



# 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
- Functional safety: monitoring of the vibration frequency of the tuning fork
- Heartbeat Technology via the free iOS/Android SmartBlue app
- 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.

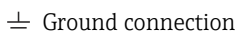


This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.



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.

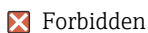


Ground terminals, which must be grounded prior to establishing any other connections. The ground terminals are located on the inside and outside of the device.

#### 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)

#### Communication-specific symbols



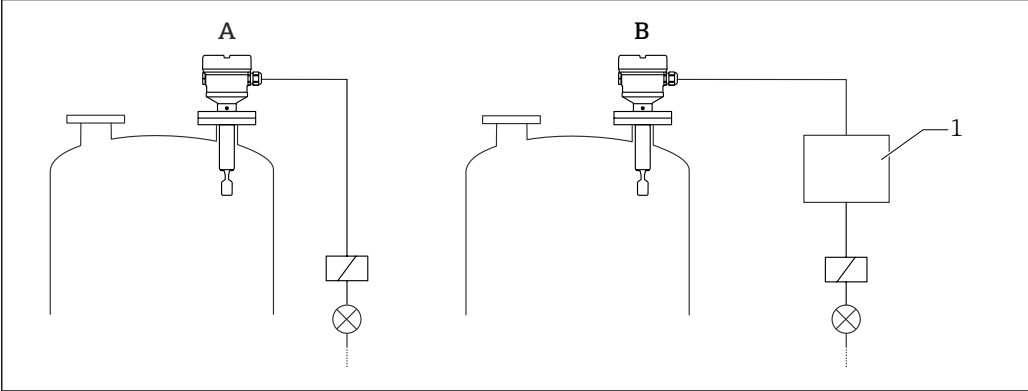
Bluetooth

Wireless data transmission between devices over a short distance.

## Function and system design

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>point level detection</b> | <p>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 .</p> <p>Specific versions are suitable for use in hazardous areas.</p> <p>The point level switch differentiates between the "covered" and "not covered" conditions.</p> <p>Depending on the MIN (minimum detection) or MAX (maximum detection) modes, there are two possibilities in each case: OK status and demand mode.</p> <p>OK status</p> <ul style="list-style-type: none"><li>■ In MIN mode, the fork is covered, e.g. Pump dry running protection</li><li>■ In MAX mode, the fork is not covered e.g. overflow prevention</li></ul> <p>Demand mode</p> <ul style="list-style-type: none"><li>■ In MIN mode, the fork is not covered e.g. pump dry running protection</li><li>■ In MAX mode, the fork is covered e.g. overflow prevention</li></ul> |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                            |                                                                                                                                                                                                                        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measuring principle</b> | <p>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.</p> |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                         |                                                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measuring system</b> | <div></div> <p>1    Example of a measuring system</p> <p>A    Device for direct connection of a load</p> <p>B    Device for connection to a separate switching unit or PLC</p> <p>1    Switching unit, PLC etc.</p> |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                      |                                                                                                                                                                              |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Dependability</b> | <p><b>Device-specific IT security</b></p> <p>The device settings and the diagnostic data can be read out via Bluetooth. Device settings cannot be changed via Bluetooth.</p> |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Input

|                          |                                                                                                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measured variable</b> | <p>Level (point level), MAX or MIN safety</p>                                                                                                                                                                                                       |
| <b>Measuring range</b>   | <p>Depends on the installation location and the pipe extension ordered</p> <p>Sensor length:</p> <ul style="list-style-type: none"><li>■ With plastic coating, maximum 3 m (9.8 ft)</li><li>■ With enamel coating, maximum 1.2 m (3.9 ft)</li></ul> |

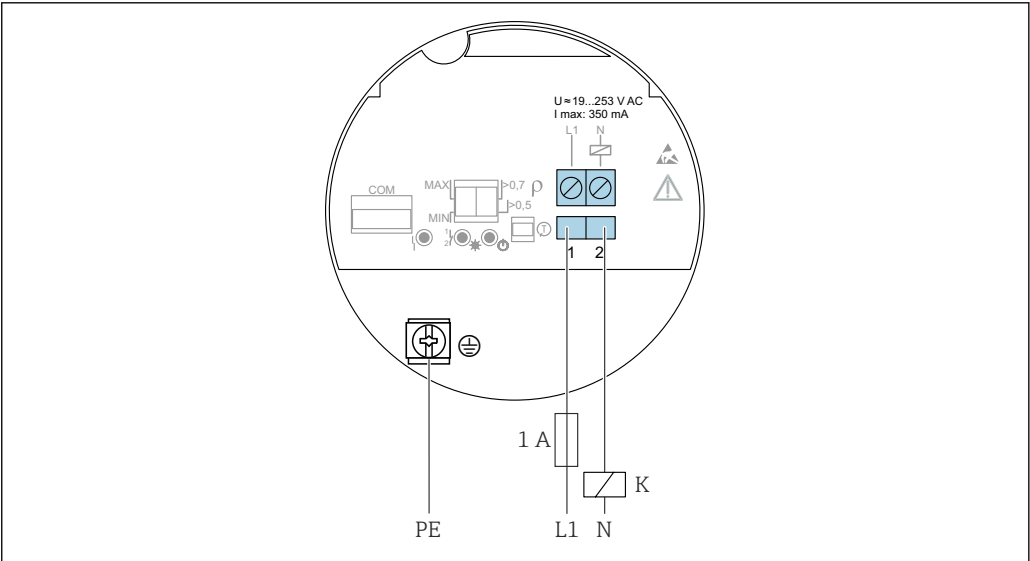
## Output

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output and input variants | <p><b>Electronic inserts</b></p> <p><b>2-wire AC (FEL61)</b></p> <ul style="list-style-type: none"> <li>Two-wire AC version</li> <li>Switches the load directly into the power supply circuit via an electronic switch</li> </ul> <p><b>3-wire DC-PNP (FEL62)</b></p> <ul style="list-style-type: none"> <li>Three-wire direct current version</li> <li>Switches the load via the transistor (PNP) and separate connection, e.g. in conjunction with programmable logical controllers (PLC)</li> <li>Ambient temperature <math>-60\text{ }^{\circ}\text{C}</math> (<math>-76\text{ }^{\circ}\text{F}</math>), optionally available to order</li> </ul> <p>Low-temperature electronic inserts are marked LT</p> <p><b>Universal current connection, relay output (FEL64)</b></p> <ul style="list-style-type: none"> <li>Switches the loads via 2 potential-free change-over contacts</li> <li>Ambient temperature <math>-60\text{ }^{\circ}\text{C}</math> (<math>-76\text{ }^{\circ}\text{F}</math>), optionally available to order</li> </ul> <p>Low-temperature electronic inserts are marked LT</p> <p><b>Direct current connection, relay output (FEL64DC)</b></p> <ul style="list-style-type: none"> <li>Switches the load via 2 potential-free changeover contacts</li> <li>Ambient temperature <math>-60\text{ }^{\circ}\text{C}</math> (<math>-76\text{ }^{\circ}\text{F}</math>), optionally available to order</li> </ul> <p>Low-temperature electronic inserts are marked LT</p> <p><b>PFM output (FEL67)</b></p> <ul style="list-style-type: none"> <li>For separate switching device (Nivotester FTL325P, FTL375P)</li> <li>PFM signal transmission; current pulses are superimposed on the power supply along the two-wire cabling</li> <li>Ambient temperature <math>-50\text{ }^{\circ}\text{C}</math> (<math>-58\text{ }^{\circ}\text{F}</math>), optionally available to order</li> </ul> <p>The low-temperature electronic inserts are marked LT</p> <p><b>2-wire NAMUR <math>&gt; 2.2\text{ mA}/&lt; 1.0\text{ mA}</math> (FEL68)</b></p> <ul style="list-style-type: none"> <li>For separate switching unit, e.g. Nivotester FTL325N</li> <li>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</li> <li>Ambient temperature <math>-50\text{ }^{\circ}\text{C}</math> (<math>-58\text{ }^{\circ}\text{F}</math>), optionally available to order</li> </ul> <p>Low-temperature electronic inserts are marked LT</p> |
| Output signal             | <p><b>Switch output</b></p> <p>The following default switching delay times can be ordered for electronic inserts FEL61, FEL62, FEL64, FEL64DC, FEL67 and FEL68:</p> <ul style="list-style-type: none"> <li>0.5 s when the tuning fork is covered and 1.0 s when it is uncovered (factory setting)</li> <li>0.25 s when the tuning fork is covered and 0.25 s when it is uncovered</li> <li>1.5 s when the tuning fork is covered and 1.5 s when it is uncovered</li> <li>5.0 s when the tuning fork is covered and 5.0 s when it is uncovered</li> </ul> <p><b>COM interface</b></p> <p>For connecting to modules VU120 or VU121 (no modifying effect)</p> <p><i>Bluetooth® wireless technology (optional)</i></p> <p>The device has a Bluetooth® wireless technology interface. Device data and diagnostic data can be read out using the free "SmartBlue" app.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ex connection data        | <p>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 devices approved for use in explosion hazardous areas.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## 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.

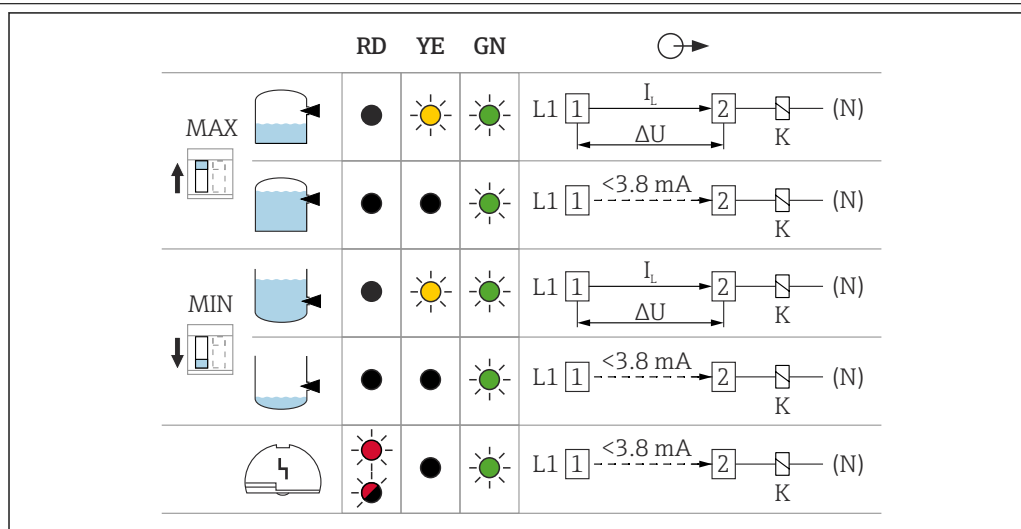
|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply voltage            | <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> |
| Power consumption         | $S \leq 2 \text{ VA}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Current consumption       | <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>                                                                                                                                                                                                                                              |
| Connectable load          | <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>                                                                                                                                                              |
| Behavior of output signal | <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>                                                                                                                                                                                                                                                                                                                |
| Terminals                 | Terminals for cable cross-section up to 2.5 mm <sup>2</sup> (14 AWG). Use ferrules for the wires.                                                                                                                                                                                                                                                                                                                                                                                    |
| Overvoltage protection    | Overvoltage category II                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Terminal assignment       | Always connect an external load. The electronic insert has integrated short-circuit protection.                                                                                                                                                                                                                                                                                                                                                                                      |



A0036060

 2 2-wire AC, electronic insert FEL61

## Behavior of switch output and signaling



A0031901

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

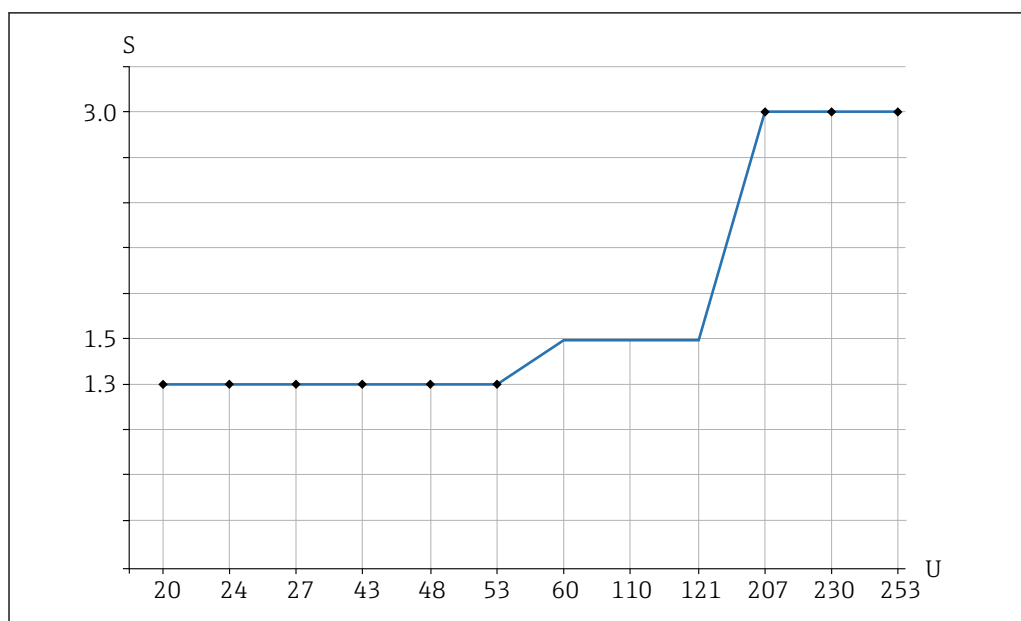
RD LED red for warning or alarm

YE LED yellow, switch status

GN LED green, operational status, device on

$I_L$  Load current switched through

## Selection tool for relays



A0042052

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

**WARNING**

**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.

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



The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".



Comply with the following according to 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 power 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. Check for an overload or short-circuit every 5 s.

---

### Load current

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

---

### Capacitance load

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

---

### Residual current

$I < 100 \text{ }\mu\text{A}$  (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

---

### Terminals

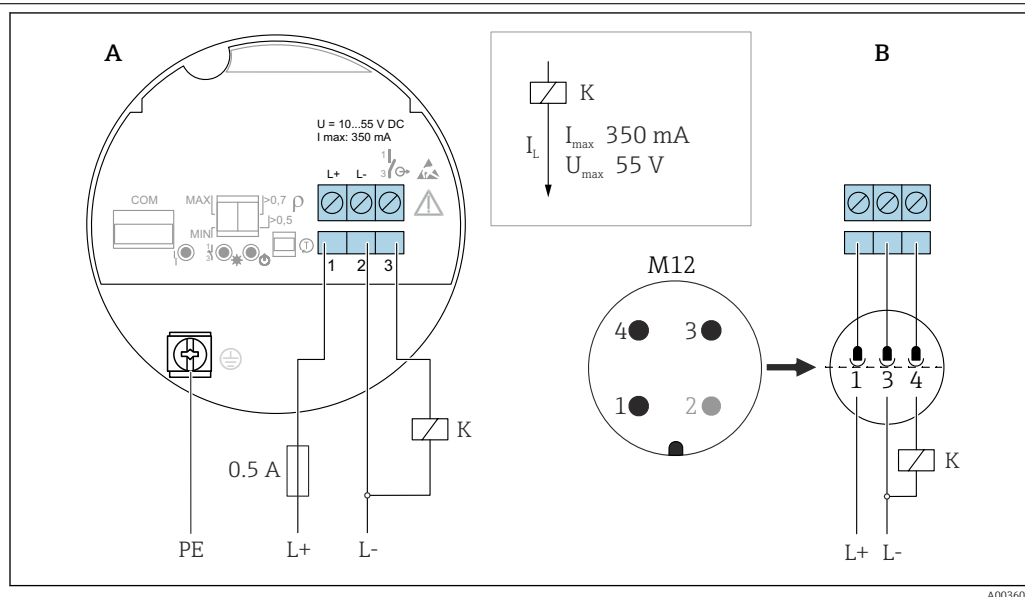
Terminals for cable cross-section up to  $2.5 \text{ mm}^2$  (14 AWG). Use ferrules for the wires.

---

### Overvoltage protection

Overvoltage category I

## Terminal assignment



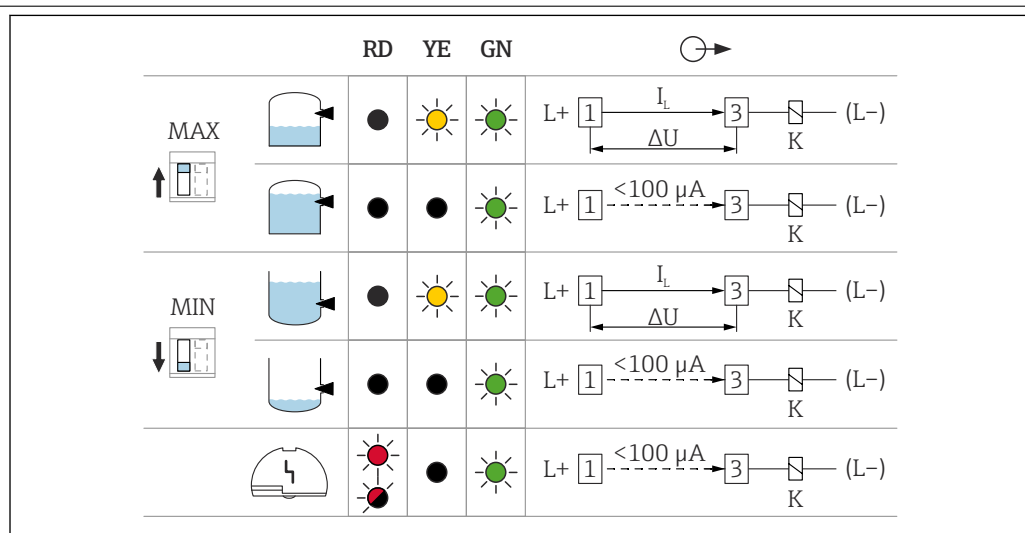
A0036061

5 3-wire DC-PNP, electronic insert FEL62

A Connection wiring with terminals

B Connection wiring with M12 plug in housing according to EN61131-2 standard

## Behavior of switch output and signaling



A0033508

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 change-over contacts
- 2 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.

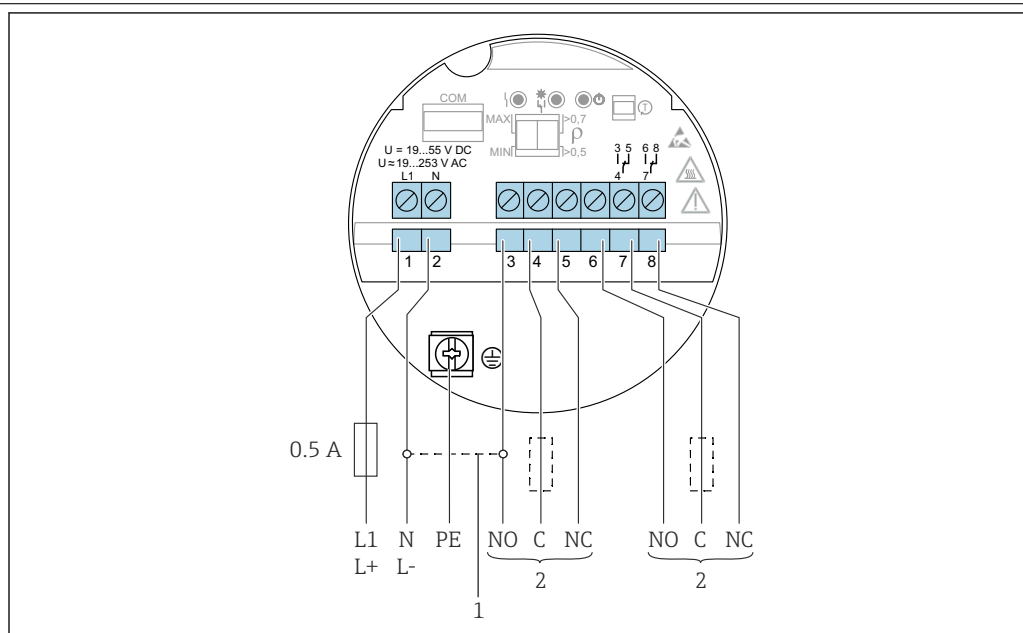
**⚠ WARNING**

**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!

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Supply voltage</b>            | <p><math>U = 19 \text{ to } 253 \text{ V}_{AC}, 50 \text{ Hz}/60 \text{ Hz} / 19 \text{ to } 55 \text{ V}_{DC}</math></p> <p> Comply with the following according to 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 power supply circuit.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Power consumption</b>         | $S < 25 \text{ VA}, P < 1.3 \text{ W}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Connectable load</b>          | <p>Loads switched via 2 potential-free changeover contacts (DPDT)</p> <ul style="list-style-type: none"> <li>▪ <math>I_{AC} \leq 6 \text{ A}, U \sim \leq AC 253 \text{ V}; P \sim \leq 1500 \text{ VA}, \cos \varphi = 1, P \sim \leq 750 \text{ VA}, \cos \varphi &gt; 0.7</math></li> <li>▪ <math>I_{DC} \leq 6 \text{ A to DC } 30 \text{ V}, I_{DC} \leq 0.2 \text{ A to } 125 \text{ V}</math></li> </ul> <p> Additional restrictions for the connectable load depend on the selected approval. Pay attention to the information in the Safety Instructions (XA).</p> <p>According to IEC 61010, the following applies: total voltage from relay outputs and power supply <math>\leq 300 \text{ V}</math>.</p> <p>Use electronic insert FEL62 DC PNP for small DC load currents, e.g. for connection to a PLC.</p> <p>Relay contact material: silver/nickel AgNi 90/10</p> <p>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.</p> <p>Both relay contacts switch simultaneously.</p> |
| <b>Behavior of output signal</b> | <ul style="list-style-type: none"> <li>▪ OK status: relay energized</li> <li>▪ Demand mode: relay de-energized</li> <li>▪ Alarm: relay de-energized</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Terminals</b>                 | Terminals for cable cross-section up to $2.5 \text{ mm}^2$ (14 AWG). Use ferrules for the wires.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Overvoltage protection</b>    | Overvoltage category II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Terminal assignment

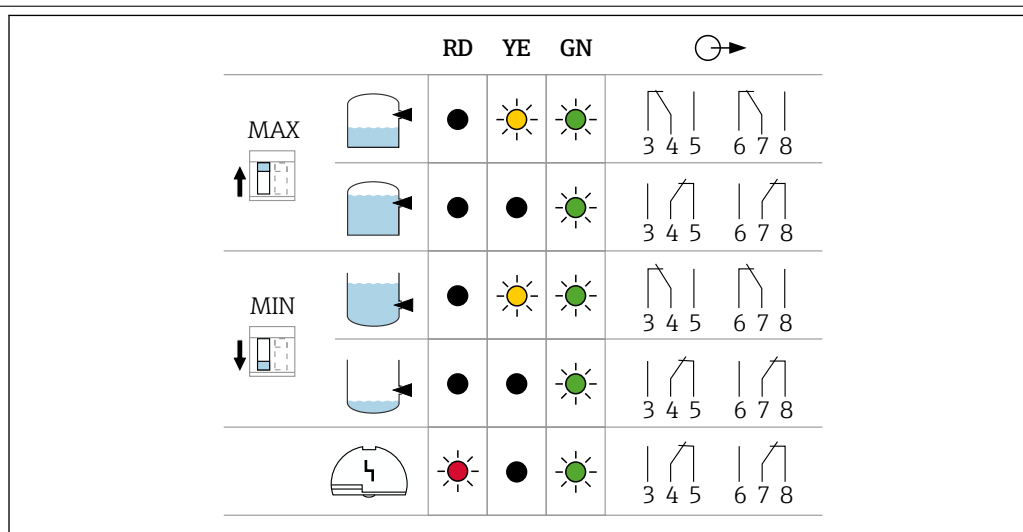


A0036062

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



A0033513

8 Behavior of switch output and signaling, electronic insert FEL64

MAX DIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

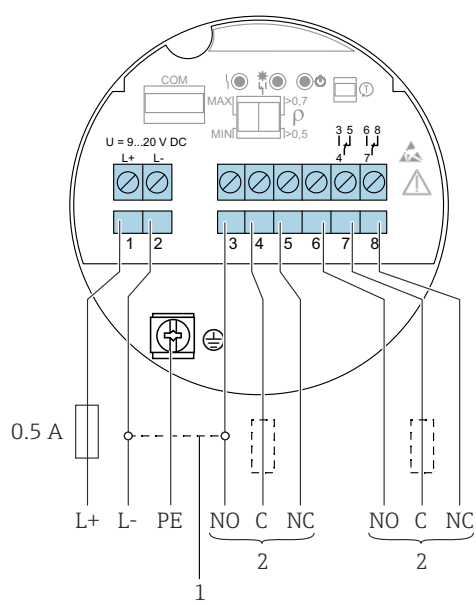
RD LED red for alarm

YE LED yellow, switch status

GN LED green, operational status, device on

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

- Switches the loads via 2 potential-free change-over contacts
- 2 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.

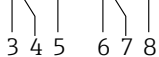
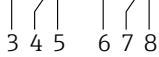
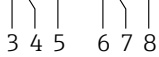
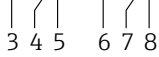
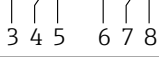
|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Supply voltage</b>            | $U = 9 \text{ to } 20 \text{ V}_{\text{DC}}$ <ul style="list-style-type: none"> <li> The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".</li> <li> Comply with the following according to 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 power supply circuit.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Power consumption</b>         | $P < 1.0 \text{ W}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Connectable load</b>          | <p>Loads switched via 2 potential-free change-over contacts (DPDT)</p> <ul style="list-style-type: none"> <li>■ <math>I_{\text{AC}} \leq 6 \text{ A}</math>, <math>U \sim \leq \text{AC } 253 \text{ V}</math>; <math>P \sim \leq 1500 \text{ VA}</math>, <math>\cos \varphi = 1</math>, <math>P \sim \leq 750 \text{ VA}</math>, <math>\cos \varphi &gt; 0.7</math></li> <li>■ <math>I_{\text{DC}} \leq 6 \text{ A}</math> to DC 30 V, <math>I_{\text{DC}} \leq 0.2 \text{ A}</math> to 125 V</li> </ul> <p> Additional restrictions for the connectable load depend on the selected approval. Pay attention to the information in the Safety Instructions (XA).</p> <p>According to IEC 61010, the following applies: Total voltage from relay outputs and power supply <math>\leq 300 \text{ V}</math></p> <p>Electronic insert FEL62 DC PNP preferred for small DC load currents, e.g. connection to a PLC.</p> <p>Relay contact material: silver/nickel AgNi 90/10</p> <p>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.</p> |
| <b>Behavior of output signal</b> | <ul style="list-style-type: none"> <li>■ OK status: relay energized</li> <li>■ Demand mode: relay de-energized</li> <li>■ Alarm: relay de-energized</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Terminals</b>                 | Terminals for cable cross-section up to $2.5 \text{ mm}^2$ (14 AWG). Use ferrules for the wires.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Overvoltage protection</b>    | Overvoltage category I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Terminal assignment</b>       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

 9 DC connection with relay output, electronic insert FEL64 DC

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

A0037685

Behavior of switch output and signaling

|                                                                                          |                                                                                   | RD                                                                                | YE                                                                                | GN                                                                                |  |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <br>MAX |  |  |  |  |  |
|                                                                                          |  |  |  |  |  |
| <br>MIN |  |  |  |  |  |
|                                                                                          |  |  |  |  |  |
|                                                                                          |  |  |  |  |  |

A0039513

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

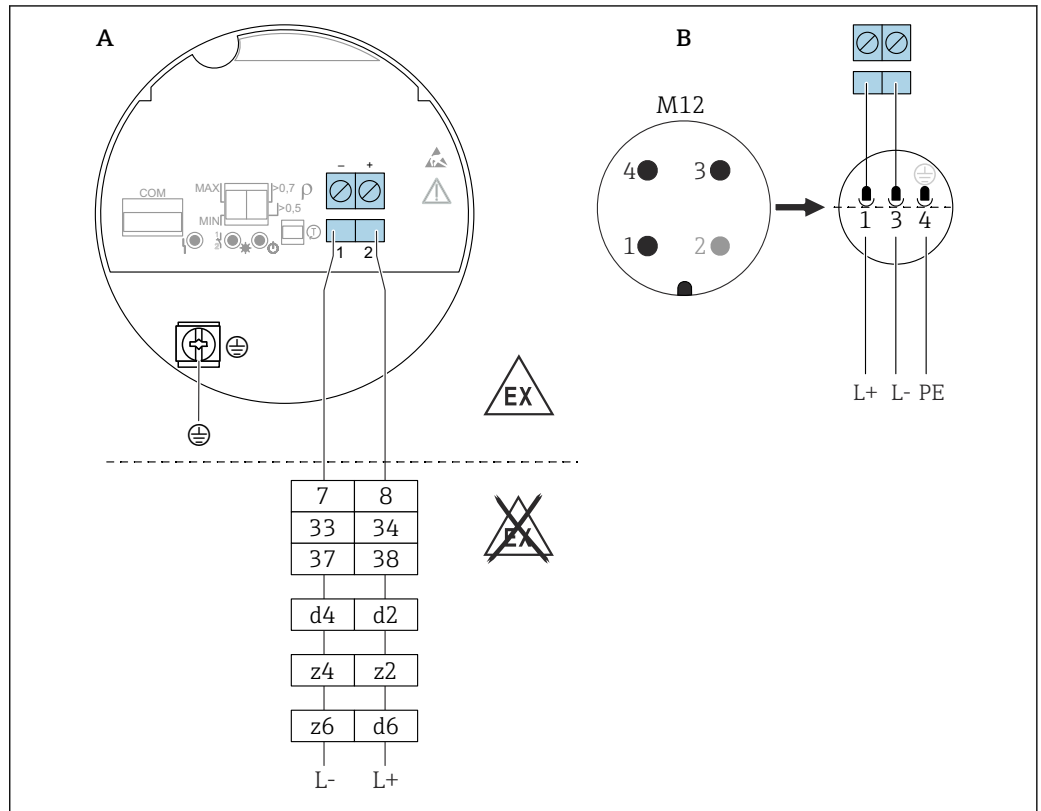
MAX DIP switch for setting MAX safety mode  
MIN DIP switch for setting MIN safety mode  
RD LED red for alarm  
YE LED yellow, switch status  
GN LED green, operational status, device on

PFM output (electronic insert FEL67)

- For connection to Endress+Hauser Nivotester switching units FTL325P and FTL375P
- 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            | <p>U = 9.5 to 12.5 V<sub>DC</sub></p> <p> The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".</p> <p> Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device.</p> |
| Power consumption         | <p>P ≤ 150 mW with Nivotester FTL325P or FTL375P</p>                                                                                                                                                                                                                                                                                                                                                                    |
| Behavior of output signal | <ul style="list-style-type: none"><li>■ OK status: MAX operating mode 150 Hz, MIN operating mode 50 Hz</li><li>■ Demand mode: MAX operating mode 50 Hz, MIN operating mode 150 Hz</li><li>■ Alarm: MAX/MIN operating mode 0 Hz</li></ul>                                                                                                                                                                                |
| Terminals                 | <p>Terminals for cable cross-section up to 2.5 mm<sup>2</sup> (14 AWG). Use ferrules for the wires.</p>                                                                                                                                                                                                                                                                                                                 |
| Overvoltage protection    | <p>Overvoltage category I</p>                                                                                                                                                                                                                                                                                                                                                                                           |

## Terminal assignment



11 PFM output, electronic insert FEL67

A Connection wiring with terminals

B Connection wiring with M12 plug in housing according to EN61131-2 standard

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

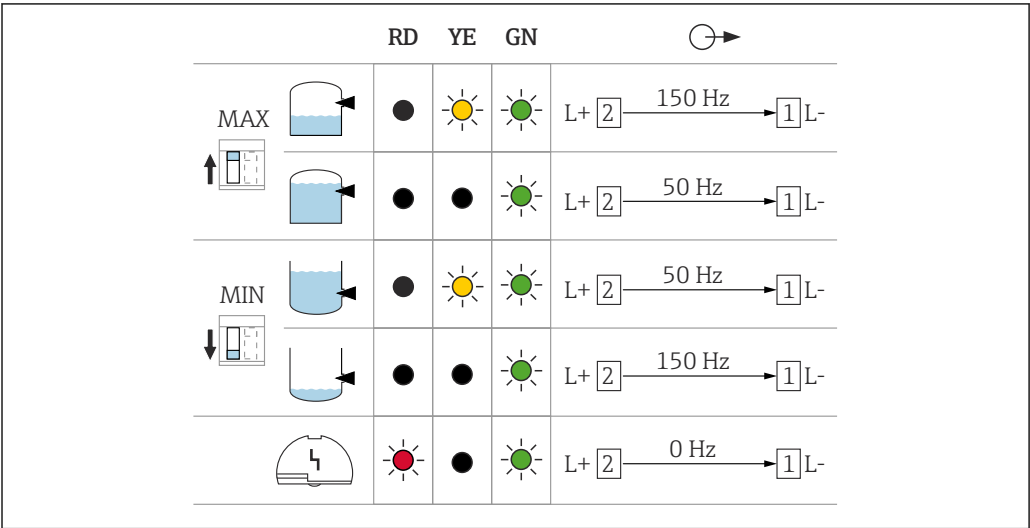
z4/ z2: Nivotester FTL375P input 2

z6/ d6: Nivotester FTL375P input 3

## Connection cable

- Maximum cable resistance: 25  $\Omega$  per core
- Maximum cable capacitance: < 100 nF
- Maximum cable length: 1000 m (3 281 ft)

Behavior of switch output and signaling



A0037696

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.

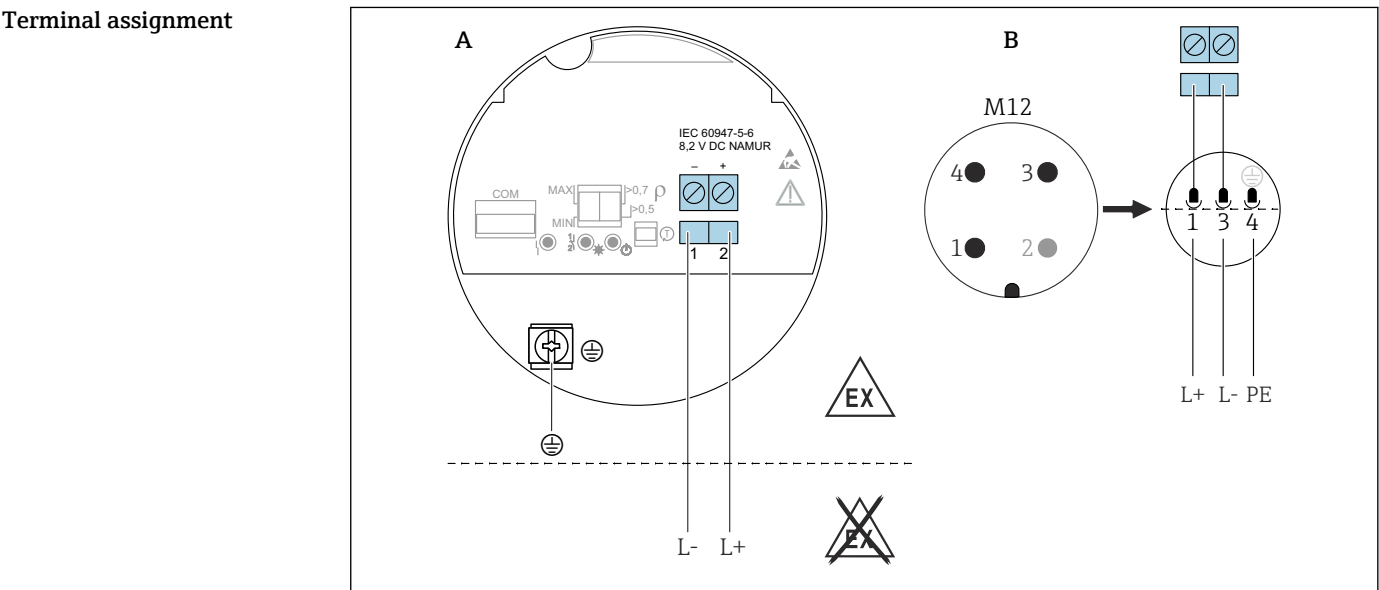
2-wire NAMUR > 2.2 mA/ < 1.0 mA (electronic insert FEL68)

- To connect to isolating amplifiers according to NAMUR (IEC 60947-5-6), e.g. Nivotester FTL325N from Endress+Hauser
- To connect to isolating amplifiers of third-party suppliers according to NAMUR (IEC 60947-5-6), a permanent power supply for the electronic insert FEL68 must be ensured
- Signal transmission H-L edge 2.2 to 3.8 mA/0.4 to 1.0 mA according to NAMUR (IEC 60947-5-6) 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.

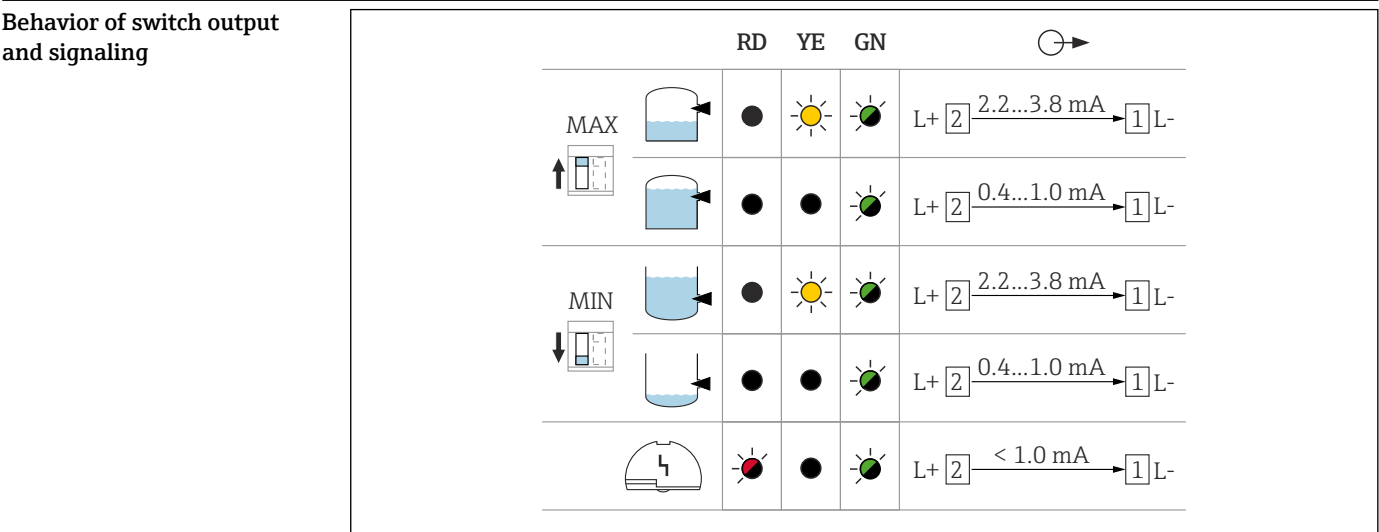
|                           |                                                                                                                                                                                                                                                                            |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply voltage            | <div>U = 8.2 V<sub>DC</sub>±20 %</div> <div><b>i</b> The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".</div> <div><b>i</b> Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device.</div> |
| Power consumption         | <div>NAMUR IEC 60947-5-6</div> <div>&lt; 6 mW with I &lt; 1 mA; &lt; 38 mW with I = 3.5 mA</div>                                                                                                                                                                           |
| Connection data interface | <div>NAMUR IEC 60947-5-6</div>                                                                                                                                                                                                                                             |
| Behavior of output signal | <div>■ OK status: output current 2.2 to 3.8 mA</div> <div>■ Demand mode: output current 0.4 to 1.0 mA</div> <div>■ Alarm: output current &lt; 1.0 mA</div>                                                                                                                 |

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

**Overvoltage protection** Overvoltage category I



13 2-wire NAMUR  $\geq 2.2 \text{ mA} / \leq 1.0 \text{ mA}$ , electronic insert FEL68  
A Connection wiring with terminals  
B Connection wiring with M12 plug in housing according to EN61131-2 standard



14 Behavior of switch output and signaling, electronic insert FEL68  
MAXDIP switch for setting MAX safety mode  
MIN DIP switch for setting MIN safety mode  
RD Red LED for alarm  
YE Yellow LED, switch status  
GN Green LED, operational status, device on

**Electronic insert FEL68 with Bluetooth module** The Bluetooth module for use in conjunction with the electronic insert FEL68 (2-wire NAMUR) must be ordered separately with the necessary battery.

**i** The following versions can be optionally selected in the Product Configurator:  
Application package: Heartbeat Verification + Monitoring for NAMUR output  
Accessory mounted: Bluetooth for NAMUR output

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

## LED module VU120 (optional)

### Supply voltage

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

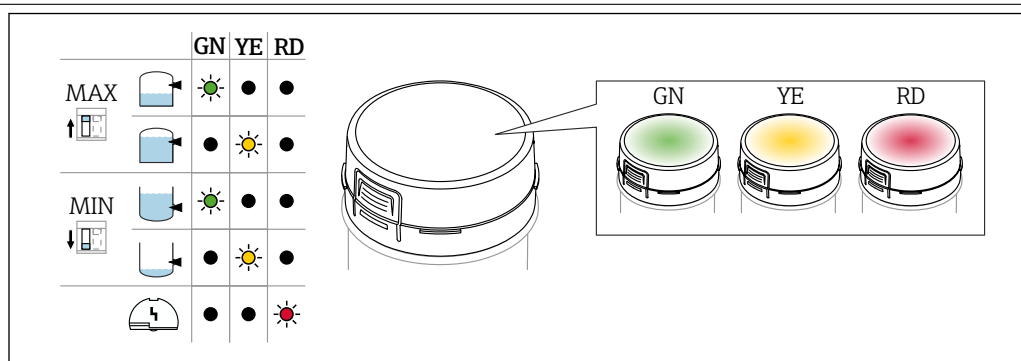
### Power consumption

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

### Current consumption

$I_{\text{max}} = 0.4 \text{ A}$

### Signaling of operational status



A0039258

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

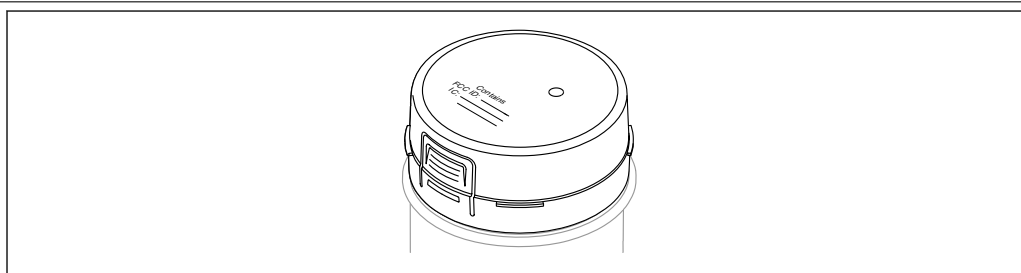
A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.



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

## Bluetooth module and Heartbeat Technology

### Bluetooth module VU121 (optional)



A0039257

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).



For additional information about the connection, see the Operating Instructions for the device. Documentation currently available on the Endress+Hauser- website: [www.endress.com](http://www.endress.com) → Downloads.

**Batteries - use and handling**

For energy-related reasons, Bluetooth module VU121 requires a special battery when operated with electronics insert FEL68 (2-wire NAMUR).



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

Replacement batteries can be purchased from a specialist retailer.

*Replacement batteries*

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

*Isolation lug in battery compartment***NOTICE****Removal of grounding lug causes battery to discharge prematurely**

Removing the grounding lug from the battery compartment of the Bluetooth module causes the battery to discharge prematurely, regardless of the sensor power supply.

- ▶ As long as the sensors are in storage, the grounding lug must remain in the battery compartment of the Bluetooth module.

*Operating life*

- If the batteries are empty, Bluetooth connection is no longer possible.
- At ambient temperatures from +10 to +40 °C (+50 to +104 °F), 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.

Requirement: The sensor is 99 % in the "good" state (demand requires increased power consumption)

The battery life is based on a scenario where the sensor is connected and powered.

*Replacing the battery*

- ▶ Before replacing the battery, the Bluetooth module must be disconnected from electronic insert FEL68.
  - ↳ Only then will the battery status display be detected correctly.

**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.

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**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

# 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> (62.4 lb/ft<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> (43.7 lb/ft<sup>3</sup>) (SGU)
- Switch direction of sensor: uncovered to covered

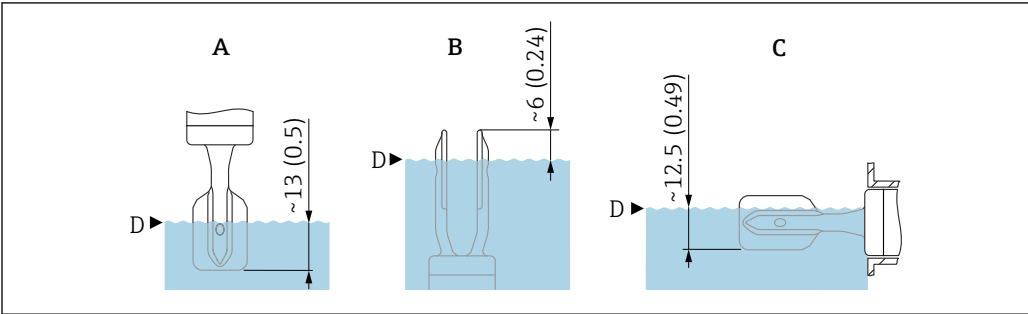
## Take switch point into consideration

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

Water +23 °C (+73 °F)

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

### Plastic-coated tuning fork (ECTFE, PFA)

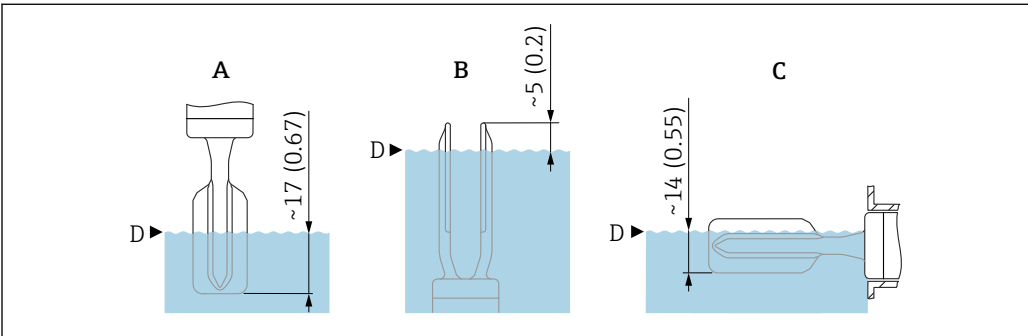


A0042269

 17 Typical switch points, plastic-coated tuning fork (ECTFE, PFA). 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



A0043327

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

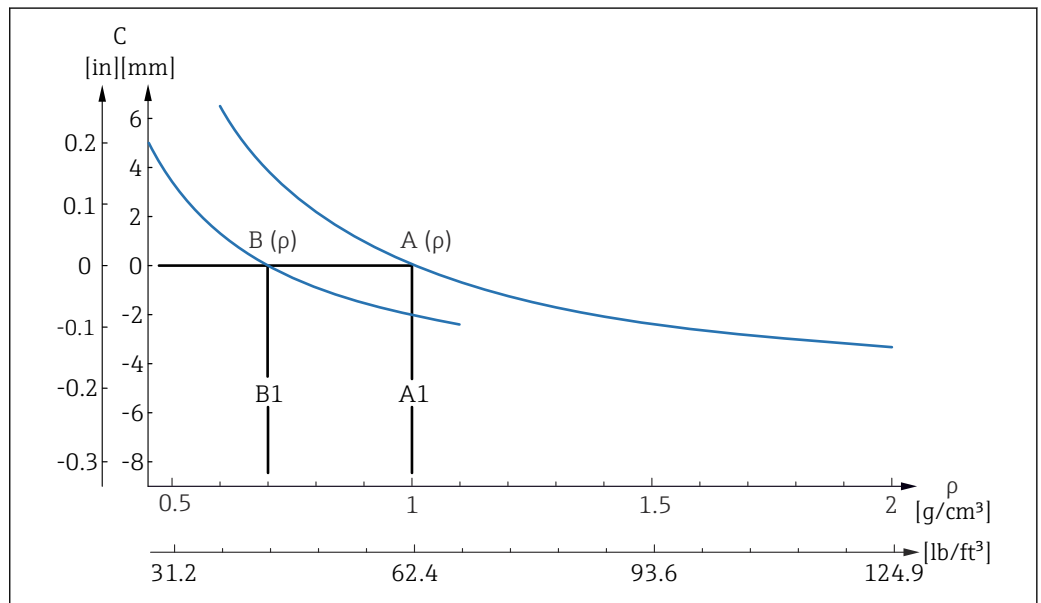
- A Installation from above
- B Installation from below
- C Installation from the side
- D Switch point

## Maximum measured error

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

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hysteresis</b>                           | At reference operating conditions: <ul style="list-style-type: none"> <li>■ Plastic coating: 2.5 mm (0.1 in)</li> <li>■ Enamel coating: 3.5 mm (0.14 in)</li> </ul>                                                                                                                                                                                                                                                                                                              |
| <b>Non-repeatability</b>                    | 0.5 mm (0.02 in)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Influence of the process temperature</b> | Temperature range and switch point shift <ul style="list-style-type: none"> <li>■ ECTFE: maximum -50 to +120 °C (-58 to +248 °F)<br/>Switch point shift in the range of 1 to 3.0 mm (0.04 to 0.12 in)</li> <li>■ PFA: maximum -50 to +150 °C (-58 to +302 °F)<br/>Switch point shift in the range of 1 to 3.0 mm (0.04 to 0.12 in)</li> <li>■ Enamel: maximum -50 to +150 °C (-58 to +302 °F)<br/>Switch point shift in the range of 1.05 to 2.0 mm (0.04 to 0.08 in)</li> </ul> |
| <b>Influence of the process pressure</b>    | Pressure range and switch point shift <ul style="list-style-type: none"> <li>■ ECTFE, PFA: maximum 0 to 40 bar (0 to 580 psi)<br/>Switch point shift in the range of 0 to -2.0 mm (0 to -0.08 in)</li> <li>■ Enamel: maximum 0 to 25 bar (0 to 363 psi)<br/>Switch point shift in the range of 0 to -1.0 mm (0 to -0.04 in)</li> </ul>                                                                                                                                           |

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

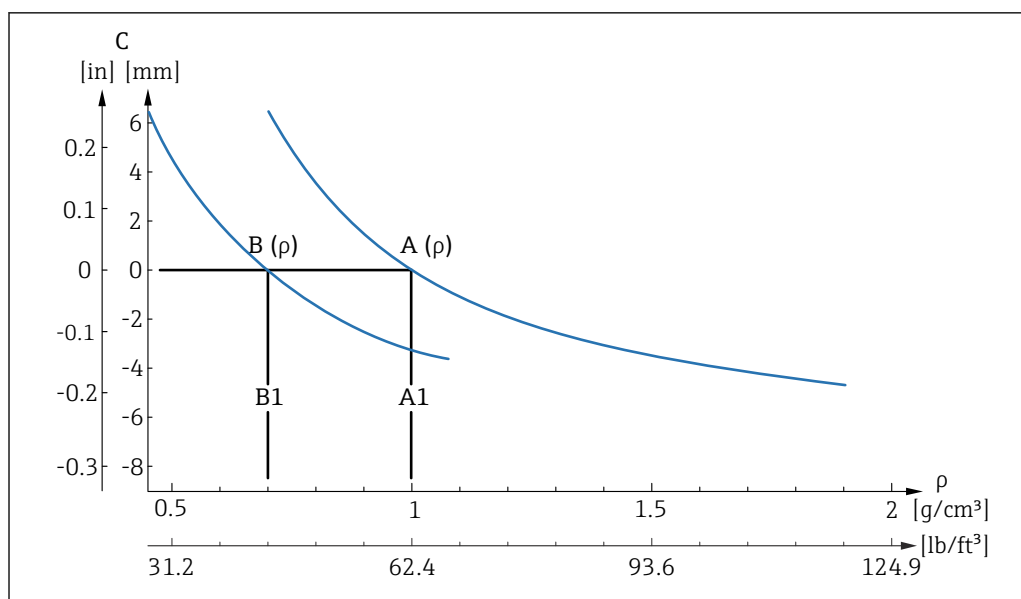


19 Reference switch points via density, plastic coating (ECTFE, PFA)

- A Density switch setting ( $\rho > 0.7 \text{ g/cm}^3$  (43.7 lb/ft<sup>3</sup>))  
 A1 Reference operating condition  $\rho = 1 \text{ g/cm}^3$  (62.4 lb/ft<sup>3</sup>)  
 B Density switch setting ( $\rho > 0.5 \text{ g/cm}^3$  (31.21 lb/ft<sup>3</sup>))  
 B1 Reference operating condition  $\rho = 0.7 \text{ g/cm}^3$  (43.7 lb/ft<sup>3</sup>)  
 C Switch point deviation

#### Density setting

- TC<sub>typ.</sub>, [mm/10 k]
  - $\rho > 0.7 \text{ g/cm}^3$  (43.7 lb/ft<sup>3</sup>): -0.25
  - $\rho > 0.5 \text{ g/cm}^3$  (31.21 lb/ft<sup>3</sup>): -0.3
- Pressure<sub>typ.</sub>, [mm/10 bar]
  - $\rho > 0.7 \text{ g/cm}^3$  (43.7 lb/ft<sup>3</sup>): -0.3
  - $\rho > 0.5 \text{ g/cm}^3$  (31.21 lb/ft<sup>3</sup>): -0.4



A0042242

20 Reference switch points via density, enamel coating

- A Density switch setting ( $\rho$ ) > 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>)
- A1 Reference operating condition  $\rho$  = 1 g/cm<sup>3</sup> (62.4 lb/ft<sup>3</sup>)
- B Density switch setting ( $\rho$ ) > 0.5 g/cm<sup>3</sup> (31.21 lb/ft<sup>3</sup>)
- B1 Reference operating condition  $\rho$  = 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>)
- C Switch point deviation

#### Density setting

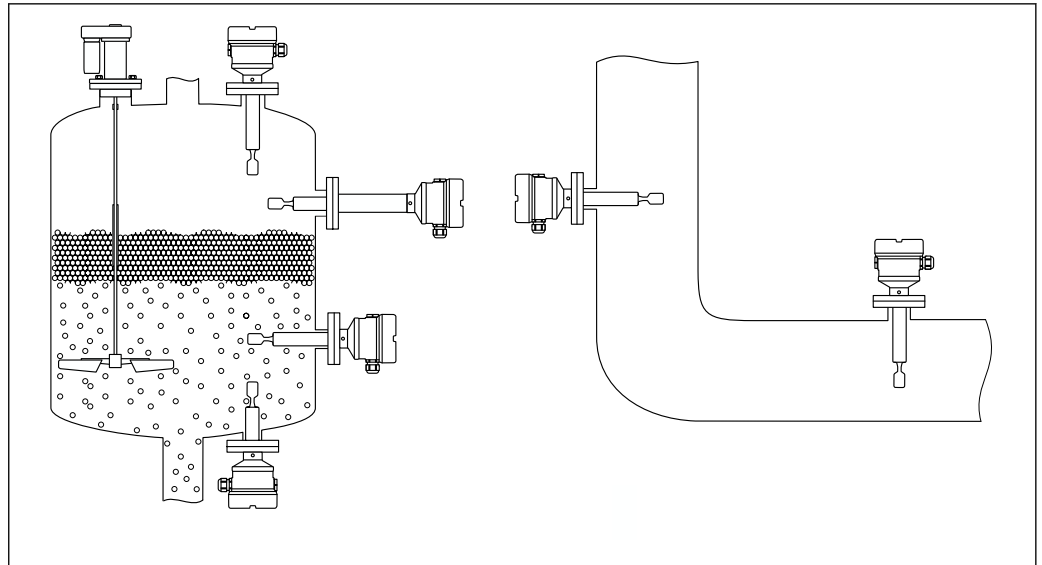
- TC<sub>typ.</sub>, [mm/10 k]
  - $\rho$  > 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>): -0.1
  - $\rho$  > 0.5 g/cm<sup>3</sup> (31.21 lb/ft<sup>3</sup>): -0.15
- Pressure<sub>typ.</sub>, [mm/10 bar]
  - $\rho$  > 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>): -0.3
  - $\rho$  > 0.5 g/cm<sup>3</sup> (31.21 lb/ft<sup>3</sup>): -0.4

## Mounting

### Mounting location, orientation

#### Mounting instructions

- Any orientation for device with a pipe length of up to 500 mm (19.7 in) approx.
- Vertical orientation from above for device with long pipe
- Minimum distance between the tuning fork and the tank wall or pipe wall: 10 mm (0.39 in)



A0042153

21 Installation examples for a vessel, tank or pipe

## Installation instructions

### Take viscosity into consideration



Viscosity values

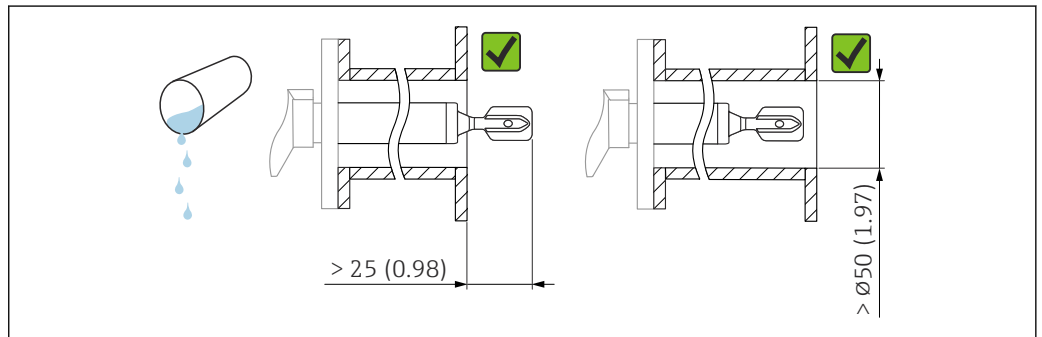
- Low viscosity:  $< 2\,000 \text{ mPa}\cdot\text{s}$
- High viscosity:  $> 2\,000 \text{ to } 10\,000 \text{ mPa}\cdot\text{s}$

#### Low viscosity



Low viscosity, e.g. water:  $< 2\,000 \text{ mPa}\cdot\text{s}$

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)

#### High viscosity

### NOTICE

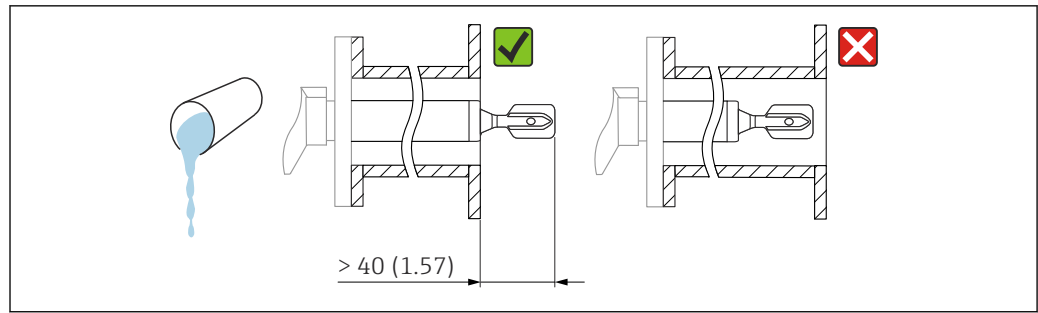
**Highly viscous liquids may cause switching delays.**

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



High viscosity, e.g. viscous oils:  $\leq 10\,000 \text{ mPa}\cdot\text{s}$

The tuning fork must be located outside the installation socket!

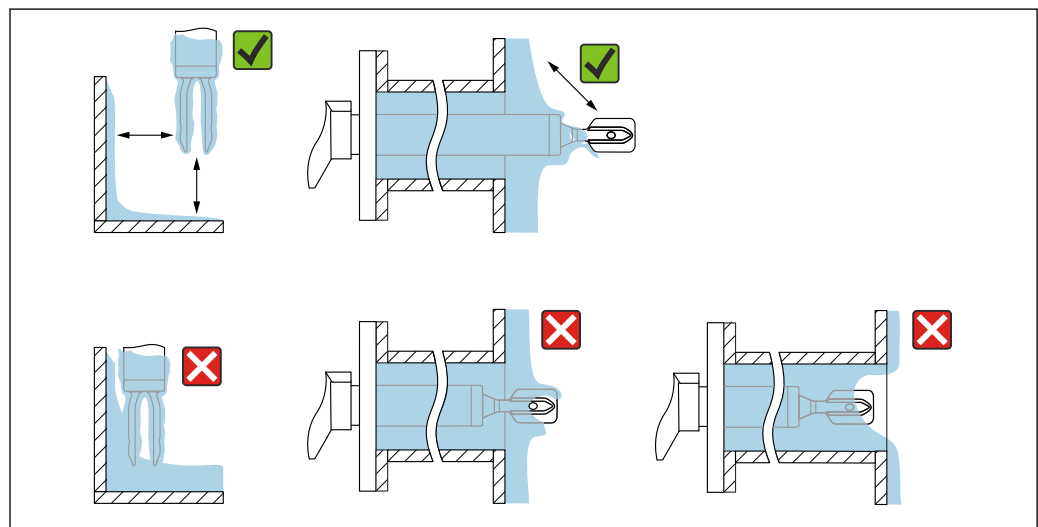


A0042205

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

### Avoid buildup

- Use short installation sockets to ensure that the tuning fork projects freely into the vessel
- Leave sufficient distance between the buildup expected on the tank wall and the tuning fork

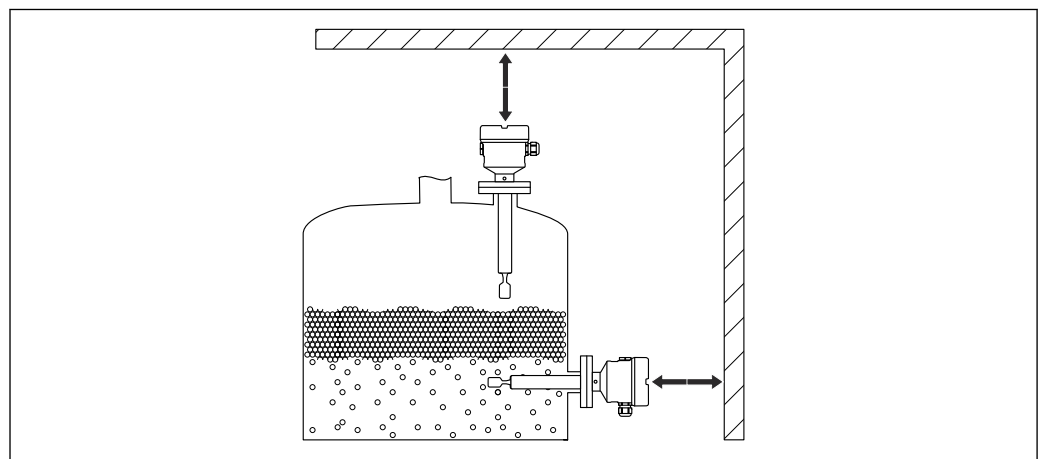


A0042206

■ 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.

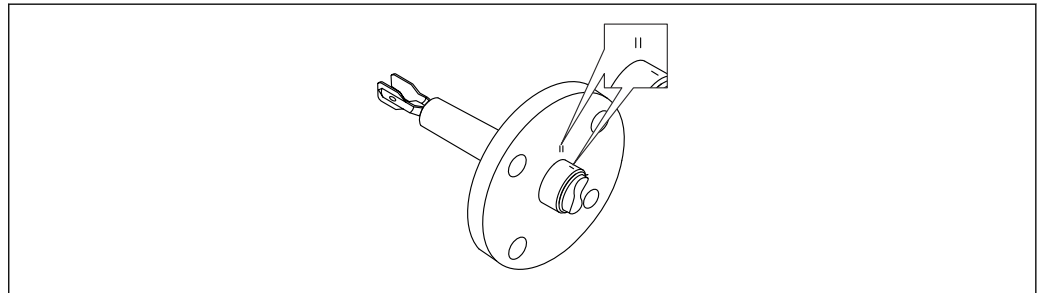


A0033236

■ 25 Take clearance into consideration

### Aligning the tuning fork using the marking

The tuning fork can be aligned using the marking in such a way that the medium drains off easily and buildup is avoided.

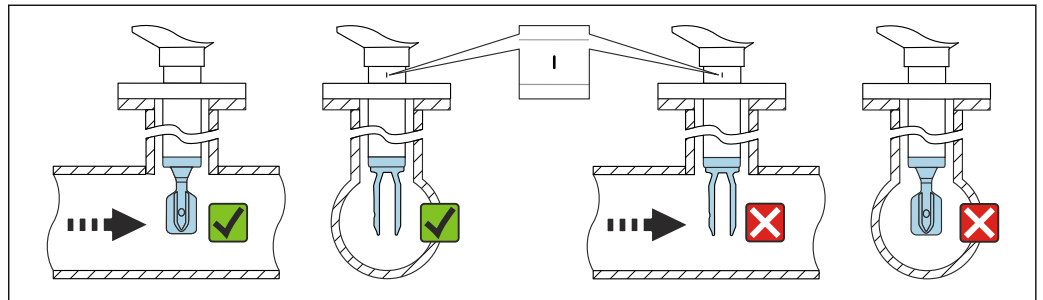


A0042207

26 Position of the tuning fork when installed horizontally in the vessel using the marking

### Installing the device in piping

- Flow velocity up to 5 m/s with a viscosity of 1 mPa·s and density of 1 g/cm<sup>3</sup> (62.4 lb/ft<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.



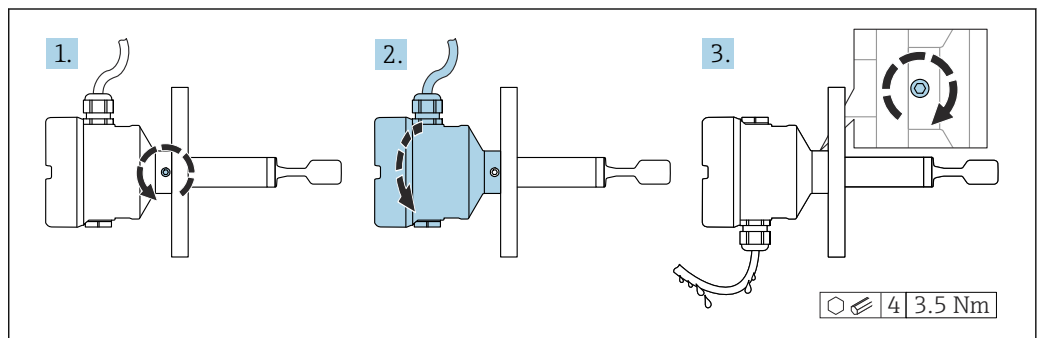
A0042208

27 Installation in pipes (take fork position and marking into consideration)

### Aligning the cable entry

- i** Housings with locking screw:
  - The housing can be turned and the cable aligned by turning the locking screw.
  - The locking screw is not tightened when the device is delivered.

Housing with locking screw: The housing can be turned and the cable aligned by turning the locking screw.



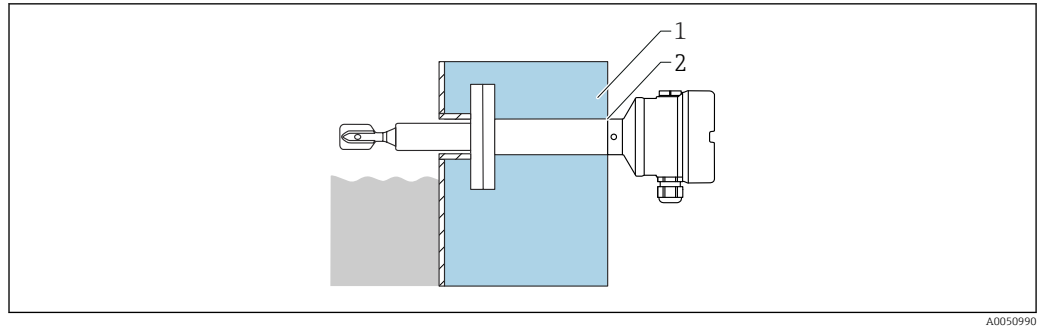
A0042214

28 Housing with external locking screw and drip loop

### Special mounting instructions

#### Vessel with heat insulation

If process temperatures are high, the device should be incorporated in the usual vessel insulation system to prevent the electronics from heating as a result of thermal radiation or convection. The insulation in this case should not be higher than the neck of the device.



A0050990

29 Vessel with heat insulation (example with temperature spacer)

- 1 Vessel insulation
- 2 Insulation up to the housing neck max.

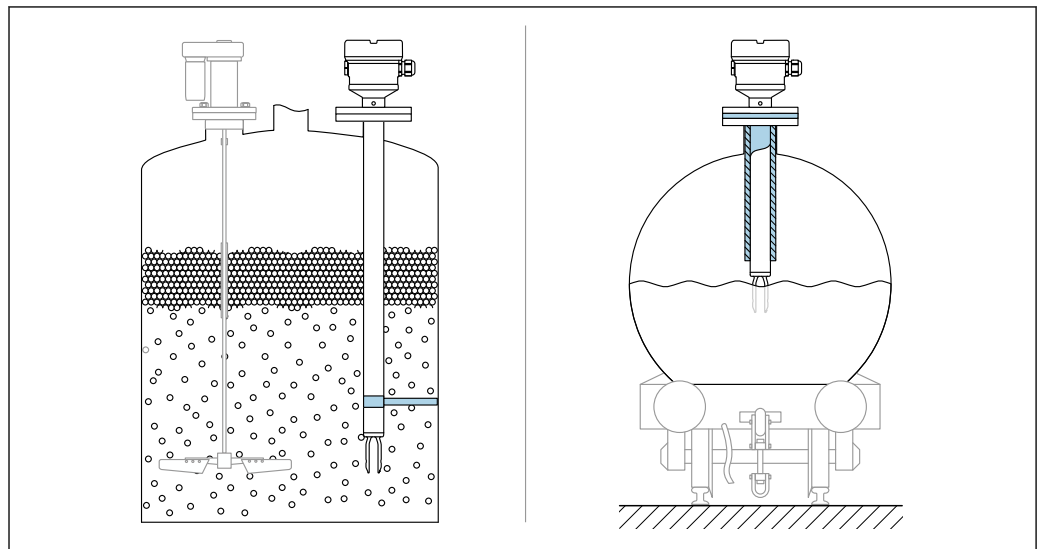
### Support the device

#### 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

30 Examples of support in the event of dynamic load

- i** Marine approval: In the case of pipe extensions or sensors longer than 1 600 mm (63 in), a support is needed at least every 1 600 mm (63 in).

## Environment

### Ambient temperature range

#### ⚠ WARNING

#### Permitted connection voltage exceeded!

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

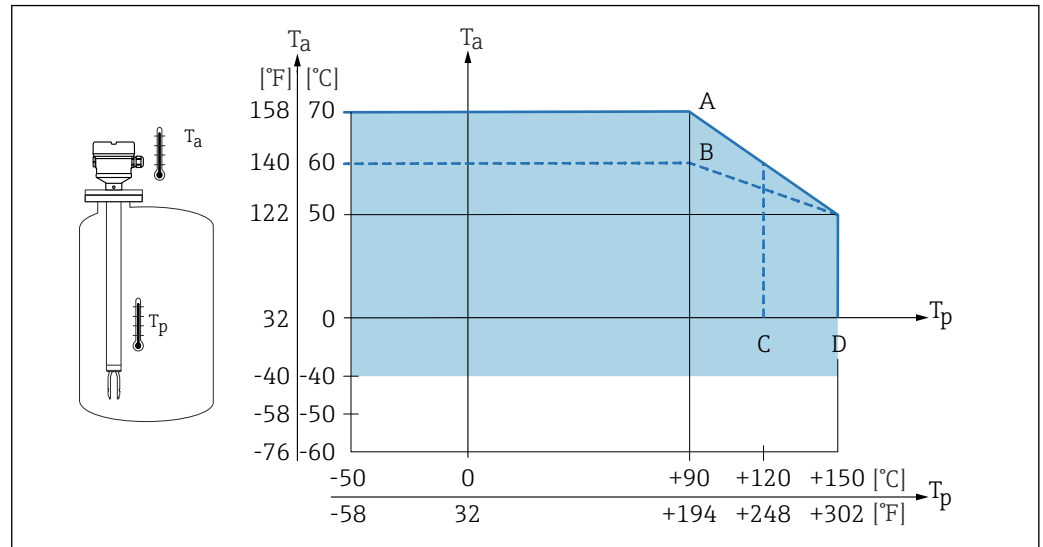
$-40$  to  $+70^{\circ}\text{C}$  ( $-40$  to  $+158^{\circ}\text{F}$ )

Optionally available to order:

- -50 °C (-58 °F) with restricted operating life and performance
- -60 °C (-76 °F) with restricted operating life and performance,
- Below -50 °C (-58 °F): devices can be permanently damaged

The minimum permitted ambient temperature of the plastic housing is limited to -20 °C (-4 °F); 'indoor use' applies to North America.

Low-temperature electronic inserts are marked LT.



31 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; for FEL64 and process temperature  $T_p > 90$  °C max. load current 4 A  
 B Device with LED module; for FEL64 and process temperature  $T_p > 90$  °C max. load current 2 A  
 C ECTFE-coated  
 D PFA- or enamel-coated

- Low temperatures are not possible for SIL
- Bluetooth module:
  - -50 °C (-58 °F) for non-Ex, Ex ia and Ex d
  - -60 °C (-76 °F) for non-Ex
- LED module:
  - -50 °C (-58 °F) for non-Ex, Ex ia and Ex d
  - -60 °C (-76 °F) for non-Ex

Outdoor operation in strong sunlight:

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

#### Hazardous area

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).

|                     |                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage temperature | -40 to +80 °C (-40 to +176 °F)<br>Optional: -50 °C (-58 °F), -60 °C (-76 °F)                                                                                        |
| Humidity            | Operation up to 100 %. Do not open in a condensing atmosphere.                                                                                                      |
| Operating altitude  | As per IEC 61010-1 Ed.3:<br>■ Up to 2 000 m (6 600 ft) above sea level<br>■ 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                                                                                                                                     |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Degree of protection</b>                | <p>Testing according to IEC 60529 and NEMA 250</p> <p>IP68 test condition: 1.83 m H<sub>2</sub>O for 24 h</p> <p><b>Housing</b><br/>See cable entries</p> <p><b>Cable entries</b></p> <ul style="list-style-type: none"> <li>■ M20 threaded joint, plastic, IP66/68 NEMA Type 4X/6P</li> <li>■ M20 threaded joint, nickel-plated brass, IP66/68 NEMA Type 4X/6P</li> <li>■ M20 threaded joint, 316L, IP66/68 NEMA Type 4X/6P</li> <li>■ M20 thread, IP66/68 NEMA Type 4X/6P</li> <li>■ G ½ thread, NPT ½, NPT ¾ IP66/68 NEMA Type 4X/6P</li> </ul> <p>Degree of protection for M12 plug</p> <ul style="list-style-type: none"> <li>■ When housing is closed and connecting cable is plugged in: IP66/67 NEMA Type 4X</li> <li>■ When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1</li> </ul> <p><b>NOTICE</b></p> <p><b>M12 plug: Loss of IP protection class due to incorrect installation!</b></p> <ul style="list-style-type: none"> <li>▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.</li> <li>▶ The degree of protection only applies if the connecting cable used is specified according to IP67 NEMA Type 4X.</li> </ul> <p> If the "M12 plug" option is selected as the electrical connection, <b>IP66/67 NEMA Type 4X</b> applies for all housing types.</p> |
| <b>Vibration resistance</b>                | <p>As per IEC60068-2-64-2008</p> <p><math>a(\text{RMS}) = 50 \text{ m/s}^2</math>, <math>f = 5 \text{ to } 2\,000 \text{ Hz}</math>, <math>t = 3 \text{ axes} \times 2 \text{ h}</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Shock resistance</b>                    | <p>In accordance with IEC60068-2-27-2008: <math>300 \text{ m/s}^2 [= 30 g_n] + 18 \text{ ms}</math></p> <p><math>g_n</math>: standard acceleration of gravity</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Mechanical load</b>                     | <p>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).</p> <p> For more details, see the "Supporting the device" section.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Pollution degree</b>                    | Pollution degree 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Electromagnetic compatibility (EMC)</b> | <ul style="list-style-type: none"> <li>■ Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)</li> <li>■ With regard to the safety function (SIL), the requirements of EN 61326-3-x are satisfied</li> </ul> <p> For more details, refer to the EU Declaration of Conformity.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## Process

|                                  |                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Process temperature range</b> | <ul style="list-style-type: none"> <li>■ ECTFE: -50 to +120 °C (-58 to +248 °F)</li> <li>■ PFA: -50 to +150 °C (-58 to +302 °F)</li> <li>■ Enamel: -50 to +150 °C (-58 to +302 °F)</li> </ul> <p>Pay attention to the pressure and temperature dependency.  "Process pressure range" section.</p> |
| <b>Thermal shock</b>             | $\leq 120 \text{ K/s}$                                                                                                                                                                                                                                                                                                                                                                 |

## Process pressure range



**The maximum pressure for the device depends on the lowest-rated element, with regard to pressure, of the selected component. This means that it is necessary to pay attention to the process connection as well as the sensor.**

- ▶ Pressure specifications,  Technical Information, "Mechanical construction" section.
- ▶ Only operate the device within the specified limits!
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.

Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:

- pR EN 1092-1: 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.
- ASME B 16.5
- JIS B 2220

The following data apply over the entire temperature range. Pay attention to exceptions for flange process connections!

- ECTFE, PFA: -1 to 40 bar (-14.5 to 580 psi)
- Enamel: max. -1 to 25 bar (-14.5 to 363 psi)

In each case, the lowest value from the derating curves of the device and the selected flange applies.



Canadian CRN approval: more details about the maximum pressure values are available in the download area of the product page under: [www.endress.com](http://www.endress.com) → Downloads.

## Overpressure limit

- Overpressure limit =  $1.5 \cdot P_N$ 
  - ECTFE, PFA:  $P_N = 40 \text{ bar (580 psi)}$
  - Enamel:  $P_N = 25 \text{ bar (362.5 psi)}$
- Membrane burst pressure at 200 bar (2 900 psi)

The device function is limited during the pressure test.

Mechanical integrity is guaranteed up to 1.5 times the process nominal pressure  $P_N$ .

## Density

**Liquids with density > 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>)**

Switch position > 0.7 g/cm<sup>3</sup> (43.7 lb/ft<sup>3</sup>), order configuration

**Liquids with density 0.5 g/cm<sup>3</sup> (31.2 lb/ft<sup>3</sup>)**

Switch position > 0.5 g/cm<sup>3</sup> (31.2 lb/ft<sup>3</sup>), can be configured via DIP switch

**Liquids with density > 0.4 g/cm<sup>3</sup> (25.0 lb/ft<sup>3</sup>)**

- Optionally available to order
  - SIL for defined media and process parameters on request
  - Fixed value that cannot be edited
- The function of the DIP switch is interrupted



For information on medium differentiation/density detection: Documentation Liquiphant density (FEL60D) with density computer FML621 (Endress+Hauser website [www.endress.com](http://www.endress.com) → Downloads)

## Viscosity

≤ 10 000 mPa·s

## Pressure shocks

≤ 20 bar/s (290 psi/s)

## Pressure tightness

Up to vacuum



In vacuum evaporation plants, select the 0.4 g/cm<sup>3</sup> (25.0 lb/ft<sup>3</sup>) / density setting.

## Solids contents

Ø ≤ 5 mm (0.2 in)

## Mechanical construction

### Design, dimensions

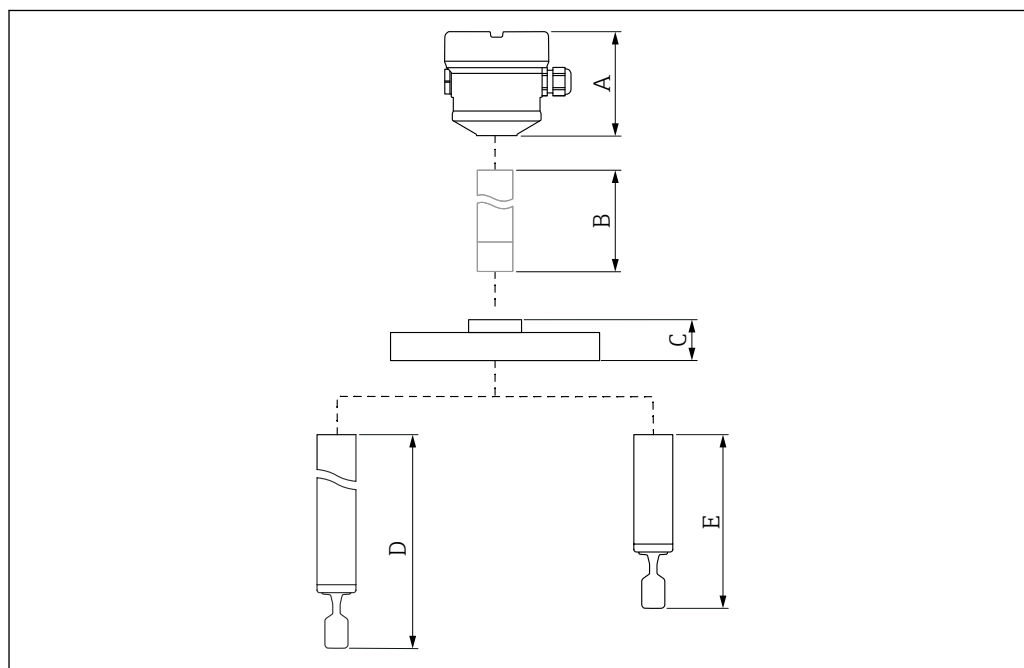
#### Device height

The device height consists of the following components:

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

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

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



A0042256

32 Components to determine the device height

- A Housing including cover  
 B Temperature spacer, pressure-tight feedthrough (optional), details in the Product Configurator  
 C Process connection  
 D Probe design: pipe extension with tuning fork  
 E Probe design: short pipe version with tuning fork

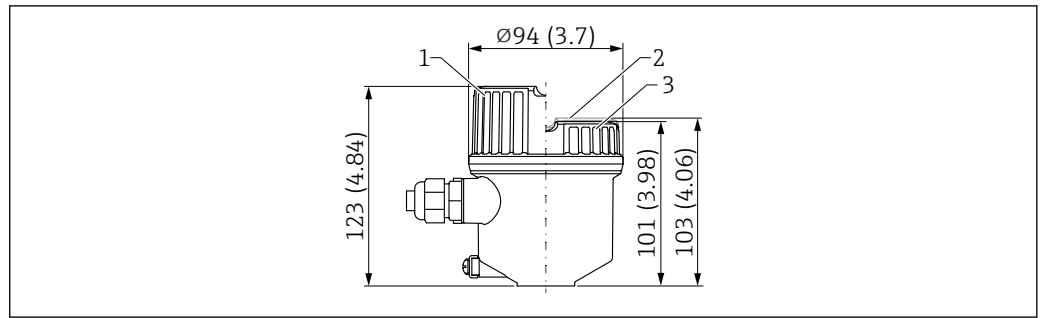
### Dimensions

#### Housing and cover

All housings can be aligned. The housing alignment can be fixed on housings with a locking screw.

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

Single compartment housing, plastic

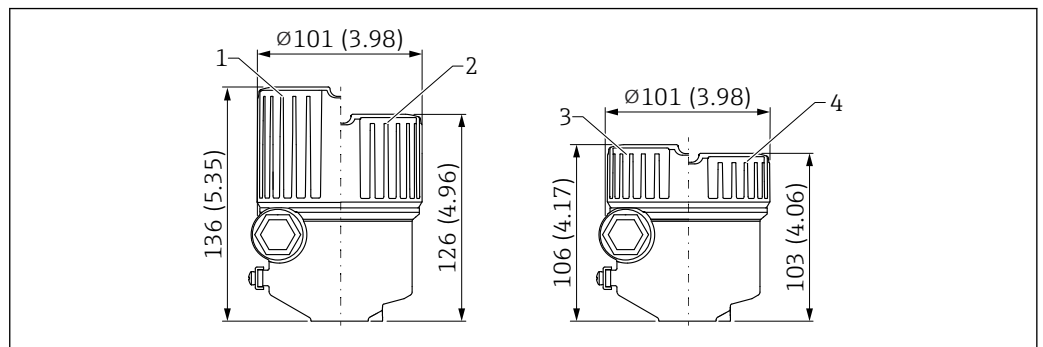


A0035911

33 Dimensions of single compartment housing, plastic. Unit of measurement mm (in)

- 1 Height with plastic cover (transparent)
- 2 Height with cover with plastic sight glass (optional)
- 3 Height with cover without sight glass

Single compartment housing, aluminium, coated

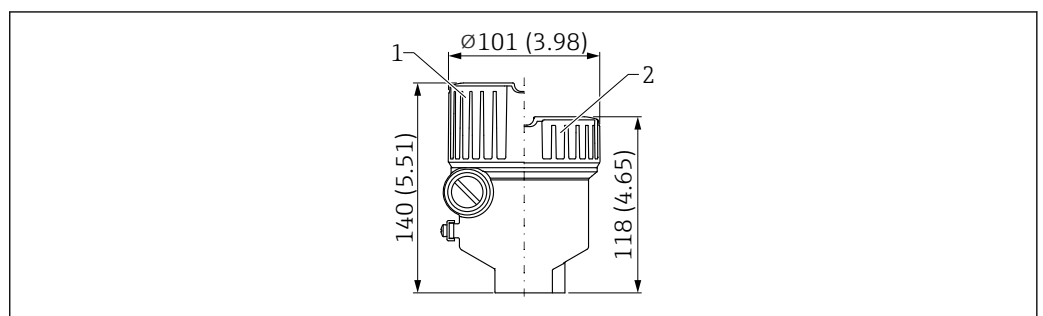


A0039402

34 Dimensions of single compartment housing, aluminum, coated. Unit of measurement mm (in)

- 1 Height with cover with sight glass made of glass for Ex ec approval
- 2 Height with cover with plastic sight glass
- 3 Height with cover without sight glass
- 4 Height with cover with plastic sight glass (optional)

Single compartment housing, aluminum, coated (Ex d/XP, dust ignition-proof)

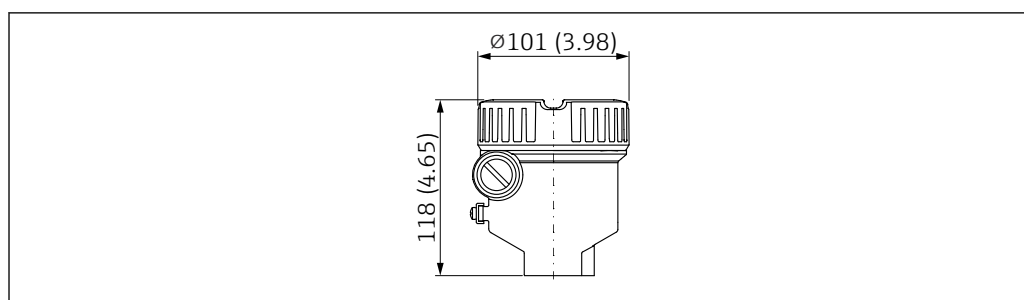


A0039401

35 Dimensions of single compartment housing, aluminum, coated; with Ex d/XP, dust ignition-proof. Unit of measurement mm (in)

- 1 Height with cover with sight glass made of glass
- 2 Height with cover without sight glass

## Single compartment housing, 316L

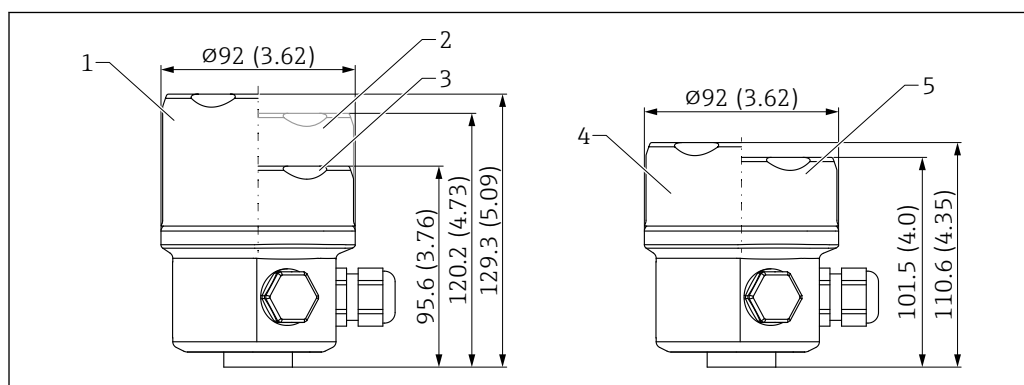


A0052845

36 Dimensions of single compartment 316L housing; with Ex d/XP also, dust ignition-proof; cover without sight glass. Unit of measurement mm (in)

## 316L single compartment housing, hygienic

**i** The housing with ground terminal and cover with cover lock are required for use in hazardous areas with a certain type of protection.

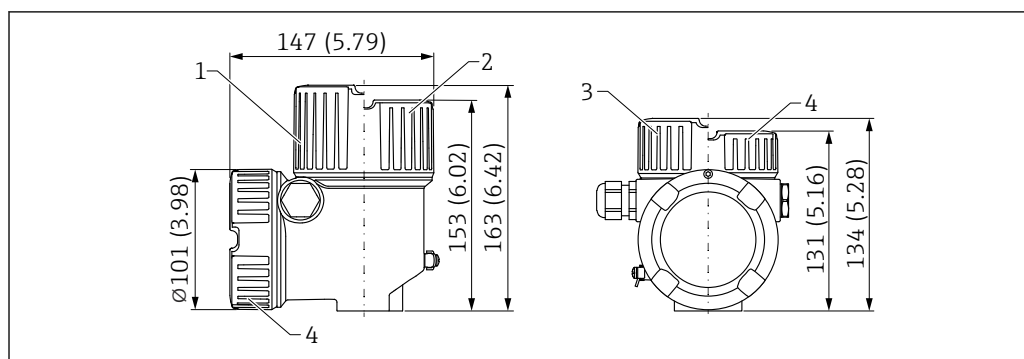


A0050817

37 Dimensions of single compartment housing, 316L, hygienic. Unit of measurement mm (in)

- 1 Height with cover with sight glass made of glass
- 2 Height with cover with plastic sight glass
- 3 Height with cover without sight glass
- 4 Height with cover with sight glass made of glass (optional)
- 5 Height with cover with plastic sight glass (optional)

## Dual compartment housing, L-shaped, aluminum, coated



A0035591

38 Dimensions of dual compartment housing, L-shaped, aluminum, coated; also with Ex d/XP, dust ignition-proof. Unit of measurement mm (in)

- 1 Height with cover with sight glass made of glass
- 2 Height with cover with plastic sight glass
- 3 Height with cover with plastic sight glass (optional)
- 4 Height with cover without sight glass

### Ground terminal

- Ground terminal inside the housing, max. conductor cross-section 2.5 mm<sup>2</sup> (14 AWG)
- Ground terminal outside on the housing, max. conductor cross-section 4 mm<sup>2</sup> (12 AWG)

### Cable glands

Cable diameter:

- Plastic: Ø5 to 10 mm (0.2 to 0.38 in)
- Nickel-plated brass: Ø7 to 10.5 mm (0.28 to 0.41 in)
- Stainless steel: Ø7 to 12 mm (0.28 to 0.47 in)



The scope of delivery comprises:

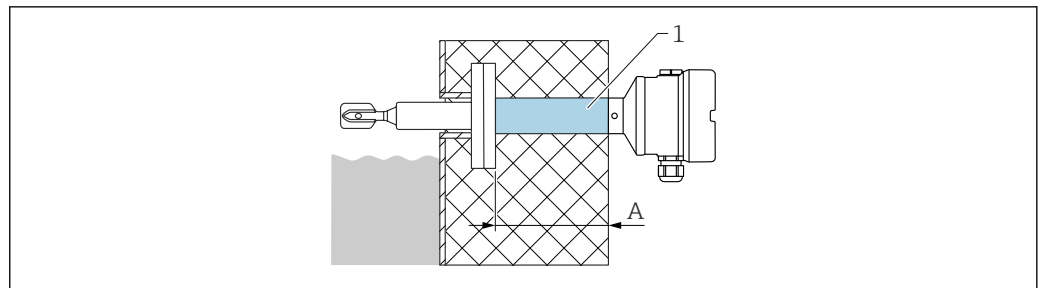
- 1 cable gland installed
- 1 cable gland sealed with dummy plug

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

Exceptions: For Ex d/XP, dust ignition-proof, only threaded insertions are permitted.

### Temperature spacer, pressure-tight feedthrough (optional)

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



A0042231

- 1 Temperature spacer and/or pressure-tight feedthrough with maximum insulation length  
A 140 mm (5.51 in)

Product Configurator, feature "Sensor design":

- Temperature spacer
- Pressure-tight feedthrough (second line of defense)

If the sensor is damaged, this protects the housing from vessel pressures up to 100 bar (1 450 psi).



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

### Probe design

#### Short pipe

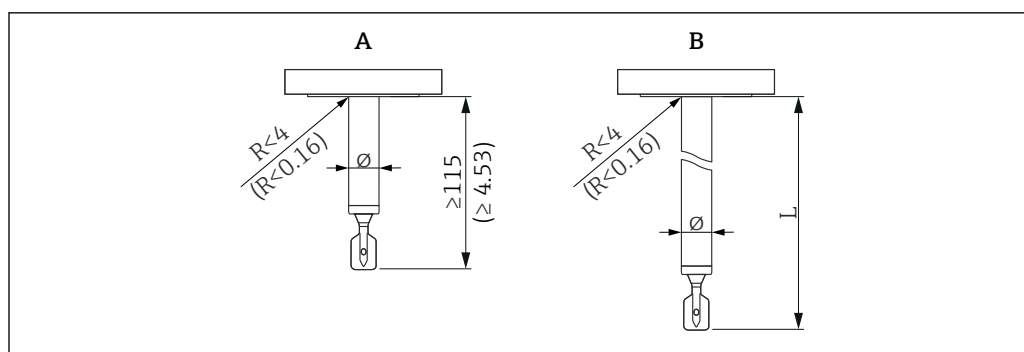
Fixed length (A)

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

#### 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)
- Length tolerances L: < 1 m (3.3 ft) = -5 mm (-0.2 in), 1 to 3 m (3.3 to 9.8 ft) = -10 mm (-0.39 in)

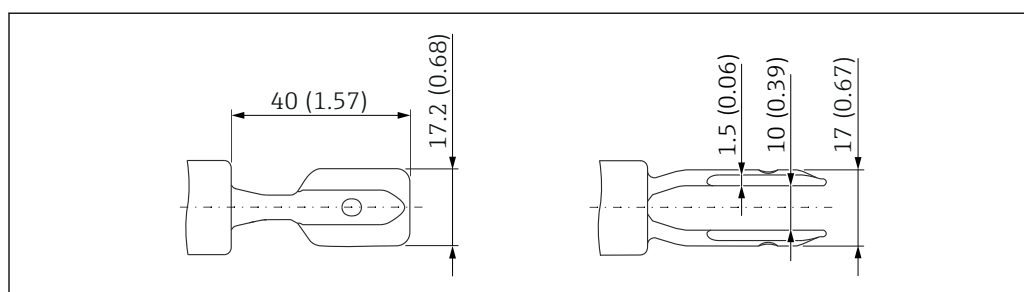


A0042250

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

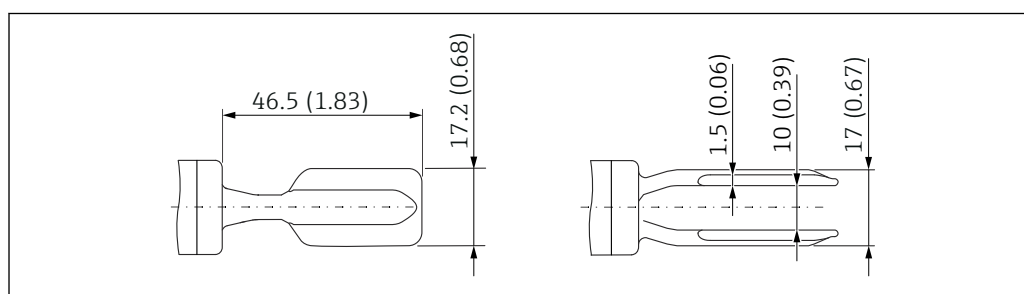
- A Short pipe: fixed length  
 B Pipe extension: variable length L  
 Ø Maximum diameter: depends on coating material  
 R Radius: take into consideration for counterflange

### Tuning fork



A0038269

40 Tuning fork with plastic coating (ECTFE, PFA). Unit of measurement mm (in)



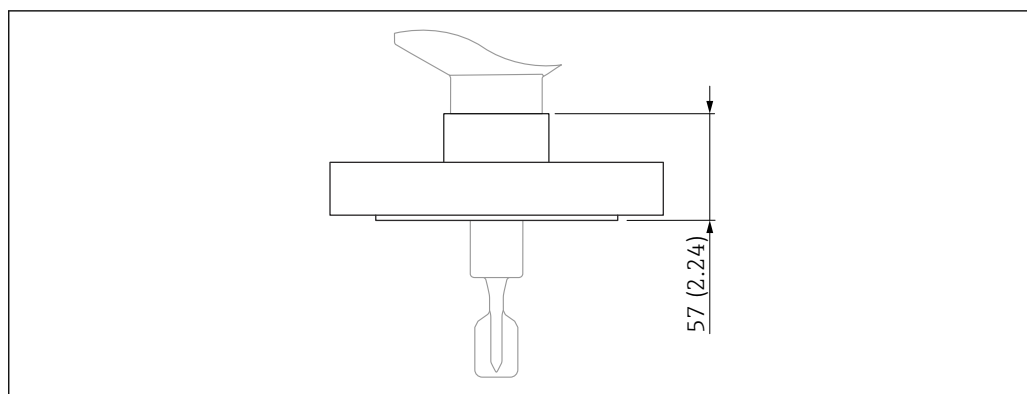
A0041851

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

### Process connections

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)

*Height of process connection*

42 Process connection with flange (maximum specification of height) . Unit of measurement mm (in)

*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 1-1/2" | 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) |

## Coating material and layer thickness

 The maximum diameter  $\varnothing$  depends on the coating material.

### ECTFE

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

### PFA (Edlon™), PFA (RubyRed®), 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)

 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®-PFA
- Very good chemical and corrosion resistance
- High abrasion performance
- Good non-stick and sliding properties
- High temperature stability
- Ideal for use in the chemical and pharmaceutical industry
- Available as PFA (Edlon™), PFA (Ruby Red®) or also as PFA (conductive), specially developed for use in explosive atmospheres

 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 stability
- Dirt-repellent
- Low resistance to impact

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

## Weight

### Basic weight: 0.65 kg (1.43 lb)

The basic weight comprises:

- Probe design: short pipe version
- Electronic insert
- Housing: single compartment, plastic with cover

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

### 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 a tall cover: 0.38 kg (0.84 lb)
- Single compartment; 316L: 2.1 kg (4.63 lb)
- Single compartment; 316L, hygienic: 0.45 kg (0.99 lb)  
optional LED module or Bluetooth module with a tall cover: 0.38 kg (0.84 lb)
- Dual compartment, L-shaped; aluminum, coated: 1.22 kg (2.69 lb)  
optional LED module or Bluetooth module with a tall 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

- 1000 mm: 0.9 kg (1.98 lb)
- 50 in: 1.15 kg (2.54 lb)

#### Process connection

See "Process connections" section

#### Protective cover, plastic

0.2 kg (0.44 lb)

#### Protective cover, 316L

0.93 kg (2.05 lb)

---

#### Materials



No coating: temperature spacer, pressure-tight feedthrough

#### Materials in contact with process

##### *Pipe extension*

- 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

##### *Flanges*

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

#### Materials not in contact with process

##### *Plastic housing*

- Housing: PBT/PC
- Dummy cover: PBT/PC
- Transparent cover: PA12
- Cover seal: EPDM
- Potential equalization: 316L
- Seal under potential equalization: EPDM
- Plug: PBT-GF30-FR
- M20 cable gland: PA
- Seal on plug and cable gland: EPDM
- Threaded adapter as substitute for cable glands: PA66-GF30

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

- Adapter for NPT ¾: plastic
- Nameplate: plastic foil
- TAG plate: plastic foil, metal or provided by customer

#### *Aluminum housing, coated*

- Housing: aluminum EN AC 43400
- Dummy cover: aluminum EN AC 43400
- Cover with sight glass: aluminum EN AC 43400, PC Lexan 943A synthetic glass  
Cover with polycarbonate sight glass, optionally available to order
- Cover seal materials: HNBR
- Cover seal materials: FVMQ (only for low temperature version)
- Plug: aluminum  
Plastic (PBT-GF30-FR) in Ex-free, Ex i or IS combination with cable gland, plastic, M20 thread or G ½ thread
- Nameplate: plastic foil
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

#### *Stainless steel housing, 316L*

- Housing: stainless steel AISI 316L (1.4409)  
Stainless steel (ASTM A351 : CF3M (cast equivalent to AISI 316L material)/DIN EN 10213 : 1.4409)
- Dummy cover: stainless steel AISI 316L (1.4409)
- Plug: stainless steel
- Cover seal materials: FVMQ (only for low temperature version)
- Cover seal materials: HNBR
- Nameplate: stainless steel housing labeled directly
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

#### *Stainless steel housing, 316L, hygienic*

- Housing: stainless steel AISI 316L (1.4404)
- Dummy cover: stainless steel AISI 316L (1.4404)
- Cover with polycarbonate sight glass optionally available. For dust ignition-proof applications, the sight glass is made of borosilicate.
- Cover seal materials: VMQ
- Plug: stainless steel or plastic
  - Plastic (PBT-GF30-FR) in Ex-free, Ex i or IS combination with cable gland, plastic, M20 thread or G ½ thread
  - Stainless steel for cable glands made of stainless steel or nickel or for Ex t, Ex ia IIIC
- Nameplate: stainless steel housing labeled directly
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

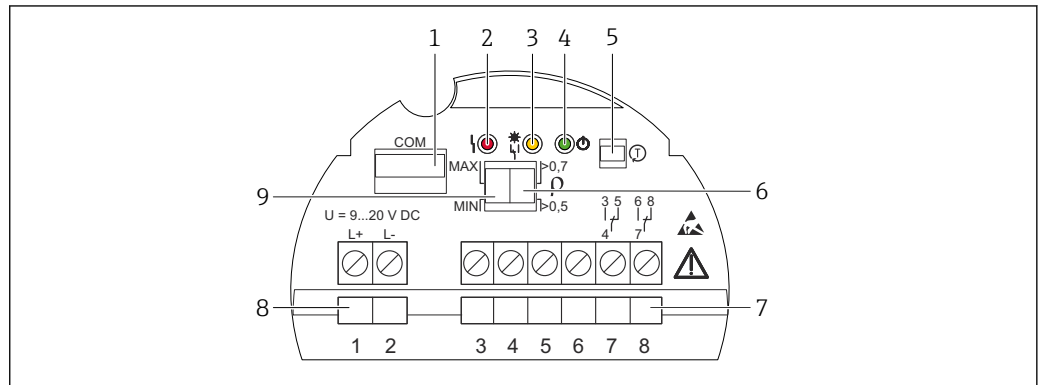
## User interface

### Operation 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 (signal lights visible from the outside)  
Observe approvals for plastic housing, aluminum housing and stainless steel housing in hygienic applications (combined with DC-PNP (electronic insert FEL62) and relay electronics (electronic inserts FEL64, FEL64DC))

## Onsite operation

## Elements on the electronic insert



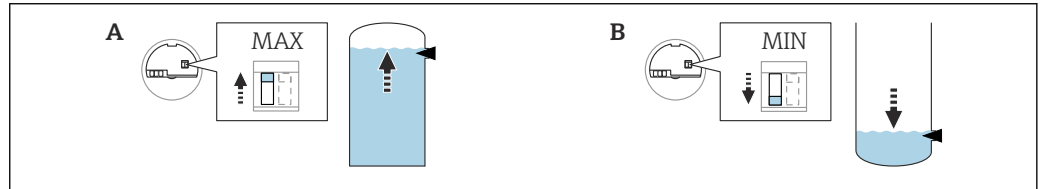
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43 Example of electronic insert FEL64DC

- 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 DIP switch for setting density 0.7 or 0.5
- 7 Terminals (3 to 8), relay contact
- 8 Terminals (1 to 2), power supply
- 9 DIP switch for configuring MAX/MIN safety mode

## Operation at electronic insert

## MAX/MIN fail-safe mode



A0033470

44 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 overfill 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



A0033471

45 Switch position on the electronic insert for density

**Liquids with density > 0.7 g/cm³ (43.7 lb/ft³)**

Switch position > 0.7 g/cm³ (43.7 lb/ft³), order configuration

**Liquids with density 0.5 g/cm³ (31.2 lb/ft³)**

Switch position > 0.5 g/cm³ (31.2 lb/ft³), can be configured via DIP switch

**Liquids with density > 0.4 g/cm<sup>3</sup> (25.0 lb/ft<sup>3</sup>)**

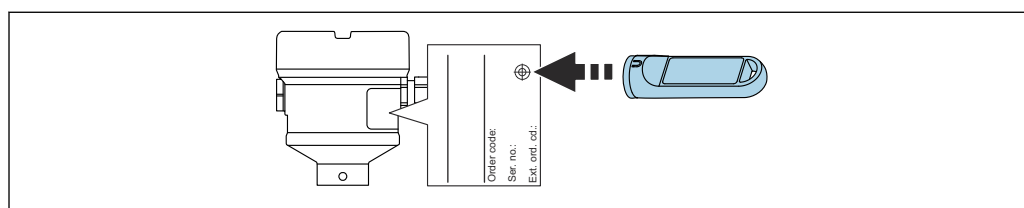
- Optionally available to order
  - SIL for defined media and process parameters on request
  - Fixed value that cannot be edited
- The function of the DIP switch is interrupted

**i** For information on medium differentiation/density detection: Documentation Liquiphant density (FEL60D) with density computer FML621 (Endress+Hauser website [www.endress.com](http://www.endress.com) → Downloads)

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

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.

The functional test can be applied for the following electronic inserts: FEL62, FEL64, FEL64DC, FEL68.



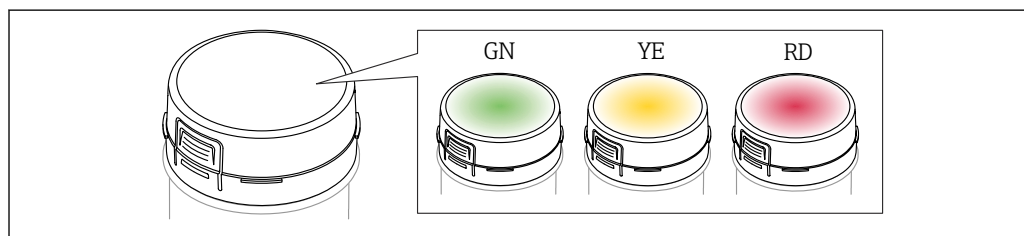
A0033419

**46** Functional test with test magnet

**i** Product Configurator: the test magnet is optionally available.

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

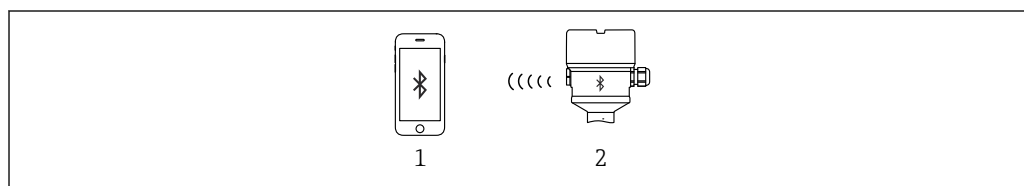
A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.



A0043925

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

**i** Additional information → **18** and in the "Accessories" section

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

A0033411

**48** 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)
- Guidance via the **SIL/WHG Prooftest** wizard
- Visible in the livelist 10 s seconds after the Bluetooth search commences
- Data can be read from the Bluetooth module 60 s after the supply voltage is switched on
- Display of the current oscillation frequency and the switch status of the device

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

*Heartbeat Technology*

 Additional information 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 testing*

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

Current certificates and approvals for the product are available at [www.endress.com](http://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**.

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**CE mark**

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

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**RCM 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 bear the RCM marking on the nameplate.



A0029561

**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 devices approved for use in explosion hazardous areas.



Equipment group IIC/IIB, III in conjunction with probes and a surface finish in ECTFE, Ruby Red: The probe can only be used in Gas Group IIC and Dust Group III if electrostatic charge can be avoided. These probes bear the warning sign "Avoid electrostatic charge".

**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.



Product Configurator: feature "Additional approval"

**Functional safety**

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



Product Configurator: feature "Additional approval"

Subsequent confirmation of usability according to IEC 61508 is not possible.

**Marine approvals**

Product Configurator: feature "Additional approval"

**Radio approval**

Further information and currently available documentation 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.



Product Configurator: feature "Additional approval"

**Service**

- Cleaned of oil+grease (wetted)
- ANSI Safety Red coating, housing cover
- Switching delay setting to be spec.
- Setting for MIN safety mode
- Default density setting > 0.4 g/cm<sup>3</sup> (25.0 lb/ft<sup>3</sup>)
- Default density setting > 0.5 g/cm<sup>3</sup> (31.2 lb/ft<sup>3</sup>)

**Test, certificate, declaration**

Documents available to order in the Product Configurator, feature "Test, certificate, declaration":

- Inspection certificate 3.1, EN10204 (material certificate, pressure-bearing parts)
- ASME B31.3 process piping, declaration
- ASME B31.1 process piping, declaration

- Pressure test, internal procedure, test report
- Helium leak-tightness test, internal procedure, test report
- Welding documentation, wetted/pressurized seams, declaration/ISO/ASME  
Welding documentation consisting of:
  - Welding drawings
  - WPQR (Welding Procedure Qualification Record) according to ISO 14613/ISO14614 or ASME Sect. IX
  - WPS (Welding Procedure Specifications)
  - WQR (Welder Qualification Record)



Documentation currently available on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Downloads or with the serial number of the device under Online Tools in the Device Viewer.

#### Pressure Equipment Directive

##### Pressure equipment with permitted pressure ≤ 200 bar (2 900 psi)

Pressure instruments with a process connection that does not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.

##### Reasons:

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".

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.

#### Process seal as per ANSI/ISA 12.27.01

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.



The following housings are approved as single seal devices:

- Single compartment, aluminum
- Single compartment, stainless steel 316L
- Single compartment, stainless steel 316L, hygienic
- Single compartment, plastic

#### China RoHS symbol

China RoHS 1, Law SJ/T 11363-2006: The measuring system complies with the substance restrictions of the Directive on the Restriction of the Use of Certain Hazardous Substances (RoHS).

#### RoHS

The measuring system meets the substance restrictions of the Directive on the Restriction of the Use of Certain Hazardous Substances 2011/65/EU (RoHS 2) and the Delegated Directive (EU) 2015/863 (RoHS 3).

#### EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity along with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the EAC mark.

#### ASME B 31.3/31.1

Design and materials in accordance with ASME B31.3/31.1. 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.

## Order information

Detailed ordering information is available from your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com) or in the Product Configurator at [www.endress.com](http://www.endress.com):

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

### 3. Select Configuration.



#### 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.

#### Location of tag name

Select in the additional specification:

- Stainless steel tag plate
- Paper adhesive label
- Tag provided by the customer
- RFID tag
- RFID tag + stainless steel tag plate
- RFID tag + paper adhesive label
- RFID tag + tag provided by the customer
- IEC 61406 stainless steel tag
- IEC 61406 stainless steel tag + NFC tag
- IEC 61406 stainless steel tag, stainless steel tag
- IEC 61406 stainless steel tag + NFC, stainless steel tag
- IEC 61406 stainless steel tag, plate supplied
- IEC 61406 stainless steel tag + NFC, plate supplied

#### Definition of tag name

Specify in the additional specification:

3 lines of maximum 18 characters each

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

#### Visualization in SmartBlue app

The first 32 characters of the tag name

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

## Test reports, declarations and inspection certificates

All test reports, declarations and inspection certificates are provided electronically in the *Device Viewer*:

Enter the serial number from the nameplate ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer))



#### Product documentation on paper

Test reports, declarations and inspection certificates in hard copy can optionally be ordered with feature 570 "Service", Version I7 "Product documentation on paper". The documents are then provided with the device upon delivery.

## Application packages



The following versions can be optionally selected in the Product Configurator:

- Heartbeat Verification + Monitoring application package  
Can only be selected in conjunction with optional Bluetooth module
- Accessories installed: Bluetooth

The Bluetooth module for use in conjunction with the electronic insert FEL68 (2-wire NAMUR) must be ordered separately with the necessary battery.

- Application package: Heartbeat Verification + Monitoring for NAMUR output  
Can only be selected in conjunction with Bluetooth module for NAMUR output
- Accessory mounted: Bluetooth for NAMUR output

## Heartbeat Technology module

### Heartbeat Diagnostics

Continuously monitors and assesses the device condition 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 condition on demand and generates the Heartbeat Technology verification report showing the verification result.

**Heartbeat Monitoring**

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

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**Heartbeat Verification**

The "Heartbeat Verification" module contains the **Heartbeat Verification** wizard, which verifies the current instrument health and creates the Heartbeat Technology verification report:

- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process for creating 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 as-delivered state of the oscillation frequency in air is indicated on the verification report. A high oscillation frequency is an indicator of corrosion. A lower oscillation frequency indicates buildup or a sensor covered by the medium. Deviations of the oscillation frequency from the oscillation frequency in the as-delivered state can be caused by the process temperature and process pressure.

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**Proof testing for SIL/WHG devices**



The proof test is only available for devices with SIL or WHG approval.

The "SIL Proof test" module, the "WHG Proof test" module or the "SIL/WHG Proof test" module contains a **SIL/WHG Prooftest** wizard, which must be performed at appropriate intervals in the following applications: SIL (IEC61508/IEC61511), WHG (German Water Resources Act (Gesetz zur Ordnung des Wasserhaushalts)):

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

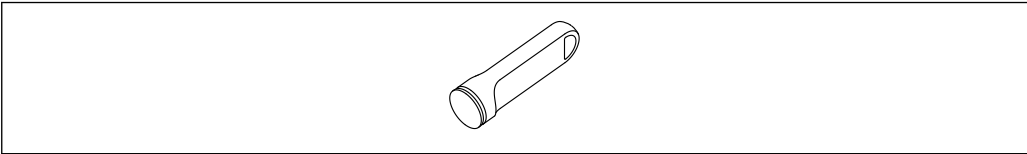
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## Accessories

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**Test magnet**

Order number: 71437508



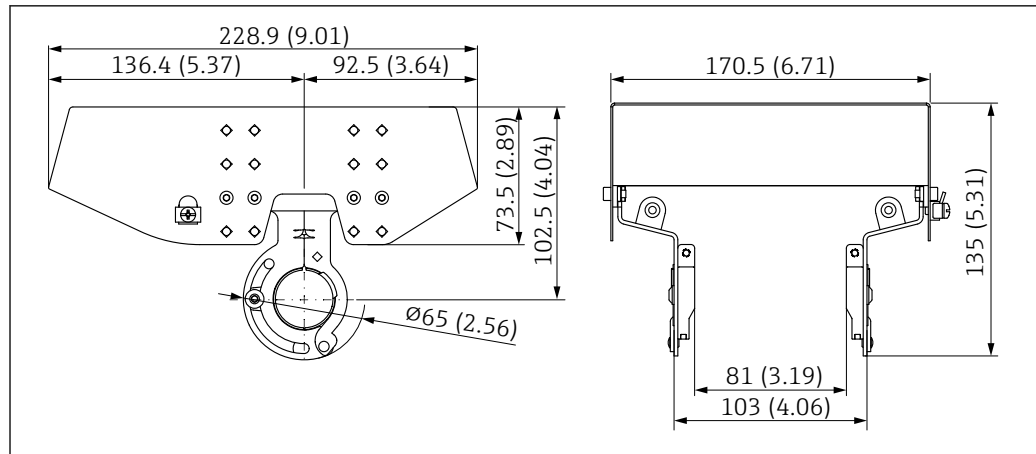
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49    *Test magnet*

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**Protective cover for aluminum dual compartment housing**

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

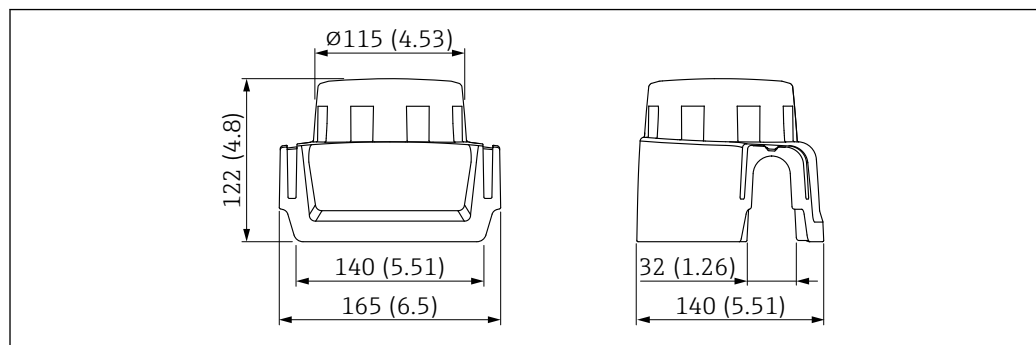


A0039231

50 Protective cover for aluminum dual compartment housing. Unit of measurement mm (in)

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

- Material: plastic
- Order number: 71438291



A0038280

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

### M12 socket

**i** The M12 sockets listed are suitable for use in the temperature range -25 to +70 °C (-13 to +158 °F).

#### M12 socket IP69

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

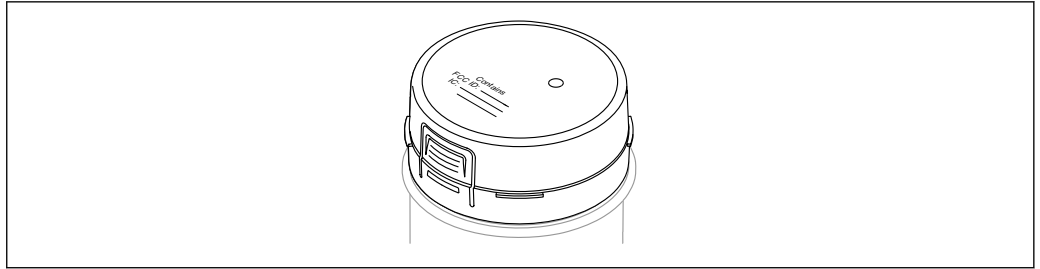
#### M12 socket IP67

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

### 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 (2-wire NAMUR).

- 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

52 Bluetooth module VU121

More detailed information and documentation are available:

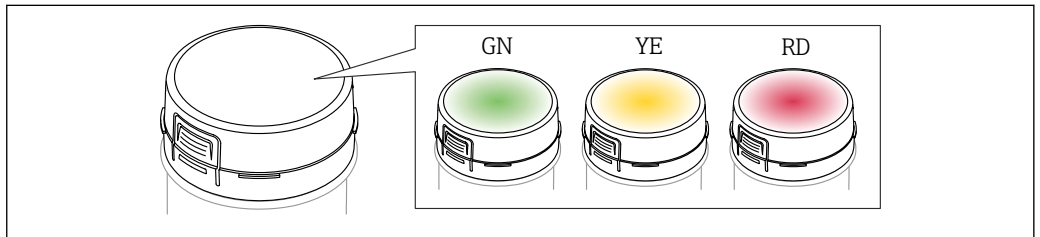
- Product Configurator on the Endress+Hauser website [www.endress.com](http://www.endress.com)
- Endress+Hauser sales organization [www.addresses.endress.com](http://www.addresses.endress.com)

**i** A tall cover is required (transparent plastic cover/cover with sight glass 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. 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



A0043925

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

More detailed information and documentation are available:

- Product Configurator on the Endress+Hauser website [www.endress.com](http://www.endress.com)
- Endress+Hauser sales organization [www.addresses.endress.com](http://www.addresses.endress.com)

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

## Documentation

**i** For an overview of the scope of the associated Technical Documentation, refer to the following:

- Device Viewer** ([www.endress.com/deviceviewer](http://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.

### Standard documentation

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

The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal. BA02036F

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

Quick guide to obtaining the first measured value – the Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.  
KA01479F

**Document type: Safety Instructions, certificates**

Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. They are an integral part of the Operating Instructions.  
Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.

**Supplementary device-  
dependent documentation**

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

**Special Documentation**

- SD02662F: Heartbeat Verification + Monitoring application package
- SD02389F: Bluetooth module VU121, radio approval
- TI00426F: Adapter and flanges (overview)

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