

# Technical Information

## Liquiphant FTL62

Vibronic



Point level switch with highly corrosion-resistant coating for liquids

### Application

- Point level switch for all liquids, for minimum or maximum detection in tanks, vessels and piping, even in hazardous areas
- Different coatings, plastics or enamel, offer a high degree of corrosion protection for applications in aggressive media
- Process temperature range:  $-50$  to  $+150$  °C ( $-58$  to  $+302$  °F)
- Pressures up to 40 bar (580 psi)
- Viscosities up to 10 000 mPa·s
- Ideal substitute for float switches; reliable function is not affected by flow, turbulence, air bubbles, foam, vibration, solids content or buildup

### Advantages

- Approved for safety systems with functional safety requirements up to SIL2/SIL3 in accordance with IEC 61508
- No calibration needed: Quick, low-cost commissioning
- Design in accordance with ASME B31.3 and CRN approval
- No mechanically moving parts: No maintenance, no wear, long operating life
- Functional safety: Monitoring of vibration frequency of the tuning fork
- RFID TAG – easy measuring point identification and simplified data access
- Functional testing by means of test button on electronic insert
- Heartbeat Technology via free iOS/Android SmartBlue app
- Measuring device with Bluetooth® wireless technology

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## About this document

### Symbols

#### Safety symbols



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



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

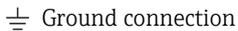


This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.



This symbol contains information on procedures and other facts which do not result in personal injury.

#### Electrical symbols



Grounded clamp, which is grounded via a grounding system.

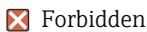


Ground terminals, which must be grounded prior to establishing any other connections. The ground terminals are located on the inside and outside of the device.

#### Symbols for certain types of information



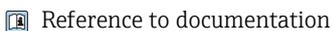
Procedures, processes or actions that are permitted.



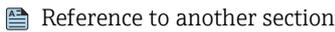
Procedures, processes or actions that are forbidden.



Indicates additional information



Reference to documentation



Reference to another section



1, 2, 3. Series of steps

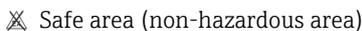
#### Symbols in graphics

**A, B, C ...** View

1, 2, 3 ... Item numbers



Hazardous area



Safe area (non-hazardous area)

## Function and system design

### point level detection

Maximum or minimum detection for liquids in tanks or pipes in all industries. Suitable for leakage monitoring, pump dry-running protection or overflow prevention, for example .

Specific versions are suitable for use in hazardous areas.

The point level switch differentiates between the "covered" and "not covered" conditions.

Depending on the MIN (minimum detection) or MAX (maximum detection) modes, there are two possibilities in each case: OK status and demand mode.

OK status

- In MIN mode, the fork is covered, e.g. Pump dry running protection
- In MAX mode, the fork is not covered e.g. overflow prevention

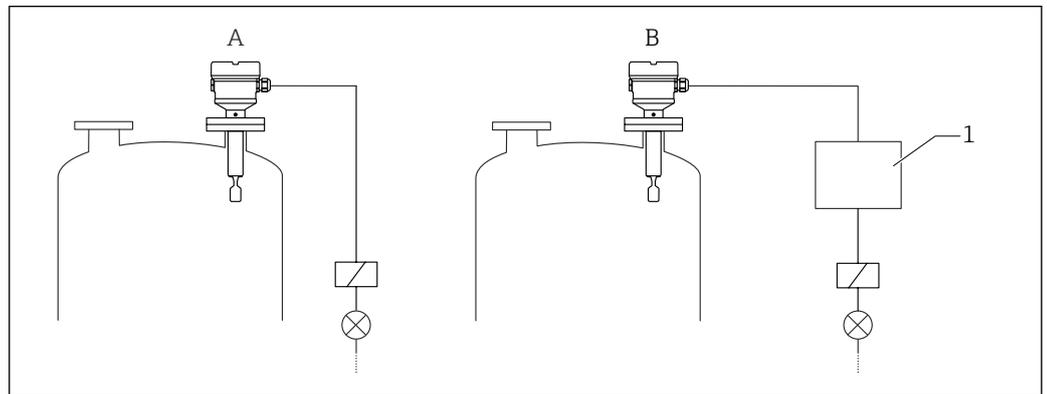
Demand mode

- In MIN mode, the fork is not covered e.g. pump dry running protection
- In MAX mode, the fork is covered e.g. overflow prevention

### Measuring principle

The sensor's tuning fork vibrates at its intrinsic frequency. As soon as the liquid covers the tuning fork, the vibration frequency decreases. The change in frequency causes the point level switch to switch.

### Measuring system



1 Example of a measuring system

A Device for direct connection of a load

B Device for connection to a separate switching unit or PLC

1 Switching unit, PLC etc.

### Dependability

#### Device-specific IT security

The device settings and the diagnostic data can be read out via Bluetooth. Device settings cannot be changed via Bluetooth.

## Input

### Measured variable

Level (point level), MAX or MIN safety

### Measuring range

Depends on the installation location and the pipe extension ordered

Sensor length:

- With plastic coating, maximum 3 m (9.8 ft)
- With enamel coating, maximum 1.2 m (3.9 ft)

## Output

### Output and input variants

#### Electronic inserts

##### 2-wire AC (FEL61)

- Two-wire AC version
- Switches the load directly into the power supply circuit via an electronic switch.

##### 3-wire DC-PNP (FEL62)

- Three-wire DC version
- Switches the load via the transistor (PNP) and separate connection, e. g. in conjunction with programmable logical controllers (PLC)
- Ambient temperature  $-60\text{ }^{\circ}\text{C}$  ( $-76\text{ }^{\circ}\text{F}$ ), optionally available to order  
Low-temperature electronic inserts are marked LT

##### Universal current connection, relay output (FEL64)

- Switches the loads via 2 potential-free changeover contacts
- Ambient temperature  $-60\text{ }^{\circ}\text{C}$  ( $-76\text{ }^{\circ}\text{F}$ ), optionally available to order  
Low-temperature electronic inserts are marked LT

##### Direct current connection, relay output (FEL64DC)

- Switches the load via 2 potential-free changeover contacts
- Ambient temperature  $-60\text{ }^{\circ}\text{C}$  ( $-76\text{ }^{\circ}\text{F}$ ), optionally available to order  
Low-temperature electronic inserts are marked LT

##### PFM output (FEL67)

- For separate switching device (Nivotester FTL325P, FTL375P)
- PFM signal transmission; current pulses are superimposed on the power supply along the two-wire cabling
- Ambient temperature  $-50\text{ }^{\circ}\text{C}$  ( $-58\text{ }^{\circ}\text{F}$ ), optionally available to order  
The low-temperature electronic inserts are marked LT

##### 2-wire NAMUR $> 2.2\text{ mA}/< 1.0\text{ mA}$ (FEL68)

- For separate switching device, e. g. Nivotester FTL325N
- Signal transmission H-L edge 2.2 to 3.8/0.4 to 1.0 mA as per IEC 60917-5-6 (NAMUR) on two-wire cable
- Ambient temperature  $-50\text{ }^{\circ}\text{C}$  ( $-58\text{ }^{\circ}\text{F}$ ), optionally available to order  
Low-temperature electronic inserts are marked LT

##### 2-wire density (FEL60D) for density measurement

Connection to Density Computer FML621



For more information, see the Technical Information for density measuring technology.

### Output signal

#### Switch output

The following default switching delay times can be ordered for electronic inserts FEL61, FEL62, FEL64, FEL64DC, FEL67 and FEL68:

- 0.5 s when the tuning fork is covered and 1.0 s when it is uncovered (factory setting)
- 0.25 s when the tuning fork is covered and 0.25 s when it is uncovered (fastest configuration)
- 1.5 s when the tuning fork is covered and 1.5 s when it is uncovered
- 5.0 s when the tuning fork is covered and 5.0 s when it is uncovered

#### COM interface

For connecting to modules VU120 or VU121 (no modifying effect)

*Bluetooth® wireless technology (optional)*

The device has a Bluetooth® wireless technology interface. Device data and diagnostic data can be read out using the free "SmartBlue" app.

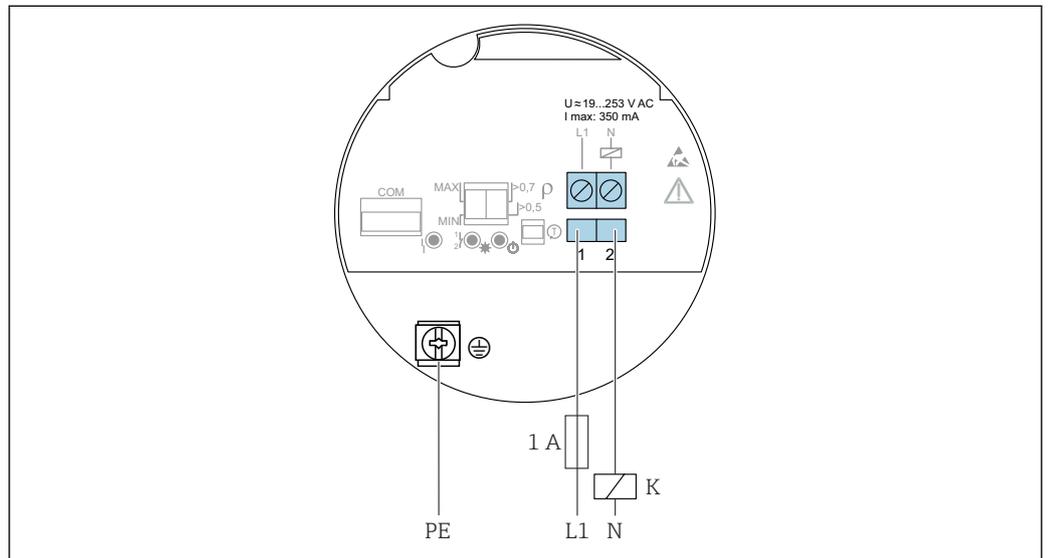
### Ex connection data

See safety instructions (XA): All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads Area of the Endress+Hauser-website. The Ex documentation is supplied as standard with all Ex devices.

## 2-wire AC (electronic insert FEL61)

- Two-wire AC version
- Switches the load directly into the power supply circuit via an electronic switch; always connect in series with a load
- Functional testing without level change  
A functional test can be performed on the device using the test button on the electronic insert.

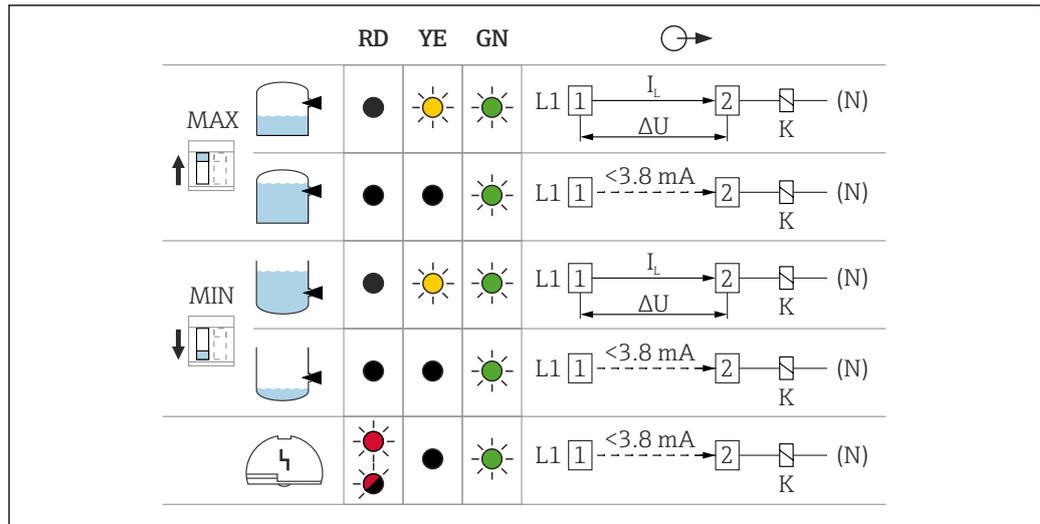
<b>Supply voltage</b>	<p><math>U = 19 \text{ to } 253 \text{ V}_{AC}, 50 \text{ Hz}/60 \text{ Hz}</math></p> <p>Residual voltage when switched through: typically 12 V</p> <p> Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device, and limit the current to 1 A, e. g. by installing a 1 A fuse (slow-blow) in the phase (not the neutral conductor) of the supply circuit.</p>
<b>Power consumption</b>	$S \leq 2 \text{ VA}$
<b>Current consumption</b>	<p>Residual current when blocked: <math>I \leq 3.8 \text{ mA}</math></p> <p>The red LED flashes in the event of an overload or short-circuit. Check for an overload or short-circuit every 5 s. The test is deactivated after 60 s.</p>
<b>Connectable load</b>	<ul style="list-style-type: none"> <li>▪ Load with a minimum holding power/rated power of 2.5 VA at 253 V (10 mA) or 0.5 VA at 24 V (20 mA)</li> <li>▪ Load with a maximum holding power/rated power of 89 VA at 253 V (350 mA) or 8.4 VA at 24 V (350 mA)</li> <li>▪ With overload and short-circuit protection</li> </ul>
<b>Behavior of output signal</b>	<ul style="list-style-type: none"> <li>▪ OK status: load on (switched through)</li> <li>▪ Demand mode: load off (blocked)</li> <li>▪ Alarm: load off (blocked)</li> </ul>
<b>Terminal assignment</b>	Always connect an external load. The electronic insert has integrated short-circuit protection.



 2 2-wire AC, electronic insert FEL61

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### Behavior of switch output and signaling

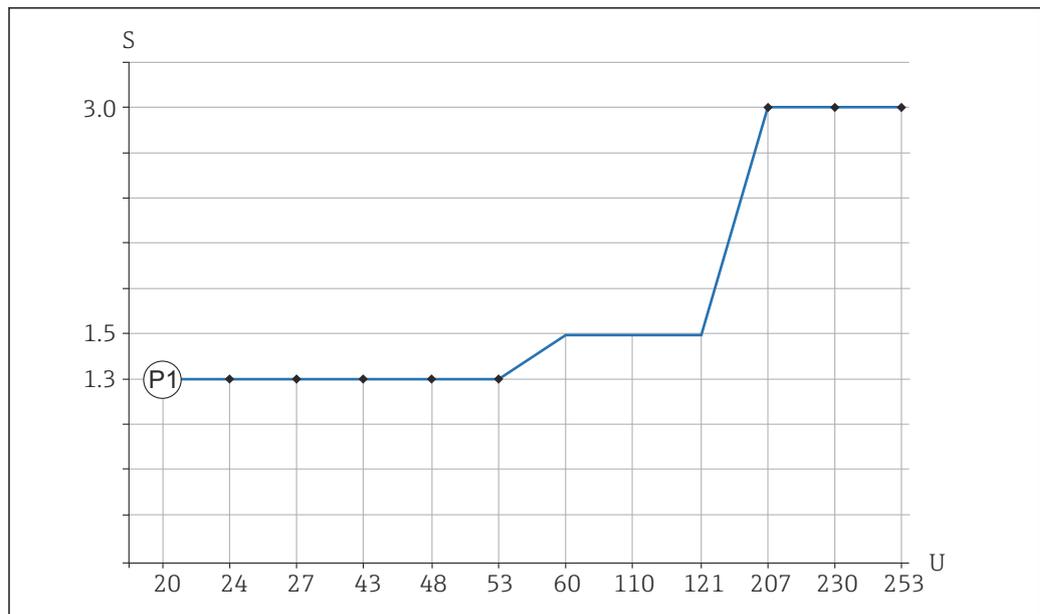


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3 Behavior of switch output and signaling, electronic insert FEL61

MAX DIP switch for setting MAX safety mode  
 MIN DIP switch for setting MIN safety mode  
 RD LED red for warning or alarm  
 YE LED yellow, switch status  
 GN LED green, operational status, device on  
 $I_L$  Load current switched through

### Selection tool for relays



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4 Recommended minimum holding power/rated power for load

S Holding power/rated power in [VA]  
 U Operating voltage in [V]

#### AC mode

- Operating voltage: 24 V, 50 Hz/60 Hz
- Holding power/rated power: > 0.5 VA, < 8.4 VA
- Operating voltage: 110 V, 50 Hz/60 Hz
- Holding power/rated power: > 1.1 VA, < 38.5 VA
- Operating voltage: 230 V, 50 Hz/60 Hz
- Holding power/rated power: > 2.3 VA, < 80.5 VA

### 3-wire DC-PNP (electronic insert FEL62)

- Three-wire DC version
- Preferably in conjunction with programmable logic controllers (PLC), DI modules as per EN 61131-2. Positive signal at switch output of electronics module (PNP)
- Functional testing without level change  
A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.

**Supply voltage**



**Failure to use the prescribed power unit.**

Risk of potentially life-threatening electric shock!

- ▶ The FEL62 may only be powered by devices with safe galvanic isolation, as per IEC 61010-1.

$U = 10 \text{ to } 55 \text{ V}_{DC}$



Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device, and limit the current to 500 mA, e. g. by installing a 0.5 A fuse (slow-blow) in the supply circuit.

**Power consumption**

$P \leq 0.5 \text{ W}$

**Current consumption**

$I \leq 10 \text{ mA}$  (without load)

The red LED flashes in the event of an overload or short-circuit.

**Load current**

$I \leq 350 \text{ mA}$  with overload and short-circuit protection

**Capacitance load**

$C \leq 0.5 \mu\text{F}$  at 55 V,  $C \leq 1.0 \mu\text{F}$  at 24 V

**Residual current**

$I < 100 \mu\text{A}$  (for blocked transistor)

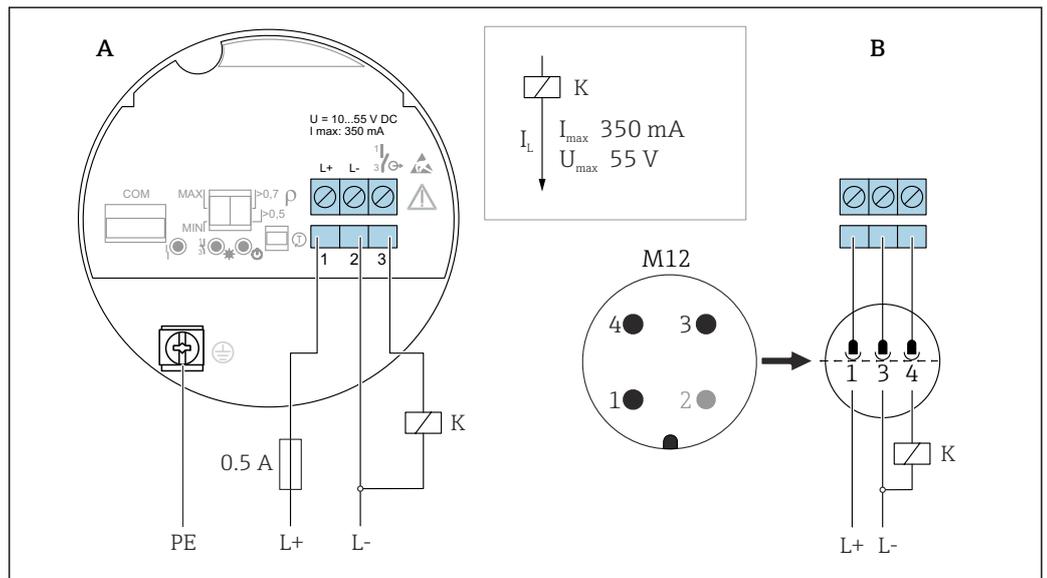
**Residual voltage**

$U < 3 \text{ V}$  (for switched through transistor)

**Behavior of output signal**

- OK status: switched through
- Demand mode: blocked
- Alarm: blocked

**Terminal assignment**

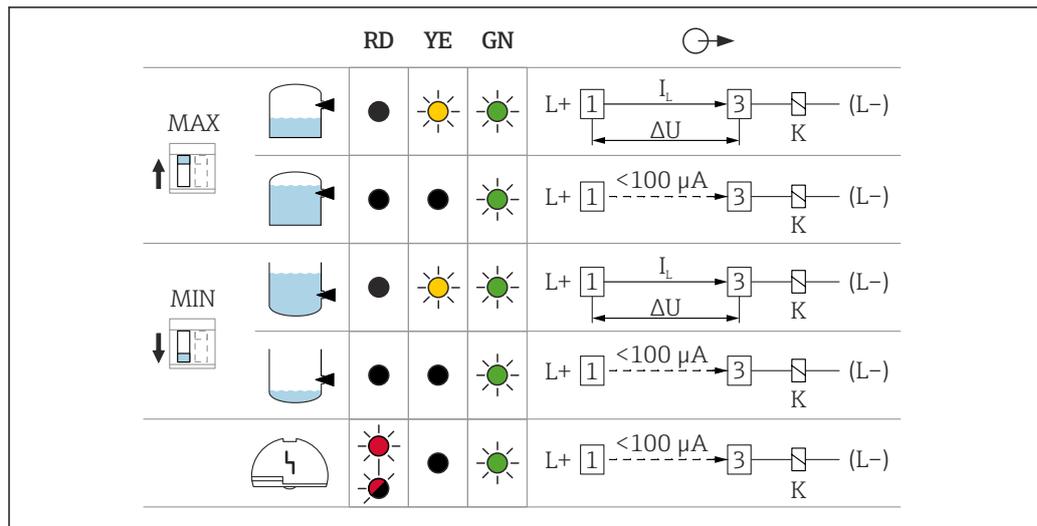


5 3-wire DC-PNP, electronic insert FEL62

A Connection wiring with terminals

B Connection wiring with M12 plug in housing as per EN61131-2 standard

## Behavior of switch output and signaling



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6 Behavior of switch output and signaling, electronic insert FEL62

MAX DIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

RD LED red for warning or alarm

YE LED yellow, switch status

GN LED green, operational status, device on

$I_L$  Load current switched through

## Universal current connection with relay output (electronic insert FEL64)

- Switches the loads via 2 potential-free changeover contacts
- Two galvanically isolated change-over contacts (DPDT), both change-over contacts switch simultaneously
- Functional testing without level change. A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.

### ⚠ WARNING

An error at the electronic insert can cause the permitted temperature for touch-safe surfaces to be exceeded. This presents a risk of burns.

- Do not touch the electronics in the event of an error!

### Supply voltage

$U = 19$  to  $253 V_{AC}$ ,  $50$  Hz/ $60$  Hz/ $19$  to  $55 V_{DC}$

- Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device, and limit the current to 500 mA, e. g. by installing a 0.5 A fuse (slow-blow) in the phase (not the neutral conductor) of the supply circuit.

### Power consumption

$S < 25 VA$ ,  $P < 1.3 W$

### Connectable load

Loads switched via 2 potential-free changeover contacts (DPDT)

- $I_{AC} \leq 6 A$  (Ex de 4 A),  $U \sim \leq AC 253 V$ ;  $P \sim \leq 1500 VA$ ,  $\cos \varphi = 1$ ,  $P \sim \leq 750 VA$ ,  $\cos \varphi > 0.7$
- $I_{DC} \leq 6 A$  (Ex de 4 A) to DC 30 V,  $I_{DC} \leq 0.2 A$  to 125 V

According to IEC 61010, the following applies: Total voltage from relay outputs and power supply  $\leq 300 V$ .

Use electronic insert FEL62 DC PNP for small DC load currents, e. g. for connection to a PLC.

Relay contact material: silver/nickel AgNi 90/10

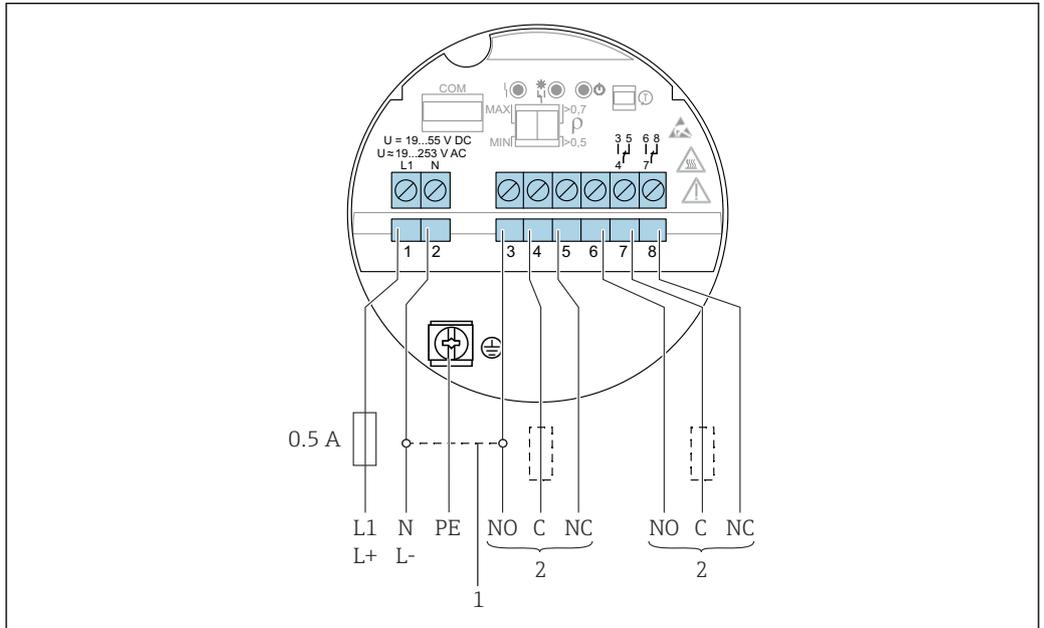
When connecting a device with high inductance, provide a spark suppressor to protect the relay contact. A fine-wire fuse (depending on the connected load) protects the relay contact in the event of a short-circuit.

Both relay contacts switch simultaneously.

**Behavior of output signal**

- OK status: Relay energized
- Demand mode: Relay de-energized
- Alarm: Relay de-energized

**Terminal assignment**

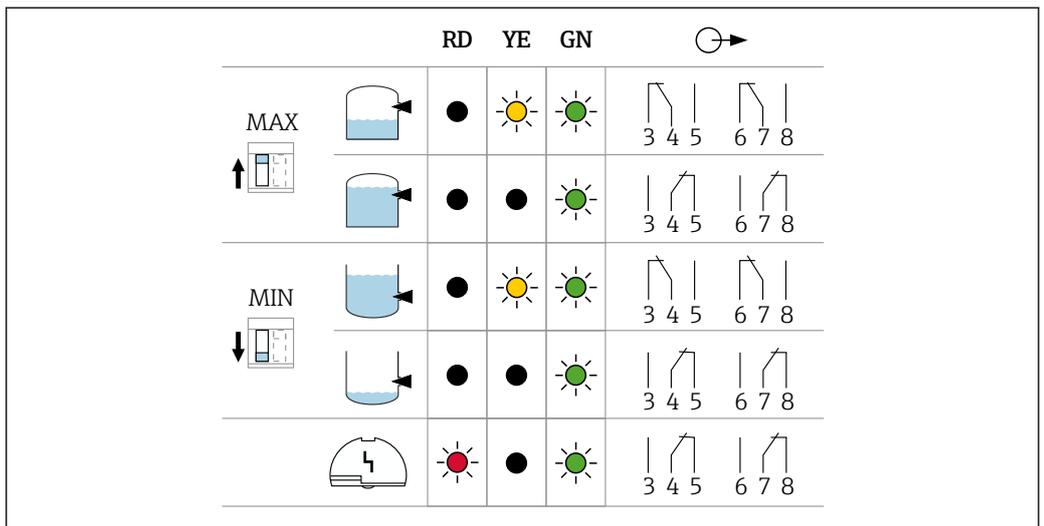


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7 Universal current connection with relay output, electronic insert FEL64

- 1 When bridged, the relay output works with NPN logic
- 2 Connectable load

**Behavior of switch output and signaling**



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8 Behavior of switch output and signaling, electronic insert FEL64

- MAXDIP switch for setting MAX safety mode
- MIN DIP switch for setting MIN safety mode
- RD LED red for alarm
- YE LED yellow, switch status
- GN LED green, operational status, device on

## DC connection, relay output (electronic insert FEL64 DC)

- Switches the loads via 2 potential-free changeover contacts
- Two galvanically isolated change-over contacts (DPDT), both change-over contacts switch simultaneously
- Functional testing without level change. Functional testing of the entire device can be performed using the test button on the electronic insert or with the test magnet (can be ordered as an option) with the housing closed.

### Supply voltage

$U = 9 \text{ to } 20 \text{ V}_{\text{DC}}$

-  Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device, and limit the current to 500 mA, e. g. by installing a 0.5 A fuse (slow-blow) in the supply circuit.

### Power consumption

$P < 1.0 \text{ W}$

### Connectable load

Loads switched via 2 potential-free changeover contacts (DPDT)

- $I_{\text{AC}} \leq 6 \text{ A}$  (Ex de 4 A),  $U \sim \leq \text{AC } 253 \text{ V}$ ;  $P \sim \leq 1500 \text{ VA}$ ,  $\cos \varphi = 1$ ,  $P \sim \leq 750 \text{ VA}$ ,  $\cos \varphi > 0.7$
- $I_{\text{DC}} \leq 6 \text{ A}$  (Ex de 4 A) to DC 30 V,  $I_{\text{DC}} \leq 0.2 \text{ A}$  to 125 V

According to IEC 61010, the following applies: Total voltage from relay outputs and power supply  $\leq 300 \text{ V}$

Preferably use electronic insert FEL62 DC PNP for low DC current loads, e. g. connection to a PLC.

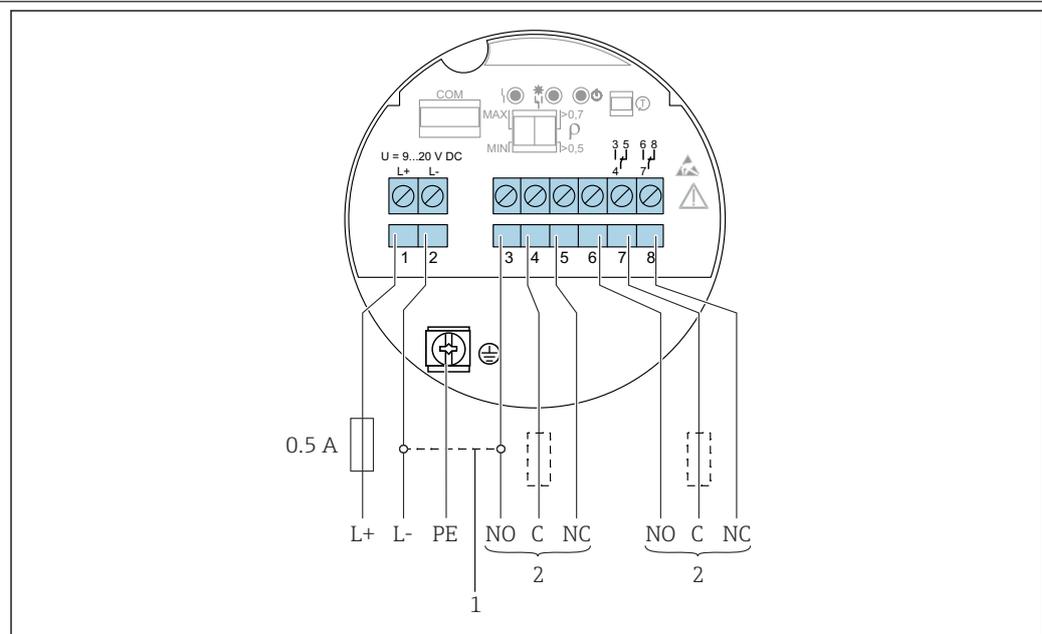
Relay contact material: silver/nickel AgNi 90/10

When connecting a device with high inductance, provide spark quenching to protect the relay contact. A fine-wire fuse (depending on the connected load) protects the relay contact in the event of a short-circuit.

### Behavior of output signal

- OK status: Relay energized
- Demand mode: Relay de-energized
- Alarm: Relay de-energized

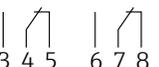
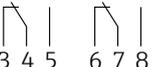
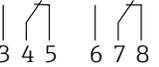
### Terminal assignment



 9 DC connection with relay output, electronic insert FEL64 DC

- 1 When bridged, the relay output works with NPN logic
- 2 Connectable load

**Behavior of switch output and signaling**

		RD	YE	GN	
<b>MAX</b> 		●	☀	●	
		●	●	●	
<b>MIN</b> 		●	☀	●	
		●	●	●	
		☀	●	●	

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**10** Behavior of switch output and signaling, electronic insert FEL64 DC

MAXDIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

RD LED red for alarm

YE LED yellow, switch status

GN LED green, operational status, device on

## PFM output (electronic insert FEL67)

- For connecting to the Nivotester FTL325P and FTL375P switching units from Endress+Hauser
- PFM signal transmission; pulse frequency modulation, superimposed on the power supply along the two-wire cabling
- Functional testing without level change:
  - A functional test can be performed on the device using the test button on the electronic insert.
  - The functional test can also be prompted by disconnecting the supply voltage or triggered directly by the Nivotester FTL325P and FTL375P switching unit.

**Supply voltage**

U = 9.5 to 12.5 V<sub>DC</sub>

Reverse polarity protection



Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device.

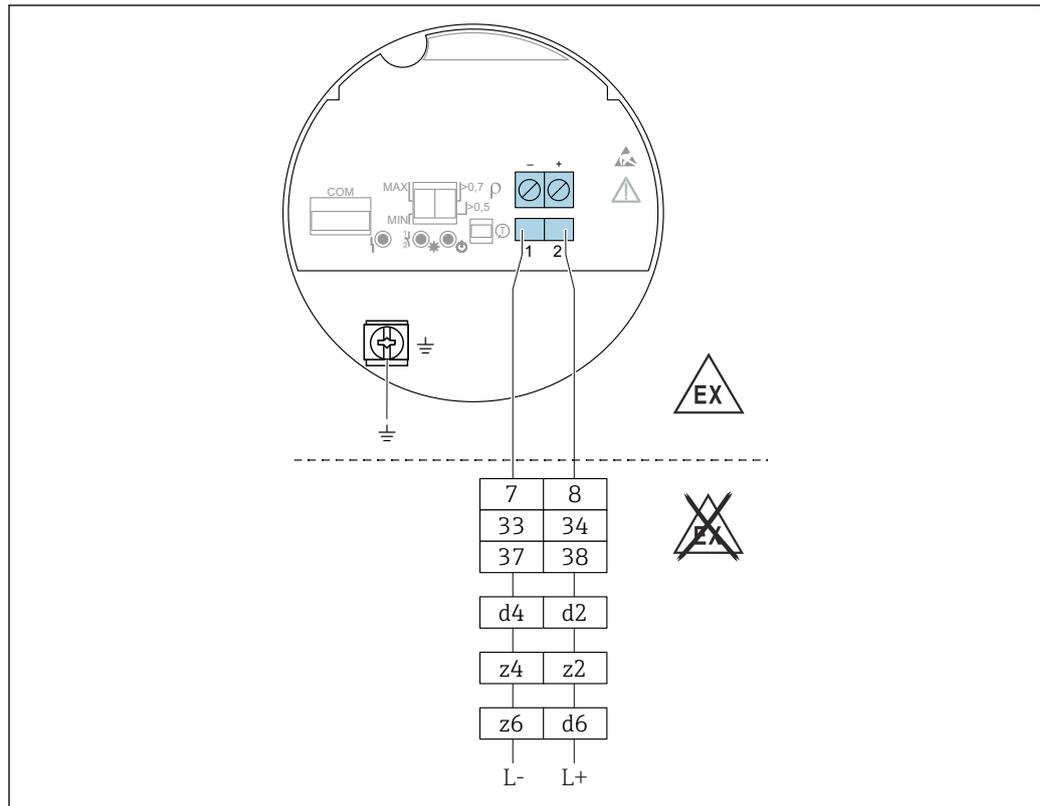
**Power consumption**

P ≤ 150 mW with Nivotester FTL325P or FTL375P

**Behavior of output signal**

- OK status: MAX operating mode 150 Hz, MIN operating mode 50 Hz
- Demand mode: MAX operating mode 50 Hz, MIN operating mode 150 Hz
- Alarm: MAX/MIN operating mode 0 Hz

## Terminal assignment



11 PFM output, electronic insert FEL67

7/ 8: Nivotester FTL325P 1 CH, FTL325P 3 CH input 1

33/ 34: Nivotester FTL325P 3 CH input 2

37/ 38: Nivotester FTL325P 3 CH input 3

d4/ d2: Nivotester FTL375P input 1

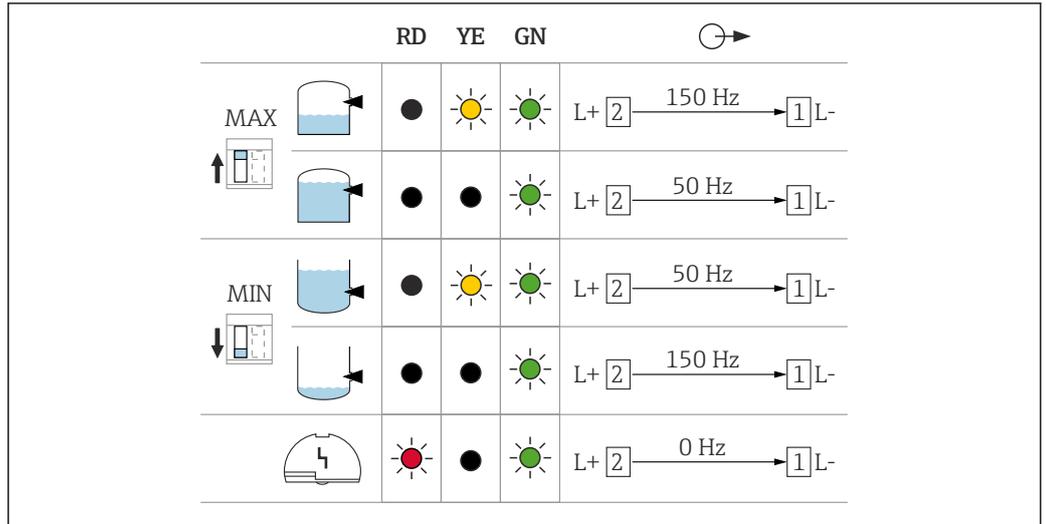
z4/ z2: Nivotester FTL375P input 2

z6/ d6: Nivotester FTL375P input 3

## Connection cable

- Maximum cable resistance: 25  $\Omega$  per core
- Maximum cable capacitance: < 100 nF
- Maximum cable length: 1 000 m (3 281 ft)

**Behavior of switch output and signaling**



12 Switching behavior and signaling, electronic insert FEL67

MAX DIP switch for setting MAX safety mode  
 MIN DIP switch for setting MIN safety mode  
 RD LED red for alarm  
 YE LED yellow, switch status  
 GN LED green, operational status, device on

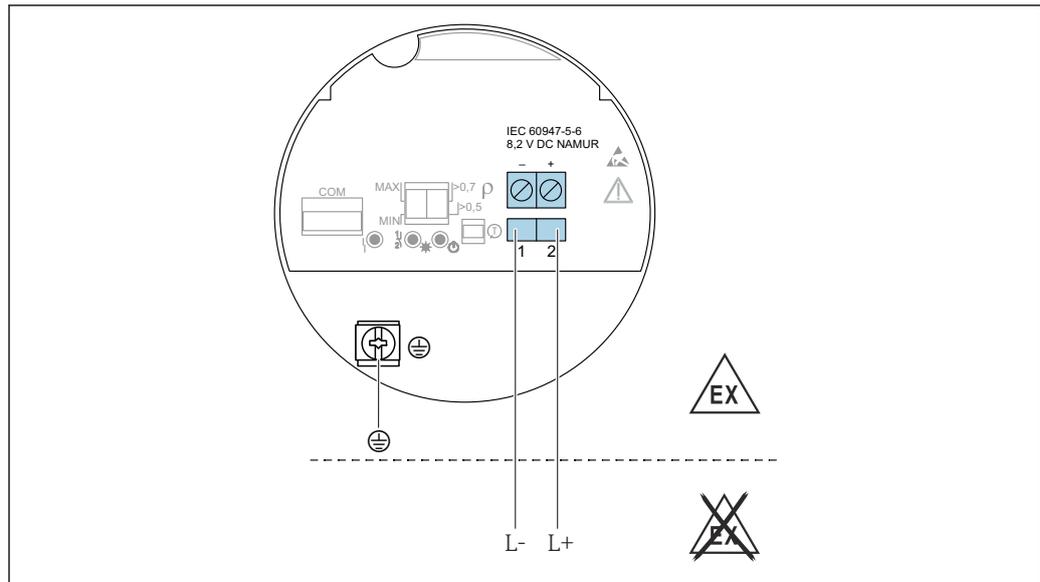
**i** The switches for MAX/MIN on the electronic insert and the FTL325P switching unit must be set according to the application. Only then is it possible to perform the functional test correctly.

**2-wire NAMUR > 2.2 mA/ < 1.0 mA (electronic insert FEL68)**

- For connection to the isolating switch repeater as per NAMUR (IEC 60947-5-6), e.g. Nivotester FTL325N from Endress+Hauser
- Signal transmission H-L edge 2.2 to 3.8 mA/0.4 to 1.0 mA as per IEC 60947-5-6 (NAMUR) on two-wire cabling
- Functional testing without level change. A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.  
 The functional test can also be triggered by interrupting the supply voltage or activated directly from the Nivotester FTL325N.

<b>Supply voltage</b>	U = 8.2 V <sub>DC</sub>  <b>i</b> Pay attention to the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device.
<b>Power consumption</b>	NAMUR IEC 60947-5-6
<b>Behavior of output signal</b>	<ul style="list-style-type: none"> <li>OK status: output current 2.2 to 3.8 mA</li> <li>Demand mode: output current 0.4 to 1.0 mA</li> <li>Alarm: output current 1.0 mA</li> </ul>

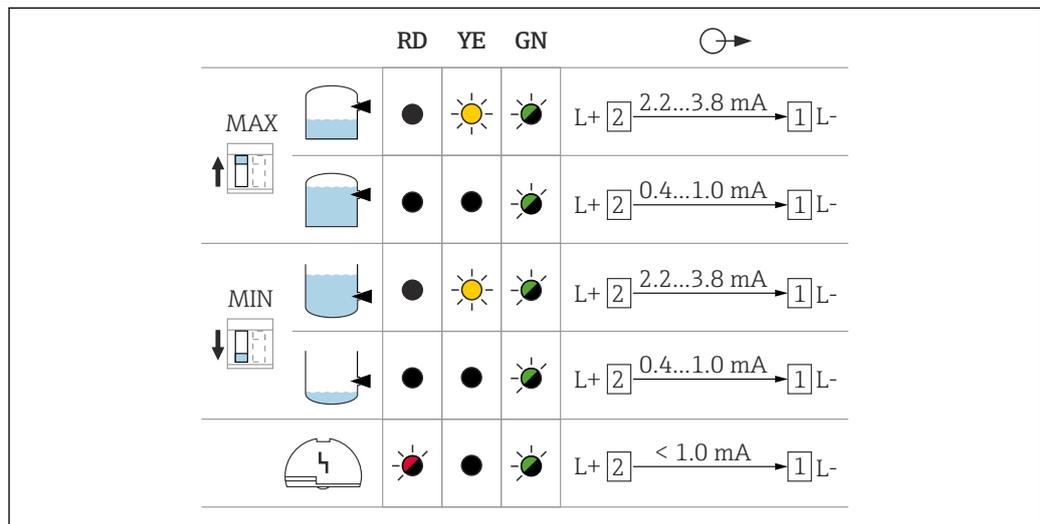
## Terminal assignment



A0036066

13 2-wire NAMUR  $\geq 2.2 \text{ mA} / \leq 1.0 \text{ mA}$ , electronic insert FEL68

## Behavior of switch output and signaling



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14 Behavior of switch output and signaling, electronic insert FEL68

MAX DIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

RD LED red for alarm

YE LED yellow, switch status

GN LED green, operational status, device on

### **i** Use of electronic insert FEL68 (2-wire NAMUR) in conjunction with Bluetooth or Heartbeat Verification + Monitoring

Ordering information in the Product Configurator:

- Order code for "Accessories", option NG "Prepared for Bluetooth"
- Order code for "Application package", option EL "Prepared for Heartbeat Verification + Monitoring"

The order number of the **Bluetooth module, including the required battery**, are subsequently displayed in the Product Configurator.

Order options that must be selected together, or that are mutually exclusive, are automatically displayed in the Product Configurator.

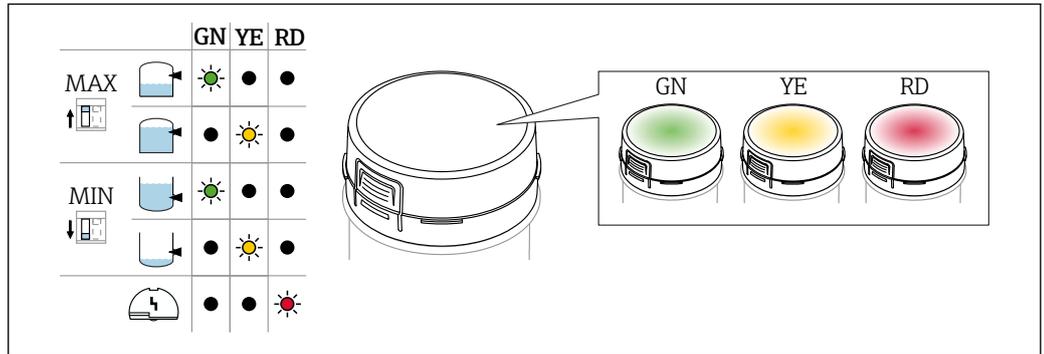
## LED module VU120 (optional)

**Supply voltage**  $U = 12 \text{ to } 55 \text{ V}_{\text{DC}}$ ,  
 $U = 19 \text{ to } 253 \text{ V}_{\text{AC}}, 50 \text{ Hz}/60 \text{ Hz}$

**Power consumption**  $P \leq 0.7 \text{ W}, S < 6 \text{ VA}$

**Current consumption**  $I_{\text{max}} = 0.4 \text{ A}$

### Signaling of operational status



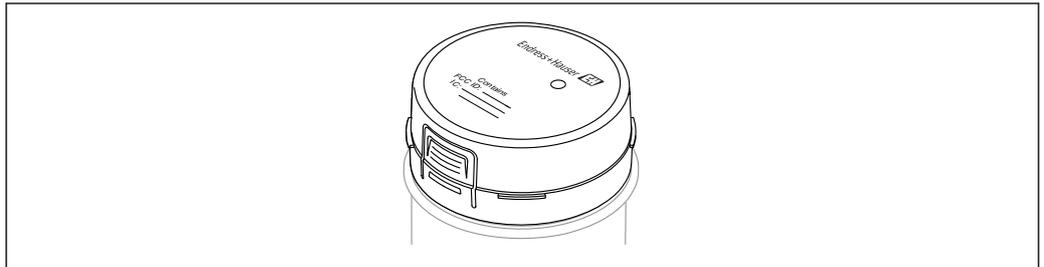
15 LED module, the LED lights up in green (GN), yellow (YE) or red (RD)

A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.

See the accompanying Operating Instructions for more detailed information on connection and the switching states. The documentation currently available can be found on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

## Bluetooth module and Heartbeat Technology

### Bluetooth module VU121 (optional)



16 Bluetooth module VU121

- The Bluetooth module can be connected via the COM interface to the following electronic inserts: FEL61, FEL62, FEL64, FEL64 DC, FEL67, FEL68 (2-wire NAMUR).
- The Bluetooth module is only available in conjunction with the Heartbeat Verification + Monitoring application package.
- The Bluetooth module with battery is suitable for use in hazardous areas.
- The Bluetooth module must be ordered separately, including the required battery, for use in conjunction with electronic insert FEL68 (2-wire NAMUR).

### Batteries

 The battery is categorized as dangerous goods when transported by air and may not be installed in the device when shipped.

 Replacement batteries can be purchased from a specialist retailer. Only the following types of AA 3.6 V lithium batteries made by the manufacturers listed below are suitable as replacement batteries:

- SAFT LS14500
- TADIRAN SL-360/s
- XENOENERGY XL-060F

### Special battery in conjunction with electronic insert FEL68 (2-wire NAMUR)

- For energy-related reasons, the Bluetooth module VU121 requires a special battery when operated with electronics insert FEL68 (2-wire NAMUR).
- The service life of the Bluetooth module without replacing the battery is at least 5 years with a maximum of 60 downloads of complete datasets (at ambient temperatures between 10 to 40 °C (50 to 104 °F)).

### Approvals

The Bluetooth module is approved for use in the following types of protection for devices: Ex i, Ex d, Ex e or Ex t. The temperature class of the device is limited to T4 to T1 if the Bluetooth module is used in type of protection Ex i /IS in conjunction with electronic insert FEL68 (2-wire NAMUR) and the required battery in the Bluetooth module.

### Additional technical data

- Free-field range: 50 m (165 ft) max.
- Operation radius with intervisibility around the device: 10 m (33 ft)

 For documentation on radio approvals, see the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

### Functions

 Additional details in the "Operability" section.

## Heartbeat Technology

### Heartbeat Technology module

The software package consists of 3 modules. These three modules combined check, evaluate and monitor device functionality and process conditions.



- Heartbeat Diagnostics
- Heartbeat Verification
- Heartbeat Monitoring

 For more detailed information, see the "Application packages" section.

## Performance characteristics

### Reference operating conditions

- Ambient temperature: +23 °C (+73 °F)
- Process temperature: +23 °C (+73 °F) ±5 °C (9 °F)
- Density (water): 1 g/cm<sup>3</sup>
- Medium viscosity: 1 mPa·s
- Process pressure: unpressurized
- Sensor installation: vertically from above
- Density selection switch: > 0.7 g/cm<sup>3</sup> (SGU)
- Switch direction of sensor: uncovered to covered

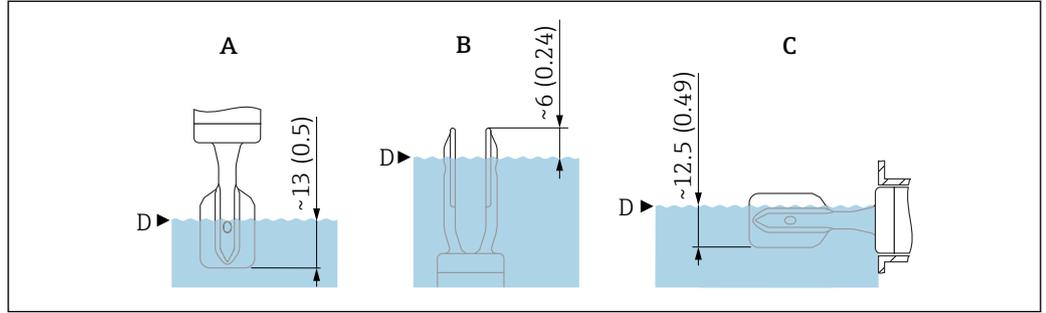
### Take switch point into consideration

The following are typical switch points, depending on the orientation of the point level switch and coating.

(Water +23 °C (+73 °F)).

**i** Minimum distance between the fork tip and the tank wall or pipe wall: 10 mm (0.39 in)

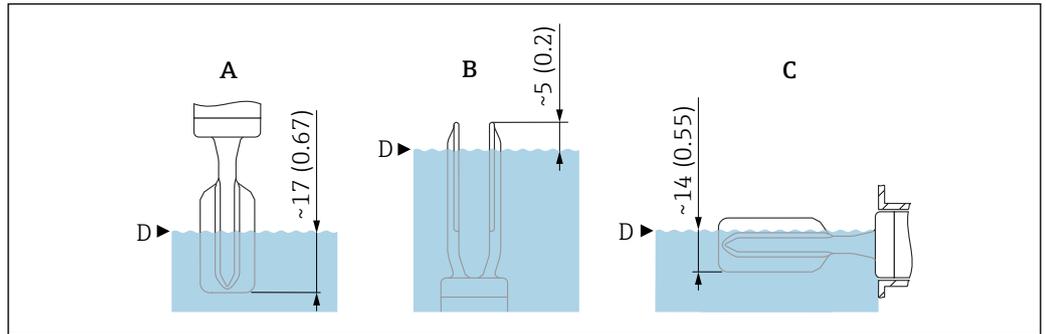
*Plastic-coated tuning fork*



**17** Typical switch points, plastic-coated tuning fork. Unit of measurement mm (in)

- A Installation from above
- B Installation from below
- C Installation from the side
- D Switch point

*Enamel-coated tuning fork*



**18** Typical switch points, enamel-coated tuning fork. Unit of measurement mm (in)

- A Installation from above
- B Installation from below
- C Installation from the side
- D Switch point

**Measured error**

- At reference operating conditions:
- Plastic coating: -0.2 to -1.2 mm (-0.008 to 0.05 in)
  - Enamel coating: 0.0 to +0.9 mm (0 to 0.04 in)

**Hysteresis**

- At reference operating conditions:
- Plastic coating: 2.5 mm (0.098 in)
  - Enamel coating: 3.5 mm (0.14 in)

**Non-repeatability**

- At reference operating conditions:
- Plastic coating: 0.1 mm (0.004 in)
  - Enamel coating: 0.3 mm (0.012 in)

**Influence of the process temperature**

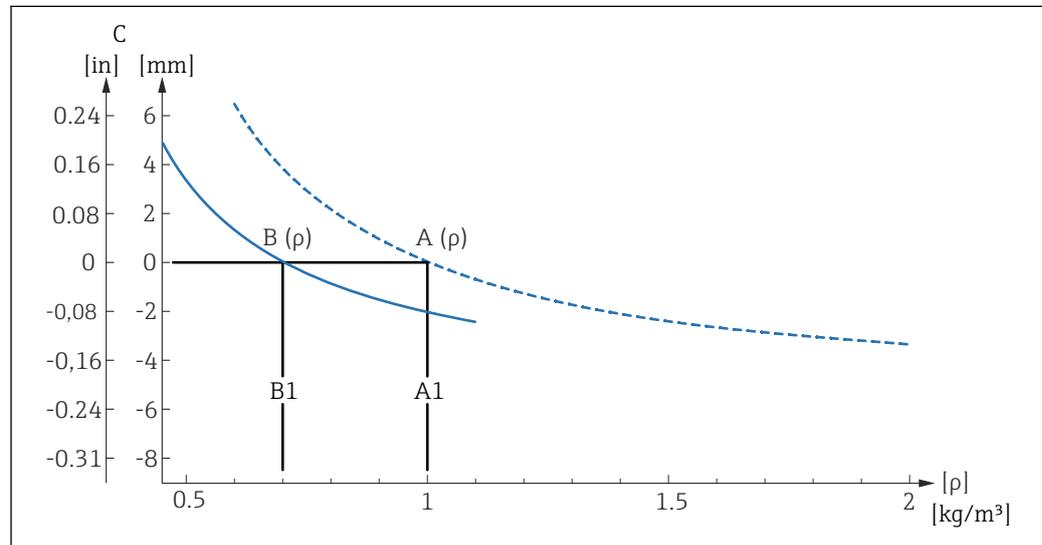
- Temperature range and switch point shift
- ECTFE, PFA: maximum -50 to +120 °C (-58 to +248 °F)  
Switch point shift between 1 to 3.0 mm (+0.04 to 0.12 in)
  - Enamel: maximum -50 to +150 °C (-58 to +302 °F)  
Switch point shift between 1.05 to 2.0 mm (0.04 to 0.08 in)

### Influence of the process pressure

#### Pressure range and switch point shift

- ECTFE, PFA: maximum 0 to 40 bar (0 to 580 psi)  
Switch point shift between 0 to -2.0 mm (0 to -0.08 in)
- Enamel: maximum 0 to 25 bar (0 to 363 psi)  
Switch point shift between 0 to -1.0 mm (0 to -0.04 in)

### Influence of the density of the process medium (at room temperature and normal pressure)



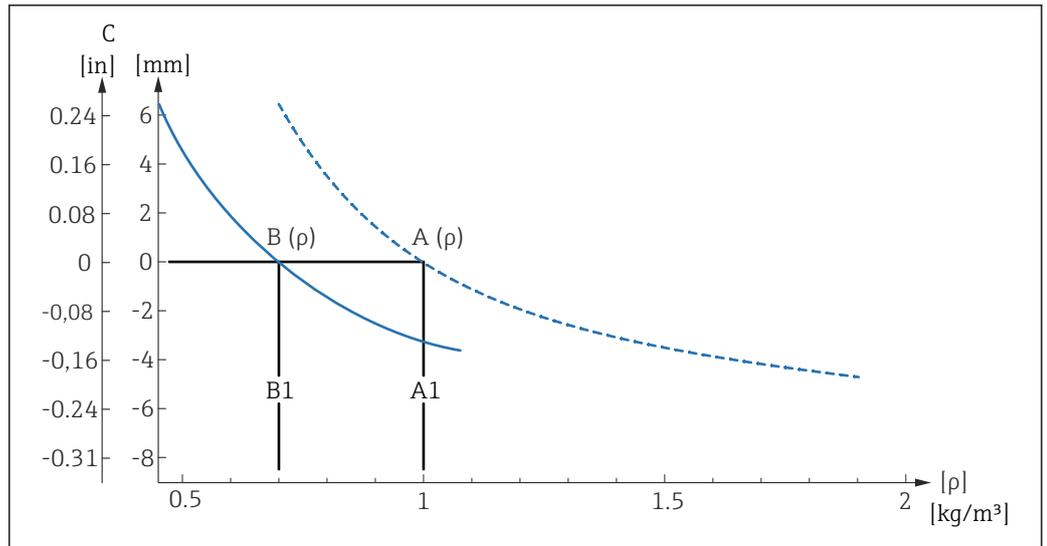
A0042241

19 Reference switch points via density, plastic coating (ECTFE, PFA)

- A Density switch setting ( $\rho > 0.7$ )
- A1 Reference operating condition  $\rho = 1.0 \text{ kg/m}^3$
- B Density switch setting ( $\rho > 0.5$ )
- B1 Reference operating condition  $\rho = 0.7 \text{ kg/m}^3$
- C Switch point deviation

#### Density setting

- $\text{TK}_{\text{type}}$ , [mm/10 k]
  - $\rho > 0.7$ : -0.25
  - $\rho > 0.5$ : -0.3
- Pressure<sub>type</sub>, [mm/10 bar]
  - $\rho > 0.7$ : -0.3
  - $\rho > 0.5$ : -0.4



20 Reference switch points via density, enamel coating

- A Density switch setting ( $\rho > 0.7$ )
- A1 Reference operating condition  $\rho = 1.0 \text{ kg/cm}^3$
- B Density switch setting ( $\rho > 0.5$ )
- B1 Reference operating condition  $\rho = 0.7 \text{ kg/cm}^3$
- C Switch point deviation

Density setting

- TK<sub>type</sub>, [mm/10 k]
  - $\rho > 0.7$ : -0.1
  - $\rho > 0.5$ : -0.15
- Pressure<sub>type</sub>, [mm/10 bar]
  - $\rho > 0.7$ : -0.3
  - $\rho > 0.5$ : -0.4

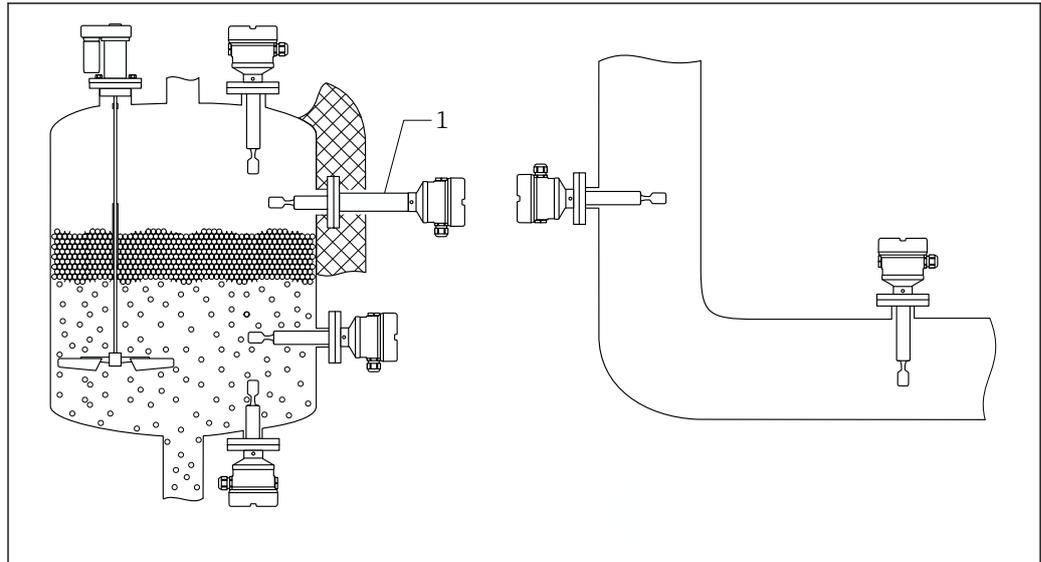
## Installation

 Open the device only in a dry environment!

**Mounting location, orientation**

Installation instructions

- Any orientation for device with short pipe up to approx. 500 mm (19.7 in)
- Vertical orientation for device with long pipe
- Minimum distance between the fork tip and the tank wall or pipe wall: 10 mm (0.39 in)



A0042153

21 Examples of installation in a vessel, pipe or tank

1 Temperature spacer/pressure-tight feedthrough (optional) for tank with insulation and/or high process temperatures

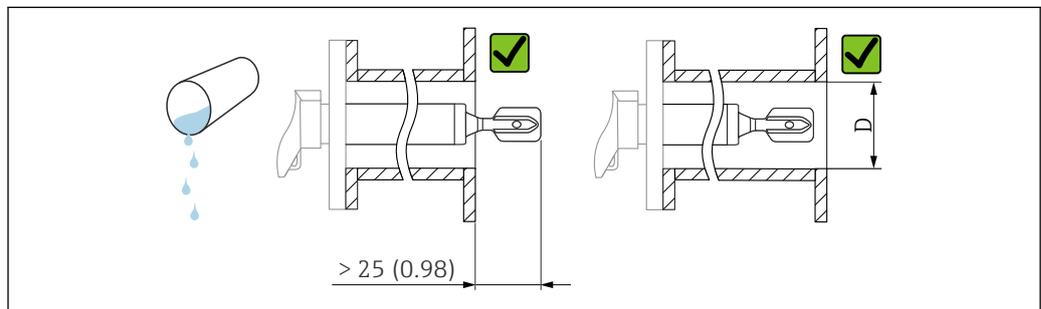
## Installation instructions

### Take viscosity into consideration

Low viscosity

**i** Low viscosity, e. g. water: < 2 000 mPa·s

It is permitted to position the tuning fork within the installation socket.



A0042204

22 Installation example for low-viscosity liquids. Unit of measurement mm (in)

D Diameter of installation socket: at least 50 mm (2.0 in)

High viscosity

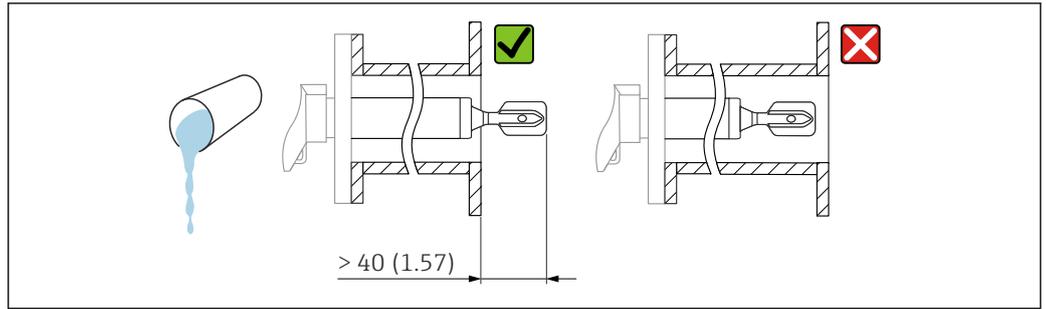
#### NOTICE

**Highly viscous liquids may cause switching delays.**

- ▶ Make sure that the liquid can run off the tuning fork easily.
- ▶ Deburr the socket surface.

**i** High viscosity, e. g. viscous oils: < 10 000 mPa·s

The tuning fork must be located outside the installation socket!

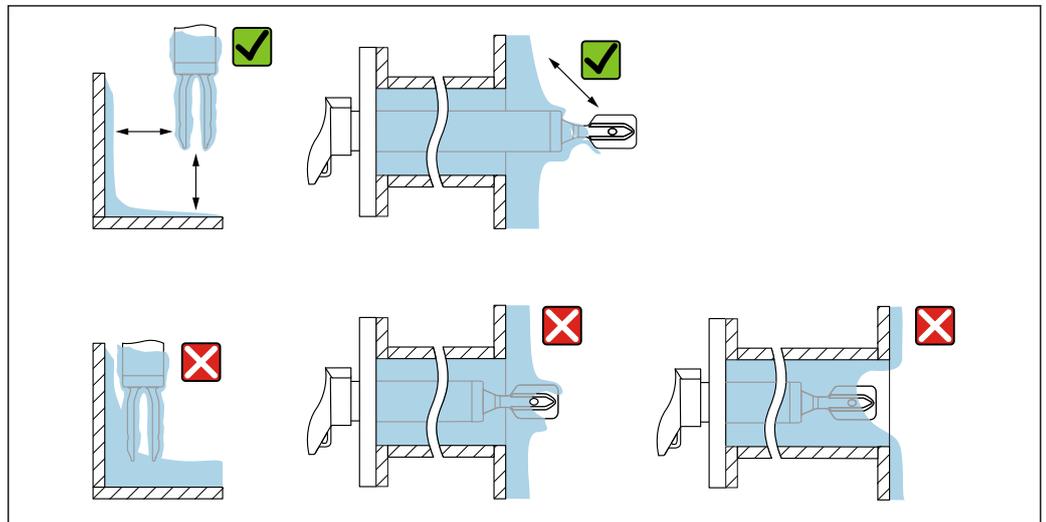


A0042205

23 Installation example for a highly viscous liquid. Unit of measurement mm (in)

**Avoid buildup**

- Use short installation sockets to ensure that the turning fork can project freely into the vessel
- Install preferably flush mount on vessels or in pipes
- Leave sufficient distance between the buildup expected on the tank wall and the tuning fork

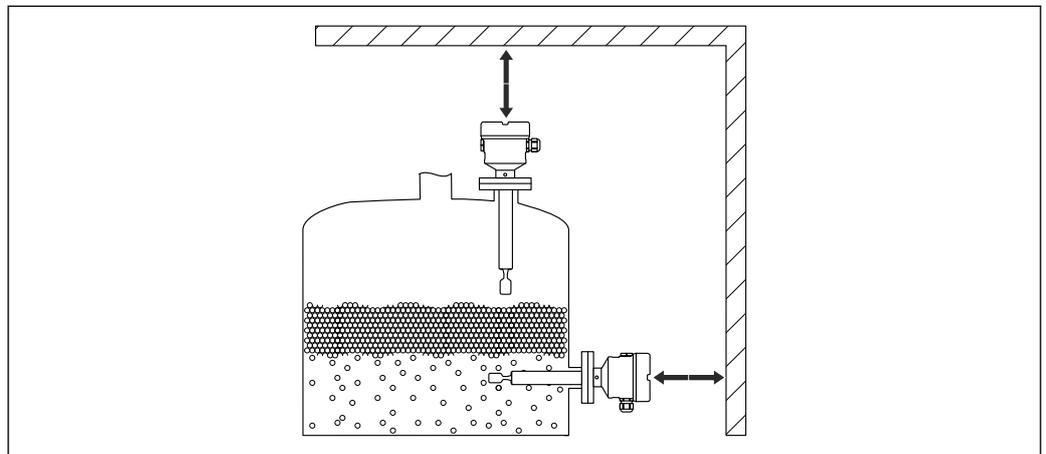


A0042206

24 Installation examples for a highly viscous process medium

**Take clearance into consideration**

Allow sufficient space outside the tank for mounting, connection and settings involving the electronic insert.

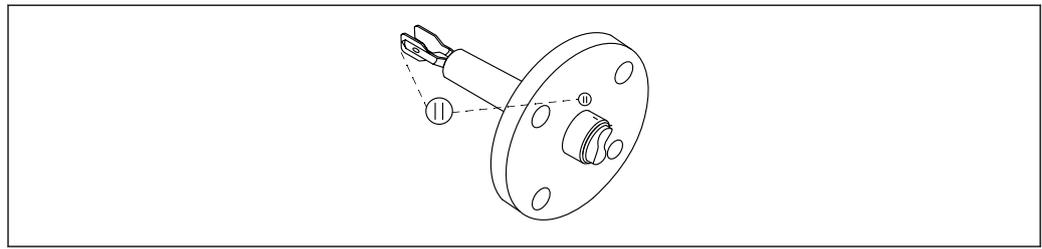


A0033236

25 Take clearance into consideration

**Align the tuning fork with the marking**

The tuning fork can be aligned with the help of the marking (II symbol) on the rear of the flange. Medium can thus run off easily and buildup is avoided.

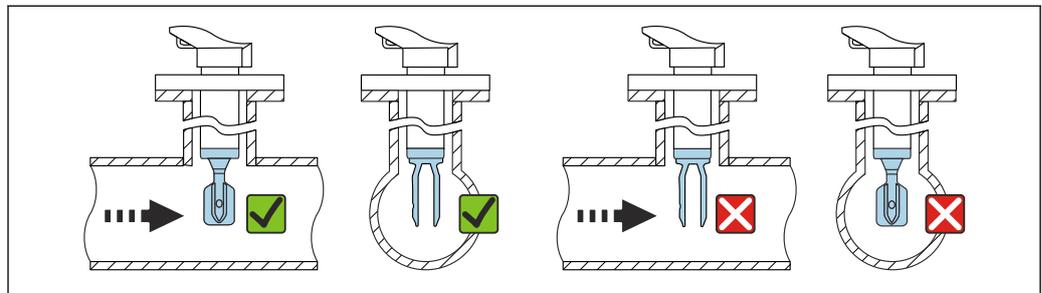


A0042207

▣ 26 Marking on flange to align the tuning fork

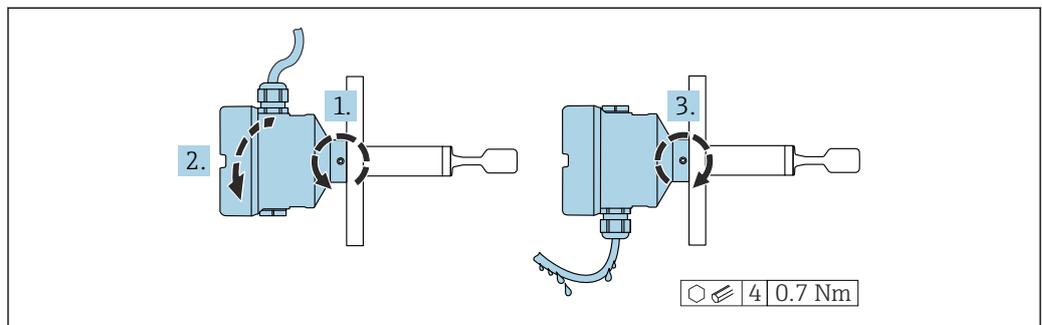
**Installing in pipes**

- Flow velocity up to 5 m/s with viscosity 1 mPa·s and density 1 g/cm<sup>3</sup> (SGU). Check for correct functioning in the event of other process medium conditions.
- The flow will not be significantly impeded if the tuning fork is correctly aligned and the marking is pointing in the direction of flow.
- The marking is visible when installed.



A0042208

▣ 27 Installation in pipes

**Aligning the cable entry**

A0042214

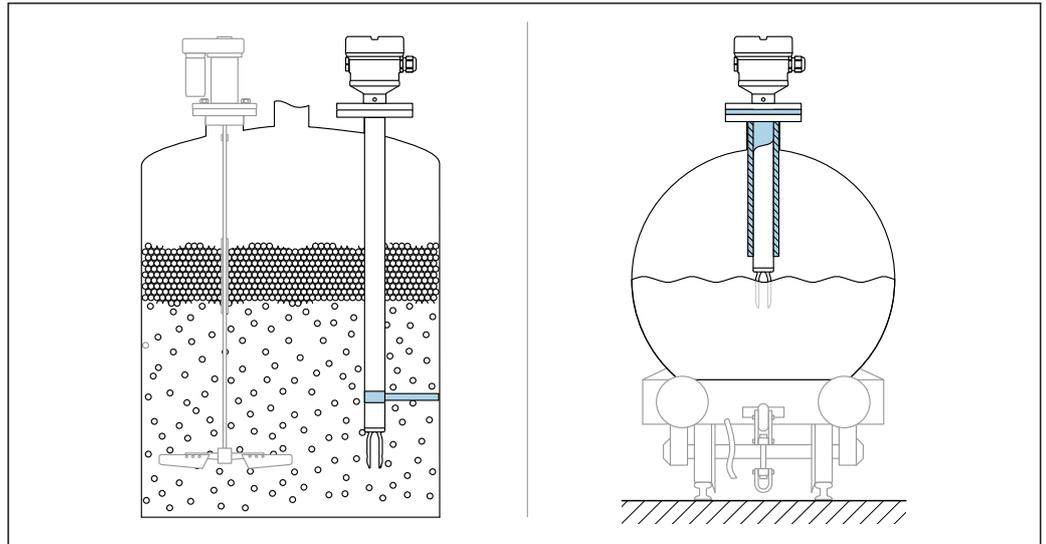
▣ 28 Housing with external locking screw

**Special mounting instructions****Support the device****NOTICE**

**If the device is supported incorrectly, shocks and vibrations can damage the coated surface.**

- ▶ Only use a support in conjunction with ECTFE or PFA plastic coating.
- ▶ Use suitable supports only.

Support the device in the event of severe dynamic load. Maximum lateral loading capacity of the pipe extensions and sensors: 75 Nm (55 lbf ft).



A0031874

29 Examples of support in the event of dynamic load

## Environment

### Ambient temperature range



#### Permitted connection voltage exceeded!

- ▶ For electrical safety reasons, the maximum connection voltage for all electronic inserts at ambient temperatures below  $-40\text{ °C}$  ( $-40\text{ °F}$ ) is limited to a maximum of 35 V DC.

$-40\text{ to }+70\text{ °C}$  ( $-40\text{ to }+158\text{ °F}$ )

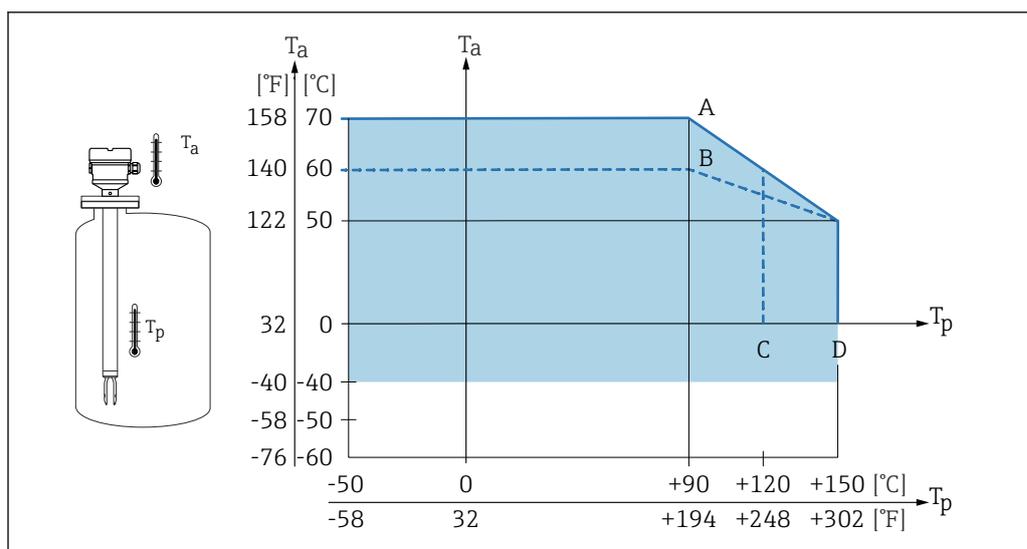
Optionally available to order:

- $-60\text{ °C}$  ( $-76\text{ °F}$ )  
Product Configurator, order code for "Test, Certificate, Declaration" option "JT"
- $-50\text{ °C}$  ( $-58\text{ °F}$ )  
Product Configurator, order code for "Test, Certificate, Declaration" option "JL"

In the hazardous area, the permitted ambient temperature can be limited depending on the zones and gas groups. Pay attention to the information in the Ex documentation (XA).

The minimum permitted ambient temperature of the plastic housing is limited to  $-20\text{ °C}$  ( $-4\text{ °F}$ ); for North America, "indoor use" applies.

Low-temperature electronic inserts are marked LT.



A0042264

30 Permitted ambient temperature  $T_a$  at the housing as a function of the process temperature  $T_p$  in the vessel:

- A Device without LED module; at process temperature and FEL64  $T_p > 90\text{ °C}$  (194 °F), max. load current 4 A  
 B Device with LED module; at process temperature and FEL64  $T_p > 90\text{ °C}$  (194 °F), max. load current 2 A  
 C ECTFE-coated  
 D PFA- or enamel-coated

- i** Bluetooth module (non-Ex):  $-40\text{ to }+85\text{ °C}$  ( $-40\text{ to }+185\text{ °F}$ )
- Bluetooth module (Ex ia):  $-40\text{ to }+65\text{ °C}$  ( $-40\text{ to }+149\text{ °F}$ ), T4
- LED module:  $-40\text{ to }+60\text{ °C}$  ( $-40\text{ to }+140\text{ °F}$ )

Outdoor operation in strong sunlight:

- Mount the device in the shade
- Avoid direct sunlight, particularly in warmer climatic regions
- Use a protective cover, which can be ordered as an accessory

#### Storage temperature

$-40\text{ to }+80\text{ °C}$  ( $-40\text{ to }+176\text{ °F}$ )  
 Optional:  $-50\text{ °C}$  ( $-58\text{ °F}$ ),  $-60\text{ °C}$  ( $-76\text{ °F}$ )

#### Humidity

Operation up to 100 %. Do not open in a condensing atmosphere.

#### Operating altitude

As per IEC 61010-1 Ed.3:  

- Up to 2 000 m (6 600 ft) above sea level
- Can be extended to 3 000 m (9 800 ft) above sea level if overvoltage protection is used

#### Climate class

As per IEC 60068-2-38 test Z/AD

#### Degree of protection

In accordance with DIN EN 60529, NEMA 250

##### IP66/IP68 NEMA 4x/6P

Types of housing:

- Single compartment; plastic
- Single compartment; aluminum, coated; Ex d/XP
- Single compartment; 316L, cast; Ex d/XP
- Dual compartment L-shaped, aluminum, coated; Ex d/XP

**i** Ordering information: Select the required option in the "Electrical connection" order code. Exclusion criteria are taken into account automatically.

If the "M12 plug" option is selected as electrical connection, then **IP66/67 NEMA TYPE 4x** is valid for all housing types.

#### Vibration resistance

As per IEC60068-2-64-2009  
 $a(\text{RMS}) = 50\text{ m/s}^2$ ,  $f = 5\text{ to }2\,000\text{ Hz}$ ,  $t = 3\text{ planes} \times 2\text{ h}$

<b>Shock resistance</b>	In accordance with IEC60068-2-27-2008: $300 \text{ m/s}^2 [= 30 g_n] + 18 \text{ ms}$ $g_n$ : standard acceleration of gravity
<b>Mechanical load</b>	Support the device in the event of severe dynamic load. Maximum lateral loading capacity of the pipe extensions and sensors: 75 Nm (55 lbf ft).  Additional details in the "Support the device" section.
<b>Electromagnetic compatibility</b>	<ul style="list-style-type: none"> <li>■ Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)</li> <li>■ The requirements of EN 61326-3-1 for the safety function (SIL) are fulfilled</li> </ul>  Details are available in the supplementary Functional Safety Manual.

## Process

<b>Process temperature range</b>	<ul style="list-style-type: none"> <li>■ ECTFE: <math>-50</math> to <math>+120</math> °C (<math>-58</math> to <math>+248</math> °F)</li> <li>■ PFA: <math>-50</math> to <math>+150</math> °C (<math>-58</math> to <math>+302</math> °F)</li> <li>■ Enamel: <math>-50</math> to <math>+150</math> °C (<math>-58</math> to <math>+302</math> °F)</li> </ul> <p>Pay attention to the pressure and temperature dependency.  Additional details in the "Process pressure range" section.</p>
<b>Thermal shock</b>	$\leq 120 \text{ K/s}$
<b>Process pressure range</b>	<p> <b>WARNING</b></p> <p><b>The maximum pressure for the measuring device is dependent on the lowest-rated element, with regard to pressure, of the selected components. This means that it is necessary to pay attention to the process connection as well as the sensor.</b></p> <ul style="list-style-type: none"> <li>▶ For pressure specifications, see the "Mechanical construction" section.</li> <li>▶ The measuring device must be operated only within the specified limits!</li> <li>▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.</li> </ul> <p>The following data apply over the entire temperature range. Pay attention to exceptions for flange process connections!</p> <ul style="list-style-type: none"> <li>■ ECTFE, PFA: <math>-1</math> to <math>40</math> bar (<math>-14.5</math> to <math>580</math> psi)</li> <li>■ Enamel: max. <math>-1</math> to <math>25</math> bar (<math>-14.5</math> to <math>363</math> psi)</li> </ul> <p>Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:</p> <ul style="list-style-type: none"> <li>■ pR EN 1092-1: 2005 With regard to its stability-temperature property, the material 1.4435 is identical to 1.4404, which is classed as 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.</li> <li>■ ASME B 16.5</li> <li>■ JIS B 2220</li> </ul> <p>In each case, the lowest value from the derating curves of the device and the selected flange applies.</p> <p>Canadian CRN approval: more details on the maximum pressure values are available in the download area of the product page under "<a href="http://www.endress.com">www.endress.com</a>".</p>
<b>Test pressure</b>	<p>Test pressure = <math>1.5 \cdot P_N</math></p> <ul style="list-style-type: none"> <li>■ ECTFE, PFA: <math>P_N = 40</math> bar (580 psi) Enamel: <math>P_N = 25</math> bar (362.5 psi)</li> <li>■ Membrane burst pressure at 200 bar (2 900 psi)</li> </ul> <p>The device function is limited during the pressure test.</p> <p>The mechanical integrity is guaranteed at pressures up to 1.5 times the process nominal pressure <math>P_N</math>.</p>
<b>State of aggregation</b>	Liquid

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<b>Density</b>	<b>Liquids with density &gt; 0.7 g/cm<sup>3</sup></b> Switch position > 0.7 g/cm <sup>3</sup> (order configuration) <b>Liquids with density 0.5 to 0.8 g/cm<sup>3</sup></b> Switch position > 0.5 g/cm <sup>3</sup> (can be configured via DIP switch) <b>Optionally available to order: Liquids with density &gt; 0.4 g/cm<sup>3</sup> (not for devices with SIL approval)</b> Fixed value that cannot be edited. The function of the DIP switch is interrupted. Order code for "Service", option "Default density setting > 0.4 g/cm <sup>3</sup> "
<b>Viscosity</b>	≤ 10000 mPa·s
<b>Pressure shocks</b>	≤ 20 bar/s (290 psi/s)
<b>Pressure tightness</b>	Up to vacuum  In vacuum evaporation systems, the density of the liquids can drop to a very low value: select density setting 0.4.
<b>Solids contents</b>	∅ ≤ 5 mm (0.2 in)
<b>Lateral loading capacity</b>	≤ 75 Nm

---

## Mechanical construction



For the dimensions, see the Product Configurator: [www.endress.com](http://www.endress.com)

Search for product → click "Configuration" to the right of the product image → after configuration click "CAD"

The following dimensions are rounded values. For this reason, they may deviate slightly from the dimensions given on [www.endress.com](http://www.endress.com).

### Design, dimensions

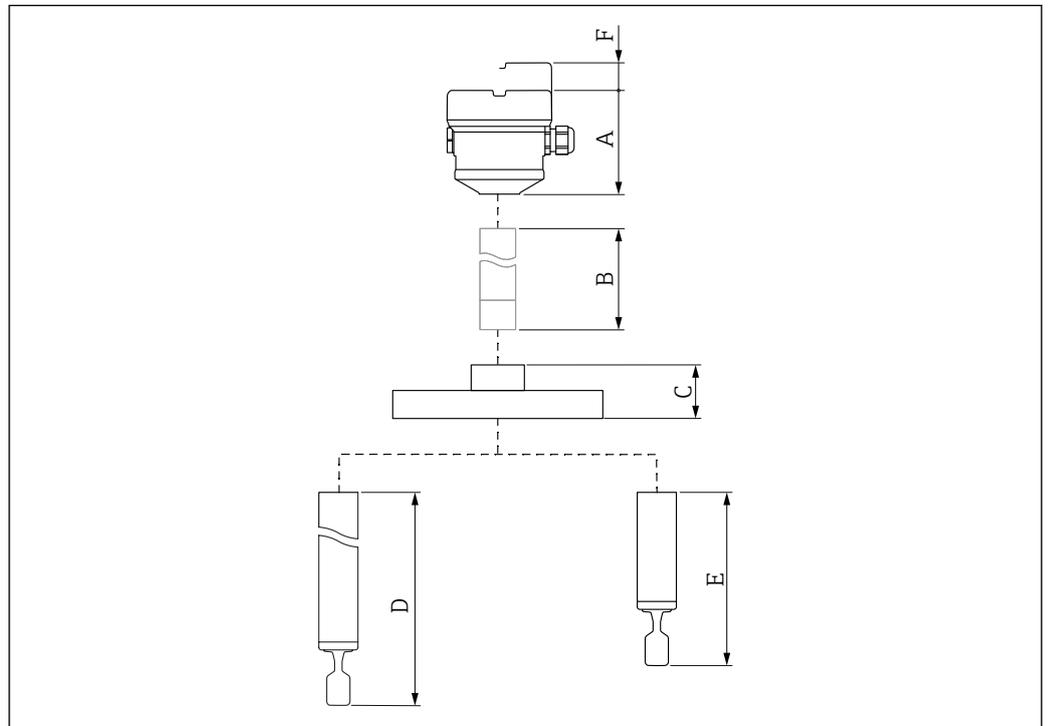
#### Device height

The device height is made up of the following components:

- Housing including cover
- Temperature spacer and/or pressure-tight feedthrough (second line of defense), optional
- Pipe extension or short pipe, optional
- Process connection

The individual heights of the components can be found in the following sections:

- Calculate device height and add the individual heights of the components
- Take the installation clearance into consideration (space that is required to install the device)



A0042256

#### 31 Components for calculating the device height

- A Housing including cover
- B Temperature spacer, pressure-tight feedthrough (optional), details in the Product Configurator
- C Process connection flange
- D Pipe extension
- E Short pipe
- F Installation clearance



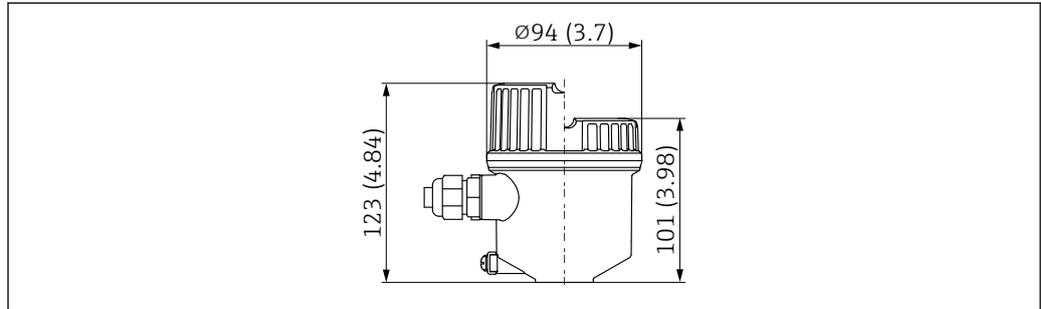
Process connection, sealing surface, pipe extension and tuning fork are plastic-coated or enamel-coated.

### Housing and cover

All housings can be aligned. The locking screw on metal housings can be used to secure the alignment of the housing.

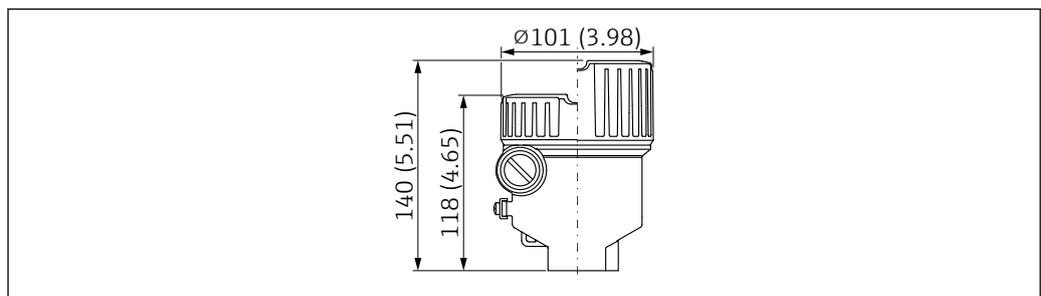
Devices with a Bluetooth or LED module require a high cover (transparent plastic cover or aluminum cover with sight glass). The Bluetooth or LED module cannot be used in conjunction with the 316L single compartment housing, cast.

#### Dimensions of housing and cover



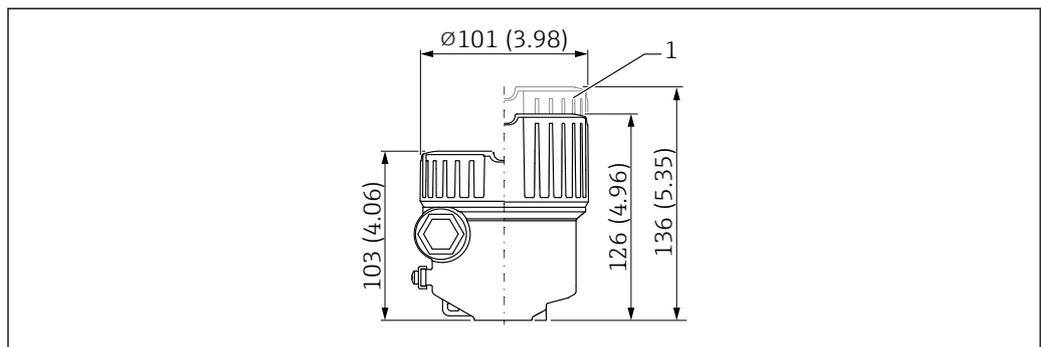
A0035911

- 32 Single compartment; plastic; Product Configurator: order code for "Housing; material", option A. Unit of measurement mm (in)



A0039401

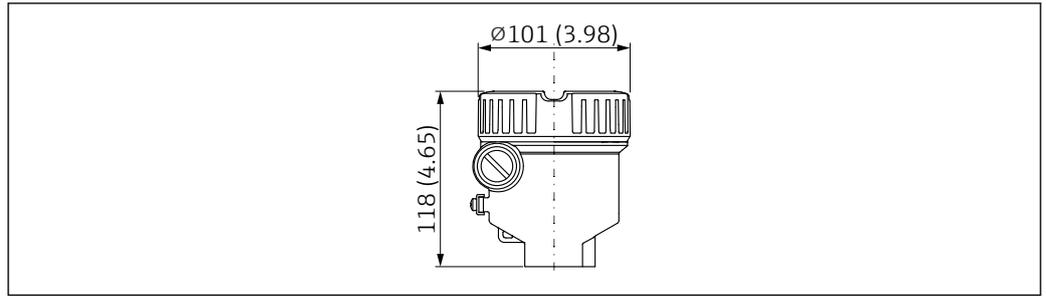
- 33 Single compartment; aluminum, coated; with Ex d/XP approval; Product Configurator: order code for "Housing; material", option B. Unit of measurement mm (in)



A0039402

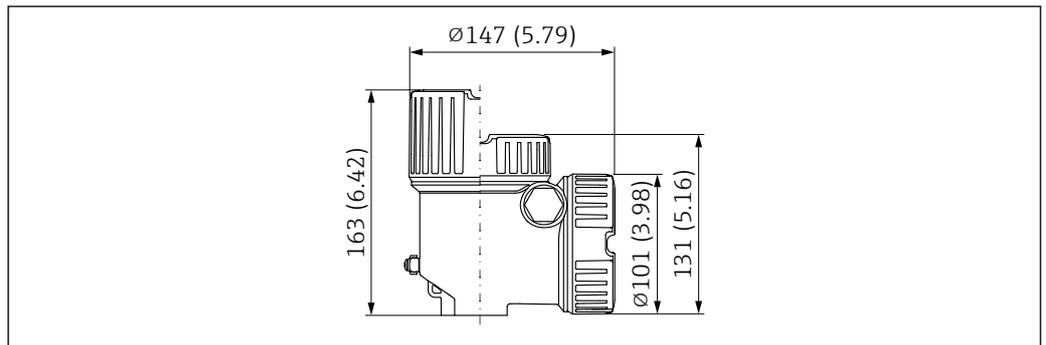
- 34 Single compartment; aluminum, coated; Product Configurator: order code for "Housing; material", option B. Unit of measurement mm (in)

1 Cover for Ex ec approval



A0035590

35 Single compartment 316L, cast; with Ex d/XP approval also; Product Configurator: order code for "Housing; material", option C. Unit of measurement mm (in)



A0035591

36 Dual compartment, L-shaped; aluminum, coated; with Ex d/XP approval also; Product Configurator: order code for "Housing; material", option M. Unit of measurement mm (in)

#### Ground terminal

- Ground terminal inside the housing, max. conductor cross-section 2.5 mm<sup>2</sup> (14 AWG)
- Ground terminal outside the housing, max. conductor cross-section 4 mm<sup>2</sup> (12 AWG)
- If safety extra-low voltage is used to supply power to electronic inserts, do not connect protective ground

#### Cable glands

Cable diameter:

- Plastic:  $\varnothing$ 5 to 10 mm (0.2 to 0.38 in)
- Nickel-plated brass:  $\varnothing$ 7 to 10.5 mm (0.28 to 0.41 in)
- Stainless steel:  $\varnothing$ 7 to 12 mm (0.28 to 0.47 in)

The scope of delivery comprises:

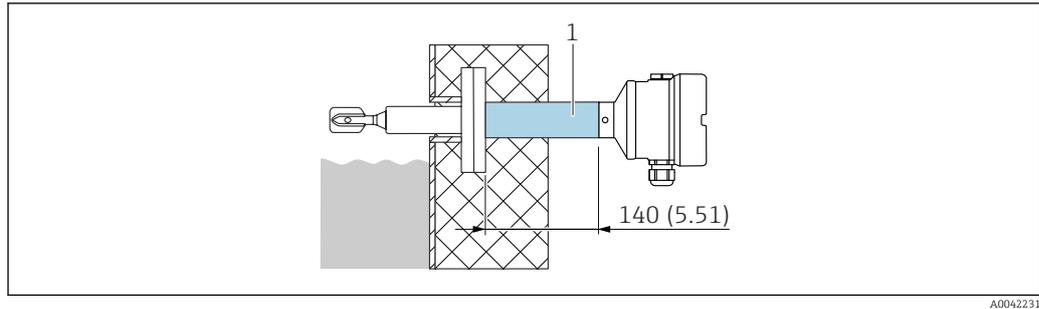
- 1 cable gland installed
- 1 cable gland sealed with dummy plug

**i** A second cable gland (not installed) is also included in the scope of delivery of the relay electronics.

Exceptions: With Ex d/XP, only threaded entries are permitted.

#### Temperature spacer (optional)

Provides sealed insulation for the vessel and a normal ambient temperature for the housing



A0042231

37 Temperature spacer, pressure-tight feedthrough (1). Unit of measurement mm (in)

Product Configurator, order code for "Sensor design":

- Option "MR" for temperature spacer
- Option "MS" for pressure-tight feedthrough (second line of defense)  
In the event of damage to the sensor, protects the housing from exposure to vessel pressures up to 100 bar (1 450 psi).

**i** The "Pressure-tight feedthrough" option can only be selected in conjunction with the "Temperature spacer" option.

### Probe design

#### Short pipe

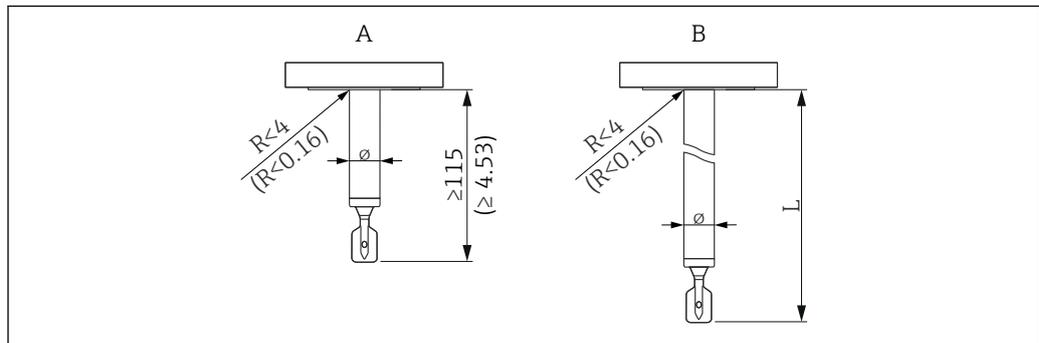
Fixed length (A)

- Base material: 316L
- Sensor length: 115 mm (4.53 in)
- Flanges according to DIN/EN, ASME, JIS from DN 40 / 1½"  
Radius (R) ≤ 4 mm (0.16 in) for DN25/ASME flanges

#### Pipe extension

Variable length L (B)

- Base material: 316L
- Sensor length depends on enamel coating: 148 to 1 200 mm (5.83 to 47.2 in)
- Sensor length depends on plastic coating: 148 to 3 000 mm (5.83 to 118 in)



A0042250

38 Probe design: short pipe, pipe extension. Unit of measurement mm (in)

A Short pipe: fixed length

B Pipe extension: length L variable

Ø Maximum diameter: depends on coating material

R Radius: take into consideration for counterflange

### Coating material and layer thickness

**i** The maximum diameter Ø depends on the coating material.

#### ECTFE

- Lower limit: 0.5 mm (0.02 in)
- Upper limit: 1.6 mm (0.06 in)
- Maximum diameter: Ø 24.6 mm (0.97 in)

**PFA (Edlon™), PFA (Ruby Red), PFA (conductive)**

- Lower limit: 0.45 mm (0.02 in)
- Upper limit: 1.6 mm (0.06 in)
- Maximum diameter:  $\varnothing$  24.6 mm (0.97 in)

**i** PFA (Edlon™): FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

**Enamel**

- Lower limit: 0.4 mm (0.02 in)
- Upper limit: 0.8 mm (0.03 in)
- Maximum diameter:  $\varnothing$  23 mm (0.91 in)

*Properties and benefits of coatings*

**ECTFE (ethylene chlorotrifluoroethylene)**

- Thermoplastic fluoropolymer coating
- Also known as HALAR®
- Very good chemical and corrosion resistance
- High abrasion performance
- Good non-stick properties
- Ideal for use in the chemicals industry

**PFA (perfluoroalkoxy)**

- Properties similar to PTFE (polytetrafluoroethylene) and FEP (perfluoroethylenepropylene)
- Also known as TEFLON®
- Very good chemical and corrosion resistance
- High abrasion performance
- Good non-stick and sliding properties
- High temperature resistance
- Ideal for use in the chemical and pharmaceutical industry
- Available as PFA (Edlon™), PFA (Ruby Red®) or PFA (conductive), developed specifically for use in hazardous areas

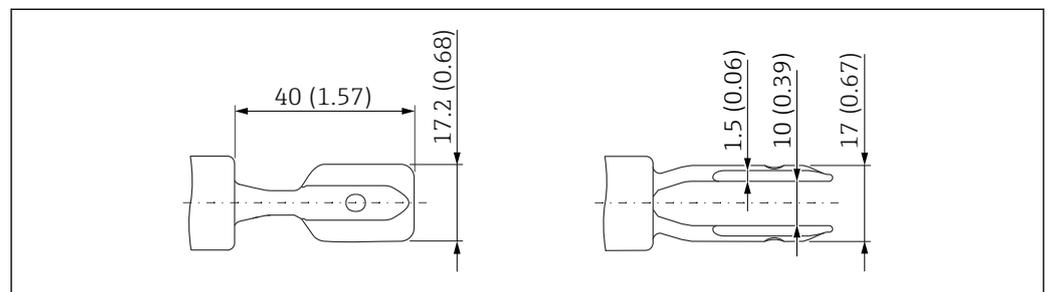
**i** PFA (Edlon™): FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

**Enamel**

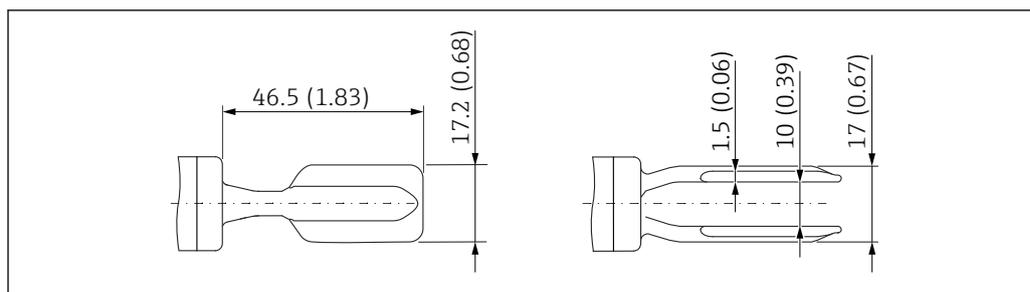
- Glass-like material
- Very good chemical and corrosion resistance
- Acid-resistant
- High temperature resistance
- Dirt-repellent
- Low resistance to impact

**i** Use of the selected coating material influences the approved IIB/IIC gas groups. Pay attention to the information in the safety documentation (XA).

**Tuning fork**



**39** Tuning fork with plastic coating. Unit of measurement mm (in)



A0041851

40 Tuning fork with enamel coating. Unit of measurement mm (in)

### Process connections

ASME B16.5 flanges, RF

Pressure rating	Type	Material	Weight
Cl.150	NPS 1"	316/316L	1.0 kg (2.21 lb)
Cl.150	NPS 1-½"	316/316L	1.5 kg (3.31 lb)
Cl.150	NPS 2"	316/316L	2.4 kg (5.29 lb)
Cl.150	NPS 2"	Enamel 1.0487	2.4 kg (5.29 lb)
Cl.150	NPS 3"	316/316L	4.9 kg (10.8 lb)
Cl.150	NPS 4"	316/316L	7 kg (15.44 lb)
Cl.300	NPS 2"	316/316L	3.2 kg (7.06 lb)
Cl.300	NPS 2"	Enamel 1.0487	3.2 kg (7.06 lb)

EN flanges EN 1092-1, A

Pressure rating	Type	Material	Weight
PN6	DN50	316L (1.4404)	1.6 kg (3.53 lb)
PN10/16	DN100	316L (1.4404)	5.6 kg (12.35 lb)
PN25/40	DN25	316L (1.4404)	1.3 kg (2.87 lb)
PN25/40	DN32	316L (1.4404)	2.0 kg (4.41 lb)
PN25/40	DN40	316L (1.4404)	2.4 kg (5.29 lb)
PN25/40	DN50	316L (1.4404)	3.2 kg (7.06 lb)
PN25/40	DN80	316L (1.4404)	5.9 kg (13.01 lb)

EN flanges EN 1092-1, B1

Pressure rating	Type	Material	Weight
PN25/40	DN50	Enamel 1.0487	3.2 kg (7.06 lb)
PN25/40	DN80	Enamel 1.0487	5.9 kg (13.01 lb)

JIS flanges B2220 (RF)

Pressure rating	Type	Material	Weight
10K	10K 50A	316L (1.4404)	1.7 kg (3.75 lb)

*Process connection, sealing surface*

- Flange ASME B16.5, RF (Raised Face)
- Flange EN1092-1, Form A
- Flange EN1092-1, Form B1
- Flange JIS B2220, RF (Raised Face)

**Weight****Basic weight: 0.65 kg (1.43 lb)**

The basic weight comprises:

- Sensor (short pipe)
- Electronic insert
- Housing: single compartment, plastic with cover



Differences in weight result from the housing, LED or Bluetooth module (incl. high cover).

**In addition to the basic weight:****Bluetooth module**

0.1 kg (0.22 lb)

**LED module**

0.1 kg (0.22 lb)

**Housing**

- Single compartment, aluminum, coated: 0.8 kg (1.76 lb)  
optional LED module or Bluetooth module with high cover: 0.38 kg (0.84 lb)
- 316L cast: 1.21 kg (2.67 lb)
- Dual compartment, L-shaped; aluminum, coated: 1.22 kg (2.69 lb)  
optional LED module or Bluetooth module with high cover: 0.38 kg (0.84 lb)

**Temperature spacer**

0.6 kg (1.32 lb)

**Pressure-tight feedthrough**

0.7 kg (1.54 lb)

**Pipe extension**

- 1 000 mm: 0.9 kg (1.98 lb)
- 100 in: 2.3 kg (5.07 lb)

**Process connections**

See "Process connections" section

**Plastic protective cover**

0.2 kg (0.44 lb)

**Materials****Materials in contact with process****Extension pipe**

- With plastic coating: carrier material: 316L (1.4435 or 1.4404)
- With enamel coating: carrier material: Alloy C4

**Tuning fork**

- With plastic coating: carrier material: 316L (1.4435 or 1.4404)
- With enamel coating: carrier material: Alloy C4

**Flange**

- With plastic coating ECTFE, PFA (Edlon™<sup>1)</sup>, PFA (Ruby Red), PFA (conductive): carrier material: 316L (1.4404)
- With enamel coating: carrier material: A516 Gr.60 (1.0487)

**Materials not in contact with process****Plastic housing**

- Housing: PBT/PC
- Blind cover: PBT/PC
- Transparent cover: PBT/PC or PA12
- Cover seal: EPDM
- Potential equalization: 316L
- Seal under potential equalization: EPDM

1) FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

- Dummy plug: PBT-GF30-FR
- M20 cable gland: PA
- Seal on dummy plug and cable gland: EPDM
- Adapter as replacement for cable glands: 316L
- Adapter for NPT $\frac{3}{4}$ : plastic
- Nameplate: plastic foil
- TAG plate: plastic foil, metal or provided by the customer

#### **Aluminum housing, coated**

- Housing: EN AC 44300 aluminum
- Blind cover: EN AC 44300 aluminum
- Cover with sight glass: EN AC 44300 aluminum, PC Lexan 943A synthetic glass  
Cover with sight glass made of polycarbonate, optionally available to order. For Ex d applications, the sight glass is made from borosilicate.
- Cover sealing materials: HNBR
- Cover sealing materials: FVMQ (in low-temperature version only)
- Nameplate: plastic foil
- TAG plate: plastic foil, stainless steel or provided by the customer
- Cable glands M20: select material (stainless steel, nickel-plated brass, polyamide)

#### **Stainless steel housing**

- Housing: stainless steel AISI 316L (1.4409)
- Cover: AISI 316L (1.4409)
- Cover sealing materials: FVMQ (in low temperature version only)
- Cover sealing materials: HNBR
- Nameplate: stainless steel 316L
- TAG plate: plastic foil, stainless steel or provided by the customer
- Cable glands M20: select material (stainless steel, nickel-plated brass, polyamide)

#### **Process connections**

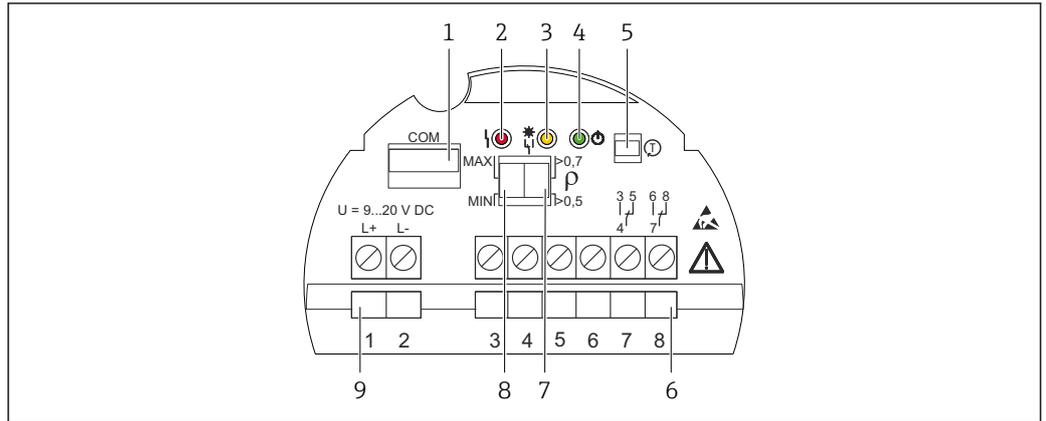
- Flanges, plastic-coated: 316L (1.4404)
- Flanges, enamel-coated: 1.0487 (ASTMA 529)
- Additional flanges:
  - According to EN/DIN 1092-1 from DN 25
  - According to ASME B16.5 from 1",
  - According to JIS B 2220 (RF) from 10K50

## **Operability**

### **Operating concept**

- Operation with button and DIP switches on the electronic insert
- Display with optional Bluetooth module and SmartBlue (app) via Bluetooth® wireless technology
- Indication of operational status (switch status or alarm status) with optional LED module (lights visible from the outside)
  - For plastic housing and aluminum housing (standard and Ex d) in conjunction with the DC-PNP (electronic insert FEL62) and relay electronics (electronic inserts FEL64, FEL64DC)
  - Ordering information: Product Configurator, order code for "Display; operation" option "B"

**Elements on the electronic insert**



41 Example of electronic insert FEL64DC

- 1 COM interface for additional modules (LED module, Bluetooth module)
- 2 LED, red, for warning or alarm
- 3 LED, yellow, switch status
- 4 LED, green, operational status (device is on)
- 5 Test button, activates functional test
- 6 Terminals (3 to 8), relay contact
- 7 DIP switch for configuring density, 0.7 or 0.5
- 8 DIP switch for configuring MAX/MIN safety mode
- 9 Terminals (1 to 2), power supply

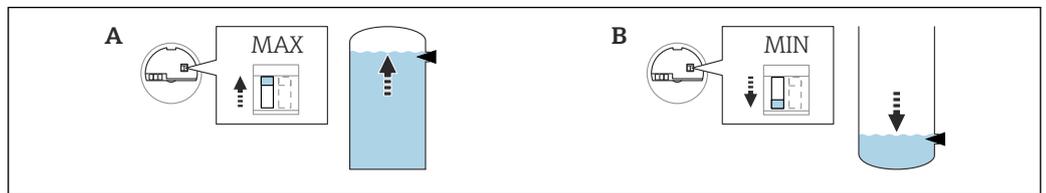
**Terminals**

Terminals for cable cross-section up to 2.5 mm<sup>2</sup> (14 AWG). Use ferrules for the wires.

**Local operation**

**Operation at electronic insert**

*MAX/MIN fail-safe mode*

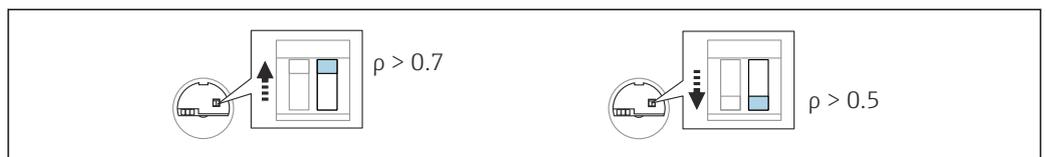


42 Switch position on the electronic insert for fail-safe mode MAX/MIN

- A MAX (maximum fail-safe mode)
- B MIN (minimum fail-safe mode)

- Minimum/maximum quiescent current safety can be switched at the electronic insert
- MAX = Maximum safety: When the tuning fork is covered, the output switches in the direction of demand. Use this for overflow prevention, for example.
- MIN = Minimum safety: When the tuning fork is uncovered, the output switches in the direction of demand. Use this for dry-running protection of pumps, for example.

*Density switchover*



43 Switch position on the electronic insert for density

Factory setting for density: 0.7

**Liquids with density > 0.7 g/cm<sup>3</sup>**

Switch position > 0.7 g/cm<sup>3</sup> (order configuration)

**Liquids with density: 0.5 to 0.8 g/cm<sup>3</sup>**

Switch position > 0.5 g/cm<sup>3</sup> (can be configured via DIP switch)

**Optionally available to order: Liquids with density > 0.4 g/cm<sup>3</sup> (not for devices with SIL approval)**

Fixed value that cannot be edited. The function of the DIP switch is interrupted.

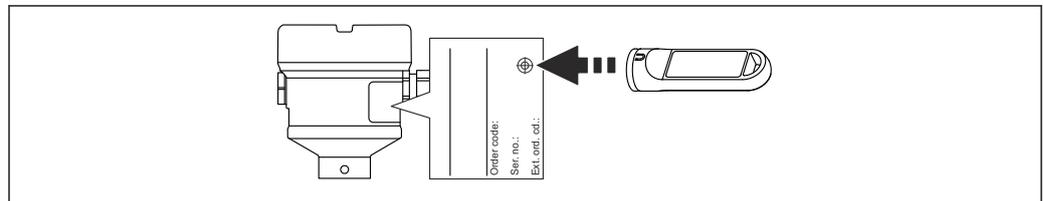
Order code for "Service", option "Default density setting > 0.4 g/cm<sup>3</sup>".

*Functional test of the electronic switch with a test magnet*

The test magnet can be ordered as an option; Product Configurator: order code for "Enclosed accessories", option R6 "Test magnet".

Possible for the following electronic inserts: FEL62, FEL64, FEL64DC, FEL68.

The functional test with the test magnet can be performed without opening the device. To perform the test, hold the test magnet against the marking on the nameplate of the housing. The functional test with the test magnet acts in the same way as the functional test using the test button on the electronic insert.



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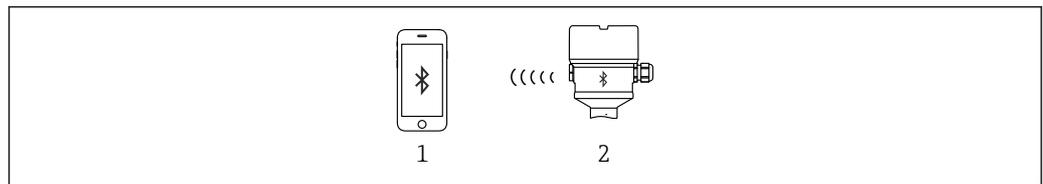
44 Functional test with test magnet

**Local display****LED module VU120 (optional)**

Depending on the MAX/MIN setting, an LED indicates the operational status (switch status or alarm status) in green, yellow and red. The LED lights up very brightly and can be easily identified from a distance.

Connection to the following electronic inserts: FEL62, FEL64, FEL64 DC.

Further information: → 17

**Remote interrogation****Heartbeat diagnostics and verification with Bluetooth® wireless technology***Access via Bluetooth® wireless technology*

A0033411

45 Remote operation via Bluetooth® wireless technology

1 Smartphone or tablet with SmartBlue (app)

2 Device with optional Bluetooth module

*Bluetooth module VU121 (optional)**Functions*

- Connection via COM interface: Bluetooth module for device diagnostics via a smartphone app or tablet app
- Display the battery status via app when used with electronic insert FEL68 (NAMUR)
- User guidance (wizard) for SIL/WHG proof testing

- Visible in the livelist 10 seconds after the Bluetooth search commences
- Data can be read from the Bluetooth module 60 seconds after the supply voltage is switched on
- Display of the current vibration frequency and the switching state of the device

The yellow LED flashes when the Bluetooth module is connected to another Bluetooth device, e. g. mobile phone.

#### Heartbeat Technology

 Additional details in the "Application packages" section.

## Diagnostic information

### Heartbeat Technology

The electronics module and the tuning fork are checked using Heartbeat Technology, and a verification of the Liquiphant is performed. The switch output is not changed during this test. The test can be performed at any time and does not influence the switch output in the safety circuit. In the case of proof-testing, the SmartBlue app supports users in every step of the test. The switch output is also switched during this test. During the proof-test, alternative monitoring measures must be taken to ensure process safety.

#### Proof test

During the proof test, the SmartBlue app provides support for each individual stage of the test (proof-test wizard). The switch output is also switched during this test. During the proof test, alternative monitoring measures must be taken to ensure process safety.

#### Evaluation of the vibration frequency

If the vibration frequency exceeds the upper warning frequency, a warning is displayed. A warning is activated when the fork becomes corroded, for example. The switch output remains in the current state. The warning is displayed in the SmartBlue app and output in the Heartbeat Technology protocol. When a warning occurs, it is necessary to check the Liquiphant sensor.

The current oscillation frequency must be in the range between the upper and lower alarm frequency. If the current oscillation frequency is above the upper alarm frequency or below the lower alarm frequency, an alarm is output. The output switches to the safety-oriented state.

## Certificates and approvals



The certificates, approvals and other documentation currently available can be accessed as follows:

Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

### CE mark

The measuring system complies with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

### RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.



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### Ex approval

All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads Area. The Ex documentation is supplied as standard with all Ex devices.



Ex temperature class: T1 to T6

If using type of protection Ex i and electronic insert FEL68 (NAMUR) and the Bluetooth module in addition (battery required): T4 to T1.

**Explosion-protected smartphones and tablets**

If used in hazardous areas, mobile end devices with an Ex approval must be used.

**Overfill protection**

Before mounting the device, observe the documentation from the WHG approvals (German Federal Water Act).

Approved for overfill protection and leakage detection.

 Ordering information: Product Configurator, order code for "Additional approval", option "LD"

**Functional safety**

The Liquiphant has been developed according to the IEC 61508 standard. The device is suitable for overfill prevention and dry-running protection up to SIL 2 (SIL 3 with homogeneous redundancy). For a detailed description of the safety functions with the Liquiphant, settings and functional safety data, see the "Functional Safety Manual" on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

 Ordering information: Product Configurator, order code for "Additional approval", option "LA"  
Subsequent confirmation of usability according to IEC 61508 is not possible.

**Marine certificate**

- ABS (American Bureau of Shipping), option "LF" → pending
- LR (Lloyd's Register) marine approval, option "LG" → pending
- BV (Bureau Veritas) marine approval, option "LH" → pending
- GL (German Lloyd)/DNV (Det Norske Veritas), option "LJ" → pending

 Ordering information: Product Configurator, order code for "Additional approval", for option see items listed.

**Radio approval**

 Further information and the documentation currently available can be found on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

**CRN approval**

Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are marked with a registration number.

Any restrictions regarding the maximum process pressure values are listed on the CRN certificate.

 Ordering information: Product Configurator, order code for "Additional approval", option "LS"

**Test reports****Test, report, declaration**

The following documentation can be ordered:

- Inspection certificate 3.1, EN10204 (material certificate, pressure-bearing parts)
- ASME B31.3 process piping, declaration
- Pressure test, internal procedure, test report
- Helium leak test, internal procedure, test report
- Welding documentation, wetted/pressurized seams

 Ordering information: Product Configurator, order code "Test, Certificate, Declaration".

 The documentation currently available can be found on the Endress+Hauser- website: [www.endress.com](http://www.endress.com) → Downloads or using the serial number of the device under Online Tools in the Device Viewer.

**Service**

- Cleaned of oil+grease (wetted)
- Switching delay setting to be spec.
- Setting for MIN safety mode
- Default density setting > 0.4 g/cm<sup>3</sup>
- Default density setting > 0.5 g/cm<sup>3</sup>
- Density special calibration

*Hard-copy product documentation*

Hard-copy versions of the test reports, declarations and inspection certificates can also be order via order code 570 "Service", option I7 "Hard-copy product documentation". The documents are then provided with the device upon delivery.

<b>Pressure Equipment Directive</b>	<p><b>Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)</b></p> <p>Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.</p> <p><i>Reasons:</i></p> <p>According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings".</p> <p>If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.</p>
<b>Process seal as per ANSI/ISA 12.27.01</b>	<p>North American practice for the installation of process seals. In accordance with ANSI/ISA 12.27.01, Endress+Hauser devices are designed as either single seal or dual seal devices with a warning message. This allows the user to waive the use of - and save the cost of installing - an external secondary process seal in the protective conduit as required in ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North-American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids. More information is provided in the Safety Instructions (XA) for the relevant device.</p> <p> Aluminum, stainless steel and plastic housing are approved as single-seal devices.</p>
<b>China RoHS symbol</b>	China RoHS 1, law SJ/T 11363-2006: The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive (RoHS).
<b>RoHS</b>	The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).
<b>Additional certification</b>	<p><b>EAC conformity</b></p> <p>The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.</p> <p>Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.</p>
<b>ASME B 31.3</b>	Design and materials in accordance with ASME B31.3. The welds are through-penetration welded and meet the requirements of the ASME Boiler and Pressure Vessel Code, Section IX and EN ISO 15614-1.

## Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Click "Corporate" → Select country → Click "Products" → Select product using the filters and search field → Open product page → The "Configuration" button to the right of the product image opens the Product Configurator.
- Endress+Hauser Sales Center: [www.addresses.endress.com](http://www.addresses.endress.com)



### Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

**TAG**

### Measuring point (TAG)

The device can be ordered with a tag name.

**Position of the tag marking**

Choose from the following in the additional specification:

- Tag plate, stainless steel
- Plastic film
- Supplied label/plate
- RFID TAG
- RFID TAG + tag plate stainless steel
- RFID TAG + plastic film
- RFID TAG + supplied label/plate

**Definition of the tag name**

Specify in the additional specification:

3 lines containing up to 18 characters each

The specified tag name appears on the selected label and/or on the RFID TAG.

**Presentation in the SmartBlue app**

The first 32 characters of the tag name

The tag name can always be changed specifically for the measuring point via Bluetooth.

## Application packages

-  Ordering information in the Product Configurator:
- Order code for "Application package", option EH "Heartbeat Verification + Monitoring" can only be selected in conjunction with optional Bluetooth module:  
Order code for "Accessory mounted", option "NF"
  - In conjunction with electronic insert FEL68 (2-wire NAMUR):  
Order code for "Application package", option EL "Prepared for Heartbeat Verification + Monitoring"  
The Bluetooth module, including the required battery, must be ordered separately in this case:  
Order code for "Accessories", option NG "Prepared for Bluetooth".

Order options that must be selected together, or that are mutually exclusive, are automatically displayed in the Product Configurator.

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### Heartbeat Technology module

#### Heartbeat Diagnostics

Continuously monitors and evaluates the device status and process conditions. Generates diagnostic messages when certain events occur and provides troubleshooting measures in accordance with NAMUR NE 107.

#### Heartbeat Verification

Performs a verification of the current device status upon request and generates a Heartbeat Technology verification report showing the result of the verification.

#### Heartbeat Monitoring

Continuously provides device and/or process data for an external system. Analysis of this data forms the basis for process optimization and predictive maintenance.

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### Heartbeat Verification

The "Heartbeat Verification" module includes the Heartbeat Verification Wizard, which performs a verification of the current device condition and generates the Heartbeat Technology verification report:

- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process of generating the verification report.
- The operating hours counter and minimum/maximum temperature indicator (peakhold) are displayed.
- In the event of an increase in the oscillation frequency of the fork, a corrosion warning will appear.
- The order configuration of the oscillation frequency in air is indicated in the verification report. An increased oscillation frequency indicates the presence of corrosion. A reduced oscillation frequency indicates that there is buildup present or that the sensor is covered by the medium. Deviations in the oscillation frequency compared to the oscillation frequency on delivery may occur due to the process temperature and process pressure.

**Proof testing for SIL/WHG devices<sup>2)</sup>**

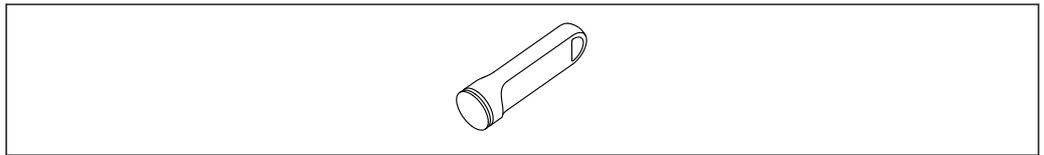
The "SIL Prooftest", "WHG Prooftest" or "SIL/WHG Prooftest" module includes a wizard for the proof testing that is required at appropriate intervals for the following applications: SIL (IEC61508/IEC61511), WHG (German Federal Water Act):

- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process of generating the verification report.
- The verification report can be saved as a PDF file.

## Accessories

**Test magnet**

Order number: 71437508

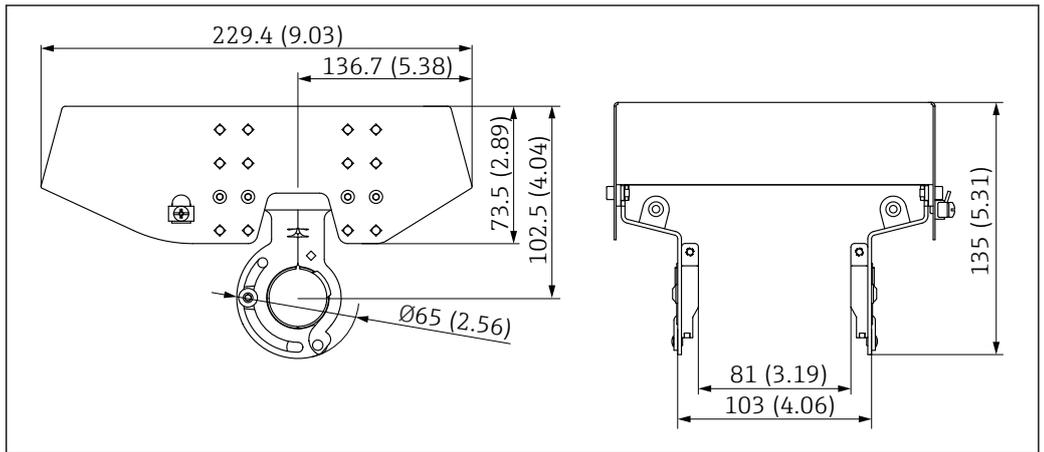


A0039209

46 Test magnet

**Weather protection cover for dual-compartment housing, aluminum**

- Material: stainless steel 316L
- Order number: 71438303

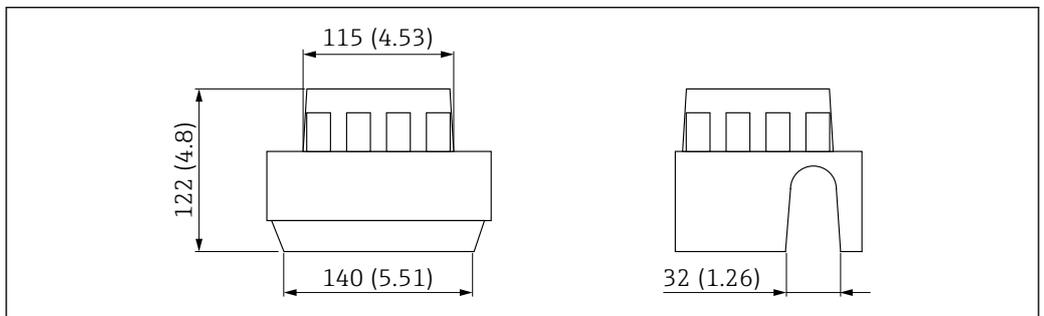


A0039231

47 Weather protection cover for dual-compartment housing, aluminum. Unit of measurement mm (in)

**Protective cover for single compartment housing, aluminum or 316L**

- Material: plastic
- Order number: 71438291



A0038280

48 Protective cover for single compartment housing, aluminum or 316L. Unit of measurement mm (in)

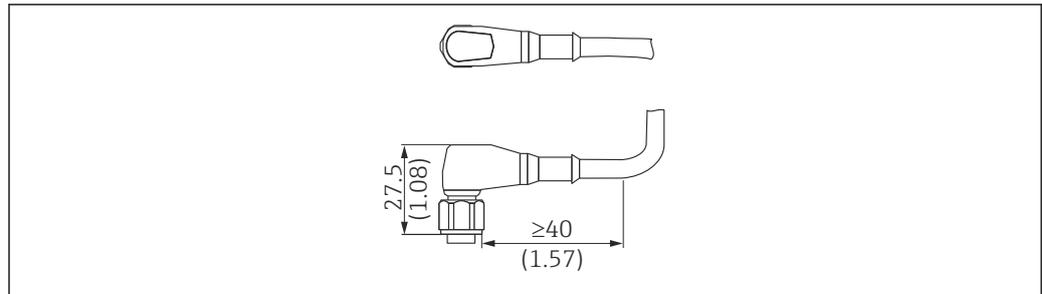
2) Available only for devices with SIL or WHG approval

**Plug-in jack**

 The plug-in jacks listed are suitable for use in the temperature range -25 to +70 °C (-13 to +158 °F).

**Plug-in jack M12 IP69**

- Terminated at one end
- Elbowed 90°
- 5 m (16 ft) PVC cable (orange)
- Slotted nut 316L (1.4435)
- Body: PVC (orange)
- Order number: 52024216

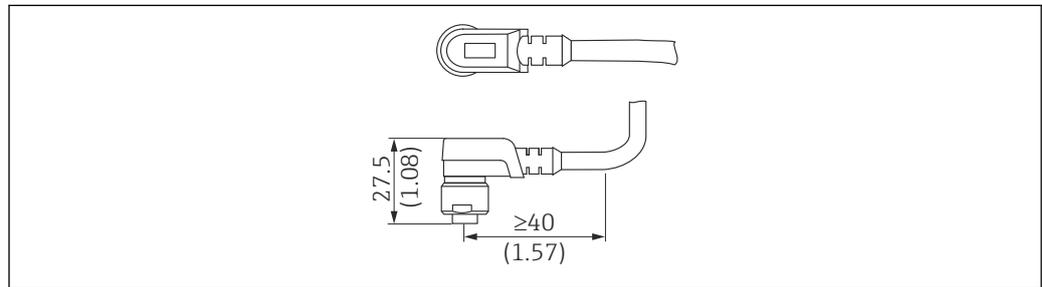


A0023713

 49 Plug-in jack M12 IP69. Unit of measurement mm (in)

**Plug-in jack M12 IP67**

- Elbowed 90°
- 5 m (16 ft) PVC cable (gray)
- Slotted nut Cu Sn/Ni
- Body: PUR (blue)
- Order number: 52010285



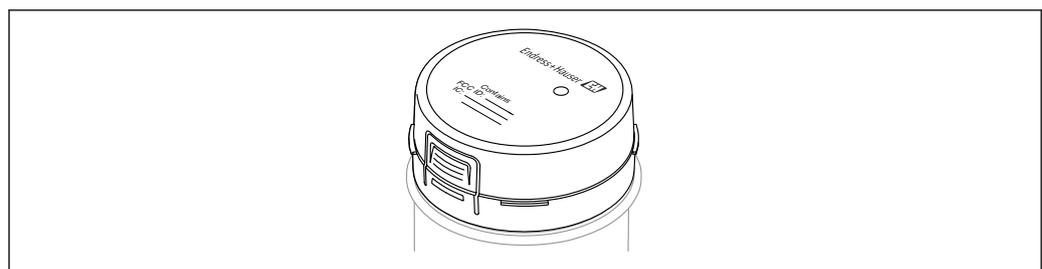
A0022292

 50 Plug-in jack M12 IP67. Unit of measurement mm (in)

**Bluetooth module VU121 (optional)**

The Bluetooth module can be connected to the following electronic inserts via the COM interface: FEL61, FEL62, FEL64, FEL64DC, FEL67, FEL68 (NAMUR 2-wire).

- Bluetooth module without battery for use in conjunction with electronic inserts FEL61, FEL62, FEL64, FEL64DC and FEL67  
Order number: 71437383
- Bluetooth module with battery for use in conjunction with electronic insert FEL68 (2-wire NAMUR)  
Order number: 71437381



A0039257

 51 Bluetooth module VU121

More detailed information is available:

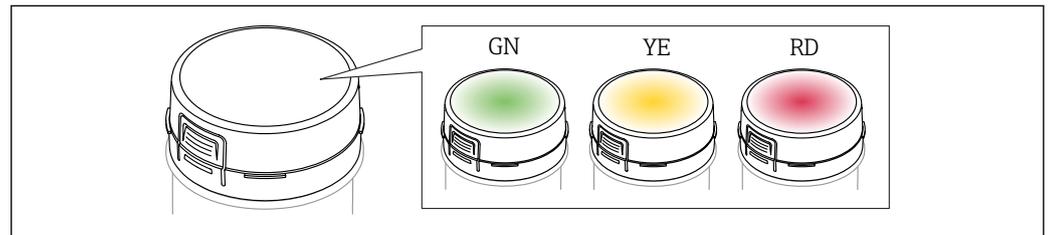
- Product Configurator on the Endress+Hauser web page: [www.endress.com](http://www.endress.com)
- Endress+Hauser Sales Center [www.addresses.endress.com](http://www.addresses.endress.com)

**i** A tall cover is required (transparent plastic cover or aluminum cover with sight glass) when using or retrofitting the Bluetooth module. The Bluetooth module cannot be used in conjunction with the single compartment 316L housing, cast. The cover depends on the housing and approval of the device.

### LED module VU120 (optional)

A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.

Order number: 71437382



**i** 52 LED module, the LED lights up in green (GN), yellow (YE) or red (RD)

More detailed information is available:

- Product Configurator on the Endress+Hauser web page: [www.endress.com](http://www.endress.com)
- Endress+Hauser Sales Center [www.addresses.endress.com](http://www.addresses.endress.com)

**i** A tall cover is required (transparent plastic cover or aluminum cover with sight glass) when using or retrofitting the Bluetooth module. Use of the Bluetooth module is not possible in conjunction with the single compartment 316L housing, cast. The cover depends on the housing and approval of the device.

## Supplementary documentation

**i** The certificates, approvals and other documentation currently available can be accessed as follows:  
Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads.

### Special Documentation

SD02389F: Radio approval for Bluetooth module VU121

### Supplementary device-dependent documentation

#### Document type: Operating Instructions (BA)

Installation and initial commissioning – contains all functions in the operating menu that are required for a typical measuring task. Functions beyond this scope are not included.  
BA02036F

#### Document type: Brief Operating Instructions (KA)

Quick guide to the first measured value – includes all essential information from the incoming acceptance to the electrical connection.  
KA01479F

#### Document type: Safety Instructions, certificates

Depending on the approval, Safety Instructions are also supplied with the device, e. g. XA. This documentation is an integral part of the Operating Instructions.  
The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

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