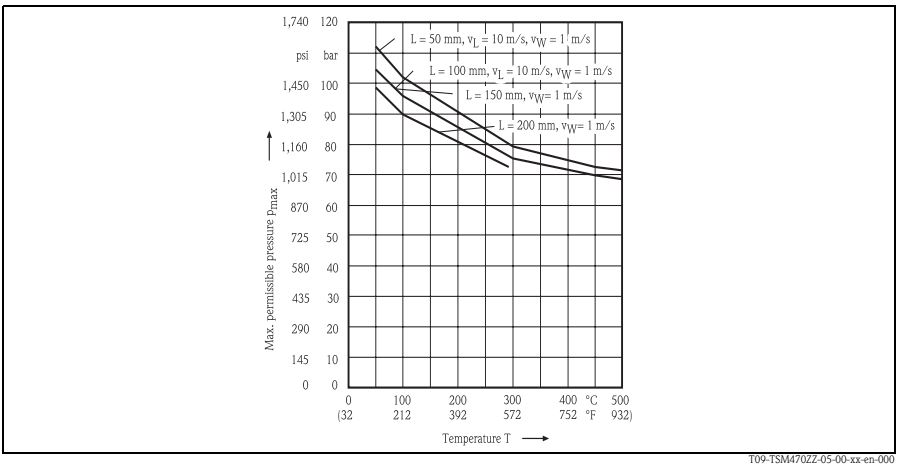
- Process temperature limits
  -50 to 150 °C (-58 to 302 °F)

Caution!
Restrictions depending on process connection and ambient temperature:

– No restriction with coupling (see Accessories, → Chap. 6.2.1, → Chap. 6.2.3, order no. **51004751**, **51004753**) and neck tube length min. 20 mm.
– with process connection:

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

- Process pressure limits
  p/T load diagram as per DIN 43763 or Dittrich



T09-TSM470ZZ-05-00-xx-en-000

Fig. 12: p/T load diagram

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

9 Dangerous good sheet

Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser
People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

Process data/ *Prozessdaten* Temperature / *Temperatur* _____ [°C] Pressure / *Druck* _____ [Pa]

Conductivity / *Leitfähigkeit* _____ [S] Viscosity / *Viskosität* _____ [mm²/s]

Medium and warnings
Warnhinweise zum Medium



	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include security sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Reason for return / *Grund zur Rücksendung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____ Contact person / *Ansprechpartner* _____

_____ Department / *Abteilung* _____

Address / *Adresse* Phone number/ *Telefon* _____

_____ Fax / E-Mail _____

_____ Your order No. / *Ihre Auftragsnr.* _____

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

PVSF/Nuria VII

_____ _____

(place, date / *Ort, Datum*) (Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)

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BA201R/09/en/02.05
51009833
CCS/FM6.0+SGML