Level	Pressure	Flow	Temperature	Liquid Analysis	Registration	Systems Components	Services	Solutions

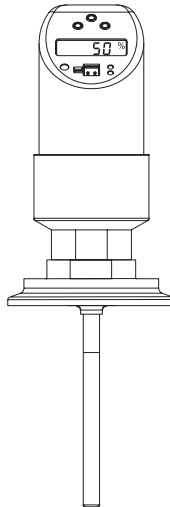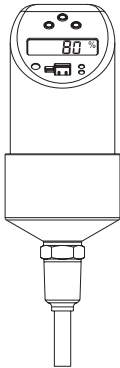Operating Instructions

Flowphant T DTT31, DTT35

Flow Switch

Endress+Hauser

People for Process Automation

Table of contents

Endress+Hauser

1   Safety instructions

1.1   Designated use

The Flowphant T is a flow switch for measurement and monitoring of mass flow rates in indus-trial processes. 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 incor-rectly 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 authorized 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 labeled and identified as defective.

1.3   Operational safety

Ex-area
The Flowphant 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 "Declara-tion 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.
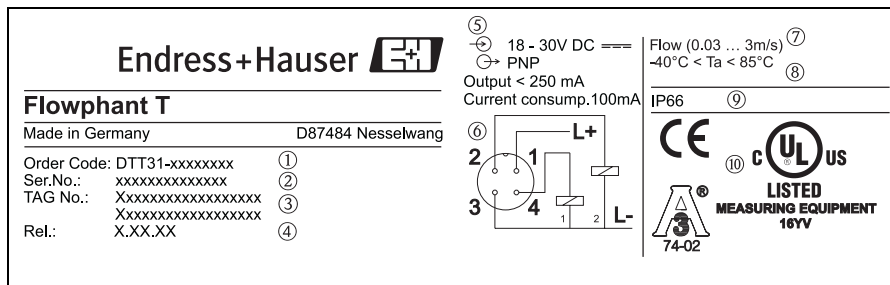
T09-DTT31xxx-18-xx-xx-xx-000.eps

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 range
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 Section 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:
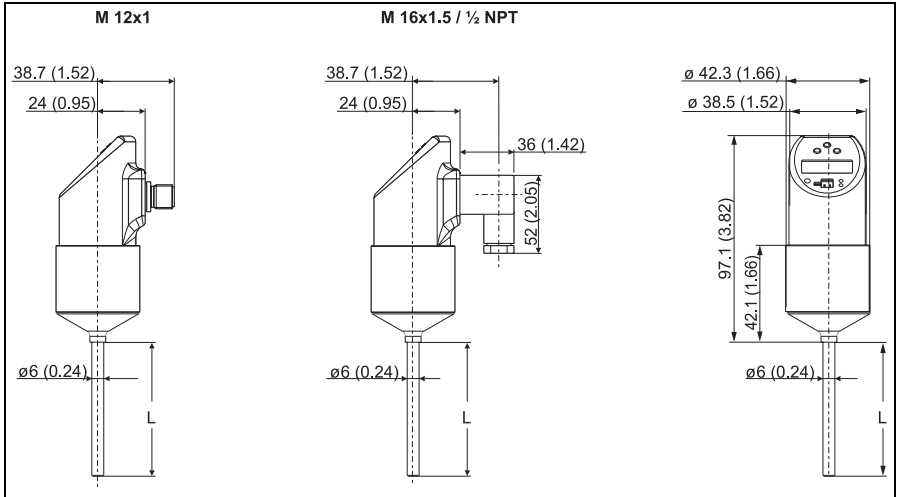 Storage temperature –40 °C to +85 °C (–40 °F to 185 °F).

3.2   Dimensions

Fig. 2: Dimensions in mm (inch)

Version L with 30 and 100 mm (1.18 and 3.94 in)
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 Flowphant T.

	DTT31			DTT35
	 A	B	C	D AF27 M24x1.5 T09-TTR31xxx-17-xx-xx-en-000
Field of application	Measurement and monitoring of mass flow rates			Measurement and monitoring, mass flow rates in hygienic processes
Process connection	**Item A** Version without process connection ('w'). Suitable welding bosses and coupling (see section 7)	**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 ¼ (② = AF14) and G ½ (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 7.1.2)
Sensor length L	Version L with 30 and 100 mm (1.18 and 3.94 in)			
Operational range	Liquids from 0.03 to 3.0 m/s (0.1 to 9.84 ft/s)			

3.4   Installation instructions

Mounting instructions:

- Any orientation
- The onsite display can be rotated electronically 180° – see section 5.1 "Onsite operation"
- The housing can be rotated up to 310°.

Caution!
Do not turn the device into the process connection thread at the housing. Always install the device at the hexagonal-headed bolt ($\rightarrow$ Fig. 3, item 1). Use a suitable open-ended wrench for this task (see Table $\rightarrow$ Chap. 3.3).

Note!
For correct flow measurement, the complete sensor length must be immersed in the fully developed flow profile.
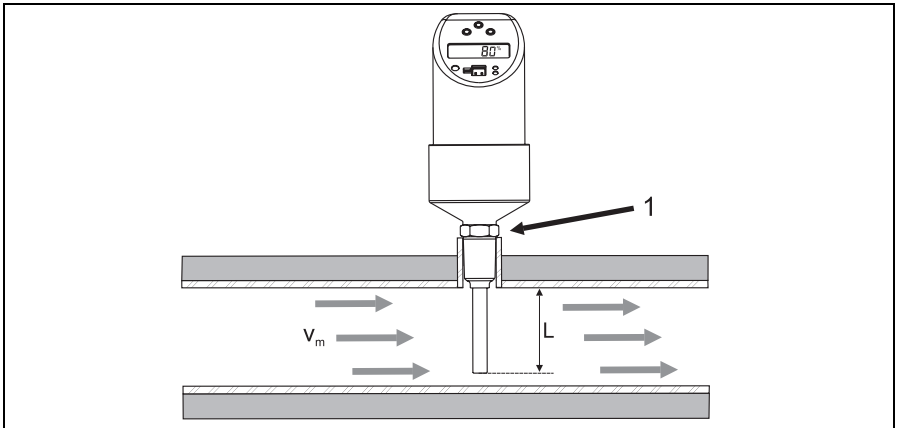
T09-DTT31xxx-11-00-xx-xx-000

Fig. 3: Installing the device (example). Sensor length L is completely immersed in the flow profile.

4   Wiring

4.1   DC voltage version with M12 connector

T09-DTT3xxxx-04-xx-xx-xx-000.eps
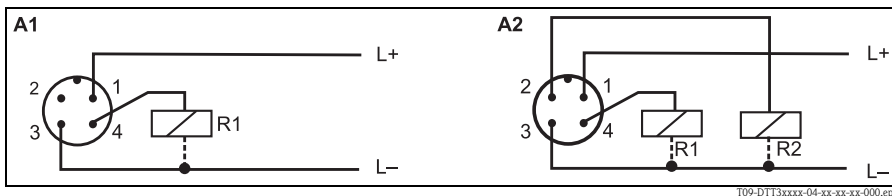
Fig. 4: Flowphant T with M12x1 connector

A1: 1x PNP switch output
A2: PNP switch outputs R1 and R2

4.2   DC voltage version with valve connector

P01-PTx3xxxx-04-xx-xx-xx-003
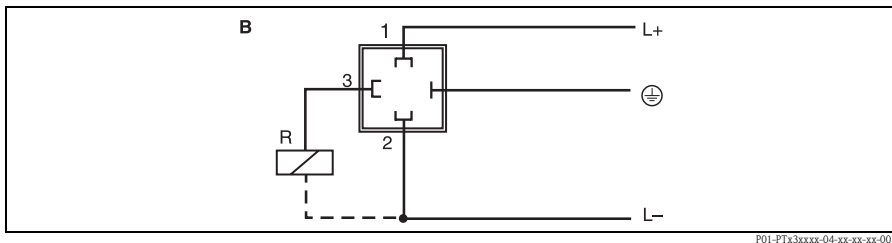
Fig. 5: Flowphant T with M 16x1.5 or ½" NPT valve plug

B: 1x PNP switch output

5   Operation

5.1   Onsite operation

The Flowphant T is operated by means of three keys. The digital display and the light emitting diodes (LED) support navigation in the operating menu.
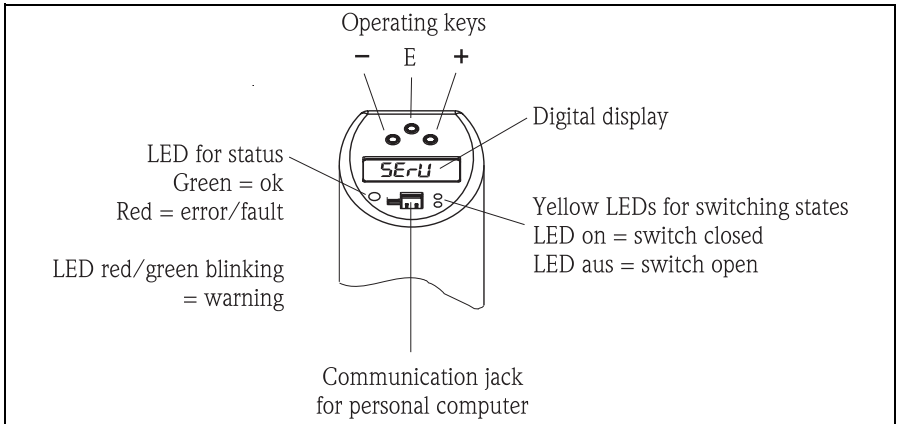
Fig. 6: Position of operating elements and possibilities for display

Background illumination of the digital display:
–   White = OK status
–   Red = alarm/error status

5.1.1   Navigating in the operating menu
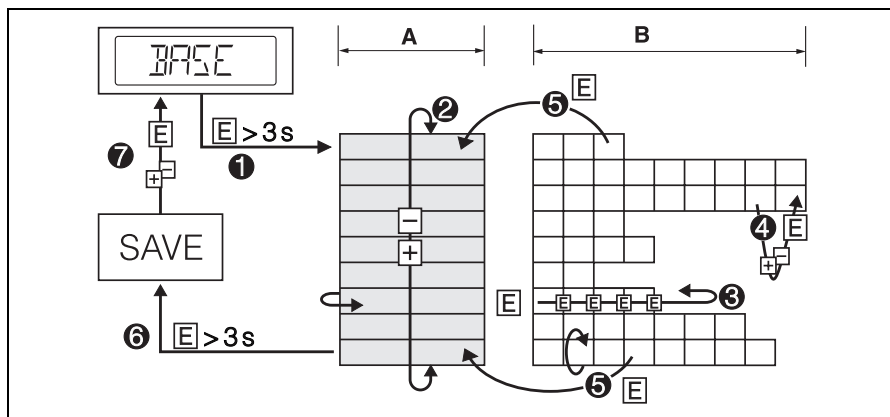
T09-TTR31xxx-19-xx-xx-xx-002

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.

Navigating the 'Learn' function
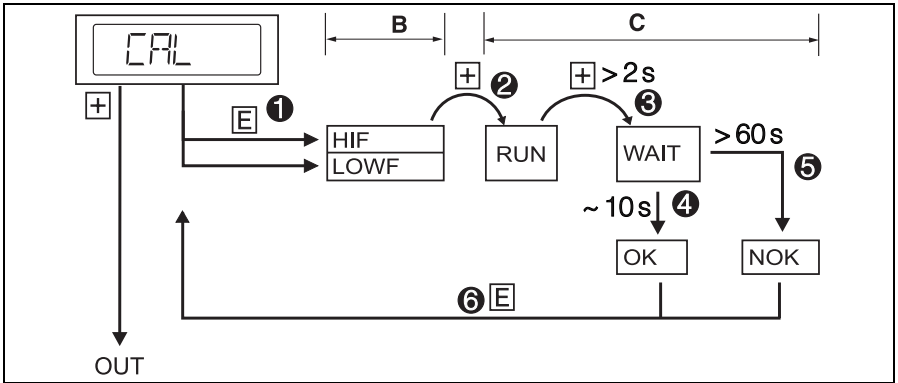
Fig. 8: Navigating the 'Learn' function using the Calibration (CAL) function group as an example

① *Select the HIF (Learn High Flow) or LOWF (Learn Low Flow) function with the E key*

② *Select the "RUN" function with the + key, learn function is initialized*

③ *Select the "WAIT" function with the + key, press for longer than 2 s*

④ *Accept ('learn') the current measured value after approx. 10 s – "OK" appears on the display*

⑤ *If "NOK" (not OK) appears on the display after 60 s, no current measured value was set*

⑥ *Return to the CAL function group (Home position) with the E key*

5.1.2 Structure of the operating menu

The structure below shows all the possible fields of the operating menu.
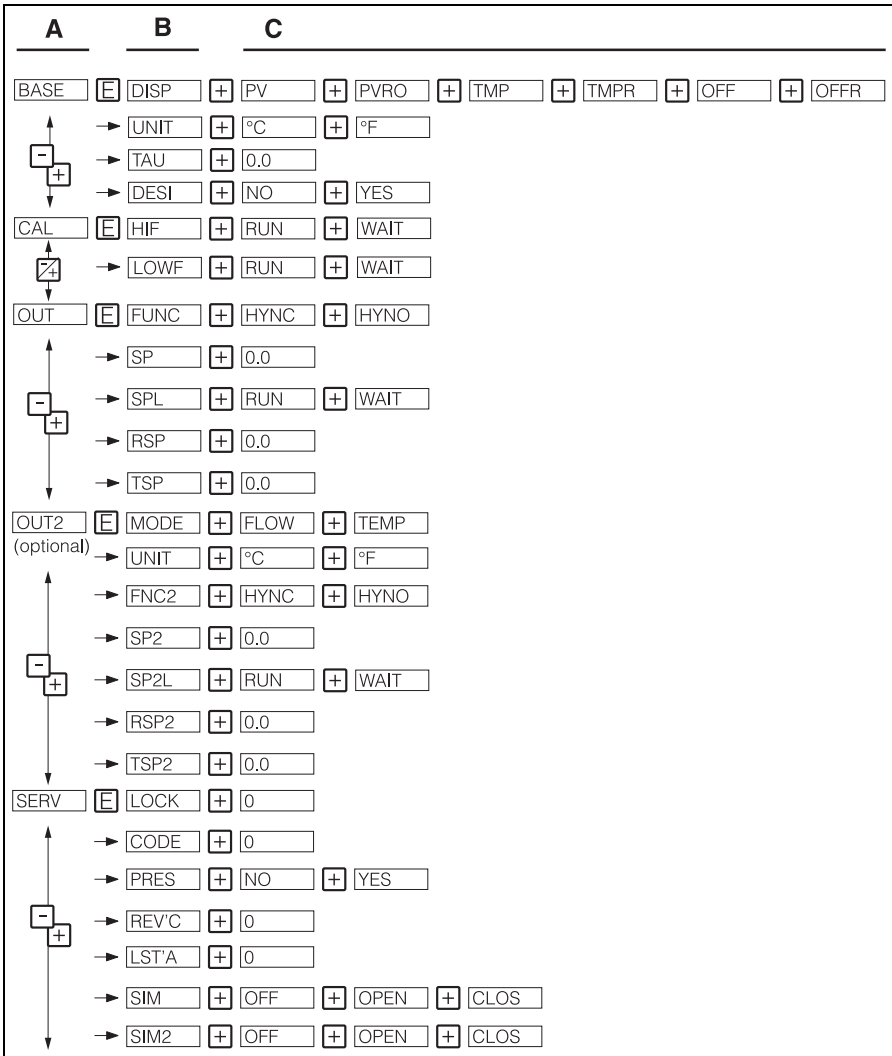
Fig. 9: Operating menu: A function groups, B functions, C settings

5.1.3 Basic settings

Menu-guided operation with the operating keys.

Function group	Function (display)	Description
BASE (basic functions)	Display (DISP)	Display assignment: OFF Display of current measured value or of configured switch point (switch 1) Display of current measured value or of configured switch point (switch 1) rotated 180° Display of current medium temperature Display of current medium temperature rotated 180° Factory setting: **current measured value**
	UNIT	Display medium temperature unit °C or °F Factory setting: **°C** ✎ Note! Only visible if the current medium temperature is selected in the DISP mode.
	Damping (TAU)	Measured value damping with regard to display value and output: 0 (no damping) or 9 to 40 s (in increments of 1 second) Factory setting: **0 s**
	DESINA (DESI) Only for 2 x PNP switch outputs	Behavior as per DESINA: The PIN of the M12 connector is assigned in accordance with the guidelines of DESINA. (DESINA = DistributEd and Standardized INstAllation technology for machine tools and manufacturing systems)
CAL (calibration)	Learn High Flow (HIF)	Setting for maximum flowrate occurring. 100% value
	Learn Low Flow (LOWF)	Setting for minimum flowrate occurring. 0% value

Function group	Function (display)	Description
OUT (Setting for the 1st output) OUT2 (Setting for the 2nd output, optional)	Switching mode (MODE)	Output switching mode for channel 2: flow or temperature Factory setting: **flow**
	UNIT	Temperature unit selection (°C/°F) ✎ Note! Function only visible if switching mode (MODE) is set to temperature in the 2nd output.
	Function 1 (FUNC) Function 2 (FNC2), optional	Switch output function: hysteresis function NC contact or NO contact (see diagram)
	Switch point (SP) Switch point 2 (SP2), optional	Enter value 5 to 100% in increments of 1%. Factory setting: **50%** **Or optionally for SP2:** Enter value –15 to 85 °C (–5 to 185 °F) in increments of 1 °C (1 °F) if the switching mode (MODE) is set to temperature. Factory setting: **55 °C (131 °F)**
	Switch point learn (SPL) Switch point learn 2 (SP2L), optional	Take current flowrate as SP.
	Switch–back point (RSP) Switch–back point 2 (RSP2), optional	Enter value 0 to 95% in increments of 1%. Factory setting: **40%** ✎ Note! The value has to be at least 5% smaller than the switch point (SP or SP2). **Or optionally for RSP2:** Enter value –20 to 80 °C (–4 to 176 °F) in increments of 1 °C (1 °F) if the switching mode (MODE) is set to temperature. Factory setting: **50 °C (122 °F)** ✎ Note! Value has to be at least 5 °C (9 °F) smaller than switch point 2 (SP2).

Function group	Function (display)	Description
OUT and OUT2 continued	Switch point delay (TSP) Switch point delay (TSP2), optional	Can be set anywhere between 0 and 99 s in increments of 1 second. Factory setting: **0 s**
SERV (Service functions)	Operating code (LOCK)	Enter the device locking code.
	Edit operating code (CODE)	Locking, only visible with valid operating code.
	Preset (PRES)	Resetting of all settings to factory settings.
	Static revision counter (REVC)	Configuration counter, incremented each time the configuration is changed.
	Device status (STAT)	
	Last error (LSTA)	Display of last error to occur.
	Simulation 1 (SIMU) Simulation 2 (SIM2), optional	Simulation switch output 1: on/off with display, optionally corresponding to switch output 2.

Functions of the switch point

- Hysteresis function
  The hysteresis function enables two-point control via a hysteresis. Depending on the mass flow, the hysteresis can be set via the switch point SP and the switch-back point RSP.

- NO contact or NC contact
  This switch function is freely selectable.

a0005280
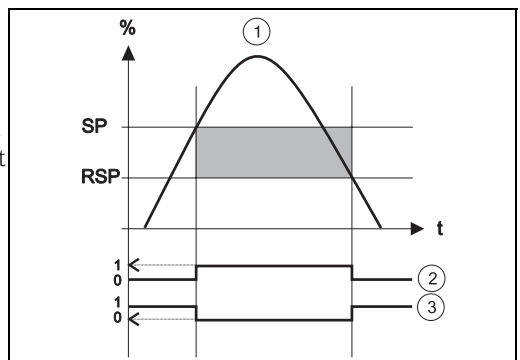
Fig. 10: ① *Hysteresis function,* ② *NO contact,*
           ③ *NC contact*

SP switch point; RSP switch-back point

5.2   Operation with PC and ReadWin® 2000
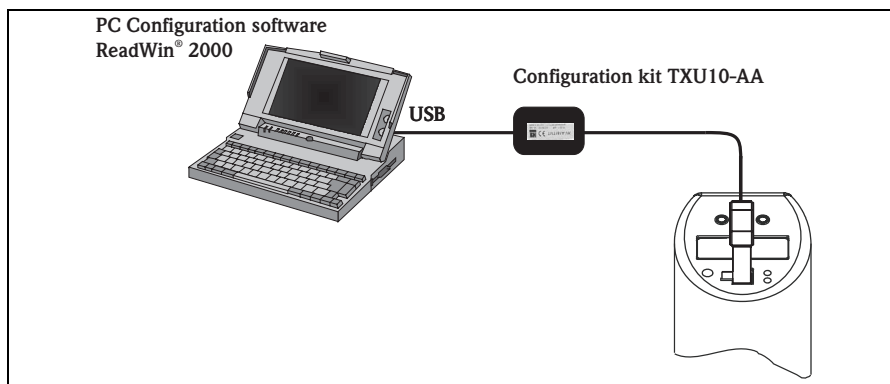
Fig. 11: Operation with PC

5.2.1   Additional operating options

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

Function group	Function (display)	Description
SERV (service functions)	Switching processes 1 Switching processes 2, optional	Number of changes in switching status for switch output 1; optionally switch output 2
INFO (device information)	TAG 1 TAG 2, optional	Tagging, 18–digit
	Order code	Order code
	Serial number	Device serial number
	Sensor serial number	Sensor serial number
	Electronics serial number	Electronics serial number
	Device revision	Display of entire revision
	Hardware revision	Hardware version
	Software revision	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 BA137R/09/en.

6   Maintenance

Any buildup on the sensor can have a negative effect on the accuracy. For this reason, check the sensor for buildup at regular intervals.

Caution!
Make sure the process is unpressurized before you remove the device! Do not twist the device out of the process connection thread at the housing. Always use a suitable open-ended wrench for dismantling (see also → Fig. 3) (→ Chap. 3.3).

7   Accessories

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

7.1   Adapter concept for DTT35

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.

7.1.1   Adapter change

The adapter can be changed on DTT35.
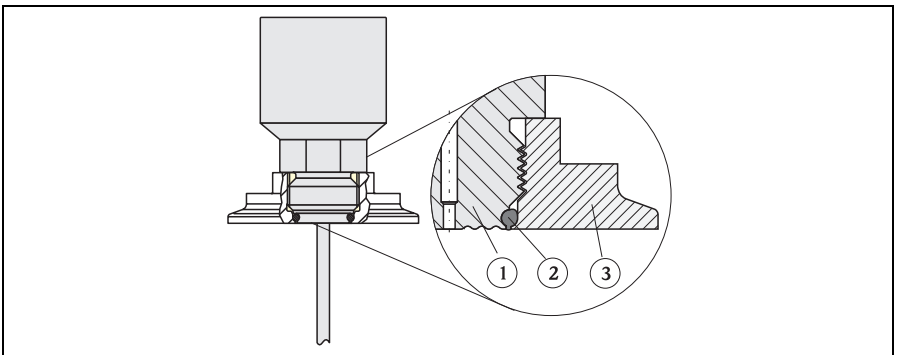
T09-TTR31xxx-17-xx-xx-xx-000

Fig. 12: 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 (0.61 x 0.1 in).
  EPDM 70 Shore material has FDA 3-A approval.
- Only fix the device (sensor module) in place with an open-ended wrench AF 27.
- Screw and unscrew the adapter with an open-ended wrench AF 27 or AF 32, depending on the process connection (see section 7.1.2: 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 you replace the O-ring at the same intervals as you replace the other seals in your process.

7.1.2 Adapter versions

EN10204-3.1 = Material certificate (melt analysis)

DTT35: order numbers for clamp adapter versions.

- Version DB
  Without EN10204-3.1: order no. 71020524
  With EN10204-3.1: order no. 51008165
- Version DL
  Without EN10204-3.1: order no. 71020525
  With EN10204-3.1: order no. 51008166
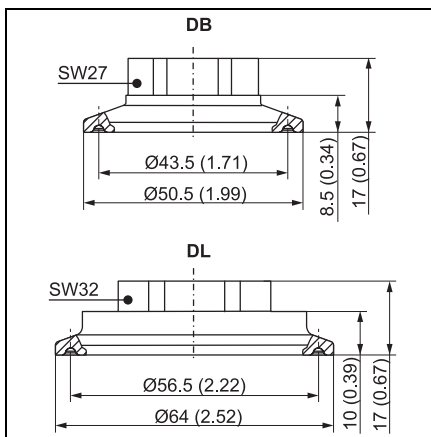
P01-PTx3xxxx-06-xx-xx-en-009

DTT35: order numbers for hygiene adapter versions.

- Version LB: order no. 51008170
- Version LL: order no. 51008171
- Version HL: order no. 51007718
- Version PG
  With EN10204–3.1: order no. 71007023
  Coupling nut: order no. 71007021
- Version PH
  Without EN10204–3.1: order no. 71020526
  With EN10204–3.1: order no. 51008167
  Coupling nut: order no. 51009524
- Version PL
  Without EN10204–3.1: order no. 71020528
  With EN10204–3.1: order no. 51008169
  Coupling nut: order no. 51009525
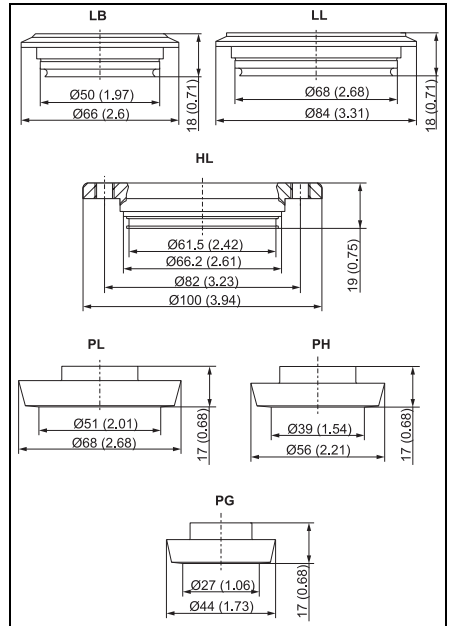
P01-PTx3xxxx-06-xx-xx-en-010

7.1.3 O–ring for adapter replacement

O–ring 15.54 x 2.62 mm (0.61 x 0.1 in), EPDM 70 Shore FDA, order no. 51008363

7.2 Welding bosses and coupling

7.2.1 Welding boss with sealing taper

Collar welding boss

Seal, moveable coupling, material of parts in contact with process: 316L, PEEK
Order no. 51004751
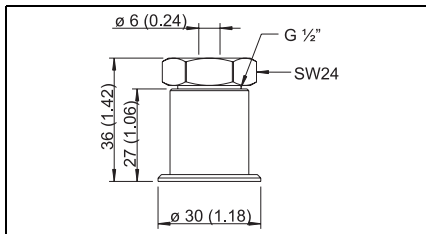
T09-TSM470AX-06-09-00-en-000

7.2.2 Collar welding boss

Material of parts in contact with process: 316L
Order no. 51004752
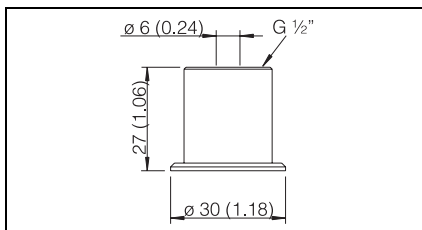
T09-TSM470BX-06-09-00-en-000

7.2.3 Coupling with sealing taper

G ½" process connection
Seal, moveable coupling, material of parts in contact with process: 316L
Order no. 51004753
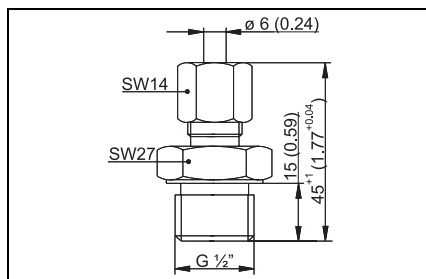
T09-TSM470AX-06-09-00-en-001

7.3   Electrical connection

7.3.1   Plug-in jack; connecting cable

M 12x1 plug-in jack; straight
Connection to M 12x1 housing connector
Material: grip body PA, coupling nut CuZn,
nickel-plated
Degree of protection (connected): IP 67
Order no. 52006263
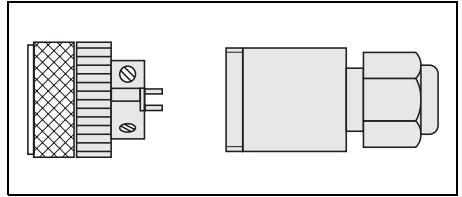
P01-PMP13xxx-00-xx-00-xx-003

M 12x1 plug-in jack; elbowed
Connection to M 12x1 housing connector
Material: grip body PBT/PA,
Coupling nut GD-Zn, nickel-plated
Degree of protection (connected): IP 67
Order no. 51006327
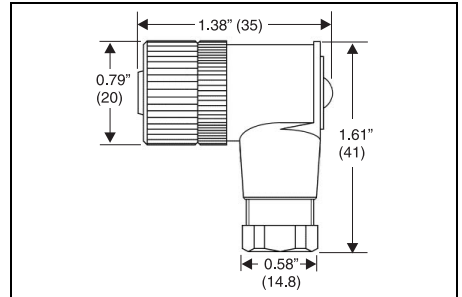
T09-TTR3xxxx-06-09-xx-en-000

PVC cable, 4 x 0.34 mm^2 with M12 socket,
elbowed, screw plug, length 5 m
(16.4 ft) degree of protection: IP 67
Order no. 51005148

Core colors:
  – 1 = BN brown
  – 2 = WH white
  – 3 = BU blue
  – 4 = BK black
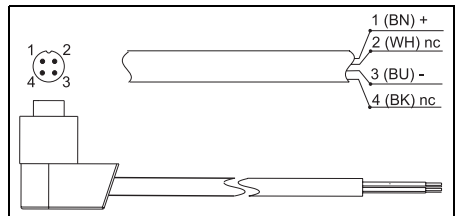
T09-TMR31xxx-00-00-xx-xx-001

PVC cable, 4 x 0.34 mm^2 with M12 socket,
with LED, elbowed, 316L screw plug,
length 5 m (16.4 ft), especially for hygiene
applications, degree of protection
(connected): IP 69K
Order no. 52018763
Display:
– gn: device operational
– ye1: switch status 1
– ye2: switch status 2
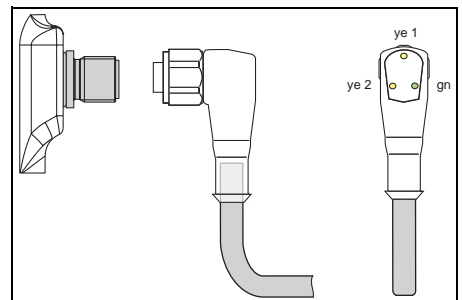
T09-TTR31xxx-00-00-xx-xx-001

7.4   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
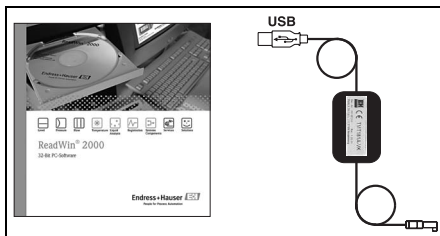
T09-TTR31xxx-00-00-xx-xx-000

8   Troubleshooting

8.1   Error messages and warning messages

If an error in the device occurs, the color of the status LED changes from green to red and the background illumination of the digital display changes from white to red. A status LED flashing red and green signals a warning. 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 underrange/overrange
E013	Error at heating resistor
E015	Error in EEPROM
E019	Power supply has undervoltage/overvoltage
E020	Error in Flash
E021	Internal memory error
E022	USB power supply
E027	Characteristic does not suit medium

Code	Explanation
W107	Simulation active
W202	Flow outside the sensor range
W209	Device starts
W210	Configuration modified
W212	Sensor signal outside the permitted range

Code	Explanation
W250	Number of switch cycles exceeded
W260	Value for High Flow (HIF) and Low Flow (LOWF) faulty
W270	Short-circuit and overload at output 1
W280	Short-circuit and overload at output 2

8.2   Repair

A repair is not planned.

8.3   Disposal

Please pay particular attention to the local disposal regulations of your country. When disposing, ensure that the materials of the device components are separated and processed accordingly.

8.4   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   Troubleshooting and internal modifications.
                Operating Instructions do not change.

8.5   Release history

Date	Device rel.	Device and software no. (Firmware/software)	Changes	Operating Instructions
02.2006	01.00.00	01.00.00	Original firmware	BA218r/09/en (71022235)

9 Technical data

9.1 Power supply

Supply voltage
- DC voltage version 18 to 30 V DC

Current consumption
- < 100 mA (open-circuit operation) at 24 V DC, max. 150 mA (open-circuit operation); with reverse polarity protection

Power supply failure
- Behavior in case of overvoltage (> 30 V)
  The device factory 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). If the supply voltage is exceeded, the properties specified are no longer guaranteed.
- 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).

9.2 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 event of overcurrent, the switching current is tested again every 0.5 s; max. capacitance load: 14 μF for max. supply voltage (without resistive load); periodical protective disconnection in event of overcurrent (f = 2 Hz) and 'Warning' display.

Signal on alarm
- Switch outputs: with safe status (switch open)

9.3 Operating conditions

- Any orientation
- Top housing section can be rotated 310°

Operating conditions: Environment
- Ambient temperature range
  −40 to +85 °C (-40 to 185 °F)
- Storage temperature
  −40 to +85 °C (-40 to 185 °F)
- Climate class
  4K4H as per DIN EN 60721-3-4

- Degree of protection
  With M 16x1.5 or ½" NPT valve plug: IP 65
  With M 12x1 connector: IP 66
- 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 guidelines of German Lloyd GL
- Electromagnetic compatibility
  Interference emission as per IEC 61326, class B equipment
  Interference immunity as per IEC 61326, Appendix A (industry) and NAMUR Recommenda-
  tion NE21; EMC influence: ≤ 0.5 %

Operating conditions: Process
- Process flow limits
  Liquids: 0 to 3.0 m/s (0 to 9.84 ft/s)
- Process temperature limits
  –20 to 85 °C (–4 to 185 °F)
- Process pressure limits
  p/T load diagram as per DIN 43763 or Dittrich/Kohler (or as per ASME/ANSI PTC 19.3
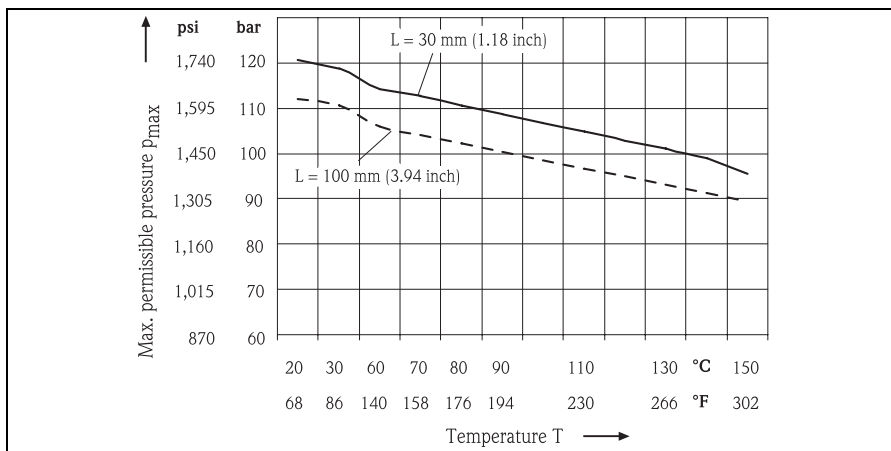
A0005432-EN

Fig. 13: p/T load diagram

L = insertion length
v_W = water fluid velocity = 3 m/s (9.84 ft/s)

10 Dangerous Goods 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 _____ **Serial number**
Geräte-/Sensortyp *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.

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

P/SF/Konta V8i

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