BA00235R/09/EN/19.25-00
71758960
2025-12-29

Valid as of version
01.00 (device version)

Operating Instructions
Flowphant T DTT31, Flowphant T DTT35

Flow 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
1, 2, 3, ...	Item numbers
1., 2., 3., ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
	Hazardous area
	Safe area (non-hazardous area)
	Flow direction

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
04.2014	01.00.08	-	BA00235R	71252243
01.2014	01.00.08	-	BA00235R	71243851
07.2013	01.00.08	-	BA00235R	71226086
11.2008	01.00.04	-	BA00235R	71098493
11.2008	01.00.04	-	BA00235R	71098493
11.2008	01.00.04	Calibration function: variable setting for HIF (70 to 100%) and LOWF (0 to 20%); warning message W200	BA00235R	71036990
12.2006	01.00.03	-	BA00235R	71036990
12.2006	01.00.03	Analog output version (4 to 20 mA) available	BA00235R	71036990
02.2006	01.00.00	Original firmware	BA00218R	71022232

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 flow switch for monitoring mass flow rates in industrial processes. It is designed to meet state-of-the-art safety requirements and complies with applicable standards and EC regulations. The device can, however, be a source of danger if used incorrectly or for anything other than the designated use.

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

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.

NOTICE

Hazardous area.
The device is not approved for use in hazardous areas.
- Do not use the device in the hazardous area.

Risk of injury!
- Operate the device only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for ensuring that the device is in good working order.

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 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.

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 flow switch that measures the "flow" process variable in industrial and hygienic processes using the calorimetric measuring principle. 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

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

5 Installation

5.1 Installation requirements

NOTICE

Damage to the device.

► To ensure correct monitoring, the sensor must be installed in a way that produces a fully developed flow profile.
► Stabilization sections (5x DN) must be provided in the pipe downstream from a pump, pipe elbows, internal fixtures and cross-sectional changes.

NOTICE

Damage to the device. The top housing section can be rotated by 310°.

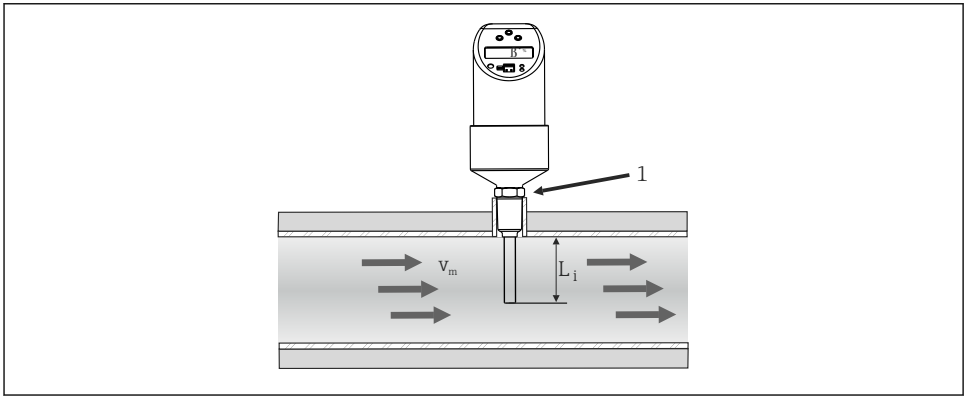
- ▶ Do not turn the device into the process connection thread at the housing.
- ▶ Always install the device at the wrench flats provided.
- ▶ Use a suitable open-ended wrench to do this.

The local display can be rotated electronically by 180 °.

5.2 Installing the device

Installation instructions

Minimum sensor immersion length: L_i ≥10 mm (0.4 in).



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1 Installation instructions

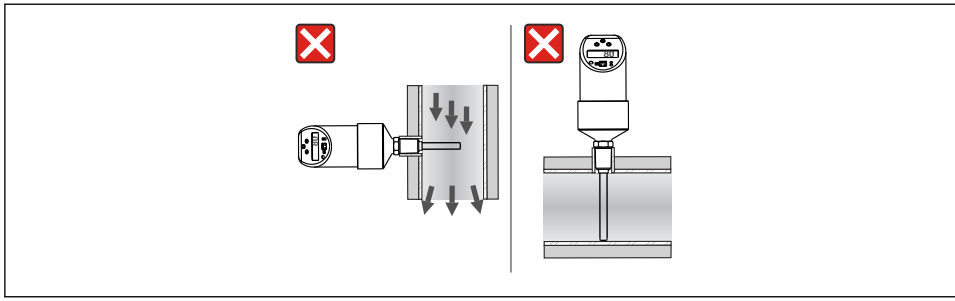
1. Make sure that the sensor tip is completely surrounded by medium.
2. Position the sensor tip in the area of maximum flow velocity (pipe center).

Orientation

NOTICE

Incorrect orientation. Damage to the device.

- ▶ Do not install the device in down pipes open towards the end.
- ▶ Make sure that the sensor tip is not touching the pipe wall.



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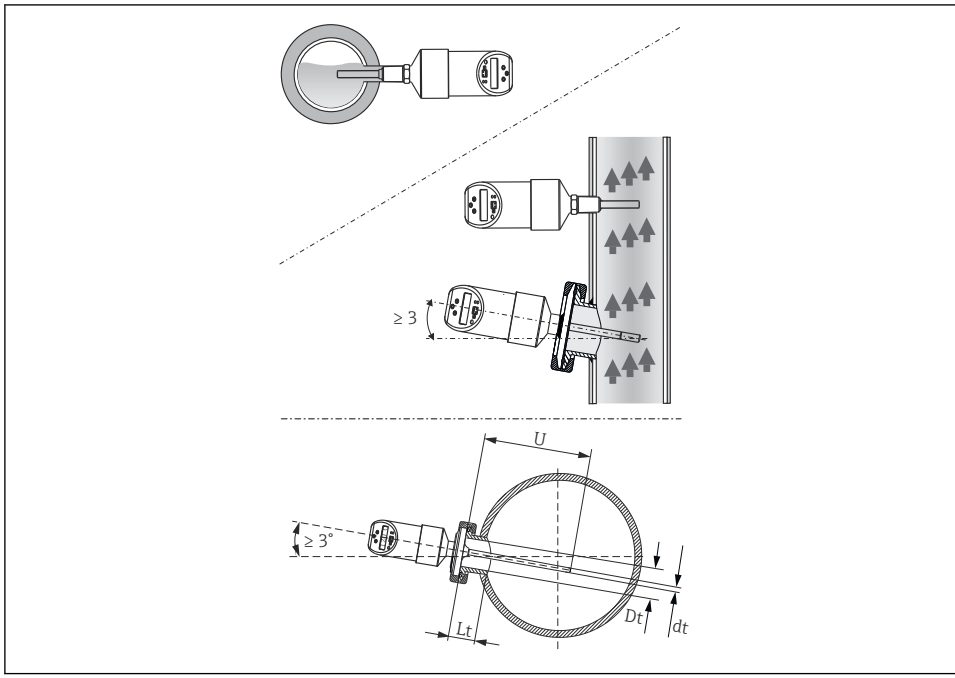
2 *Incorrect orientation*

For horizontal pipes: lateral installation. Install the device from above only if the pipe is completely filled with medium.

For vertical pipes: install the device in the ascending pipe.



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3 *Correct orientation*

► **Hygienic version:** Install the device at an angle of 3 ° at least to ensure self-draining.

5.2.1 Hygiene-compliant installation

CAUTION

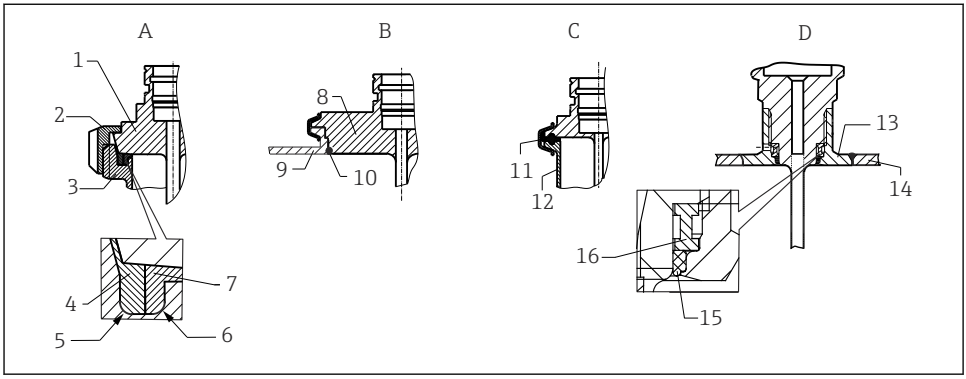
In the event of a defective sealing ring (O-ring) or seal, perform the following steps:

- 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 ≤ (Dt-dt)

Installation instruction 3-A/cleanability: Lt ≤ 2 (Dt-dt)



4 *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:

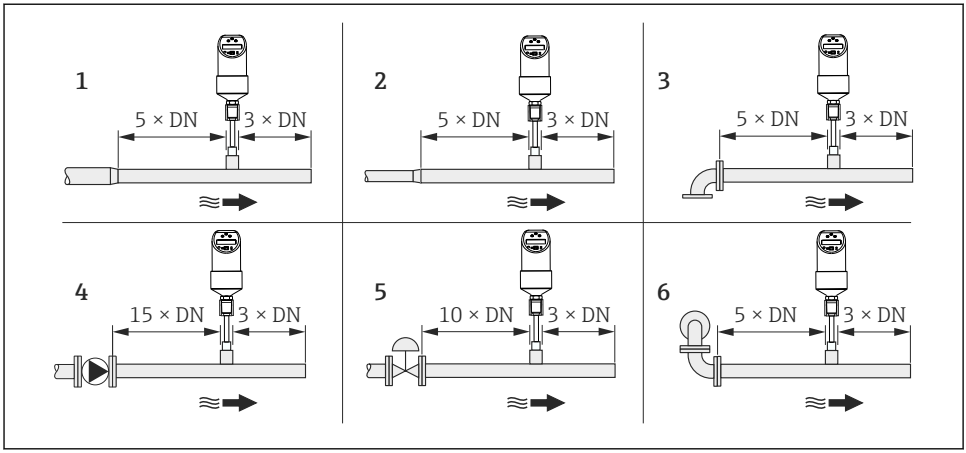
1. The installed sensor is suitable for CIP (cleaning in place). Cleaning is carried out in combination with piping or tank. For tank installation, use process connection nozzles to ensure the cleaning assembly directly sprays this area to clean it effectively.
2. The Varivent® connections enable flush-mounted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

Cleanability is retained after installation.

5.3 Inlet and outlet runs

The thermal measuring principle is sensitive to disturbed flow conditions.

- Install the device as far away as possible from any flow disturbances. For further information, please refer to ISO 14511.
- If possible, install the device upstream of fittings such as valves, T-pieces or elbows.
- To attain the specified measurement accuracy of the device, the inlet and outlet runs mentioned below must be maintained at the very minimum.
- If several flow disturbances are present, maintain the longest specified inlet run.



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1 *Reduction*
2 *Expansion*
3 *90° elbow or T-piece*
4 *Pump*
5 *Control valve*
6 *2 x 90° elbow, 2- or 3-dimensional*

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

⚠ WARNING

Risk of injury. The sensor tip of the device heats up once the device is connected to the power supply.

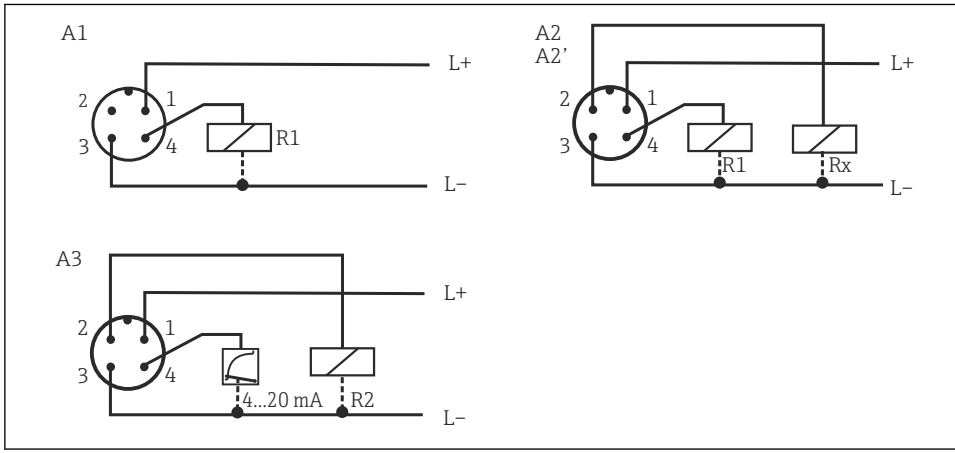
► Wear appropriate protective equipment.

⚠ 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.

Hygienic version: According to the 3-A Sanitary Standard and EHEDG, electrical connecting cables must be smooth, corrosion-resistant and easy to clean.

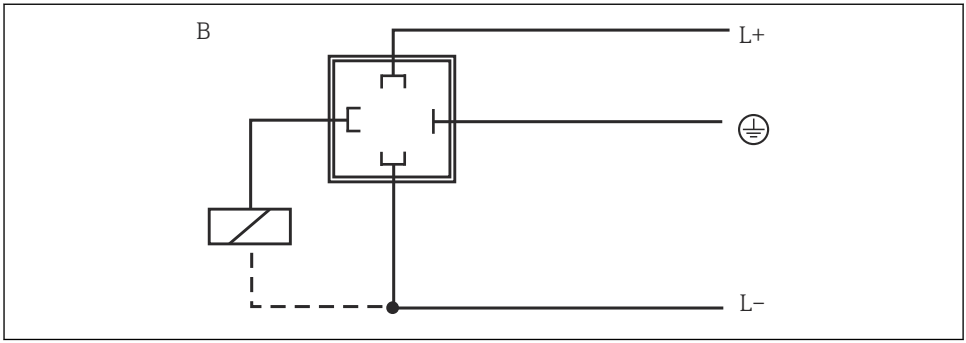


5 Device with M12x1 connector

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

R2 = diagnostics/NC contact

6.1.2 DC voltage version with valve connector



6 Device with M16x1.5 valve connector or NPT ½"

B 1x PNP switch output

6.2 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 options

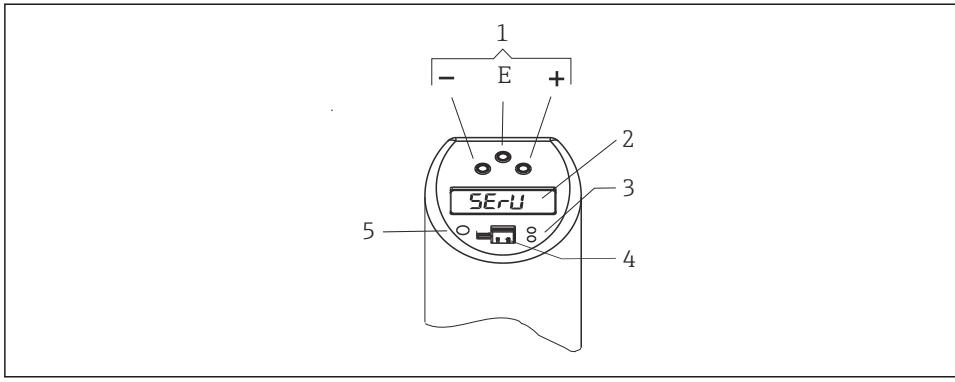
7.1 Overview of operation options

The device is operated using three keys on the housing. The digital display and the light emitting diodes (LED) assist navigation through the operating menu.

NOTICE

Damage to the device.

► Do not use a pointed object to operate the three keys on the device.



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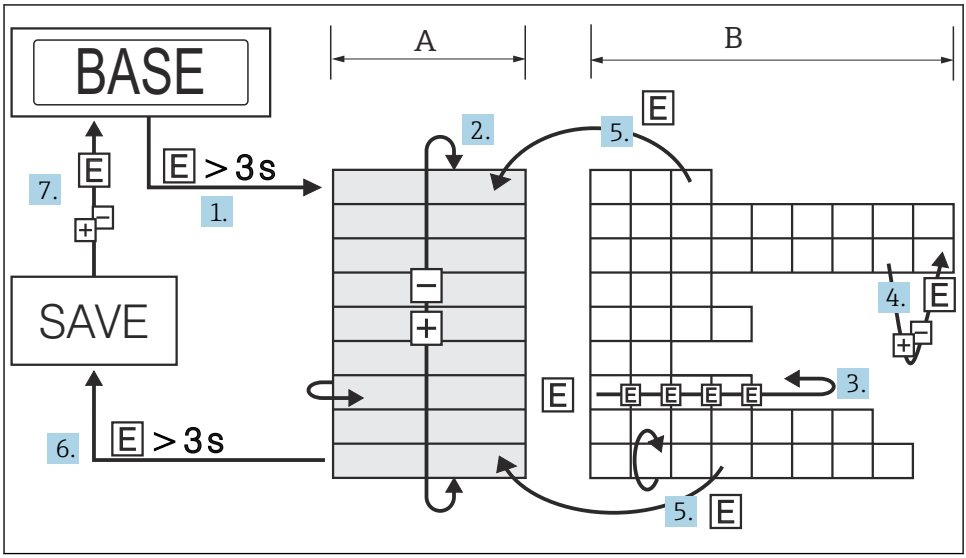
7 Position of the operating elements and possibilities for display

1 Operating keys
2 Digital display: illuminated white (= ok); red (= alarm/error)
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

7.2 Structure and function of the operating menu

7.2.1 Navigation in the operating menu



8 *Navigation in the operating menu*

A Function group selection
B Function selection

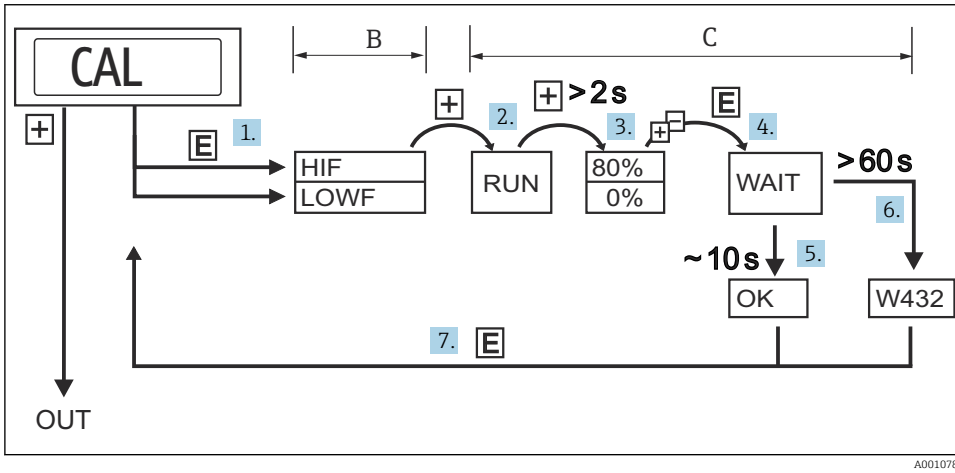
1. To enter the operating menu, press the E key for longer than 3 s.
2. Select the "Function group" with the + or − key.
3. Select the "Function" with the E key.
4. If software locking is enabled, it must be disabled before making entries or changes. Enter and change the parameters with the + or − key.
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 the E key.

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

7.2.2 Navigating the Calibration (CAL) function group

Variable limits for HIF (Learn High Flow) or LOWF (Learn Low Flow) can be set with the 'Learn Function'.

- HIF setting (Learn High Flow): Enter any flow rate from 70 to 100 % of the maximum value in the process. The device then uses this value to automatically calculate the corresponding 100 % value.
- LOWF setting (Learn Low Flow): Enter any flow rate from 0 to 20 % of the maximum value in the process. The device then uses this value to automatically calculate the corresponding 0 % value.



9 *Navigating the 'Learn' function taking the example of the Calibration (CAL) function group*

B Function selection
C Selection of settings

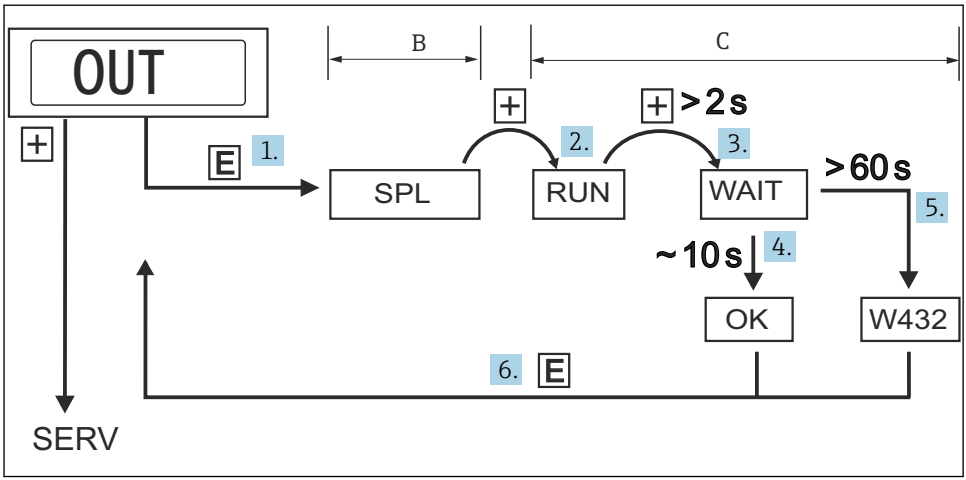
1. Select the "HIF" (Learn High Flow) or "LOWF" (Learn Low Flow) function with the E key.
2. Select the "RUN" function with the + button. Learn function is initialized.
3. Select the flow rate with the + key; press for longer than 2 s.
4. If "HIF" (Learn High Flow) is set, the upper flow rate (70 to 100 %) is selected. Enter the current relative flow rate in increments of 1 % with the + or - key (factory setting 80 %).
5. If "LOWF" (Learn Low Flow) is set, the lower flow rate (0 to 20 %) is selected. Enter the current relative flow rate in increments of 1 % with the + or - key (factory setting 0%).
6. Select the "WAIT" function with the E key.
7. Accept ('learn') the current measured value after approx. 10 s, "OK" appears on the display.

8. Or: The message "W432" appears on the display after 60 s. A sufficiently stable flow could not be detected during the learning process. The system takes an average of the 10 values last measured during the learning process.
9. Return to the CAL function group (Home position) with the E key.

The device is still operative if message W432 is displayed. There can be large measurement uncertainties, however. Recommendation: Repeat the learning process (points 1 to 7) until "OK" appears on the display.

7.2.3 Navigating the function switch point "Learn" (SPL)

Variable limits for HIF (Learn High Flow) or LOWF (Learn Low Flow) can be set with the 'Learn Function'.



10 Navigating the function switch point 'Learn' (SPL)

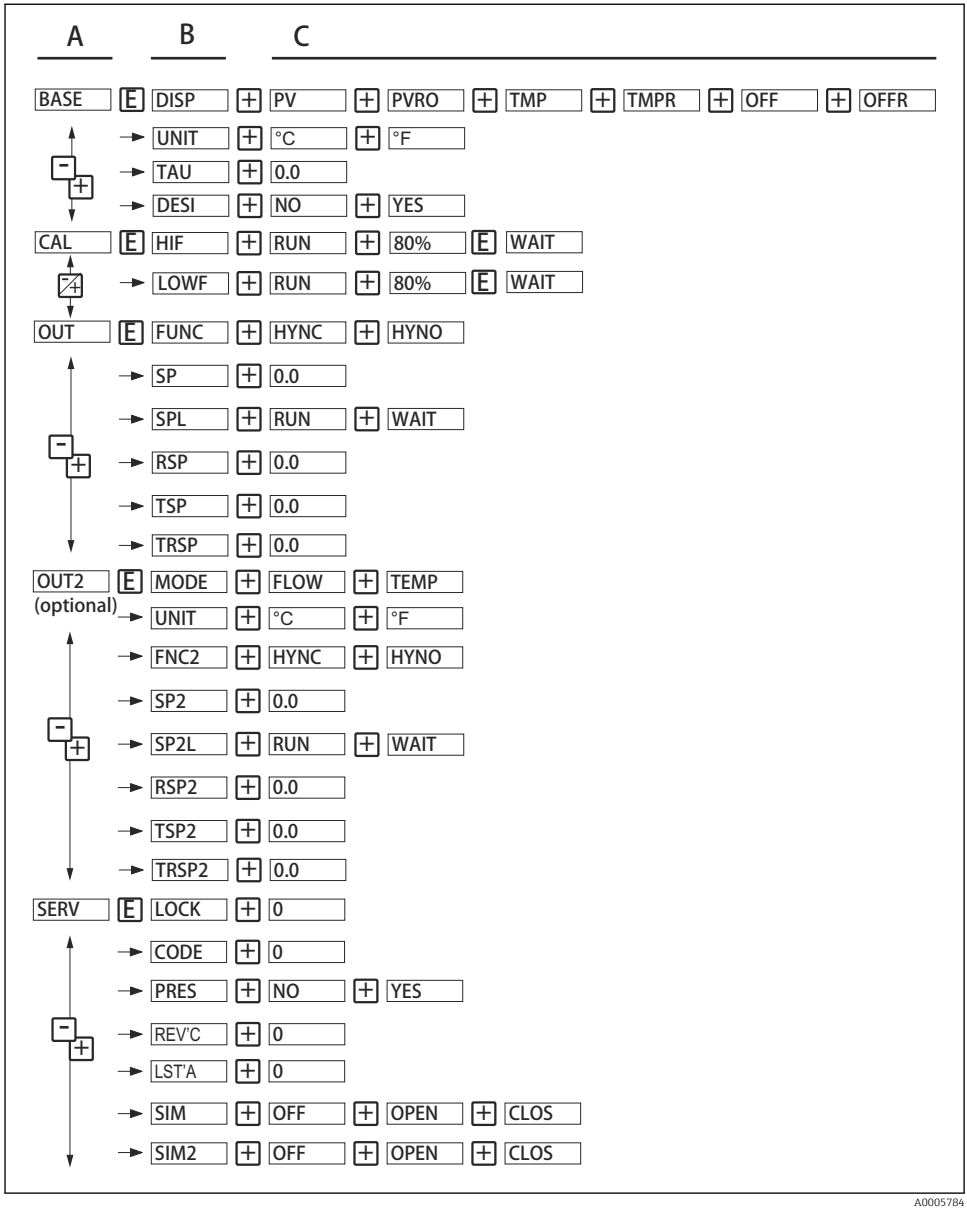
B Function selection
C Selection of settings

1. Select SPL (switch point 'Learn'), optionally SPL2 (switch point 2 'Learn') with the E key.
2. Select the "RUN" function with the + key; the 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. Or: The message "W432" or "NOK" appears on the display after 60 s. W432: A sufficiently stable flow could not be detected during the learning process. The system takes an average of the 10 values last measured during the learning process.

6. NOK: The switch point determined is under 5 % of the measuring range and cannot be accepted because the switch point must be at least 5 % greater than the switchback point (RSP).

The device is still operative if message "W432" or "NOK" is displayed. There can be large deviations at the switch point. Recommendation: Repeat the learning process (points 1 to 4) until "OK" appears on the display.

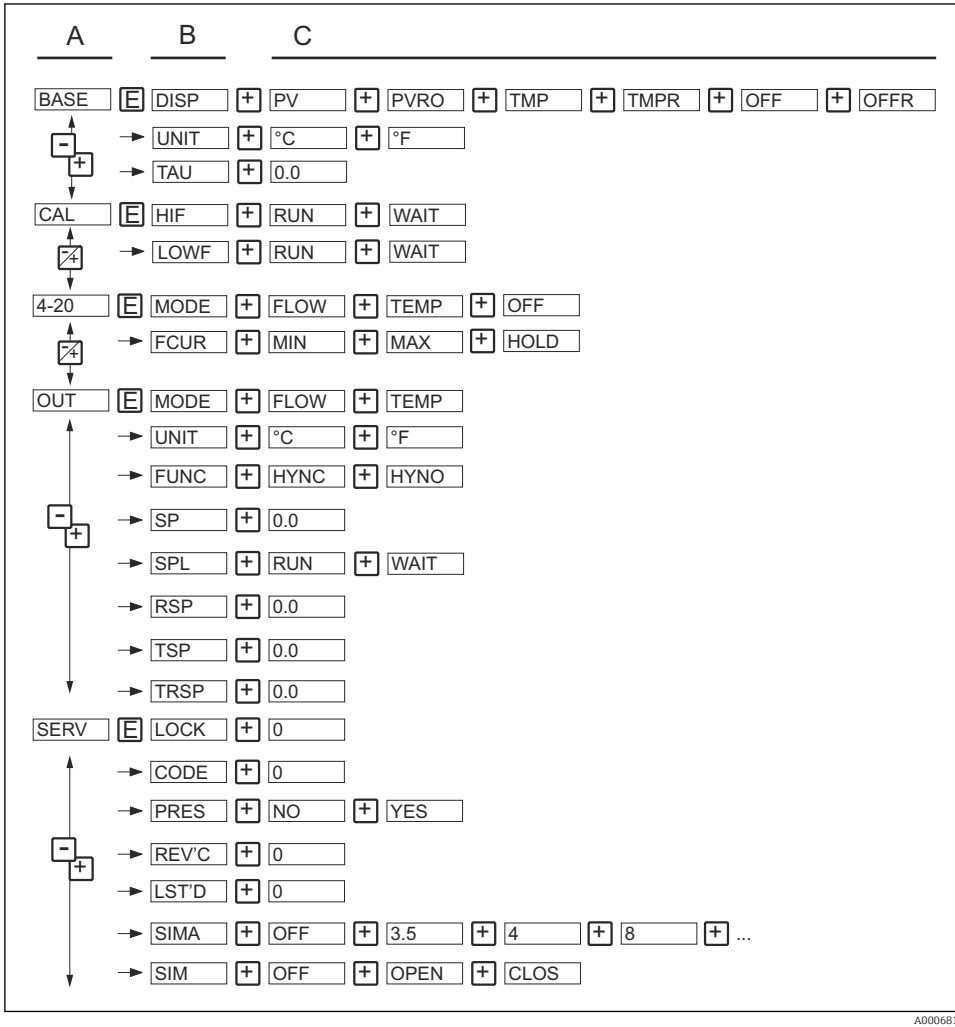
7.2.4 Structure of the operating menu for 2 switch outputs



11 Operating menu

A Function groups
B Functions
C Settings

7.2.5 Structure of the operating menu for 1 x analog output (4 to 20 mA) and 1 x switch output



12 Operating menu

A Function groups
B Functions
C Settings

7.2.6 Basic settings

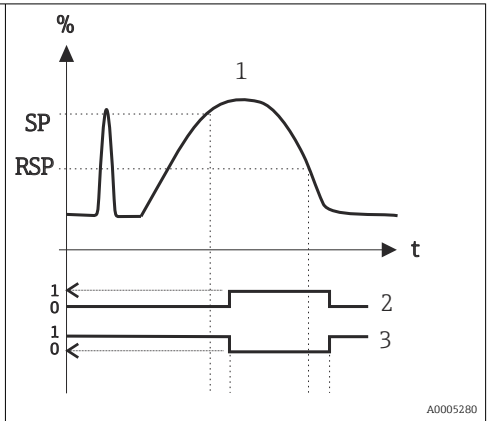
Function group	Function		Settings	Description
BASE Basic settings	**DISP**	Display	**PV**	Displays the current measured value
			PVRO	Displays the current measured value rotated by 180 °
			TMP	Displays the current medium temperature
			TMPR	Displays the current medium temperature rotated by 180 °
			OFF	Display off
			OFFR	Display off, rotated by 180 °
				Factory setting: **current measured value (PV)**
	UNIT	Technical unit	x**C** x**F**	Medium temperature displayed in the unit °C or °F Only visible if the current medium temperature TMP is selected in the DISP mode.
				Factory setting: **°C**
	TAU	Damping	**0.0**	Measured value damping with regard to display value and output: 0 (no damping) or 9 to 40 s (in increments of 1 s)
				Factory setting: **0 s**
	DESI	DESINA Only for 2x PNP switch outputs	**NO** **YES**	Behavior as per DESINA: The PIN assignment of the M12 connector is in accordance with the DESINA Guidelines (DESINA = distributed and standardized installation technology for machine tools and manufacturing systems)
				Factory setting: **NO**

7.2.7 Calibration

Function group	Function		Settings	Description
CAL Calibration	**HIF**	Learn High Flow	**RUN** **WAIT**	Setting for the maximum flow rate that occurs. 100 % value
	LOWF	Learn Low Flow	**RUN** **WAIT**	Setting for the minimum flow rate that occurs. 0 % value

7.2.8 Settings for output - 2 x switch output

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 switchback point RSP.
- NO contact or NC contact: This switch function can be selected as required.
- 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.



13 SP switch point; RSP switchback point

1 Hysteresis function
2 NO contact
3 NC contact

Function group	Function		Settings	Description
OUT Output 1 **OUT2** Output 2, optional	**MODE**	Switching mode	**FLOW** **TEMP**	Output switching mode for channel 2 FLOW: flow rate TEMP: temperature
				Factory setting: **FLOW**
	UNIT	Technical unit	x**C** x**F**	Temperature unit selection (°C or °F) Function is only visible if the switching mode MODE is set to temperature TEMP in the 2nd output.
				Factory setting: **°C**
	FUNC **FNC2**	Switching characteristics	**HYNC**	Hysteresis/NC contact
			HYNO	Hysteresis/NO contact → 25
				Factory setting: **HYNO**
	SP **SP2**	Switch point value	**0.0**	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 if the switching mode MODE is set to temperature TEMP.
				Factory setting: **55 °C**

Function group	Function		Settings	Description
	SPL **SP2L**	Switch point "Learn"	**RUN** **WAIT**	RUN, WAIT: Take the current flow rate as the switch point SP or SP2.
	RSP **RSP2**	Switchback point value	**0.0**	Enter value 0 to 95 % in increments of 1 %. Factory setting: **40 %** Value must be at least 5 % less than 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 TEMP. Value must be at least 5 °C (9 °F) less than switch point 2 (SP2).
				Factory setting: **50 °C**
	TSP **TSP2**	Switch point delay	**0.0**	Can be configured from 0 to 99 s in increments of 1 s, as required.
				Factory setting: **0 s**
	TRSP **TRSP2**	Switchback point delay	**0.0**	Can be configured from 0 to 99 s in increments of 1 s, as required.
				Factory setting: **0 s**

7.2.9 Settings for output - 1 x analog output (4 to 20 mA) and 1 x switch output

Function group	Function		Settings	Description
4-20 Output 1	**MODE**	Measured variable for analog output	**FLOW** **TEMP**	Output FLOW: flow rate or TEMP: temperature If TEMP (temperature) is set, the measuring range is fixed at −20 to +85 °C (−4 to +185 °F) .
				Factory setting: **FLOW**
	FCUR	Fault current	**MIN** **MAX** **HOLD**	Current value in the event of an error: MIN = ≤ 3.5 mA MAX = ≥ 21.7 mA HOLD = last current value
				Factory setting: **MAX**
OUT Output 2	**MODE**	Switching mode	**FLOW** **TEMP**	Output switching mode FLOW: flow rate or TEMP: temperature
				Factory setting: **temperature (TEMP)**
	UNIT	Technical unit	x**C** x**F**	Temperature unit selection (°C or °F) Function is only visible if the switching mode MODE is set to temperature TEMP in the 2nd output.

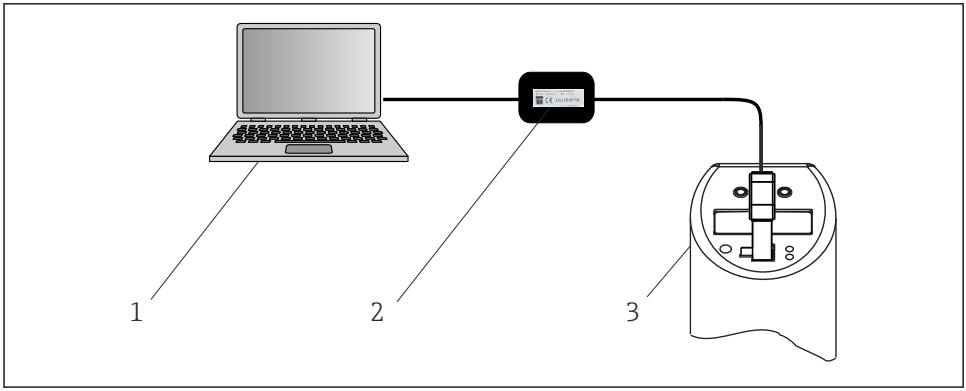
Function group	Function		Settings	Description
				Factory setting: **°C**
	FUNC	Switching characteristics	**HYNC** **HYNO**	HYNC: hysteresis/NC contact HYNO: hysteresis/NO contact
				Factory setting: **HYNO**
	SP	Switch point value	**0.0**	Enter value 5 to 100% in increments of 1 %.
				Factory setting: **50**%
				Enter value −15 to 85 °C (−5 to 185 °F) in increments of 1 K if the switching mode MODE is set to temperature TEMP.
				Factory setting: **55 °C**
	SPL	Switch point 'Learn'	**RUN** **WAIT**	RUN, WAIT: Take the current flow rate as the switch point SP. See 'Navigating the Learn function'.
	RSP	Switchback point value	**0.0**	Enter value 0 to 95% in increments of 1 %. Value must be at least 5 % less than switch point SP.
				Factory setting: **40 %**
				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 TEMP. Value must be at least 5 °C (9 °F) less than switch point SP2.
				Factory setting: **50 °C**
	TSP	Switch point delay	**0.0**	Can be configured from 0 to 99 s in increments of 1 s, as required
				Factory setting: **0 s**
	TRSP	Switchback point delay	**0.0**	Can be configured from 0 to 99 s in increments of 1 s, as required
				Factory setting: **0 s**

7.2.10 Setting the service functions

Function group	Function		Settings	Description
SERV Service functions	**LOCK**	Locking code	**0**	Enter the locking code of the device.
	Code	Change locking code	**0**	User-defined numerical code 1 to 9 999 0= no locking Only visible if the locking code is valid.
	PRES	Reset	**NO** **YES**	Reset all entries to the delivery settings.

Function group	Function		Settings	Description
	REV'C	Static revision counter	**0**	Configuration counter, incremented each time the configuration is changed.
	STAT	Device status		
	LST'D	Last error	**0**	Displays the last error to occur.
Switch output version	**SIM** **SIM2**	Simulation for 2x switch output	**OFF** **OPEN** **CLOS**	No simulation Switch output open Switch output closed
Analog output version (4 to 20 mA)	**SIM** **SIM2**	Simulation for 1x analog output (SIMA) and 1x switch output (SIM)	**OFF** **OPEN** **CLOS**	No simulation Switch output open Switch output closed
			3.5 **4** **8** ...	3.5, 4, 8...: Simulation values for analog output in mA (3.5/4.0/8.0/12.0/16.0/20.0/21.7)

7.3 Access to the operating menu via the operating tool



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14 Operation, visualization and maintenance with PC and configuration software

1 PC with FieldCare configuration software
2 Configuration kit TXU10-AA or FXA291 with USB port
3 Flow switch

7.3.1 Additional operating options

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

Function group	Function (display)	Description
SERV (service)	Switching operations 1 Switching operations 2, optional	Number of changes in the switching state for switch output 1; optionally for switch output 2
INFO (device information)	TAG 1 TAG 2	Tagging, 18-digit
	Order code	Order code
	Device serial number	-
	Sensor serial number	-
	Electronics serial number	-
	Device version	Displays the overall device version
	Hardware revision	-
	Software revision	-

7.3.2 Notes on operation with FieldCare

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

The "PCP Communications DTM" and Device DTM are needed to configure the device with FieldCare.

This device supports offline operation and the transfer of parameters from and to the device. Online device operation is not supported.

Detailed information on FieldCare is provided in the associated Operating Instructions (BA027/S/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 a device reset.
E012	Measurement error or medium temperature outside the measurable range	Check medium temperature. Check whether the device needs to be returned to the manufacturer.
E013	Sensor heating defective	Return device to manufacturer.
E019	Power supply out of specification	Check operating voltage.
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.
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.

Code	Explanation	Remedy
W107	Simulation active	--
W200	Medium temperature out of specification (>85 °C)	Check the medium temperature and adapt it to the specification if necessary
W202	Measured flow outside the range between the set Low and High Flow (< −10% or > 110%)	Set the High and Low Flow again; reset the device to the factory default setting if necessary (PRES function)
W209	Device starting up	--
W210	Configuration changed (warning code is displayed for approx. 15 s)	--
W240	Flow velocity too high (> 3 m/s in water), the device is being operated outside its specified measuring range. The measurement is uncertain.	Reduce the flow velocity of the medium
W250	Number of max. switching cycles exceeded	--
W260	Values for High Flow (HIF) and Low Flow (LOWF) are too close together	Set the High and Low Flow again (greater distance). Check whether the device needs to be reset to the factory setting (PRES function).
W270	Short-circuit and overload at output 1	Check output circuit.
W280	Short-circuit and overload at output 2	Check output circuit.
W432	Values for High Flow (HIF) or Low Flow (LOWF) could not be determined with certainty. The device can still be operated, however.	Set the High and Low Flow again (keep flow velocity constant).

9 Maintenance

⚠ CAUTION

Damage to the device.

- ▶ Ensure that the process is unpressurized before you remove the device.
- ▶ Do not turn 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.

Sensor is working correctly.

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

10.1 Spare parts

Product spare parts that are currently available can be found online at:
www.endress.com/onlinetools

10.2 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.

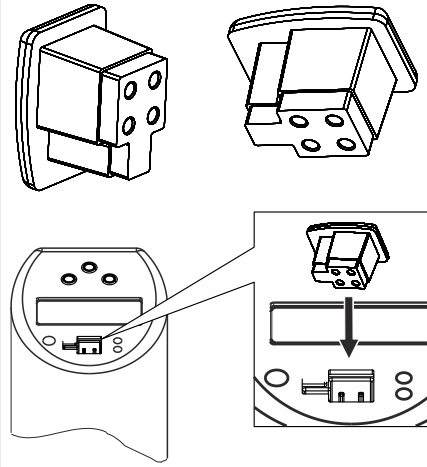
10.3 Disposal

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

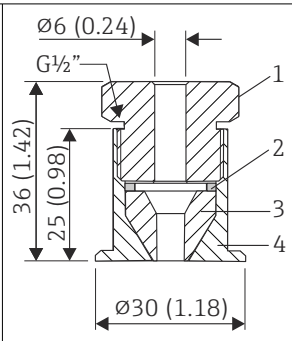
11.1 Device-specific accessories

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)

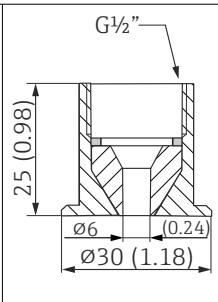


15 Dimensions in mm (in)

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

11.1.3 Collar welding boss

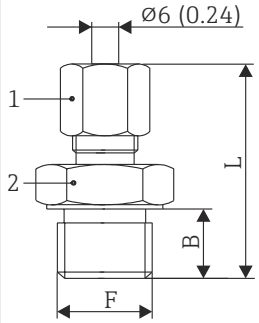
- Collar welding boss movable with sealing taper and washer
- Material of parts in contact with the process: 316L, PEEK
- Max. process pressure 10 bar (145 psi)



16 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



17 Dimensions in mm (in)

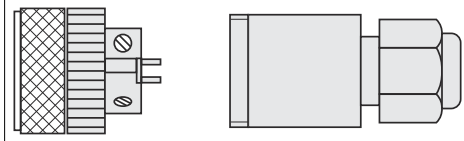
1 AF14

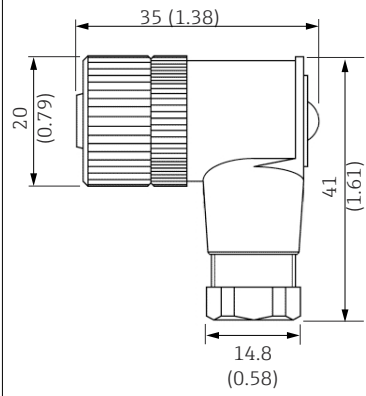
Version	F in mm (in)		L in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure
TA50	G½"	AF 27	47 mm (1.85 in)	15 mm (0.6 in)	SS316 [1]	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
				20 mm (0.8 in)	PTFE [2]	200 °C (392 °F)	5 bar at 20 °C (72.5 psi at 68 °F)
	G¾"	AF 32	63 mm (2.48 in)	20 mm (0.8 in)	SS316 [1]	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
					PTFE [2]	200 °C (392 °F)	5 bar at 20 °C (72.5 psi at 68 °F)
	G1"	AF 41	65 mm (2.56 in)	25 mm (0.98 in)	SS316 [1]	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
					PTFE [2]	200 °C (392 °F)	5 bar at 20 °C (72.5 psi at 68 °F)
	NPT½"	AF 22	50 mm (1.97 in))	20 mm (0.8 in)	SS316 [1]	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)

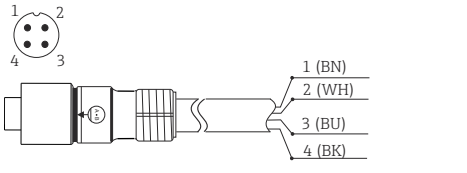
Version	F in mm (in)		L in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure
	R½"	AF 22	52 mm (2.05 in)	20 mm (0.8 in)	PTFE [2]	200 °C (392 °F)	5 bar at 20 °C (72.5 psi at 68 °F)
	R¾"	AF 27	52 mm (2.05 in)	20 mm (0.8 in)	PTFE [2]	200 °C (392 °F)	5 bar at 20 °C (72.5 psi at 68 °F)

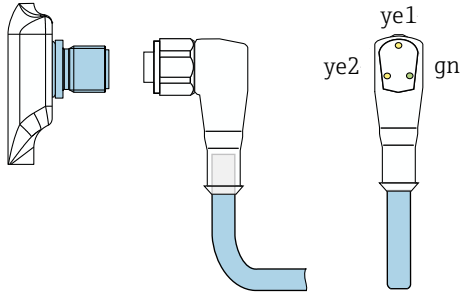
1) SS316 clamping ring: can only be used once. Once released the compression fitting cannot be repositioned on the thermowell. Fully adjustable immersion length on initial installation.
2) PTFE/Elastosil® clamping ring: reusable; once loosened, the compression fitting can be moved up or down on the thermowell. Fully adjustable immersion length.

11.2 Communication-specific accessories

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 mm² (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	

Accessories	Description
▪ PVC cable, 4 x 0.34 mm² 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.	

11.2.1 Configuration kit

- Configuration kit for PC-programmable transmitters and temperature switches; 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**

11.2.2 Configuration software

Download the free FieldCare “Device Setup” configuration program directly from the Internet at the following address:

www.endress.com/fieldcare

You can order FieldCare ’Device Setup’ from the manufacturer's sales department.

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

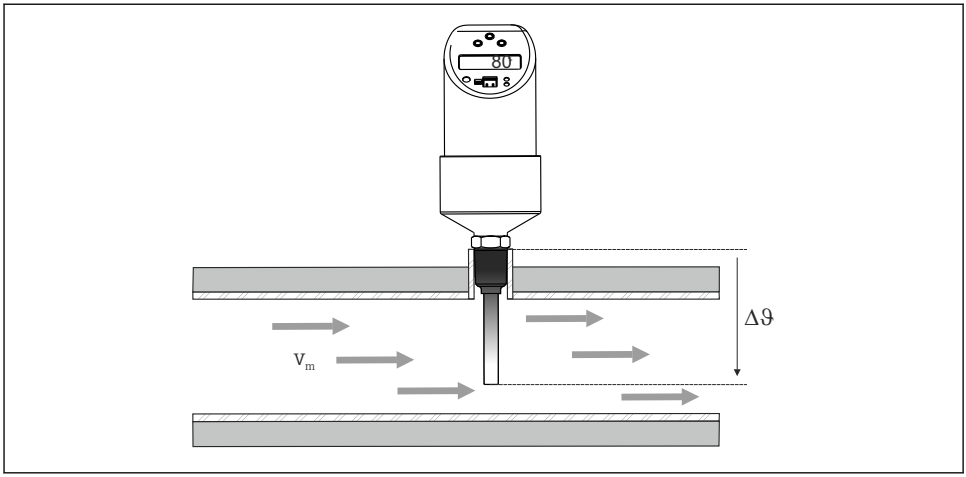
Data Managers are flexible and powerful systems to organize process values. Up to 20 universal inputs and up to 14 digital inputs for direct connection of sensors, optionally with HART, are available as an option. The measured process values are clearly presented on the display and logged safely, monitored 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



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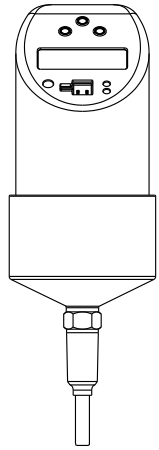
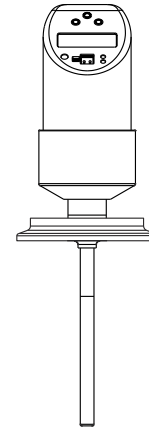
The device measures the mass flow of a liquid medium using the calorimetric measurement method. The calorimetric measuring principle is based on the cooling of a heated temperature sensor. Heat is removed from the sensor by forced convection due to medium flowing by. The extent of this heat transfer depends on the flow velocity of the medium and the difference in temperature between the sensor and the medium (King's Law). The higher the flow velocity or the mass flow of the medium, the greater the temperature sensor cooling.

12.1.2 Measuring system

Overview

Flowphant product family	Flowphant T DTT31	Flowphant T DTT35
	 A0005276	 A0023194
Sensor	RTD	RTD
Field of application	Monitoring of mass flow of water, water-like substances and low-viscosity oils (viscosity: 0.184 to 20 mPa·s; thermal conductivity: 29 to 688 mW/m·K). Example: aqueous solution monoethylene glycol (20 vol%) at 20 °C: viscosity: 1.65 mPa·s; thermal conductivity: 512 mW/mK	Monitoring of mass flow of liquid media in hygienic processes (viscosity: 0.184 to 20 mPa·s; thermal conductivity: 29 to 688 mW/mK). Example: aqueous solution monoethylene glycol (20 vol%) at 20 °C: viscosity: 1.65 mPa·s; thermal conductivity: 512 mW/mK

Process connection	**Industrial:**
	▪ Compression fitting
	▪ Thread:
	  ▪ G½" and G¼"
	  ▪ ANSI NPT¼" and NPT½"
		Hygiene:
		▪ Conical metal-metal G½"
		▪ Clamp 1" - 1½", DIN 32676 [1], DN25 to 40
		▪ Clamp 2", DIN 32676, DN50
		▪ Varivent F, N
		▪ DIN 11851
		▪ APV Inline

Measuring range	Mass flow as a relative value from 0 to 100%. Process measuring limit for liquids: 0.03 to 3 m/s (0.1 to 9.84 ft/s)	

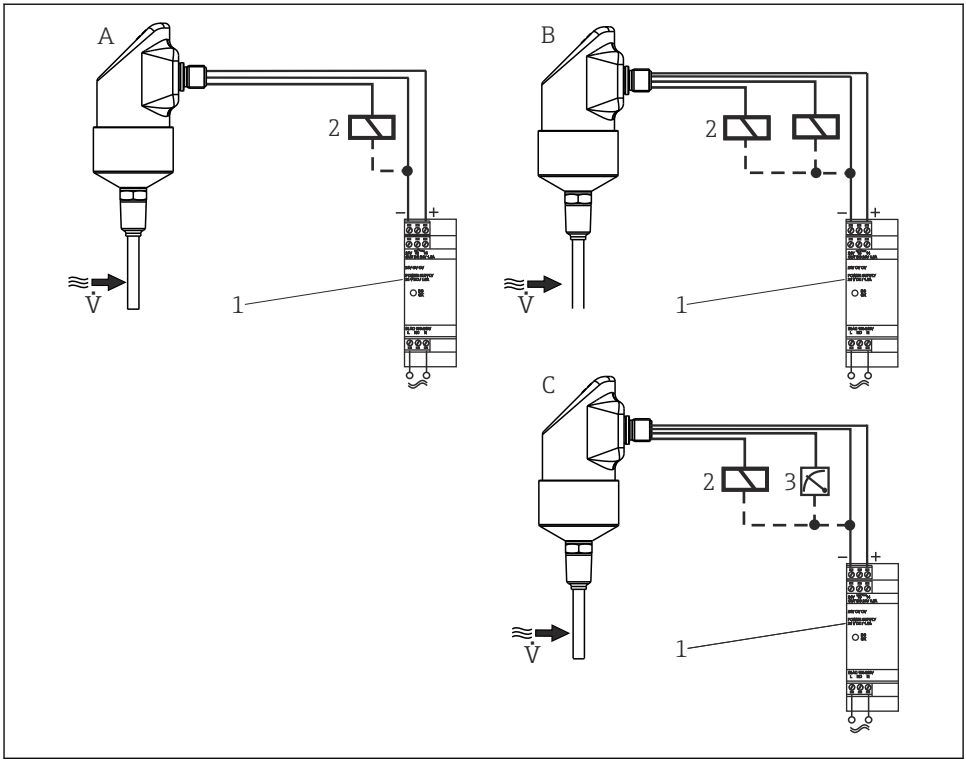
1) DIN 32676 replaces ISO 2852.

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.



A0005373

A 1 x PNP switch output
B 2 x PNP switch output
C PNP switch output with additional analog output 4 to 20 mA (active)
1 Transmitter power supply unit
2 Load (programmable logic controller, process control system, relay)
3 Indicator (at the 4 to 20 mA analog output)

12.2 Input

12.2.1 Measured variable

- Flow velocity of liquid media (calorimetric measuring principle)
- Temperature (RTD), optionally for two switch outputs or additional analog output

12.2.2 Measuring range

Flow	0.03 to 3 m/s (0.1 to 9.84 ft/s)
Temperature	−20 to 85 °C (−4 to 185 °F)

12.3 Output

12.3.1 Output signal

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

The analog output reports the measured flow as a relative value expressed as a percentage of the set measuring range.

12.3.2 Signal on alarm

Analog output: signal on alarm according to NAMUR NE43

Underranging	Linear drop to 3.8 mA
Overranging	Linear rise to 20.5 mA
Sensor breakage; sensor short-circuit	≤3.6 mA or ≥ 21.0 mA (output 21.7 mA is guaranteed for setting ≥ 21.0 mA)
Switch outputs	In the safe state (switch open)

12.3.3 Load

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

12.3.4 Range of adjustment

Switch output	Switch point (SP) and switchback point (RSP) in increments of 1% with min. hysteresis of 5%
Damping	User-configurable 0 = off (no damping) or 10 to 40 s in increments of 1 s
Unit	%, optionally °C, °F (with two outputs and temperature monitoring)

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 Environment

12.4.1 Ambient temperature

–40 to 85 °C (–40 to 185 °F)

12.4.2 Storage temperature

–40 to 85 °C (–40 to 185 °F)

12.4.3 Operating altitude

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

12.4.4 Degree of protection

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

12.4.5 Shock resistance

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

12.4.6 Vibration resistance

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

12.4.7 Electromagnetic compatibility (EMC)

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 the measuring range.

Interference immunity as per IEC/EN 61326 series, industrial requirements

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

12.4.8 Electrical safety

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

12.5 Process

12.5.1 Process temperature range

−20 to 85 °C (−4 to 185 °F).

The sensor can be exposed to process temperatures up to 130 °C (266 °F) without being damaged. The monitoring system switches off automatically at T ≥85 °C (185 °F) and starts again at T ≤85 °C (185 °F).

12.5.2 Process pressure range

Maximum permissible process pressure P_{max} ≤ 10 MPa = 100 bar (1 450 psi)

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

12.5.3 Flow limit

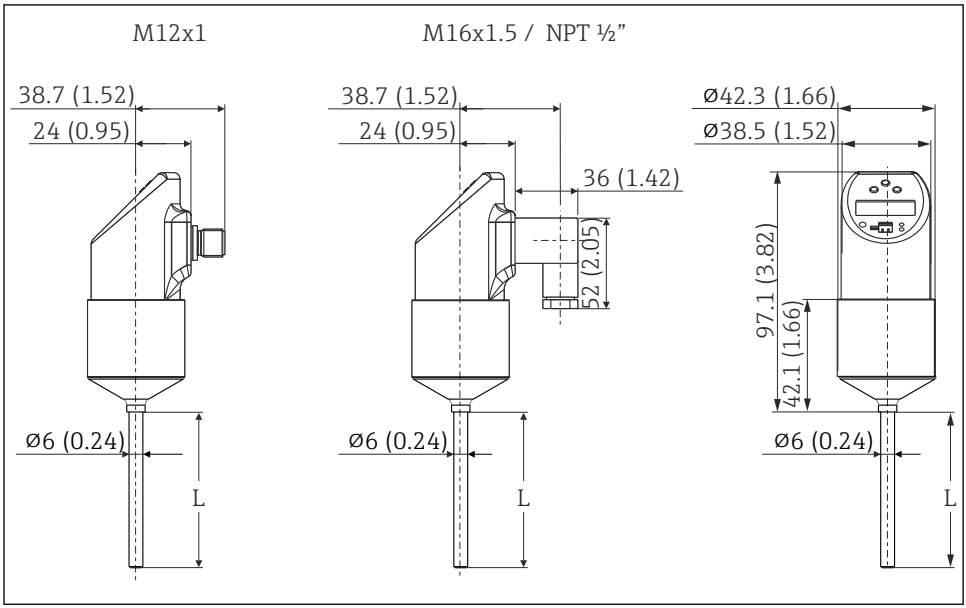
Liquids: 0 to 3.0 m/s (0 to 9.84 ft/s)

12.5.4 Operational range

Liquids: 0.03 to 3.0 m/s (0.1 to 9.84 ft/s)

12.6 Mechanical construction

12.6.1 Design and dimensions

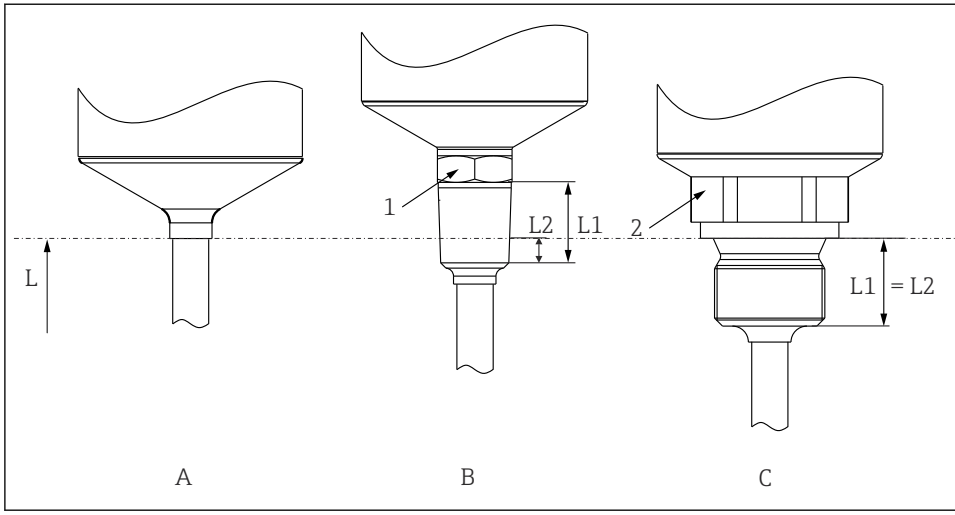


18 *All dimensions in mm (in)*

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

12.6.2 Process connections

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

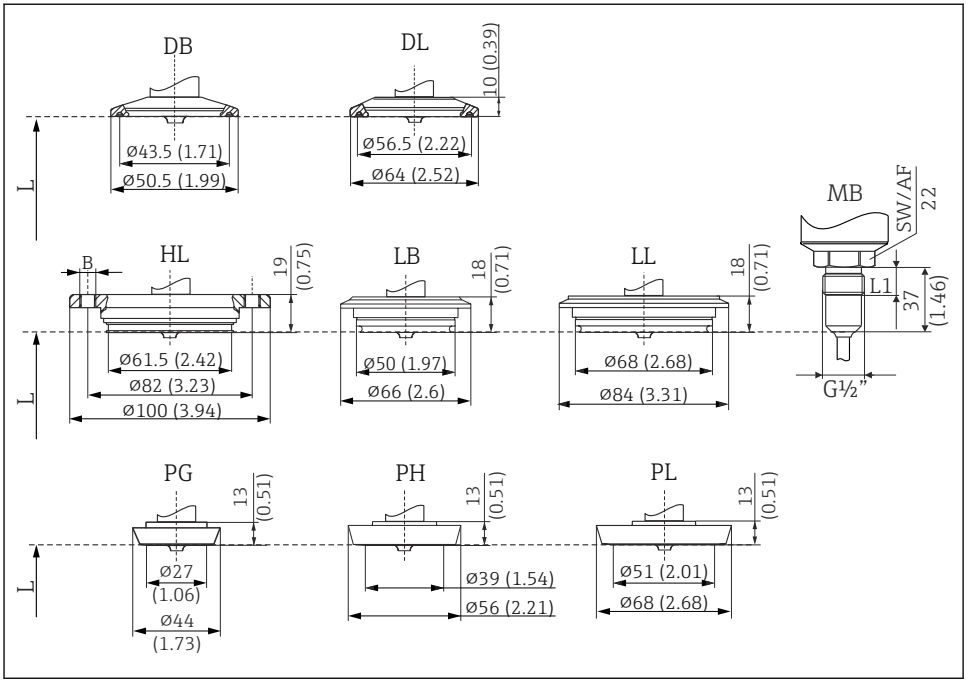


19 *Process connection versions*

1 Threaded process connection
2 Threaded process connection, inches, cylindrical as per ISO 228
L Insertion length
L_1 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.



20 Process connection versions, all dimensions in mm (in)

L Insertion length

Item no.	Process connection versions	Hygiene standard
DB	Clamp 1" - 1½", DN25 to 40 DIN 32676 [1)]	3-A marked and EHEDG certified (only in conjunction with seal according to EHEDG position paper)
DL	Clamp 2", DN50 DIN 32676 [1)]	
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 F DN25-32, PN 40, 316L	
LL	Varivent N DN40-162, PN 40, 316L	
MB	Metal sealing system for hygienic processes, G½" thread, thread length L1 = 14 mm (0.55 in). Suitable welding boss available as an accessory. 316L	-
PG	DIN 11851, DN25, PN40 (including coupling nut), 316L	3-A marked and EHEDG certified (only in conjunction with self-centering seal according to EHEDG position paper)

Item no.	Process connection versions	Hygiene standard
PH	DIN 11851, DN40, PN40 (including coupling nut), 316L	
PL	DIN 11851, DN50, PN40 (including coupling nut), 316L	

1) DIN 32676 replaces ISO 2852.

12.6.3 Weight

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

12.6.4 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®)

12.6.5 Surface roughness

R_a ≤0.76 µm (30 µin)

12.7 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**.

12.7.1 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).

12.7.2 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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