Operating Instructions
Thermophant T TTR31, Thermophant T TTR35

Temperature switch

Endress+Hauser

People for Process Automation

Table of contents

1 About this document

1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

1.2 Symbols

1.2.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠ CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Electrical symbols

Symbol	Meaning
⎓	Direct current
∼	Alternating current
⏦	Direct current and alternating current
⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⏛	**Potential equalization connection (PE: Protective earth)** Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: • Interior ground terminal: potential equalization connection is connected to the supply network. • Exterior ground terminal: device is connected to the plant grounding system.

1.2.3   Symbols for certain types of information

Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓ ✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.
🛈	**Tip** Indicates additional information.
📖	Reference to documentation
📄	Reference to page
🖼	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3.…	Series of steps
↳	Result of a step
❓	Help in the event of a problem
👁	Visual inspection

1.2.4   Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,…	Item numbers	1., 2., 3.…	Series of steps
A, B, C, …	Views	A-A, B-B, C-C, …	Sections
⚠EX	Hazardous area	⚠EX (crossed out)	Safe area (non-hazardous area)

1.3   Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the product configuration:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid** This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	**Quick guide to obtaining the first measured value** The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Reference** The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: From product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for parameters** The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions. The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.

1.4   Change history

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

XX	• Change to main version • No longer compatible • The device and Operating Instructions change
YY	• Change to functionality and operation • Compatible • No changes to the Operating Instructions
ZZ	• Fixes and internal changes • No changes to the Operating Instructions

1.4.1   Software history

Date	Software version	Software modifications	Documentation	Material number
09.2018	01.02	-	BA00229R	71415668
08.2016	01.02	-	BA00229R	71335970
04.2014	01.02	-	BA00229R	71252257
02.2006	01.02	-	BA00229R	72098141
02.2006	01.02	-	BA00229R	71025402
02.2006	01.02.01	Parameter functional safety for the optional analog output is not applicable	BA00229R	71025402
02.2005	01.02.00	Internal	BA00201R	51009832
12.2004	01.01.00	New analog electronics	BA00201R	51009832
06.2004	01.00.00	Original firmware	KA00174R	51008031

2   Basic safety instructions

2.1   Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
▶ Are authorized by the plant owner/operator.

- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:
- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2   Intended use

The device is a temperature switch for monitoring, displaying and controlling process temperatures. Use the device for these purposes only.

The manufacturer is not liable for harm caused by improper or unintended use.

2.3   Workplace safety

For work on and with the device:
- ▶ Wear the required personal protective equipment according to federal/national regulations.

2.4   Operational safety

The measuring system meets the general safety requirements according to EN 61010-1 and the EMC requirements according to IEC/EN 61326 in addition to NAMUR recommendations NE 21, NE 43 and NE 53.

- • Functional safety:
  The device has been developed according to the IEC 61508 and IEC 61511-1 (FDIS) standards. The device version with a PNP switch output and additional analog output is fitted with mechanisms for error detection and prevention within the electronics and software.
- • Hazardous area:
  The device is not approved for use in hazardous areas.

Risk of injury!
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories from the manufacturer.

2.5   Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

2.6   IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3   Product description

The device is a temperature switch for monitoring, displaying and controlling the temperature measured variable in industrial or hygienic processes. The process connection can be configured according to the process type.

4   Incoming acceptance and product identification

4.1   Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
    ↳ Report all damage immediately to the manufacturer.
       Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

The following options are available for identification of the device:
- Nameplate specifications
- Enter the serial number from the nameplate into *Device Viewer*
  (www.endress.com/deviceviewer): all the information about the device and an overview of
  the technical documentation supplied with the device are displayed.
- Enter the serial number from the nameplate into the *Endress+Hauser Operations app* or
  scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations
  app*: all the information about the device and the technical documentation pertaining to the
  device is displayed.

4.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)
- Technical values such as supply voltage, current consumption, ambient temperature,
  communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

▶ Compare the information on the nameplate with the order.

4.2.2 Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Wetzer GmbH + Co. KG
Address of manufacturer:	Obere Wank 1, D-87484 Nesselwang or www.endress.com

4.3 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the
relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

5   Installation

5.1   Installation requirements

5.2   Installing the device

NOTICE

Damage to the device. The top housing section can be rotated by 310°.
▶ Do not twist the device into the process connection thread at the housing.
▶ Always install the device at the wrench flats provided.
▶ Always use a suitable open-ended wrench for this purpose.

Make sure self-draining in the process is guaranteed. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.
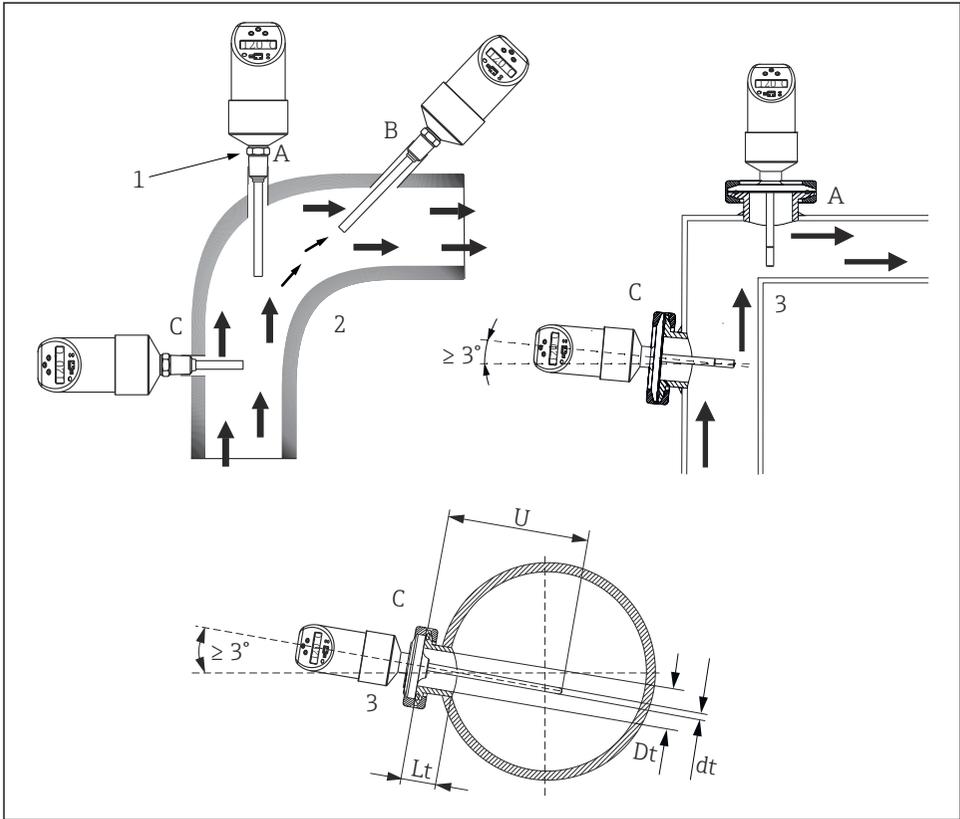
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⊡ *1   Installation options for temperature monitoring in pipelines*

1   Hexagonal screw of process connection
2   Device for use in industrial processes
3   Device for use in hygienic processes
A   Installation on elbows, against the direction of flow
B   Installation in smaller pipes, inclined against the direction of flow. Installation of hygiene version at a
*   min. angle of 3° to ensure self-draining*
C   Installation perpendicular to the direction of flow

5.3   Hygiene-compliant installation

⚠ CAUTION

**In the event of a defective sealing ring (O-ring) or seal, perform the following steps:**

▶ Remove the device.
▶ Clean the thread and the O-ring joint/sealing surface.
▶ Replace the sealing ring and the seal.
▶ Perform process cleaning after installation.

🛈 Ensure compliance with the requirements of the EHEDG and the 3-A Sanitary Standard.

Installation instruction EHEDG/cleanability: $Lt \leq (Dt\text{-}dt)$

Installation instruction 3-A/cleanability: $Lt \leq 2(Dt\text{-}dt)$
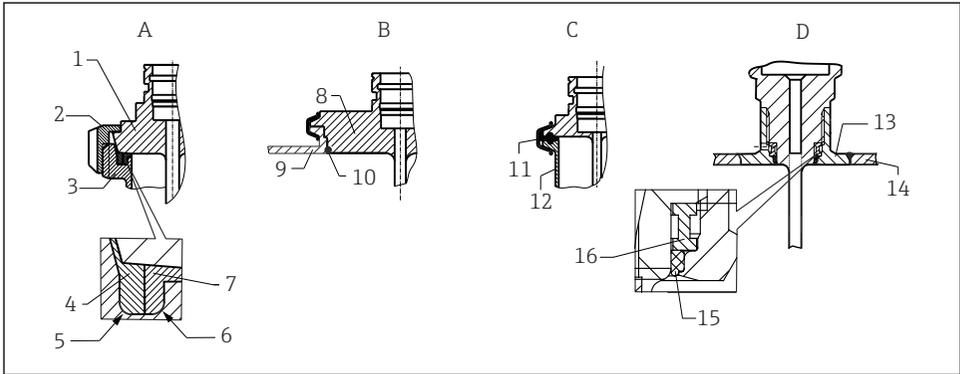
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⊠ *2*   *Detailed installation instructions for hygiene-compliant installation*

A   *Dairy fitting according to DIN 11851, only in conjunction with EHEDG-certified and self-centering sealing ring*
1   *Sensor with dairy fitting*
2   *Groove slip-on nut*
3   *Counterpart connection*
4   *Centering ring*
5   *R0.4*
6   *R0.4*
7   *Sealing ring*
B   *Varivent® process connection for VARINLINE® housing*
8   *Sensor with Varivent connection*
9   *Counterpart connection*
10   *O-ring*
C   *Clamp according to DIN 32676, DN25-40*
11   *Molded seal*
12   *Counterpart connection*
D   *Liquiphant M G1" process connection, horizontal installation*
13   *Weld-in adapter*
14   *Vessel wall*
15   *O-ring*
16   *Thrust collar*

For welded connections, perform welding work on the process side as follows:

1. Ensure the surface is honed and mechanically polished, Ra ≤0.76 µm (30 µin).
2. Use suitable welding material.
3. Avoid crevices, folds and gaps.
4. Flush-weld or weld with welding radius ≥3.2 mm (0.13 in).

Welding work has been carried out properly.

To maintain cleanability, observe the following when installing the thermometer:

1. The installed sensor is suitable for CIP (cleaning in place). Cleaning is carried out in combination with piping or tank. For tank installation, use process connection nozzles to ensure the cleaning assembly directly sprays this area to clean it effectively.

2. The Varivent® connections enable flush-mounted installation.

Cleanability is retained after installation.

5.4   Post-installation check

❑	Is the device undamaged (visual inspection)?
❑	Is the device correctly secured?
❑	Does the device match the measuring point specifications (ambient temperature, measuring range)?

# 6   Electrical connection

6.1   Connecting requirements

6.1.1   DC voltage version with M12x1 connector

⚠ CAUTION

Observe the following to avoid damaging the analog input of a programmable logic controller (PLC):

▶ Do not connect the active PNP switch output of the device to the 4 to 20 mA input of a PLC.

ℹ **Hygiene version:** According to the 3-A Sanitary Standard and EHEDG, electrical connecting cables must be smooth, corrosion-resistant and easy to clean.
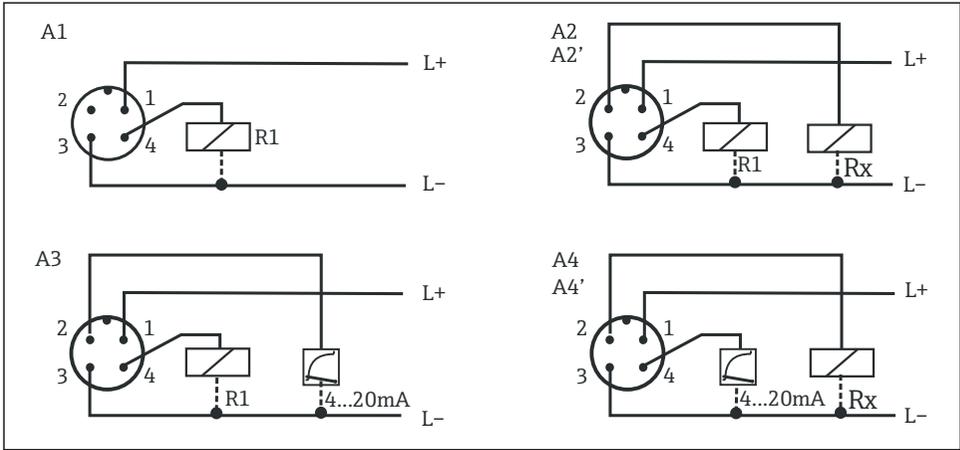
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🔲 *3   Pin assignment on M12x1 connector*

A1   1x PNP switch output
A2   2 x PNP switch output R1 and m (R2)
A2'   2x PNP switch output R1 and m (diagnostics/NC contact for "DESINA" setting)
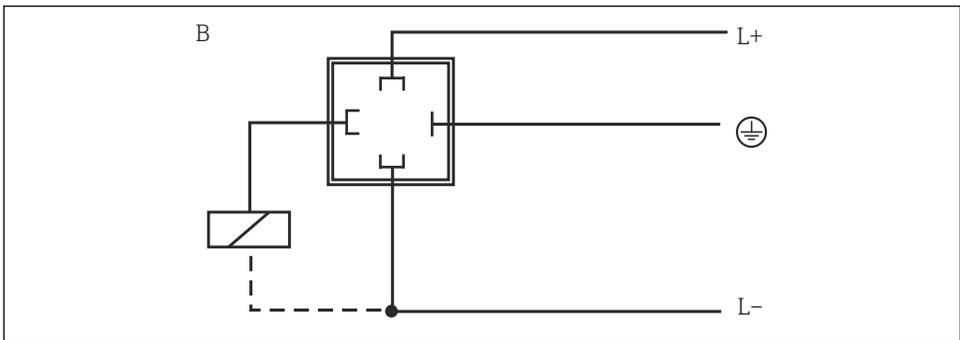*A3   1x PNP switch output and 1x analog output (4 to 20 mA)*
A4   1x analog output (4 to 20 mA) and 1x PNP switch output m (R2)
*A4'   1x analog output (4 to 20 mA) and 1x PNP switch output m (diagnostics/NC contact for "DESINA"
       setting)*

R2 = diagnostics/NC contact

6.2   DC voltage version with valve connector

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🔲 *4   Device with M16x1.5 valve connector or NPT ½"*

B   1x PNP switch output

6.3   Post-connection check

|	
❑	Are the device and cable undamaged (visual check)?
❑	Do the mounted cables have suitable strain relief?
❑	Does the supply voltage match the information on the nameplate?

7   Operation method

7.1   Local operation

NOTICE

Damage to the device.

▶ Do not operate the three device keys with a pointed object.

ℹ️ The device is operated via three keys. The digital display and the light emitting diodes (LED) assist navigation through the operating menu.
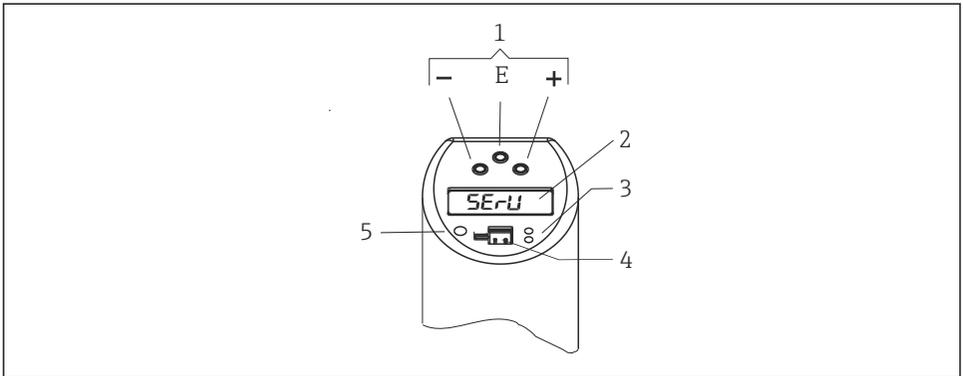
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⊡ *5   Position of the operating elements and possibilities for display*

1   Operating keys
2   Digital display: illuminated white (= ok); red (= alarm/fault)
3   Yellow LED for switching states: LED on = switch closed; LED off = switch open
4   Communication jack for PC configuration
5   LED for status display: green = OK; red = error/fault; flashing red/green = warning

### 7.1.1 Navigation in the operating menu
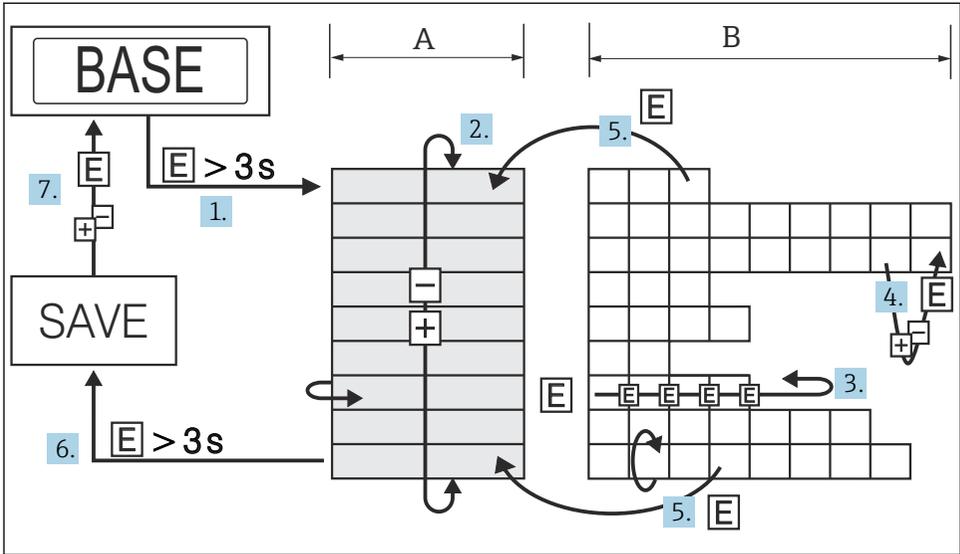
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⊠ 6   *Navigation in the operating menu*

A   Function group selection
B   Function selection

1.   Enter the operating menu: press key E for longer than 3 s.

2.   Select the "Function group" with the + or − key.

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

4.   If software locking is enabled, it must be disabled before making entries or changes.
     Enter and change the parameters with the + or − key.

5.   Press the E key to return to "Function".

6.   Press the E repeatedly to return to "Function group" until the relevant function group is
     reached.

7.   To return to the measuring position (Home), press the E key for longer than 3 s.

8.   To display the prompt to save data (press + or − to select the option "YES" or "NO"),
     confirm with key E.

9.   When prompted to save the data, select "YES" or "NO" using the + or − keys. Press key E
     to confirm.

ℹ️   If "YES" is selected when asked to save the data, changes are made to the parameter
     settings.

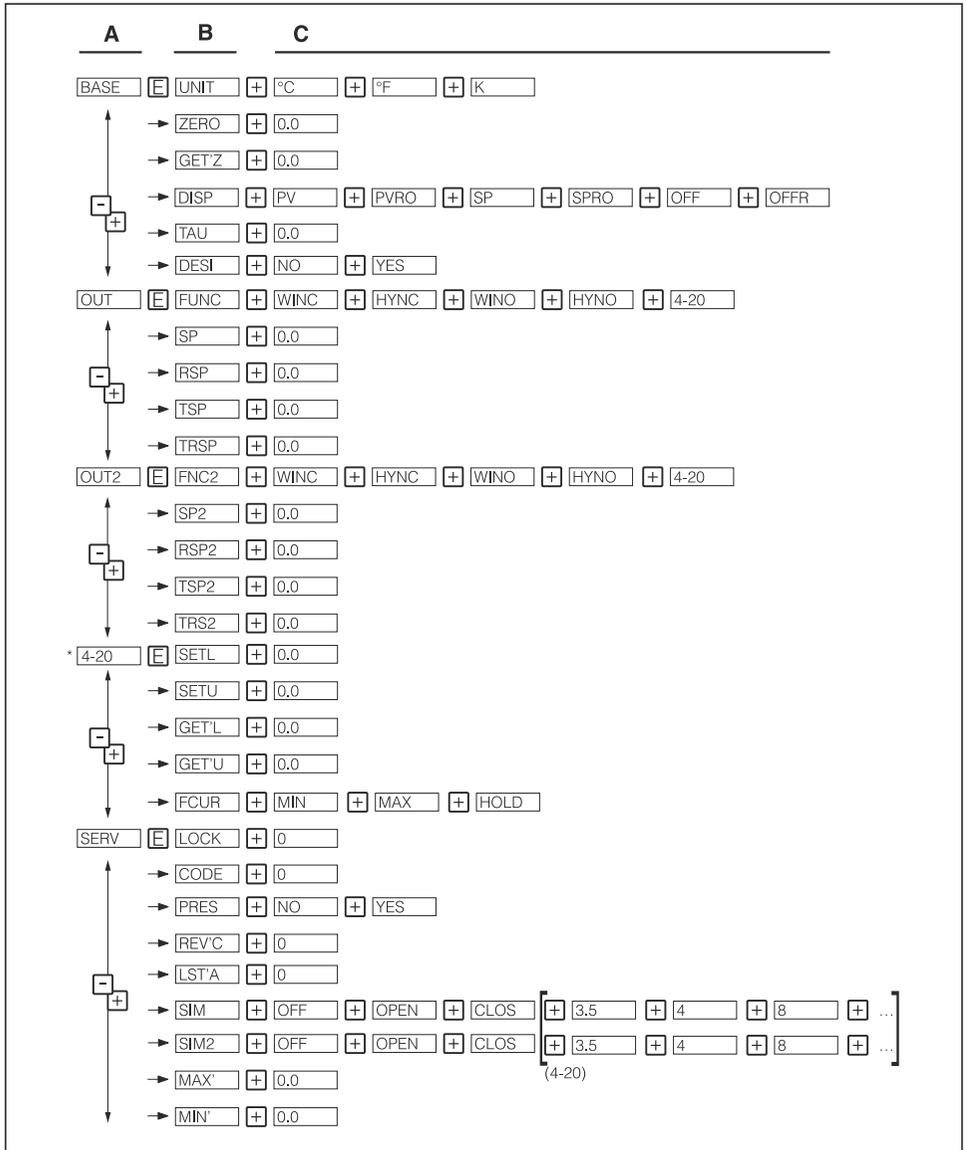## 7.1.2   Structure of the operating menu for 1x or 2x switch output
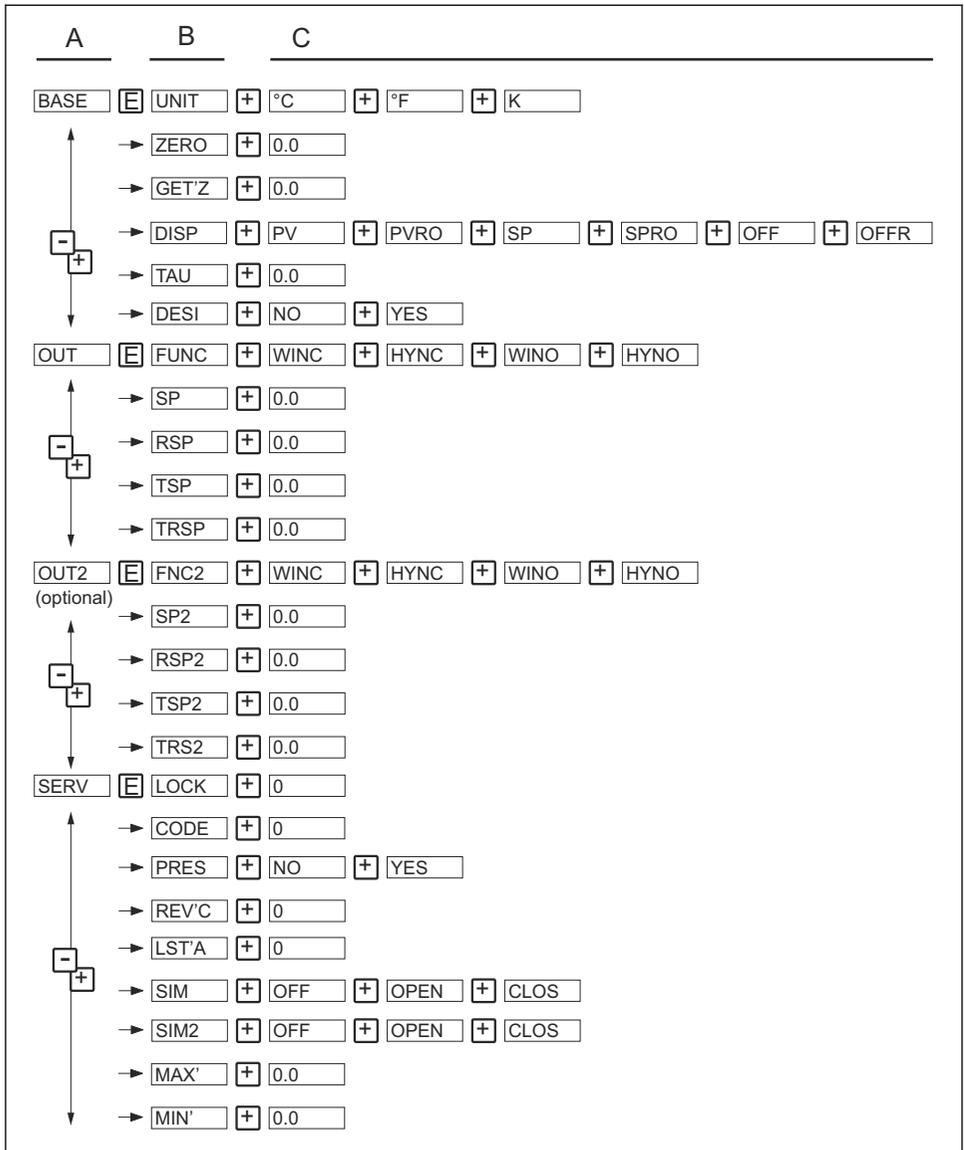
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⊠ *7   Operating menu: A function groups, B functions, C settings*

7.1.3   Structure of the operating menu for 1x switch output and 1x analog output4 to 20 mA

For devices with an analog output, both output 1 and output 2 can be configured as an analog output. It is also possible to configure output 1 and output 2 as a switch output.

A **B** **C**

BASE — E — UNIT — + °C — + °F — + K

ZERO — + 0.0

GET'Z — + 0.0

DISP — + PV — + PVRO — + SP — + SPRO — + OFF — + OFFR

TAU — + 0.0

DESI — + NO — + YES

OUT — E — FUNC — + WINC — + HYNC — + WINO — + HYNO — + 4-20

SP — + 0.0

RSP — + 0.0

TSP — + 0.0

TRSP — + 0.0

OUT2 — E — FNC2 — + WINC — + HYNC — + WINO — + HYNO — + 4-20

SP2 — + 0.0

RSP2 — + 0.0

TSP2 — + 0.0

TRS2 — + 0.0

* 4-20 — E — SETL — + 0.0

SETU — + 0.0

GET'L — + 0.0

GET'U — + 0.0

FCUR — + MIN — + MAX — + HOLD

SERV — E — LOCK — + 0

CODE — + 0

PRES — + NO — + YES

REV'C — + 0

LST'A — + 0

SIM — + OFF — + OPEN — + CLOS — + 3.5 — + 4 — + 8 — + …

SIM2 — + OFF — + OPEN — + CLOS — + 3.5 — + 4 — + 8 — + …

(4-20)

MAX' — + 0.0

MIN' — + 0.0

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🔲 *8* *Operating menu: A function groups, B functions, C settings*

ℹ The function group 4-20 is available only if the 4 to 20 mAanalog output (4-20) is selected under FUNC or FNC2 in function group OUT or OUT2.

7.1.4   Basic settings

Function group	Function		Settings	Description
BASE	UNIT	Technical unit	℃ ℉ K	Select unit on display: ℃, ℉, K factory setting: **℃**
	ZERO	Zero point configuration	**0.0**	Position adjustment: Within ±10 K of the upper sensor limit
	GETZ	Zero point adoption	0.0	No settings possible (not available in the PC software)
	DISP	Display	**PV** **PVR0** **SP** **SPRO** **OFF** **OFFR**	PV: Display measured value PVRO: Display of measured value rotated by 180˚ SP: Display set switch point SPRO: Display of set switch point rotated by 180˚ OFF: Display off OFFR: Display off rotated by 180˚ Factory setting: **current measured value (PV)**
	TAU	Damping: display value, output signal	0.0	Damping of measured value or display value and output: 0 (no damping) or 9 to 40 s (in increments of 1 s) Factory setting: **0 s**
BASE	DESI	DESINA	**NO** **YES**	The PIN assignment of the M12 connector is in accordance with the guidelines of DESINA. Factory setting: **NO** ℹ️ DESINA can be selected only if output 1 and 2 are selected.

7.1.5   Output setting - 1x or 2x switch output

- **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 switchback point RSP.
- **Window function**
  The window function allows a process temperature range to be monitored.
- **NO contact or NC contact**
  This switch function is freely selectable.

- **Delay times for switch point SP and switchback point RSP can be configured in increments of 1 s.**
  This makes it possible to filter out undesired temperature peaks of short duration or of high frequency.
- **Factory setting**
  Switch point SP1: 45 ℃ (113 ℉); switchback point RSP1: 44.5 ℃ (112.1 ℉)
  Switch point SP2: 55 ℃ (131 ℉); switchback point RSP2: 54.5 ℃ (130.1 ℉)
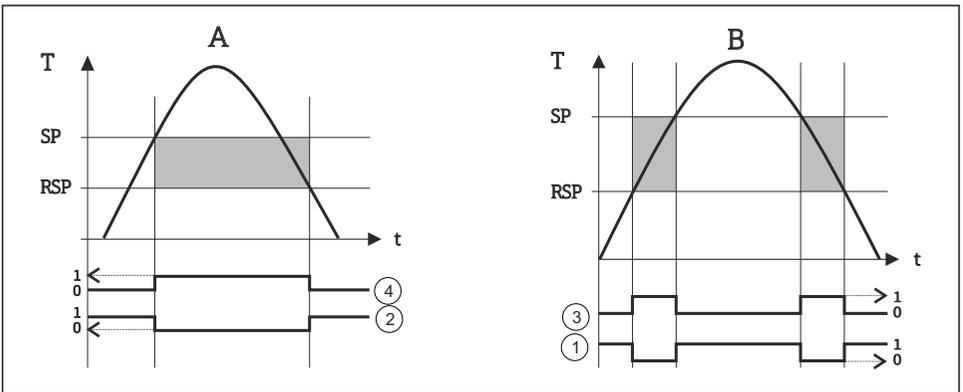- **Range of adjustment**
  LRL = Lower Range Limit
  URL = Upper Range Limit
  LRV = Lower Range Value
  URV = Upper Range Value

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🖾 *9   Switch point functions*

A   Hysteresis function
B   Window function
1   Window - NC contact
2   Hysteresis - NC contact
3   Window - NO contact
4   Hysteresis - NO contact
SP   Switch point
RSP Switchback point

Function group	Function		Settings	Description
OUT Output 1 **OUT2** Output 2, optional	**FUNC FNC2**	Switching characteristics	**WINC HYNC WINO HYNO**	WINC: Window/NC contact HYNC: Hysteresis/NC contact WINO: Window/NO contact HYNO: Hysteresis/NO contact Factory setting: **HYNO**
	SP SP2	Switch point value	**0.0**	Switch point −49.5 to 150 ℃ (−57.1 to 302 ℉) in increments of 0.1 K
	RSP RSP2	Switchback point value	**0.0**	Switchback point −50 to 149 ℃ (−58 to 300 ℉) in increments of 0.1 K
OUT Output 1 **OUT2** Output 2, optional	**TSP TSP2**	Switch point delay	**0.0**	Delay time 0 to 99 s in increments of 0.1 s Factory setting: **0 s**
	TRSP TRSP2	Switchback point delay	**0.0**	Delay time 0 to 99 s in increments of 0.1 s Factory setting: **0 s**
Minimum distance between SP and RSP: 0.5 K URL				

7.1.6   Setting for output - 1x switch output and 1x analog output 4 to 20 mA

Function group	Function		Settings	Description
OUT Output 1 **OUT2** Output 2	**FUNC FNC2**	Switching characteristics	**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 Factory setting: **HYNO**
	SP SP2	Switch point value	**0.0**	Switch point −49.5 to 150 ℃ (−57.1 to 302 ℉) in increments of 0.1 K
	RSP RSP2	Switchback point value	**0.0**	Switchback point −50 to 149 ℃ (−58 to 300 ℉) in increments of 0.1 K
	TSP TSP2	Switch point delay	**0.0**	Delay time 0 to 99 s in increments of 0.1 s Factory setting: **0 s**
OUT Output 1 **OUT2** Output 2	**TRSP TRSP2**	Switchback point delay	**0.0**	Delay time 0 to 99 s in increments of 0.1 s Factory setting: **0 s**
Minimum distance between SP and RSP: 0.5 K URL				

| Function group	Function		Settings	Description
4-20 Analog output	**SETL**	Value for 4 mA (LRV)	**0.0**	−50 to 130 ℃ (−58 to 266 ℉) Lower range value in increments of 0.1 K Factory setting: **0.0 ℃ (32 ℉)**
	SETU	Value for 20 mA (URV)	**0.0**	−30 to 150 ℃ (−22 to 302 ℉) Upper range value in increments of 0.1 K Factory setting: **150 ℃ (302 ℉)**
	GETL	Temperature applied for 4 mA (LRV)	**0.0**	Accept temperature value as lower range value (not via PC software)
	GETU	Temperature applied for 20 mA (URV)	**0.0**	Accept temperature value as upper range value (not via PC software)
	FCUR	Fault current	**MIN** **MAX** **HOLD**	Current value in the event of an error: MIN = ≤ 3.6 mA MAX = ≥ 21.0 mA HOLD = last current value Factory setting: **MAX**
Minimum distance between SETL and SETU: 20 K				

The function group 4-20 is available only if the 4 to 20 mA analog output (4-20) is selected under FUNC or FNC2 in function group OUT or OUT2.

7.1.7 Setting the service functions

Function group	Function		Settings	Description
SERV Service functions	**LOCK**	Locking code	**0**	Enter the locking code to enable the device.
	CODE	Change locking code	**0**	Freely selectable numerical code 1 to 9999. 0 = no locking; A locking code that has already been assigned can only be changed by first entering the old code to enable the device.
	PRES	Reset	**NO** **YES**	Resets 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 is available)	Simulation Output 1 or 2	**OFF** **OPEN** **CLOS** **3.5** (if analog output is 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 max. measured process value
	MIN`	Min. indicator	**0.0**	Display min. measured process value

7.2   Access to the operating menu via the operating tool

The device can be configured using ReadWin 2000 or FieldCare configuration software. This requires a configuration kit (e.g. TXU10-AA, FXA291) as a connection between the USB port of the PC and the device.
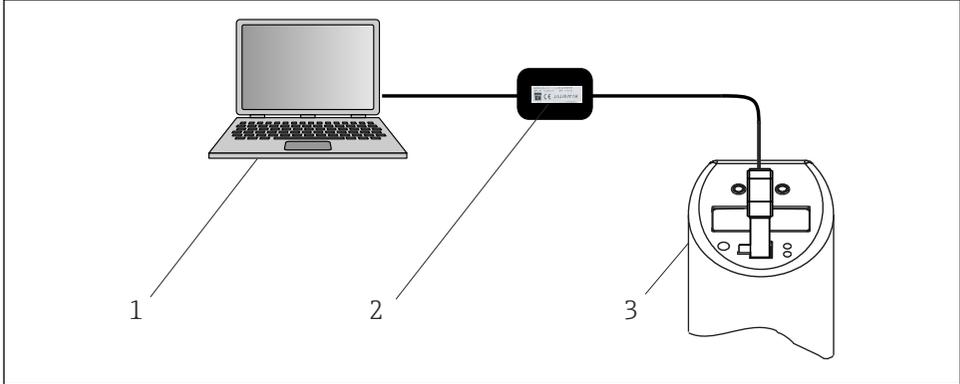
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⊞ 10   Operation with PC

1   PC with configuration software
2   Configuration kit with USB port
3   Temperature switch

7.2.1   Additional operating options

In addition to the operating options listed in the previous "Local operation" section, further information about the temperature switch is available via the configuration software:

Function group	Description
SERV	Number of switch changes, output 1
	Number of switch changes, output 2
	Device status
INFO	Tagging, 18-digit
	Order code
	Device serial number
	Sensor serial number
	Electronics serial number
	Displays overall version
	Hardware version
	Software version

7.2.2 Notes on operating with Readwin 2000

Further information on the ReadWin 2000 configuration software is available in the Operating Instructions (BA137R/09/en), which can be found on the CD-ROM of the configuration software..

7.2.3 Notes on operation with FieldCare

FieldCare is a universal configuration and service software based on FDT/DTM technology.

- ▪ To configure the device with FieldCare, the "PCP (ReadWin) Communications DTM" and the device DTM for the Thermophant are required.
- ▪ All devices with software version 1.01.00 or higher can be configured with FieldCare.
- ▪ This device supports offline configuration and upload/download of parameters. Online configuration of the device is not supported.

Detailed information on FieldCare can be found in the associated Operating Instructions (BA027S/c4) or at www.endress.com.

8 Diagnostics and troubleshooting

8.1 General troubleshooting

If a fault occurs in the device, the color of the status LED changes from green to red and the lighting of the digital display from white to red. A flashing red/green status LED signals a warning. The display shows:
- ▪ An E-code in the event of faults
  The measured value is uncertain if a fault occurs.
- ▪ A W-code in the event of warnings
  The measured value is reliable if warnings occur.

Code	Explanation	Remedy
E011	Device configuration is incorrect	Perform device reset
E012	Measurement error or medium temperature outside the measurable range	Check the medium temperature; return the device to the manufacturer if necessary
E019	Power supply out of specification	Check operating voltage and set to a valid value
E015	Memory error	Return device to manufacturer
E020		
E021		
E022	Power is only supplied to the device via the communication interface (measurement is disabled)	Check operating voltage
E025	Switching contact 1 is not open even though it should be	Switching contact is defective, return to manufacturer

Code	Explanation	Remedy
E026	Switching contact 2 is not open even though it should be	Switching contact is defective, return to manufacturer
E040	VCC (controller voltage) is outside the operating range	Return device to manufacturer
E042	Output current can no longer be generated (only for 4 to 20 mA output, e.g. load too high at analog output or open analog output)	Check load; switch off analog output
E044	Output current drifts too much (± 0.5 mA)	Return device to manufacturer

Code	Explanation	Remedy
W107	Simulation active	Switch off output simulation for output 1 and 2
W202	Measured value is outside the sensor range	Operate device in the specified measuring range
W209	Device starting up	
W210	Configuration changed (warning code is displayed for approx. 15 s	
W212	Sensor signal is outside the permitted range	Operate device in the specified measuring range
W250	Number of maximum switching cycles exceeded	Replace the device
W270	Short-circuit and overload at output 1	Check output circuit Increase the load resistance at switch output 1
W280	Short-circuit and overload at output 2	Check output circuit Increase the load resistance at switch output 2

9 Maintenance

⚠ CAUTION

Damage to the device.
▶ Ensure that 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 to remove the device.

Buildup on the sensor negatively affects measurement accuracy.

▶ Check the sensor for buildup at regular intervals.

9.1 Cleaning

9.1.1 Cleaning of surfaces not in contact with the medium

- Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
- Do not use any sharp objects or aggressive cleaning agents that corrode the surfaces (e.g. displays, housing) and seals.
- Do not use high-pressure steam.
- Observe the degree of protection of the device.

The cleaning agent used must be compatible with the materials of the device configuration. Do not use cleaning agents with concentrated mineral acids, bases or organic solvents.

9.1.2 Cleaning of surfaces in contact with the medium

Note the following for cleaning and sterilization in place (CIP/SIP):
- Use only cleaning agents to which the materials in contact with the medium are sufficiently resistant.
- Observe the permitted maximum medium temperature.

10 Repair

Repairs are not envisaged for the device.

10.1 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: https://www.endress.com
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

10.2 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

11 Accessories

11.1 Device-specific accessories
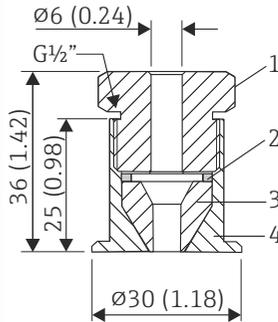
11.1.1 Rubber cover flap for interface cable
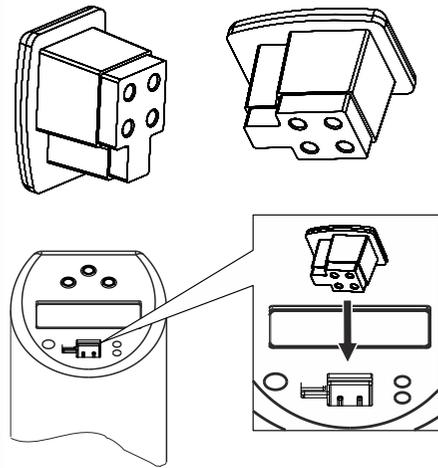
Rubber cover flap for interface cable	
	A0060952

11.1.2 Welding boss with sealing taper

| • Collar welding boss movable with sealing taper, washer and pressure screw G½"
 • Material of parts in contact with the process: 316L, PEEK
 • Max. process pressure 10 bar (145 psi) | A0048610

 ⊡ *11   Dimensions in mm (in)*

 1   Pressure screw, 303/304
 2   Washer, 303/304
 3   Sealing taper, PEEK
 4   Collar welding boss, 316L |

11.1.3 Collar welding boss

- Collar welding boss movable with sealing taper and washer
- Material of parts in contact with the process: 316L, PEEK
- Max. process pressure 10 bar (145 psi)
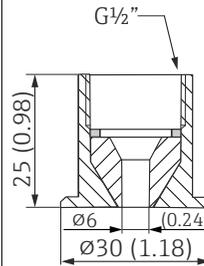
A0020710

⊡ *12   Dimensions in mm (in)*

11.1.4 Compression fitting

- Movable clamping ring, various process connections
- Material of compression fitting and parts in contact with the process: 316L
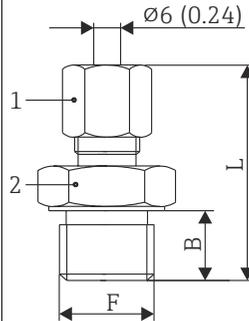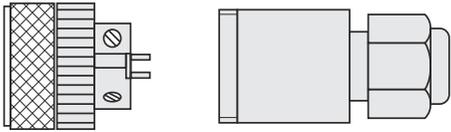

A0048609

⊡ *13   Dimensions in mm (in)*

1   AF14

Version	F in mm (in)		L in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure
TA50	G½"	AF 27	47 mm (1.85 in)	15 mm (0.6 in)	SS316 [1]	800 ℃ (1472 ℉)	40 bar at 20 ℃ (580 psi at 68 ℉)
				20 mm (0.8 in)	PTFE [2]	200 ℃ (392 ℉)	5 bar at 20 ℃ (72.5 psi at 68 ℉)
	G¾"	AF 32	63 mm (2.48 in)	20 mm (0.8 in)	SS316 [1]	800 ℃ (1472 ℉)	40 bar at 20 ℃ (580 psi at 68 ℉)

Version	F in mm (in)		L in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure
					PTFE [2]	200 ℃ (392 ℉)	5 bar at 20 ℃ (72.5 psi at 68 ℉)
	G1"	AF 41	65 mm (2.56 in)	25 mm (0.98 in)	SS316 [1]	800 ℃ (1 472 ℉)	40 bar at 20 ℃ (580 psi at 68 ℉)
					PTFE [2]	200 ℃ (392 ℉)	5 bar at 20 ℃ (72.5 psi at 68 ℉)
	NPT½"	AF 22	50 mm (1.97 in))	20 mm (0.8 in)	SS316 [1]	800 ℃ (1 472 ℉)	40 bar at 20 ℃ (580 psi at 68 ℉)
	R½"	AF 22	52 mm (2.05 in)	20 mm (0.8 in)	PTFE [2]	200 ℃ (392 ℉)	5 bar at 20 ℃ (72.5 psi at 68 ℉)
	R¾"	AF 27	52 mm (2.05 in)	20 mm (0.8 in)	PTFE [2]	200 ℃ (392 ℉)	5 bar at 20 ℃ (72.5 psi at 68 ℉)

[1]   SS316 clamping ring: can only be used once. Once released the compression fitting cannot be repositioned on the thermowell. Fully adjustable immersion length on initial installation.

[2]   PTFE/Elastosil® clamping ring: reusable; once loosened, the compression fitting can be moved up or down on the thermowell. Fully adjustable immersion length.
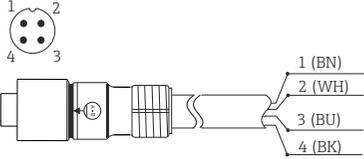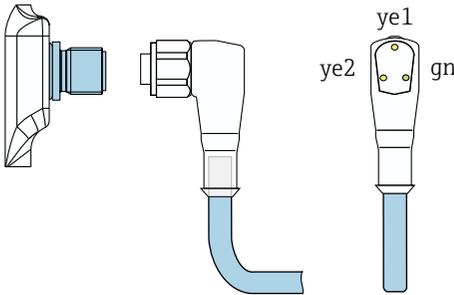
11.2   Communication-specific accessories

11.2.1   Coupling; connecting cable

Accessories	Description
• Coupling M12x1; straight • Connection to M12x1 housing connector • Materials: body PA, coupling nut CuZn, nickel-plated • Degree of protection (fully locked): IP67	A0035843

Accessories	Description
• M12x1 coupling; elbowed, for termination of connecting cable by user • Connection to M12x1 housing connector • Body materials PBT/PA • Coupling nut GD-Zn, nickel-plated • IP67 degree of protection (fully locked) • Voltage: max. 250 V • Current carrying capacity: max. 4 A • Temperature: –40 to 85 °C (–40 to 185 °F)	A0020722
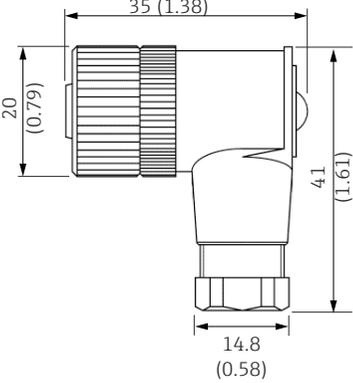
Accessories	Description
• PVC cable, 4 x 0.34 mm^2 (22 AWG) with M12x1 coupling nut made of epoxy coated zinc, straight socket contact, screw plug, 5 m (16.4 ft) • IP69K protection (optional) • Voltage: max. 250 V • Current carrying capacity: max. 4 A • Temperature: –20 to 105 °C (–4 to 221 °F) Wire colors: • 1 = BN brown • 2 = WH white • 3 = BU blue • 4 = BK black	A0020725

Accessories	Description
• PVC cable, 4 x 0.34 mm^2 with M12x1 coupling, with LED, elbowed • 316L screw plug, length 5 m (16.4 ft), specially for hygiene applications • Degree of protection (fully locked): IP69K **Display:** • gn: device is operational • ye1: switch status 1 • ye2: switch status 2 🛈 Not suitable for 4 to 20 mA analog output.	A0035844

11.2.2 Configuration kit

- Configuration kit for PC-programmable transmitters;
  Configuration software and interface cable for PC with USB port and 4-pin post connector
  Order code: **TXU10-AA**
- "Commubox FXA291" configuration kit with interface cable for PC with USB port.
  Intrinsically safe CDI interface (Endress+Hauser Common Data Interface) for transmitters
  with 4-pin post connector. Suitable configuration software is FieldCare for example.
  Order code: **FXA291**

Configuration software

The ReadWin 2000 and FieldCare 'Device Setup' configuration programs can be downloaded
free of charge directly from the Internet at the following addresses:

- www.endress.com/readwin
- www.endress.com/fieldcare

11.3 System components

RN series active barrier

Single- or two-channel active barrier for safe separation of 0/4 to -20 mA standard signal
circuits with bidirectional HART transmission. In the signal duplicator option, the input signal
is transmitted to two galvanically isolated outputs. The device has one active and one passive
current input; the outputs can be operated actively or passively.

For more information, please refer to: www.endress.com

Process indicators from the RIA product family

Easily readable process indicators with various functions: loop-powered indicators for
displaying 4-20 mA values, display of up to four HART variables, process indicators with
control units, limit value monitoring, sensor power supply, and galvanic isolation.

Universal application thanks to international hazardous area approvals, suitable for panel
mounting or field installation..

For more information, please refer to: www.endress.com

Data Manager of the RSG product family

Data Managers are flexible and powerful systems to organize process values. Up to 20
universal inputs and up to 14 digital inputs for direct connection of sensors, optionally with
HART, are available as an option. The measured process values are clearly presented on the
display and logged safely, monitored for limit values and analyzed. The values can be
forwarded via common communication protocols to higher-level systems and connected to
one another via individual plant modules.

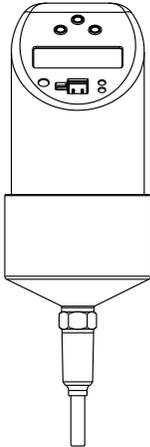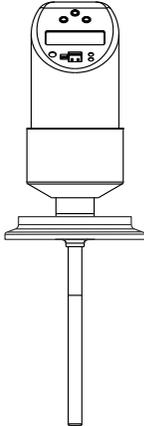For more information, please refer to: www.endress.com

12   Technical data

12.1   Function and system design

12.1.1   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 relationship between resistance and temperature is defined in the international standard IEC 60751.

12.1.2   Measuring system

Overview

Product line	Thermophant T TTR31	Thermophant T TTR35
	 A0005276	 A0023194
Sensor	Pt100 RTD	Pt100 RTD
Field of application	Measurement, monitoring and control of process temperatures in industrial processes.	Measurement, monitoring and control of process temperatures in hygienic processes.

| Product line	Thermophant T TTR31	Thermophant T TTR35

Process connection	Industry:
	• Compression fitting (sensor length ≥100 mm (3.94 in))
	• Thread:
	  • G½" and G¼"
	  • ANSI NPT¼" and NPT½"
		Hygiene:
		• Conical metal-metal G½"
		• Clamp 1" - 1½", 2", DIN 32676, DN25 to 40 Form B [1]
		• Clamp 2", DIN 32676, DN50, Form B [1]
		• Varivent F, N
		• DIN 11851
		• APV Inline

Measuring range	−50 to 150 ℃ (−58 to 302 ℉) With extension neck: −50 to 200 ℃ (−58 to 392 ℉)	−50 to 150 ℃ (−58 to 302 ℉) With extension neck: −50 to 200 ℃ (−58 to 392 ℉)

1)   DIN 32676 replaces ISO 2852.

DC voltage version (DC)

PNP switch output of electronics.

Power supply with a power supply unit.

Preferably in connection with programmable logic controllers (PLC) or for controlling a relay.
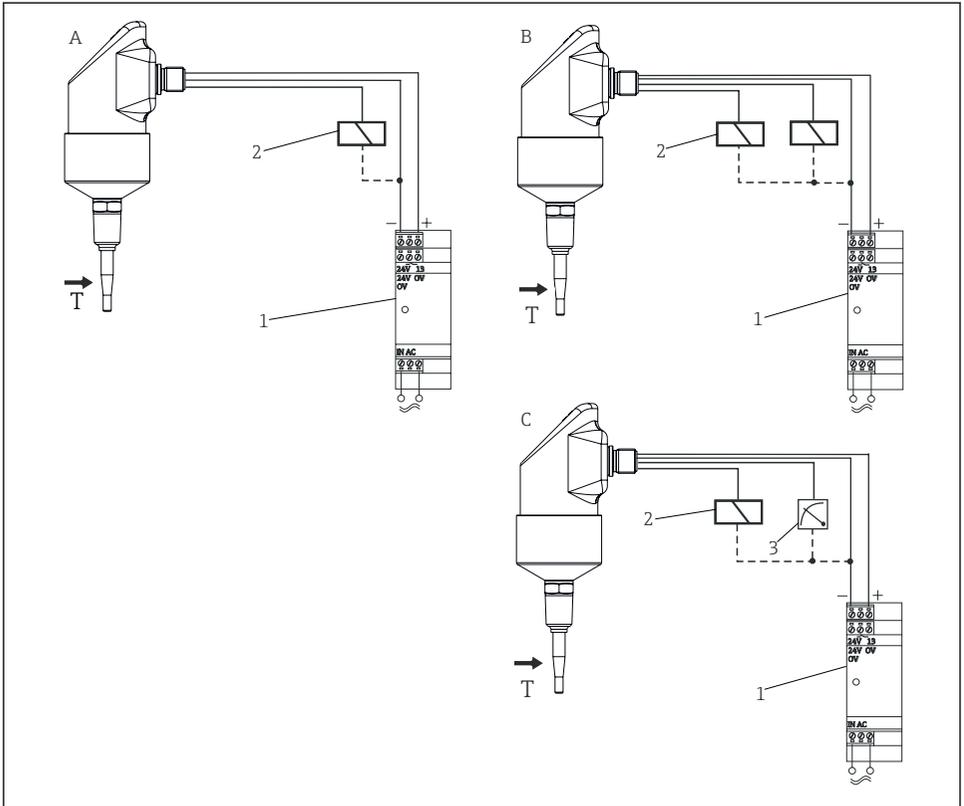
A0061051

⊞ 14   *DC voltage version (DC)*

A   1x PNP switch output
B   2x PNP switch output
C   PNP switch output with additional analog output 4 to 20 mA (active)
1   Supply unit
2   Load (programmable logic controller, process control system or relay)
3   Process indicator or data manager (at 4 to 20 mA analog output)

12.2   Input

12.2.1   Measured variable

Temperature (temperature-linear transmission behavior)

12.2.2   Measuring range

Designation	Measuring range limits	Min. measuring span
Pt100 as per IEC 60751	−50 to 150 °C (−58 to 302 °F) −50 to 200 °C (−58 to 392 °F) with extension neck	20 K (36 °F)
Sensor current: ≤0.6 mA		

12.3   Output

12.3.1   Output signal

DC voltage version (short-circuit proof version):
• 1x PNP switch output
• 2x PNP switch outputs
• PNP switch output and 4 to 20 mA output, active

12.3.2   Signal on alarm

• Analog output: ≤3.6 mA or ≥21.0 mA (if setting is ≥21.0 mA, output is ≥21.5 mA)
• Switch outputs: in safe state (switch open)

12.3.3   Load

Max. $(V_{\text{power supply}}$- 6.5 V) / 0.022 A (current output)

12.3.4   Range of adjustment

Switch output	Switch point (SP) and switchback point (RSP) in 0.1 K increments. Minimum difference between SP and RSP: 0.5 °C (0.8 °F)
Analog output (if available)	Lower range value (LRV) and upper range value (URV) can be configured as required within the sensor range. Min. measuring span 20 K (36 °F)
Damping	Can be configured as required: 0 to 40 s in increments of 0.1 s
Unit	°C, °F, K

12.3.5   Switching capacity

DC voltage version:

Switch status ON	Ia ≤ 250 mA
Switch status OFF	Ia ≤ 1 mA
Switching cycles	> 10,000,000
Voltage drop PNP	≤ 2 V
Overload protection	Switching current checked automatically: switched off in the event of overcurrent. Switching current checked again every 0.5 s. Max. capacitive load: 14 µF at max. supply voltage (without resistive load). Periodic disconnection from a protective circuit in event of overcurrent (f = 2 Hz) and "Warning" displayed.

12.3.6   Inductive load

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

12.4   Performance characteristics

The percentages in the "Performance characteristics" section refer to the nominal value of the sensor.

12.4.1   Reference operating conditions

As per DIN IEC 60770, DIN IEC 61003
T = 25 ℃ (77 ℉)
- Relative humidity 45 to 75%
- Atmospheric pressure 860 to 1060 kPa (124 to 153 psi), using water as the test medium
- Supply voltage U = 24 V_{DC}

12.4.2   Measurement error

Electronics

0.2 K

Sensor
- Tolerance class A as per IEC 60751, −50 to 200 ℃ (−58 to 392 ℉)
- Maximum measurement error in ℃ = ± 0.15 + 0.002 · |T|

|T| = Process temperature in ℃ without taking the sign into account.

Total error

Total error = electronics error + sensor error, for process temperatures:

- −50 to 75 ℃ (−58 to 167 ℉) ≤ 0.5 K
- 75 to 200 ℃ (167 to 392 ℉) ≤ 0.75 K

12.4.3   Switch point non-reproducibility

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

12.4.4   Long-term drift

≤ 0.1 K (0.18 ℉) per year under reference conditions

12.4.5   Sensor response time

Measured in accordance with IEC 60751 with 0.4 m/s (1.3 ft/s) in flowing water100 ms

t_{50}	t_{90}
< 1.0 s	< 2.0 s

12.4.6   Long-term reliability

Mean time between failure (MTBF) > 100 years

(calculated according to the "British Telecom Handbook of Reliability Data No. 5")

12.4.7   Influence of ambient temperature

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

12.4.8   Switch output response time

100 ms

12.4.9   Analog output

Measurement error	Switch point and display deviation +0.1%
Rise time t_{90}	≤200 ms
Settling time t_{99}	≤500 ms

12.5   Environment

12.5.1   Ambient temperature

−40 to 85 ℃ (−40 to 185 ℉)

12.5.2   Storage temperature

−40 to 85 ℃ (−40 to 185 ℉)

12.5.3   Operating altitude

Up to 4 000 m (13 123.36 ft) above sea level

12.5.4   Degree of protection

IP65	M16 x 1.5 or NPT ½", valve connector
IP66	M12 x 1 connector

12.5.5   Shock resistance

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

12.5.6   Vibration resistance

- 20 g as per DIN IEC 68-2-6 (10-2000 Hz)
- 4 g as per marine approval

12.5.7   Electromagnetic compatibility (EMC)

CE compliance

Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details refer to the EU Declaration of Conformity.

Maximum measurement error <1% of measuring range.

Interference immunity according to IEC/EN 61326 series, industrial requirements.

Interference emission as per IEC/EN 61326 series, Class B equipment.

12.5.8   Electrical safety

- Protection class III
- Overvoltage category II
- Pollution level 2

12.6   Process

12.6.1   Process temperature range

−50 to 150 ℃ (−58 to 302 ℉)

Device version with extension neck: −50 to 200 ℃ (−58 to 392 ℉).

Restrictions depending on process connection and ambient temperature:
- With compression fitting: no restrictions
- With process connection:

Max. ambient temperature	Max. process temperature
25 ℃ (77 ℉)	No restrictions
40 ℃ (104 ℉)	135 ℃ (275 ℉)
60 ℃ (140 ℉)	120 ℃ (248 ℉)
85 ℃ (185 ℉)	100 ℃ (212 ℉)

12.6.2   Process pressure range

Maximum permitted process pressure depending on the insertion length
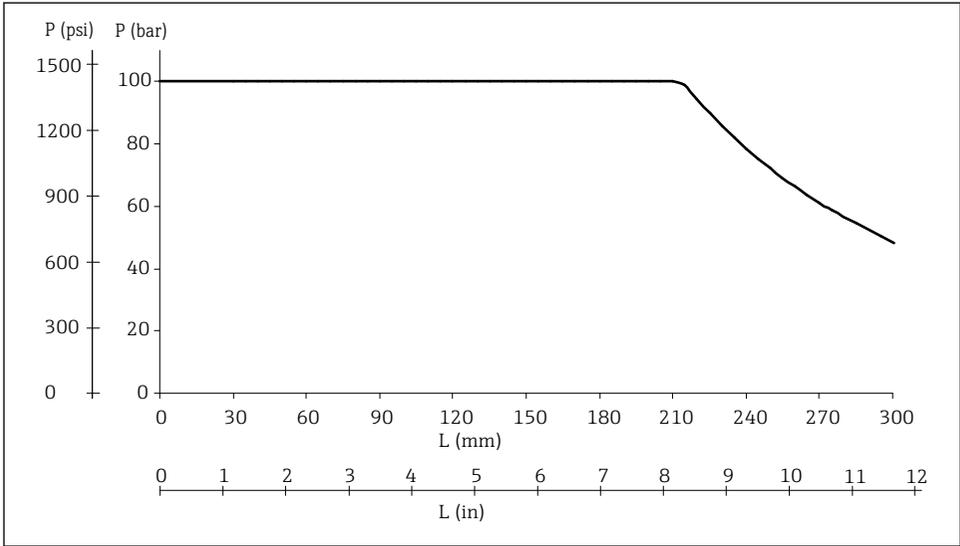
⊠ *15   Maximum permitted process pressure*

L   Insertion length
p   Process pressure

The diagram takes into consideration not only the overpressure but also the compressive load caused by flow, wherein a safety factor of 1.9 has been applied for operation with flow. Due to the increased bending stress caused by flow, the maximum permitted static operating pressure is lower in the case of longer insertion lengths.

This calculation is based on the maximum permitted flow velocity for the relevant insertion length (see diagram below).

The maximum process pressure for the conical metal-metal process connection for hygienic processes (MB option) for the device is 1.6 MPa = 16 bar (232 psi).

**Permitted flow velocity depending on the insertion length**
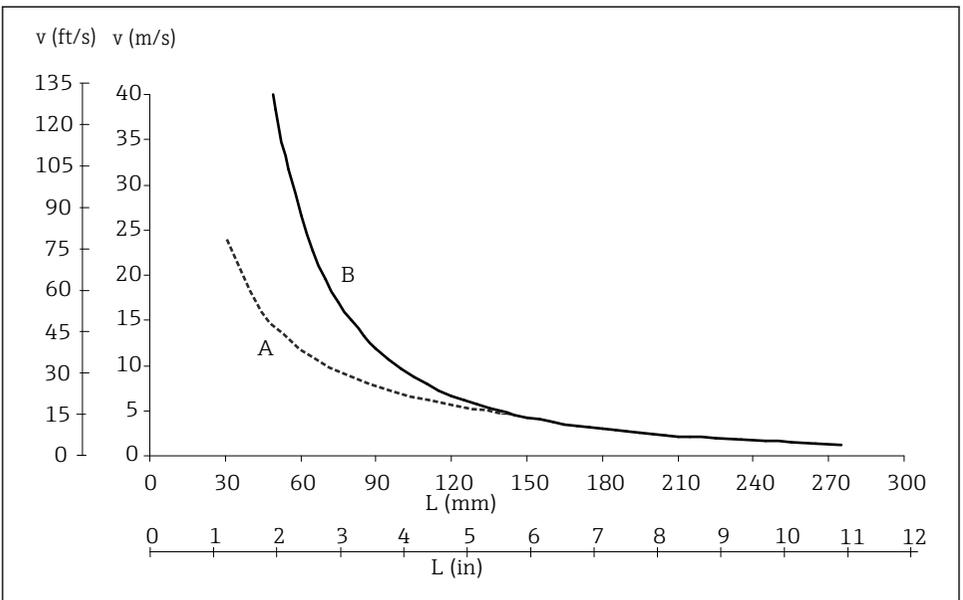
⊡ 16   *Permitted flow velocity*

A   Water
B   Air
L   Insertion length, during flow
v   Flow velocity

The permitted flow velocity is the minimum from the resonance velocity (resonance distance 80%) and the load or buckling caused by flow, which would result in the failure of the thermometer tube or the undershooting of the safety factor (1.9). The calculation was performed for the specified limit operating conditions of 200 ℃ (392 ℉) and ≤100 bar (1 450 psi) process pressure.

12.7 Mechanical construction

12.7.1 Design and dimensions
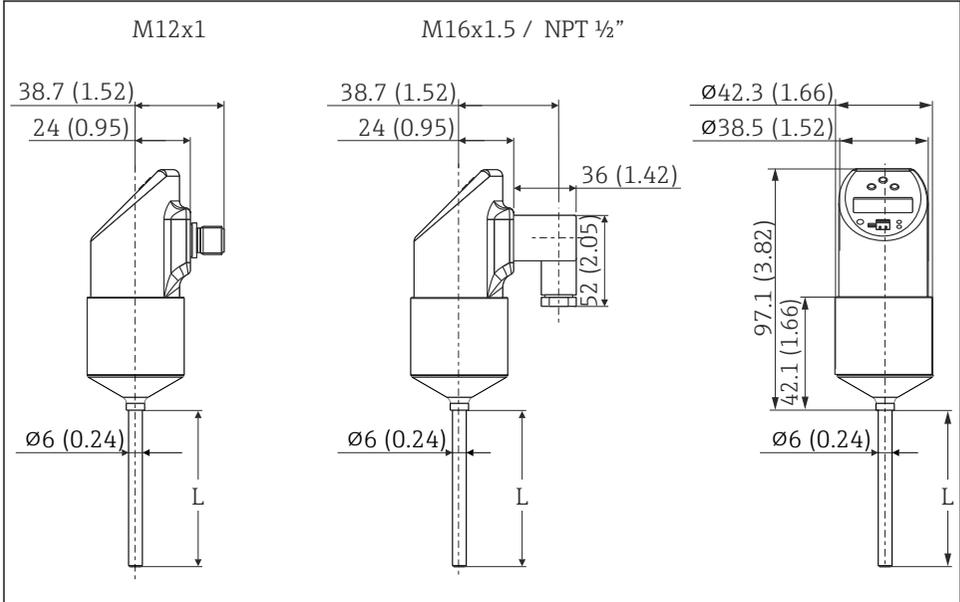
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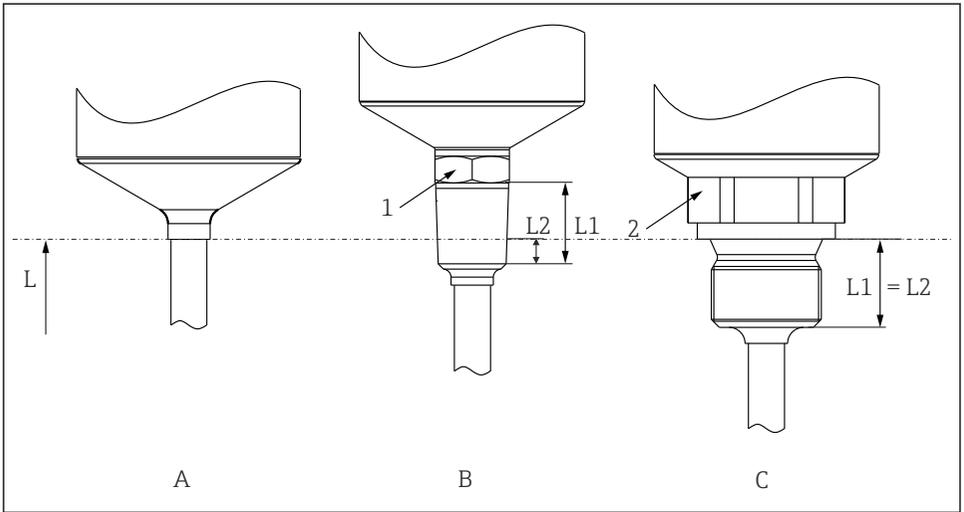🖾 *17*   *All dimensions in mm (in)*

L: Insertion length
Left: M12x1 connector as per IEC 60947-5-2
Center: Valve connector M16x1.5 or NPT ½" as per DIN 43650A/ISO 4400

12.7.2 Process connections
The following process connections can be configured for the industrial version of the device.

A0007101

⊠ *18   Process connection versions*

1   *Threaded process connection*
2   *Threaded process connection, inches, cylindrical as per ISO 228*
L   *Insertion length*
L₁   *Thread length*
L2   *Screw-in length*

Item no.	Process connection versions	Thread length L_1	Screw-in length L_2
A	Without process connection. Use of suitable welding bosses and compression fittings.	-	-
B	Threaded process connection: • ANSI NPT ¼" (1 = AF14) • ANSI NPT ½" (1 = AF27)	• 14.3 mm (0.56 in) • 19 mm (0.75 in)	• 5.8 mm (0.23 in) • 8.1 mm (0.32 in)
C	Threaded process connection, inches, cylindrical as per ISO 228: • G¼" (2 = AF14) • G½" (2 = AF27)	• 12 mm (0.47 in) • 14 mm (0.55 in)	-

The following process connections can be configured for the hygienic device version.
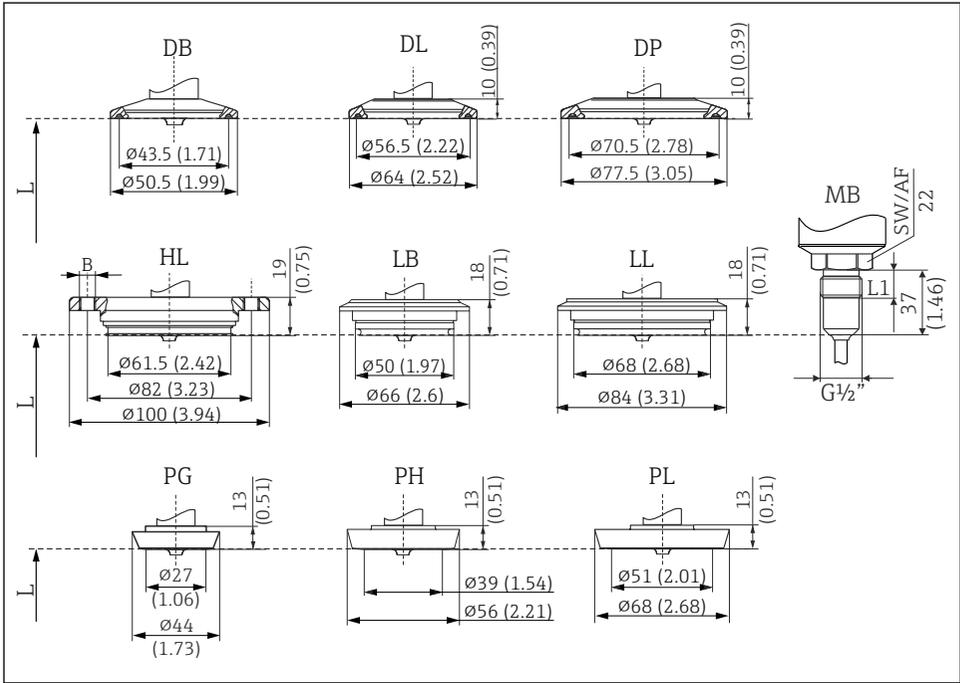
A0023235

⊠ *19   Process connection versions, all dimensions in mm (in).*

L   Insertion length L

Item no.	Process connection versions, hygiene version	Hygiene standard
DB	Clamp 1" - 1½", DN, 25 to 40DIN 32676DIN [1].	3-A marked and EHEDG certified (combined with Combifit seal).
DL	Clamp 2", DN50, DIN 32676 [1]	
DP	Clamp 2½", ISO 2852	
HL	APV Inline, DN50, PN40, 316L, B = bores 6 x Ø8.6 mm (0.34 in) + 2 x M8 thread	3-A marked and EHEDG certified
LB	Varivent [2] F DN25-32, PN 40	
LL	Varivent® [2] N DN40-162, PN 40	
MB	Metal sealing system for hygienic processes, G½" thread, thread length L1 = 14 mm (0.55 in). Suitable welding boss available as an accessory.	-
PG	DIN 11851, DN25, PN40 (including coupling nut)	3-A marked and EHEDG certified (only in combination with self-centering seal according to EHEDG position paper)

Item no.	Process connection versions, hygiene version	Hygiene standard
PH	DIN 11851, DN40, PN40 (including coupling nut)	
PL	DIN 11851, DN50, PN40 (including coupling nut)	

1) 32676 replaces ISO 2852
2) Varivent® process connections are suitable for installation in VARINLINE® housing connection flanges.

12.7.3   Weight

300 g (10.58 oz), depends on process connection and sensor length.

12.7.4   Materials

Process connection AISI 316L
- Surfaces in contact with the process in hygienic version
- Coupling nut AISI 304
- Housing AISI 316L
  O-ring between housing and sensor module: EPDM

Electrical connection
- M12 connector, exterior AISI 316L, interior polyamide (PA)
- Valve connector, polyamide (PA)
- M12 connector, exterior 316L
- Cable sheath polyurethane (PUR)
- O-ring between electrical connection and housing: FKM
- Display, polycarbonate PC-FR (Lexan®)
- Seal between display and housing: SEBS THERMOPLAST K®
- Keys: polycarbonate PC-FR (Lexan®)

12.7.5   Surface roughness

R_a ≤0.76 µm (30 µin)

12.8   Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.

2. Open the product page.

3. Select **Downloads**.

12.8.1   Hygiene standard

- EHEDG Certificate, Type EL CLASS I. EHEDG-certified/tested process connections.
- 3-A certificate authorization no. 1144, 3-A Sanitary standard 74-07. Listed process connections.
- FDA-compliant.
- All surfaces in contact with the medium are free from materials derived from bovine animals or other livestock (ADI/TSE).

12.8.2 Materials in contact with food/product (FCM)

The process contact parts (FCM) are in conformity with the following European Regulations:
- Regulation (EC) No 1935/2004, on materials and articles intended to come into contact with food, article 3, paragraph 1, article 5 and 17.
- Regulation (EC) No 2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food.
- Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food.

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