

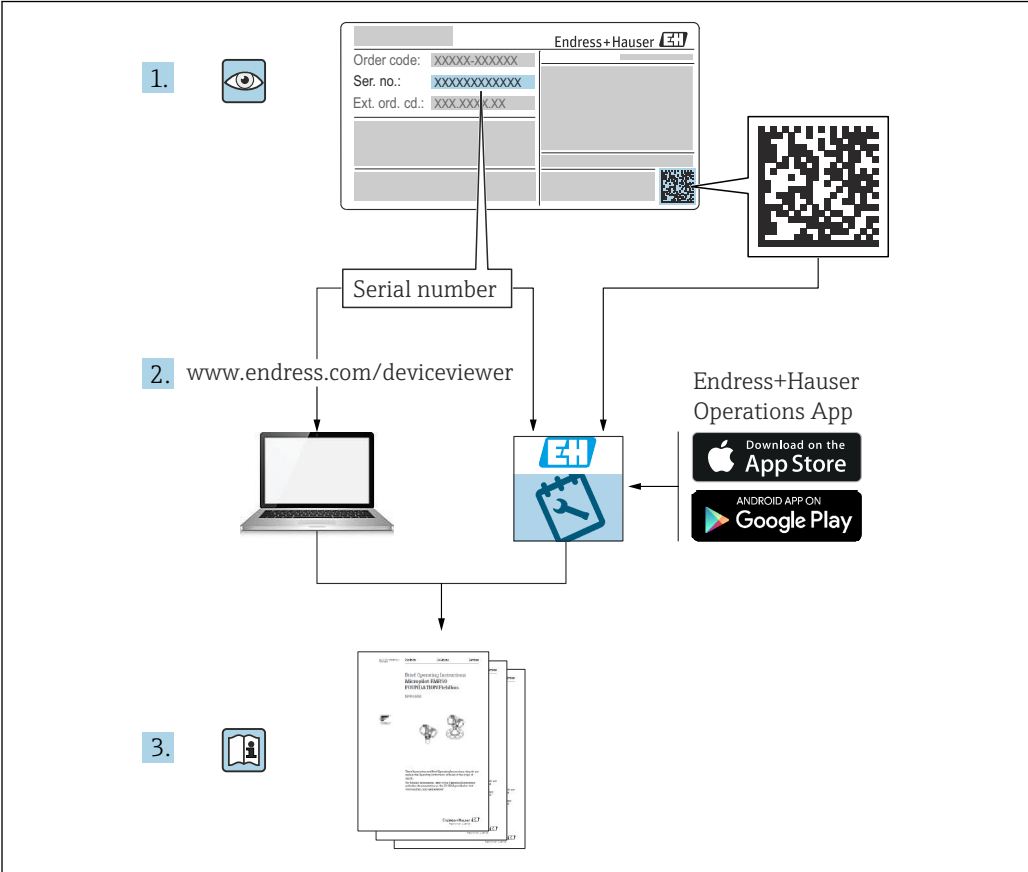
Operating Instructions

Liquiphant FTL64

Vibronic

Point level switch for liquids in high-temperature applications





A0023555

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1 About this document

1.1 Purpose of this document

These Operating Instructions contain all the information that is required in the 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.

1.2 Symbols

1.2.1 Safety symbols

DANGER

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

WARNING

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


CAUTION

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

NOTICE

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

1.2.2 Electrical symbols

 Ground connection

Grounded clamp, which is grounded via a grounding system.


 Protective earth (PE)

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.

1.2.3 Tool symbols

 Flat-blade screwdriver

 Allen key

 Open-ended wrench

1.2.4 Communication-specific symbols

 Bluetooth

Wireless data transmission between devices over a short distance.





1.2.5 Symbols for certain types of information

 Permitted



Procedures, processes or actions that are permitted.

 Forbidden

Procedures, processes or actions that are forbidden.

-  Tip
Indicates additional information
-  Reference to documentation
-  Reference to another section
-  1., 2., 3. Series of steps

1.2.6 Symbols in graphics

- A, B, C ...** View
- 1, 2, 3 ...** Item numbers
-  Hazardous area
-  Safe area (non-hazardous area)

1.2.7 Registered trademarks

Bluetooth®

The *Bluetooth*® word mark and logos are registered trademarks owned by the Bluetooth SIG, Inc. and any use of such marks by Endress+Hauser is under license. Other trademarks and trade names are those of their respective owners.

Apple®

Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

Android®

Android, Google Play and the Google Play logo are trademarks of Google Inc.



2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks, e. g., commissioning and maintenance:

- ▶ Trained, qualified specialists must have a relevant qualification for the specific function and task
- ▶ Are authorized by the plant owner/operator
- ▶ Are familiar with federal/national regulations
- ▶ Must have read and understood the instructions in the manual and supplementary documentation
- ▶ Follow instructions and comply with conditions

2.2 Intended use

- Only use the device for liquids
- Improper use can pose hazards
- Ensure that the measuring device is free of defects while it is in operation
- Use the device only for media to which the wetted materials have an adequate level of resistance
- Do not exceed or drop below the relevant limit values for the device
 -  For more details, see the "Technical data" section
 -  See the Technical Documentation

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or non-intended use.

Residual risks

Due to heat transfer from the process, the temperature of the electronics housing and the assemblies contained therein may rise to 80 °C (176 °F) during operation.

Danger of burns from contact with surfaces!

- ▶ If necessary, ensure protection against contact to prevent burns.

For requirements concerning functional safety in accordance with IEC 61508, the associated SIL documentation must be observed.

2.3 Workplace safety

For work on and with the device:

- ▶ Wear the required protective equipment according to federal/national regulations.

2.4 Operational safety

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for ensuring the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.

- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety and reliability:

- ▶ Only perform repair work on the device if this is expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use original spare parts and accessories from Endress+Hauser only.

Hazardous area

To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):

- ▶ Check the nameplate to verify whether the ordered device can be used for the intended purpose in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of this manual.

2.5 Product safety

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

It meets the general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

2.6 Functional Safety SIL (optional)

The Functional Safety Manual must be strictly observed for devices that are used in functional safety applications.

2.7 IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device has safety mechanisms integrated to prevent users from inadvertently changing settings.

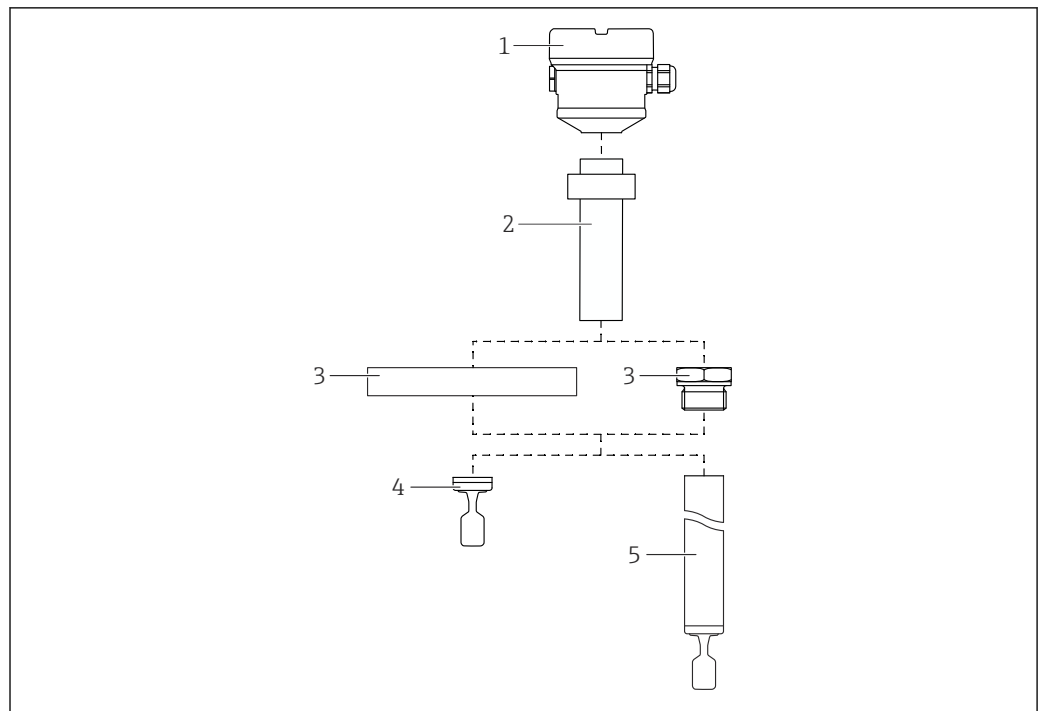
Provide additional protection for the device and data transfer to/from the device

- ▶ IT security measures defined in the plant owner/operator's own security policy must be implemented by plant owners/operators themselves.

3 Product description

- Point level switch for minimum or maximum detection
- Suitable for high-temperature applications up to 280 °C (536 °F)

3.1 Product design



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1 Product design

- 1 Housing with electronic insert and cover, Bluetooth module or LED module are optional
- 2 Temperature spacer with gas-tight glass feedthrough → 2 lengths available, depending on the process temperature
- 3 Process connection (flange or thread)
- 4 Compact probe version with tuning fork
- 5 Pipe extension probe with tuning fork

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during incoming acceptance:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the data on the nameplate match the ordering information on the delivery note?
- If required (see nameplate): are the Safety Instructions e.g. XA provided?

 If one of these conditions is not met, please contact the manufacturer's sales office.

4.2 Product identification

The device can be identified in the following ways:


- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- Enter serial number from nameplates in *W@M Device Viewer* www.endress.com/deviceviewer. All of the information on the measuring device is displayed along with an overview of the scope of technical documentation provided.
- Enter the serial number on the nameplate into the *Endress+Hauser Operations app* or scan the *2-D matrix code* on the nameplate with the *Endress+Hauser Operations app*

4.2.1 Nameplate

The information that is required by law and is relevant to the device is shown on the nameplate, e.g.:

- Manufacturer identification
- Order number, extended order code, serial number
- Technical data, degree of protection
- Firmware version, hardware version
- Approval-related information, reference to Safety Instructions (XA)
- DataMatrix code (information about the device)

4.2.2 Electronic insert

 Identify the electronic insert via the order code on the nameplate.

4.2.3 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany
Place of manufacture: See nameplate.

4.3 Storage and transport

4.3.1 Storage conditions

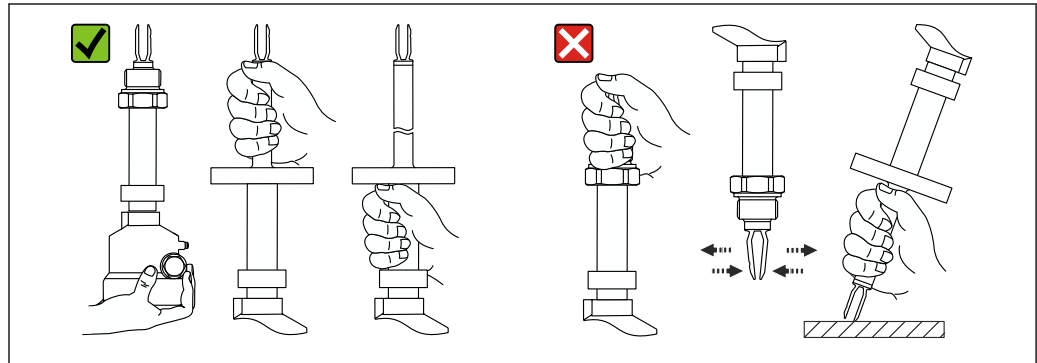
Use original packaging.

Storage temperature

-40 to +80 °C (-40 to +176 °F)
 Optional: -50 °C (-58 °F), -60 °C (-76 °F)

4.3.2 Transporting the device

- Transport the device to the measuring point in the original packaging
- Hold the device by the housing, temperature spacer, flange or extension pipe
 Take suitable measures to protect the coating!
- Do not bend, shorten or extend the tuning fork



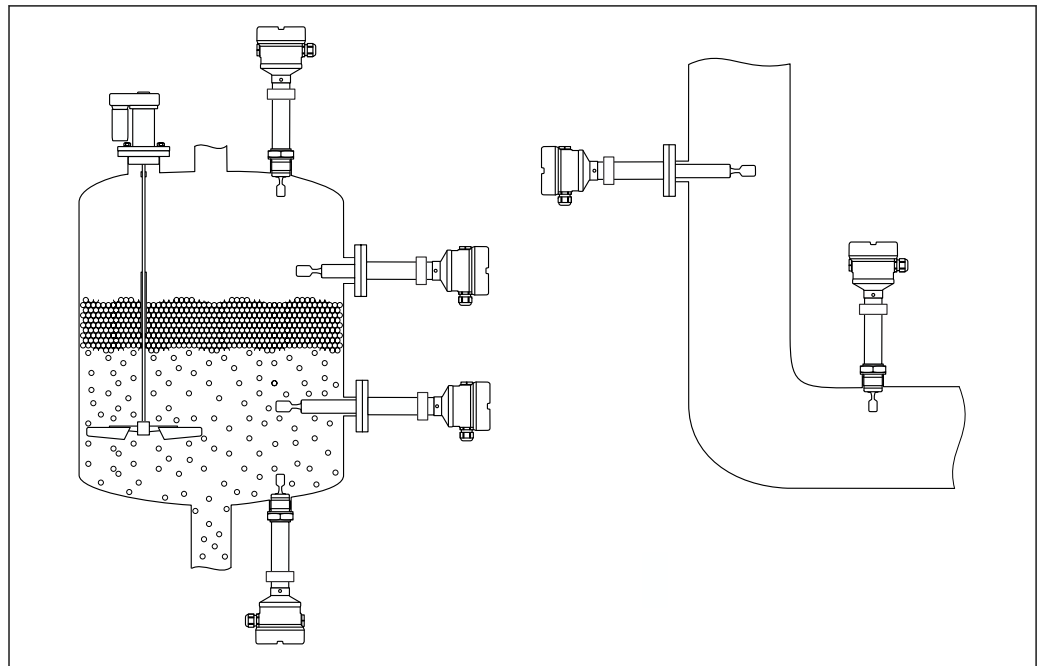
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2 Handling the device during transportation

5 Mounting

Mounting instructions

- Any orientation for version 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)



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3 Installation examples for a vessel, tank or pipe

5.1 Mounting requirements

NOTICE

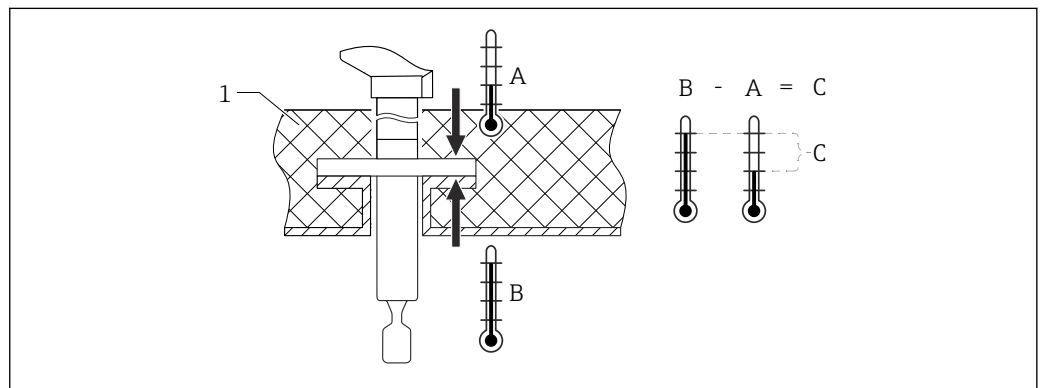
Scratches or impacts damage the coated surface of the device.

- Ensure the device is handled properly and professionally during all mounting work.

5.1.1 Pay attention to the temperature for devices with a PFA coating (conductive)

The difference in temperature between the outer and inner side of the flange may not exceed 60 °C (140 °F).

If necessary, use external insulation.



4 Difference in temperature between outer and inner side of flange

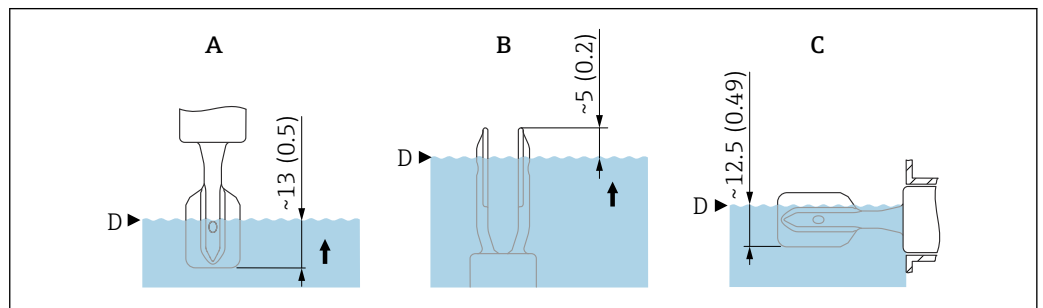
- 1 Insulation
- A Temperature of flange, outer side
- B Temperature of flange, inner side, for PFA (conductive) maximum 230 °C (446 °F)
- C Difference in temperature for PFA (conductive) maximum 60 °C (140 °F)

5.1.2 Take switch point into consideration

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

Water +23 °C (+73 °F)

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



5 Typical switch points. Unit of measurement mm (in)

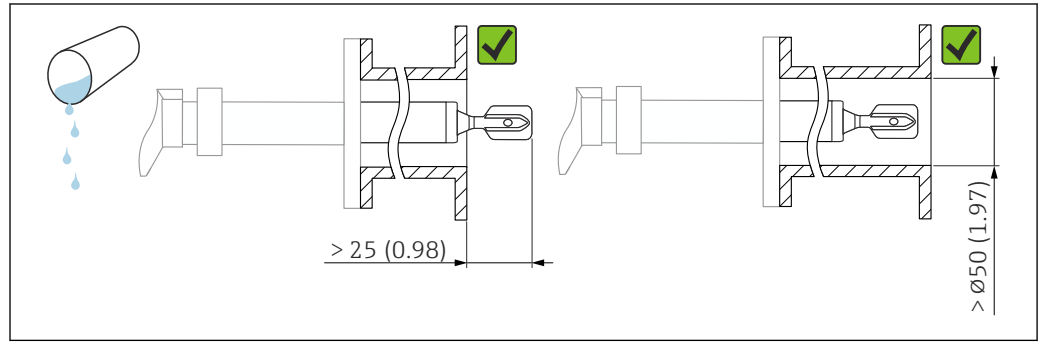
- A Installation from above
- B Installation from below
- C Installation from the side
- D Switch point

5.1.3 Take viscosity into consideration

- i** Viscosity values
- Low viscosity: < 2 000 mPa·s
 - High viscosity: > 2 000 to 10 000 mPa·s

Low viscosity

- i** Low viscosity, e.g. water: < 2 000 mPa·s
It is permitted to position the tuning fork within the installation socket.



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

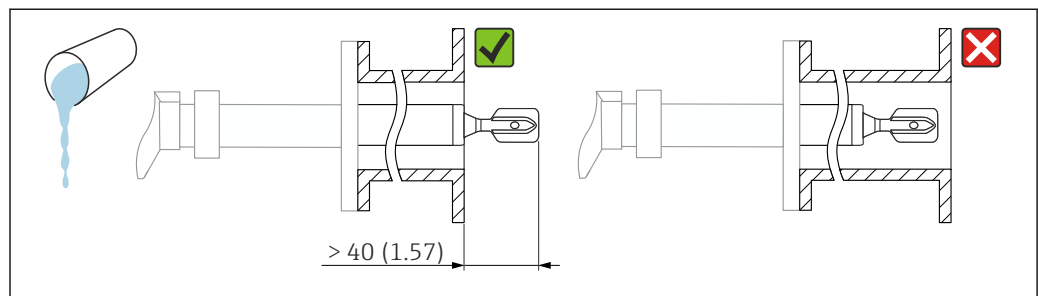
High viscosity

NOTICE

Highly viscous liquids may cause switching delays.

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

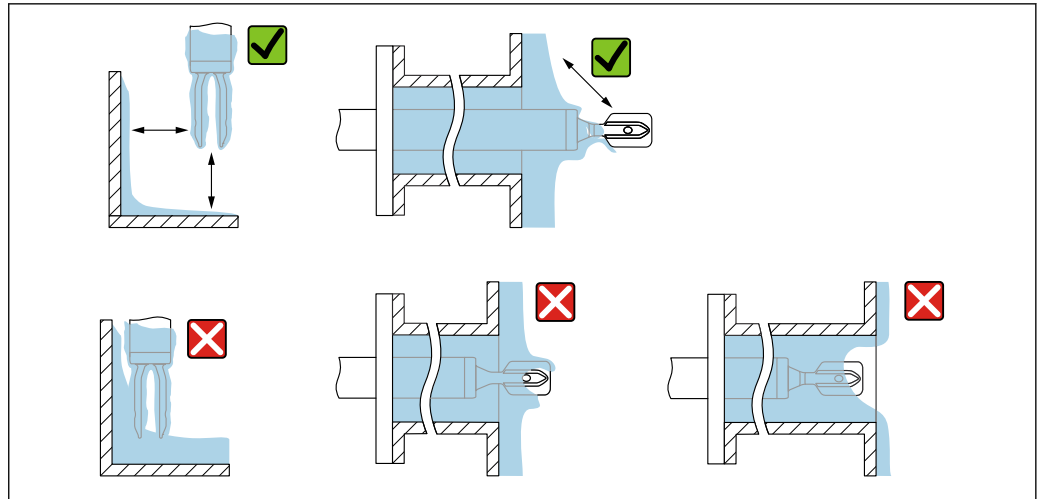
- i** High viscosity, e.g. viscous oils: $\leq 10\,000$ mPa·s
The tuning fork must be located outside the installation socket!



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

5.1.4 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

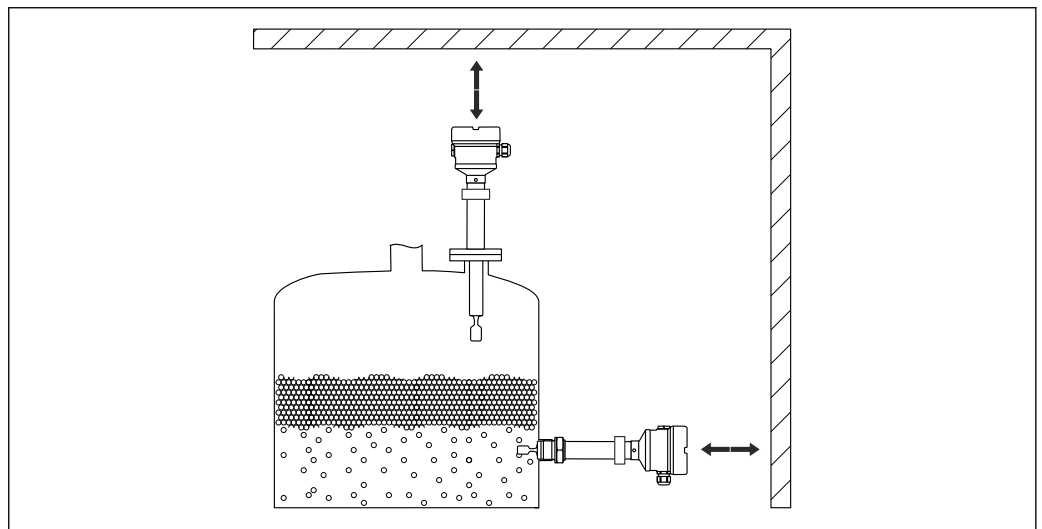


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8 Installation examples for a highly viscous process medium

5.1.5 Take clearance into consideration

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



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9 Take clearance into consideration

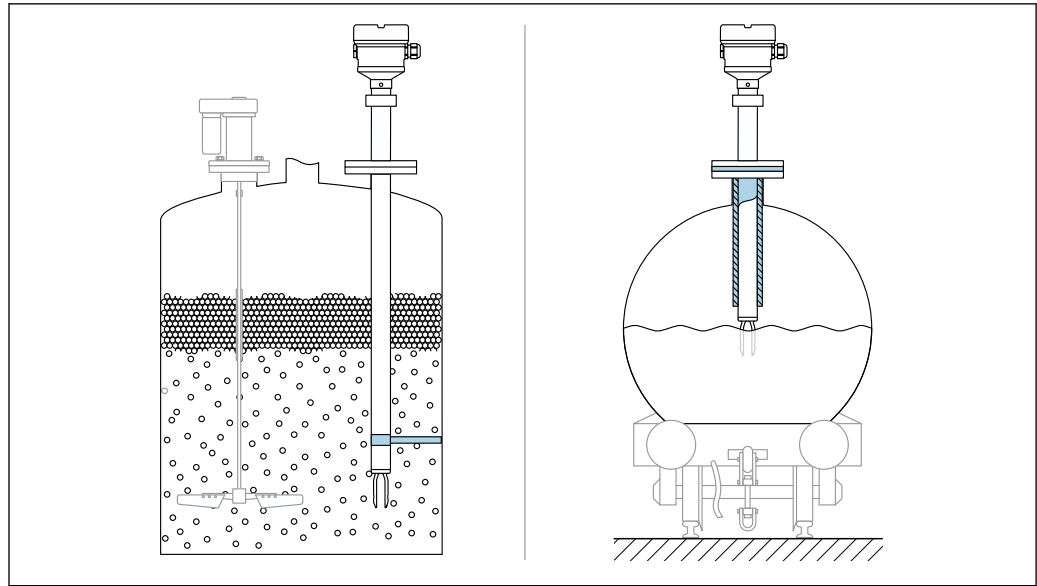
5.1.6 Support the device

NOTICE

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

- 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).



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10 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).

5.2 Mounting the device

5.2.1 Required tool

- Open-ended wrench for sensor installation
- Allen key for housing locking screw

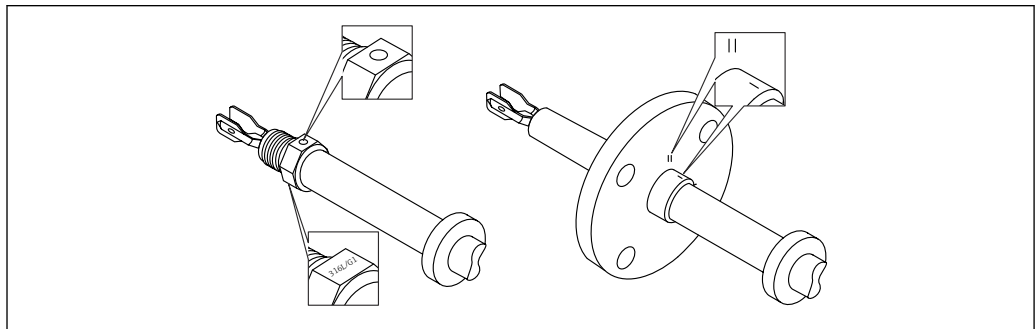
5.2.2 Installation

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.

Markings are identified on the process connection by:

Material specification, thread designation, circle, line or double line

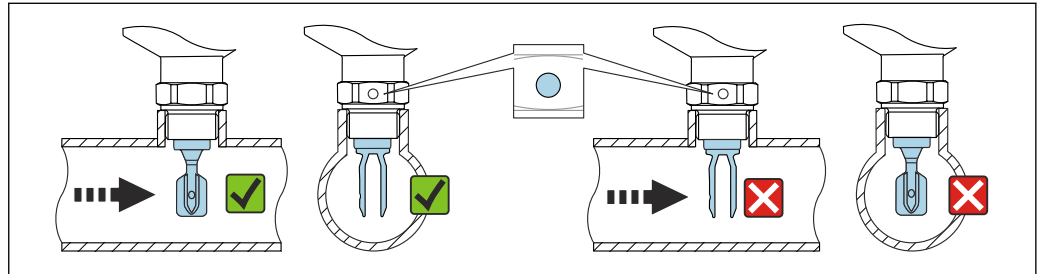


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11 Position of the tuning fork when installed horizontally in the vessel using the marking

Installing the device in piping

- Flow velocity up to 5 m/s with a viscosity of 1 mPa·s and density of 1 g/cm³ (62.4 lb/ft³) (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

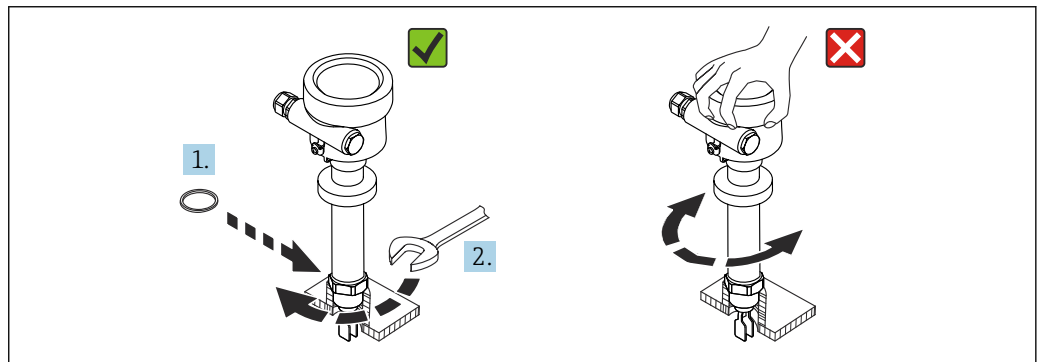


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12 Installation in pipes (take fork position and marking into consideration)

Screwing in the device

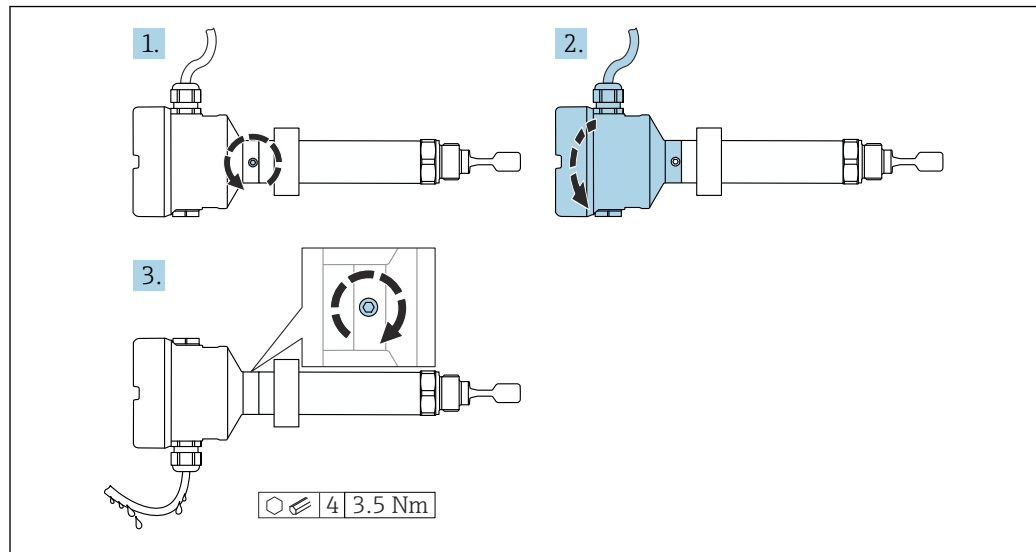
- Turn by the hex bolt only, 15 to 30 Nm (11 to 22 lbf ft)
- Do not turn at the housing!



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13 Screwing in the device

Aligning the cable entry



14 Housing with external locking screw and drip loop

- 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.

1. Loosen the external locking screw (maximum 1.5 turns).
2. Turn the housing, align the cable entry.
 - ↳ Avoid moisture in the housing, provide a loop to allow moisture to drain off.
3. Tighten the external locking screw.

NOTICE

The housing cannot be unscrewed fully.

- ▶ Loosen the external locking screw by a maximum of 1.5 turns. If the screw is unscrewed too much or completely (beyond the screw anchor point), small parts (counter disk) can become loose and fall out.
- ▶ Tighten the securing screw (hexagon socket 4 mm (0.16 in)) with maximum 3.5 Nm (2.58 lbf ft) ± 0.3 Nm (± 0.22 lbf ft).

Closing the housing covers

NOTICE

Thread and housing cover damaged from dirt and fouling!

- ▶ Remove dirt (e.g. sand) on the thread of the covers and housing.
- ▶ If you continue to encounter resistance when closing the cover, check the thread again for fouling.

i Housing thread

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

- ✘ **Do not lubricate the housing threads.**

Closing the housing covers

NOTICE**Thread and housing cover damaged from dirt and fouling!**

- ▶ Remove dirt (e.g. sand) on the thread of the covers and housing.
- ▶ If you continue to encounter resistance when closing the cover, check the thread again for fouling.

**Housing thread**

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

- Do not lubricate the housing threads.**

5.3 Sliding sleeves

For more details, see the "Accessories" section.

5.4 Post-mounting check

- Is the device undamaged (visual inspection)?
- Does the measuring device meet the measuring point specifications?

For example:

- Process temperature
 - Process pressure
 - Ambient temperature
 - Measuring range
- Are the measuring point number and labeling correct (visual inspection)?
 - Is the device adequately protected from wet conditions and direct sunlight?
 - Is the device properly secured?

6 Electrical connection

6.1 Required tool

- Screwdriver for electrical connection
- Allen key for screw of cover lock

6.2 Connecting requirements

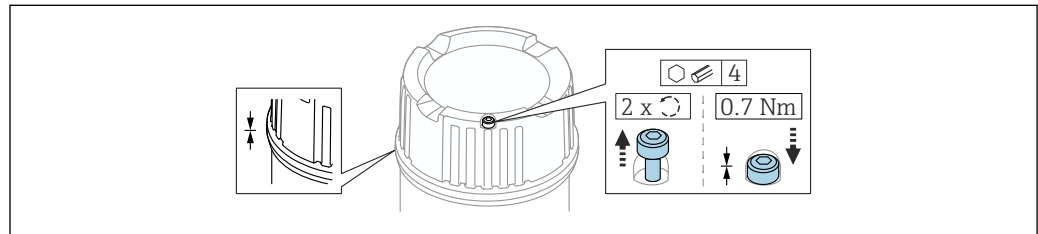
6.2.1 Cover with securing screw

The cover is locked by a securing screw in devices for use in hazardous areas with certain explosion protection.

NOTICE

If the securing screw is not positioned correctly, the cover cannot provide secure sealing.

- ▶ Open the cover: slacken the screw of the cover lock with a maximum of 2 turns so that the screw does not fall out. Fit the cover and check the cover seal.
- ▶ Close the cover: screw the cover securely onto the housing, making sure that the securing screw is positioned correctly. There should not be any gap between the cover and housing.



15 Cover with securing screw

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6.2.2 Connecting protective earth (PE)

The protective earth conductor at the device must only be connected if the device's operating voltage is $\geq 35 V_{DC}$ or $\geq 16 V_{ACeff}$.

When the device is used in hazardous areas, it must always be included in the potential equalization of the system, irrespective of the operating voltage.

- i** The plastic housing is available with or without an external protective earth connection (PE). If the operating voltage of the electronic insert is $< 35 V$, the plastic housing has no external protective earth connection.

6.3 Connecting the device

i Housing thread

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

- ✗ Do not lubricate the housing threads.**

6.3.1 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

$U = 19 \text{ to } 253 V_{AC}, 50 \text{ Hz}/60 \text{ Hz}$

Residual voltage when switched through: typically 12 V

- i** 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.

Power consumption

$S \leq 2 \text{ VA}$

Current consumption

Residual current when blocked: $I \leq 3.8 \text{ mA}$

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.

Connectable load

- 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)
- 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)
- With overload and short-circuit protection

Behavior of output signal

- OK status: load on (switched through)
- Demand mode: load off (blocked)
- Alarm: load off (blocked)

Terminals

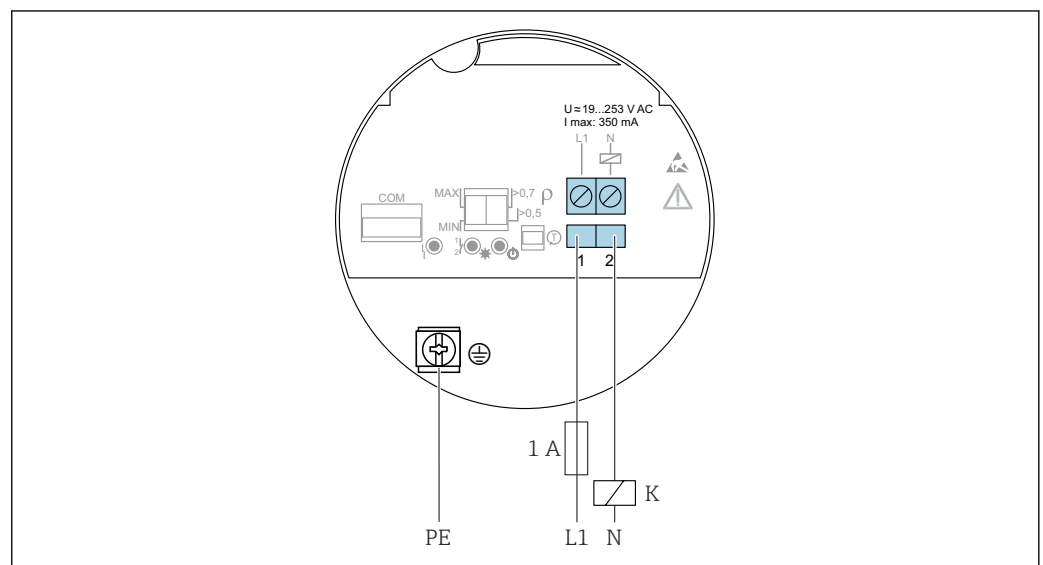
Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category II

Terminal assignment

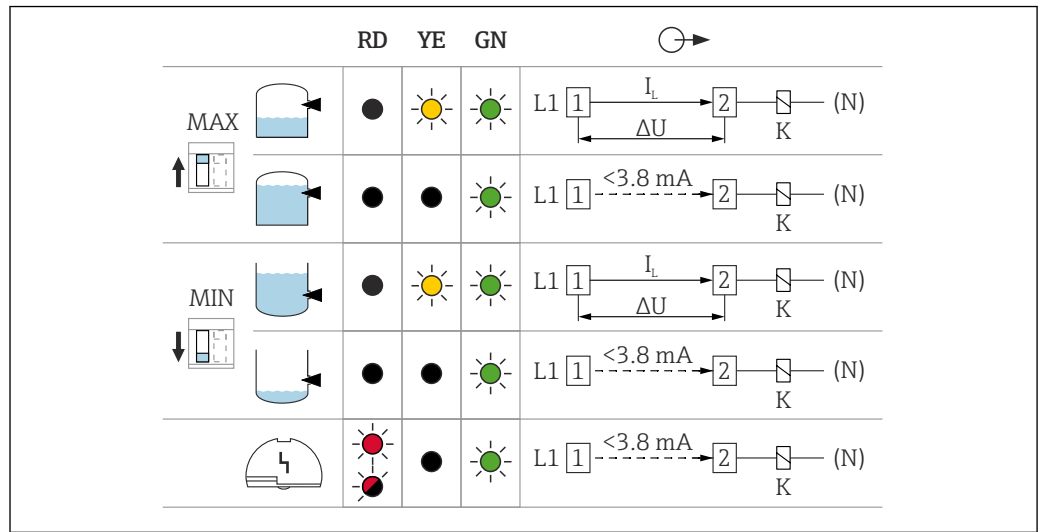
Always connect an external load. The electronic insert has integrated short-circuit protection.



16 2-wire AC, electronic insert FEL61

A0036060

Behavior of switch output and signaling

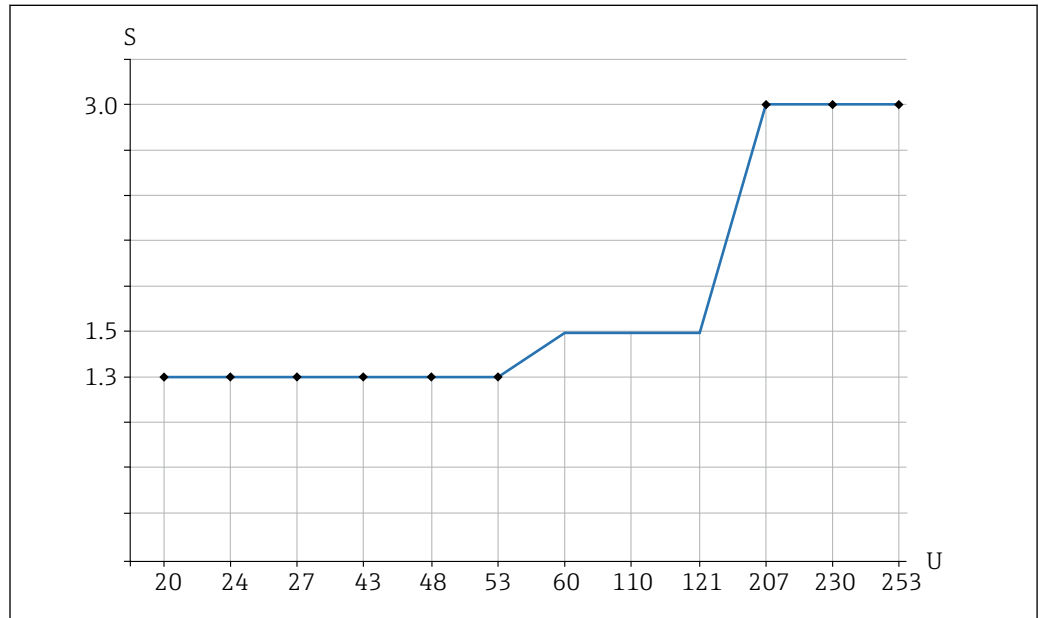


A0031901

17 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

18 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

6.3.2 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

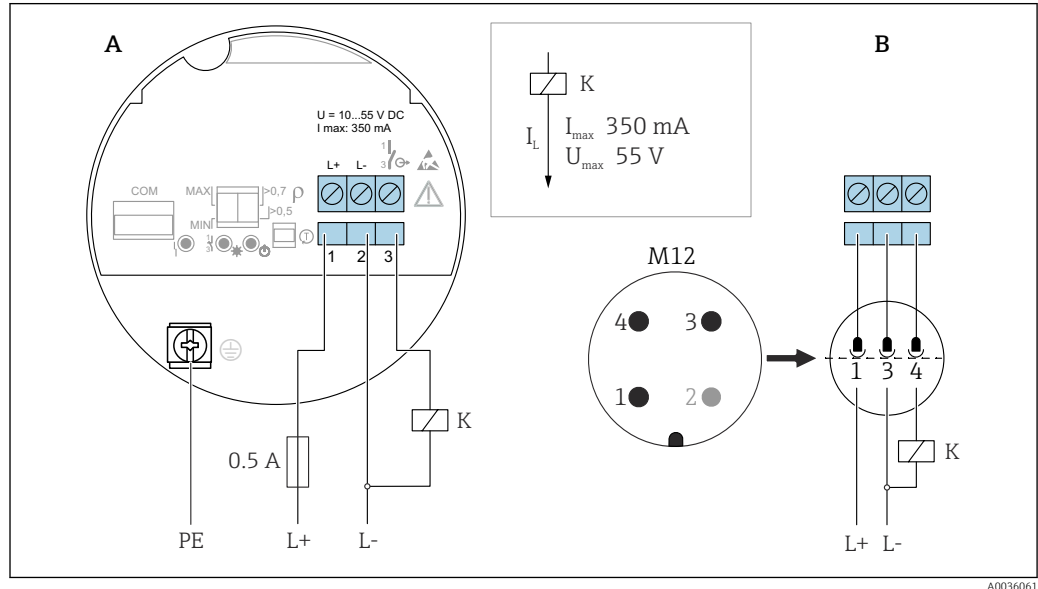
Terminals

Terminals for cable cross-section up to 2.5 mm² (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category I

Terminal assignment

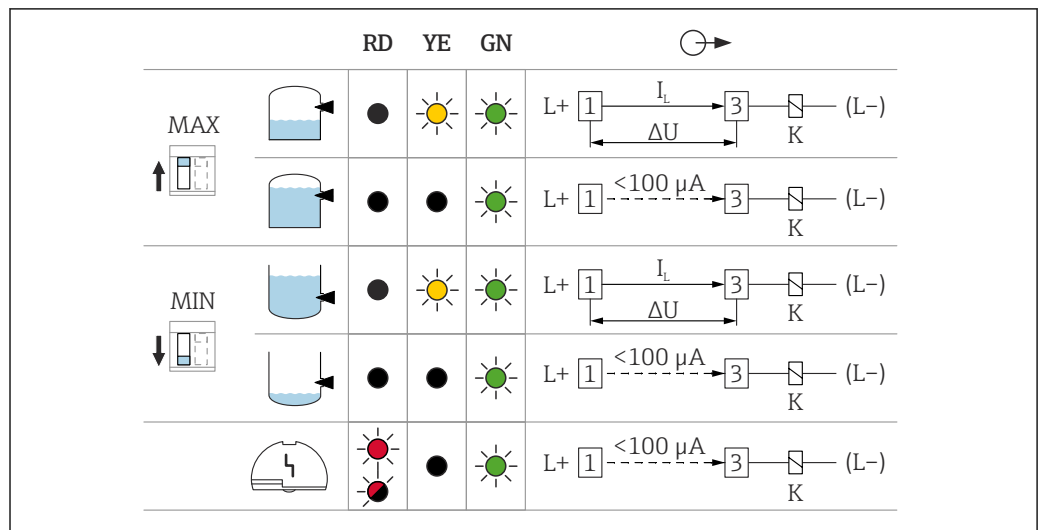


19 3-wire DC-PNP, electronic insert FEL62

A Connection wiring with terminals

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

Behavior of switch output and signaling



20 Behavior of switch output and signaling, electronic insert FEL62

MAXDIP 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

6.3.3 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!

Supply voltage

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

-  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

$S < 25 \text{ VA}, P < 1.3 \text{ W}$

Connectable load

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

- $I_{AC} \leq 6 \text{ A}, U_{\sim} \leq AC 253 \text{ V}; P_{\sim} \leq 1500 \text{ VA}, \cos \varphi = 1, P_{\sim} \leq 750 \text{ VA}, \cos \varphi > 0.7$
- $I_{DC} \leq 6 \text{ A to DC } 30 \text{ V}, I_{DC} \leq 0.2 \text{ A to } 125 \text{ V}$

-  Additional restrictions for the connectable load depend on the selected approval. Pay attention to the information in the Safety Instructions (XA).

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

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

Relay contact material: silver/nickel AgNi 90/10

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

Both relay contacts switch simultaneously.

Behavior of output signal

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

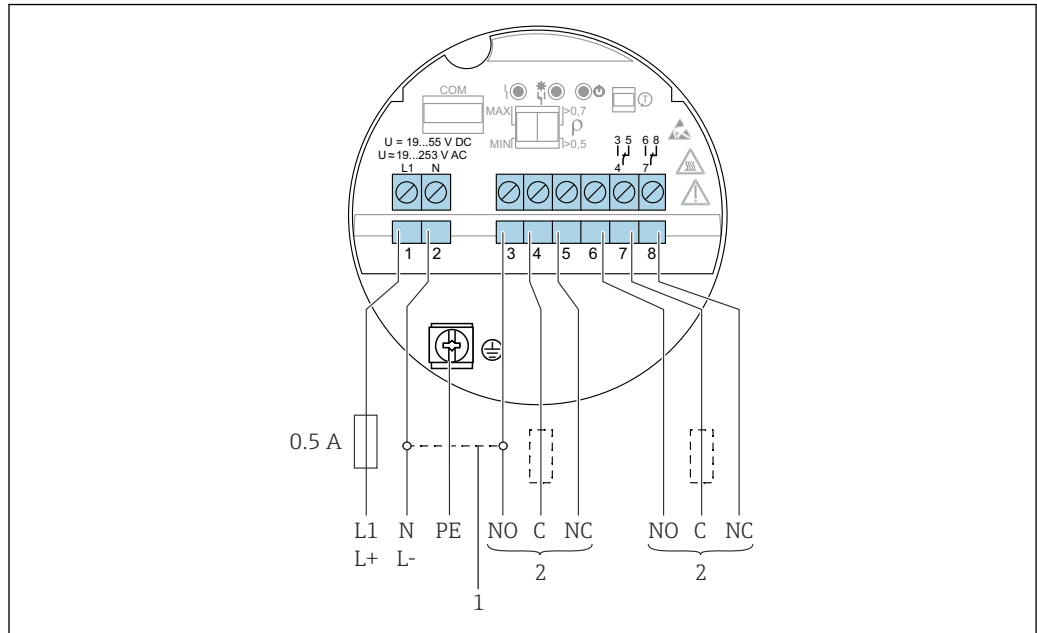
Terminals

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

Overvoltage protection

Overvoltage category II

Terminal assignment

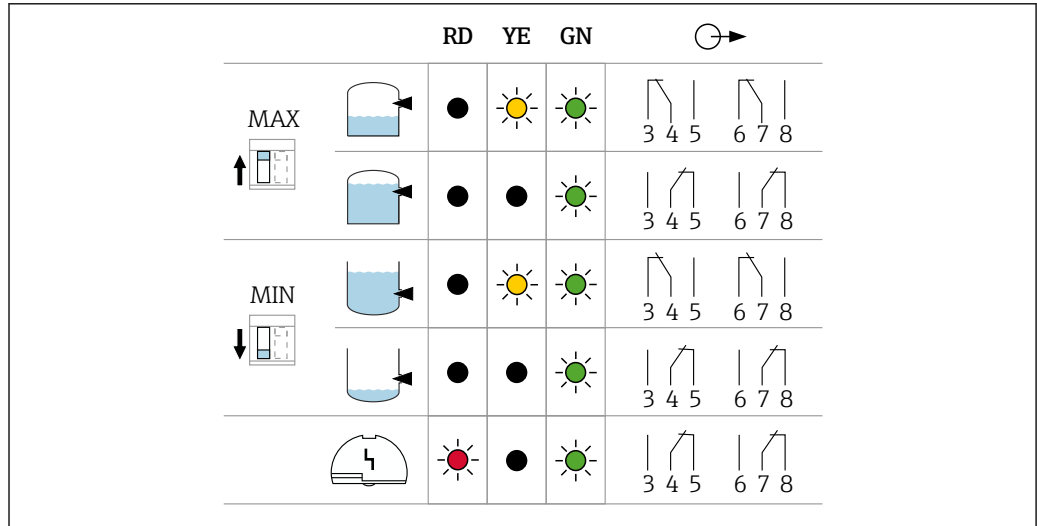


A0036062

21 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



A0039513

22 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

6.3.4 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.

Supply voltage

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

 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

$P < 1.0 \text{ W}$

Connectable load

Loads switched via 2 potential-free change-over contacts (DPDT)

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

 Additional restrictions for the connectable load depend on the selected approval. Pay attention to the information in the Safety Instructions (XA).

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

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

Relay contact material: silver/nickel AgNi 90/10

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

Behavior of output signal

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

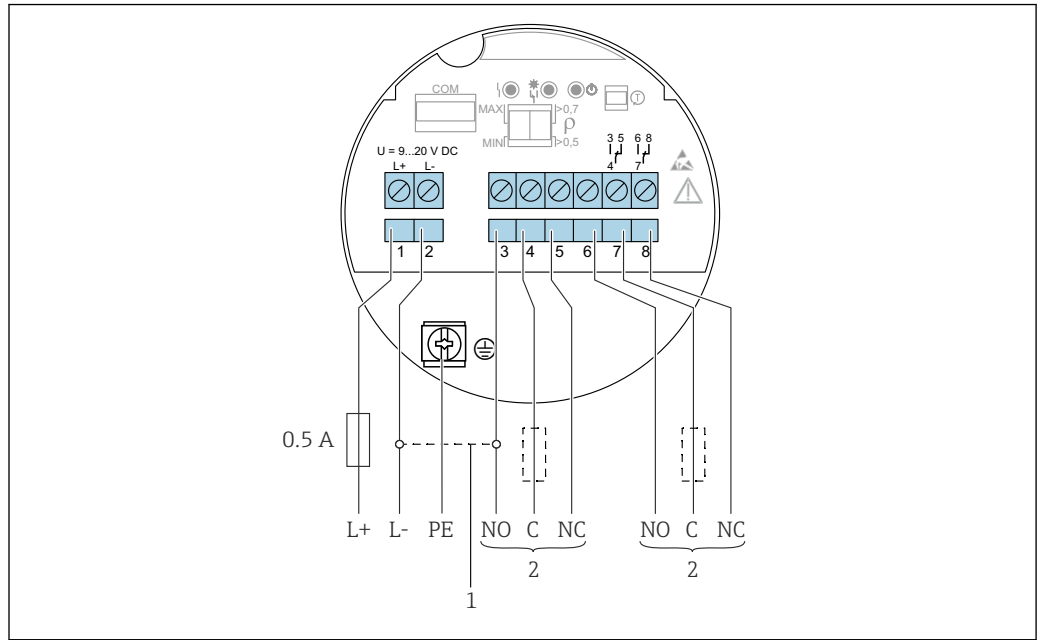
Terminals

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

Overvoltage protection

Overvoltage category I

Terminal assignment

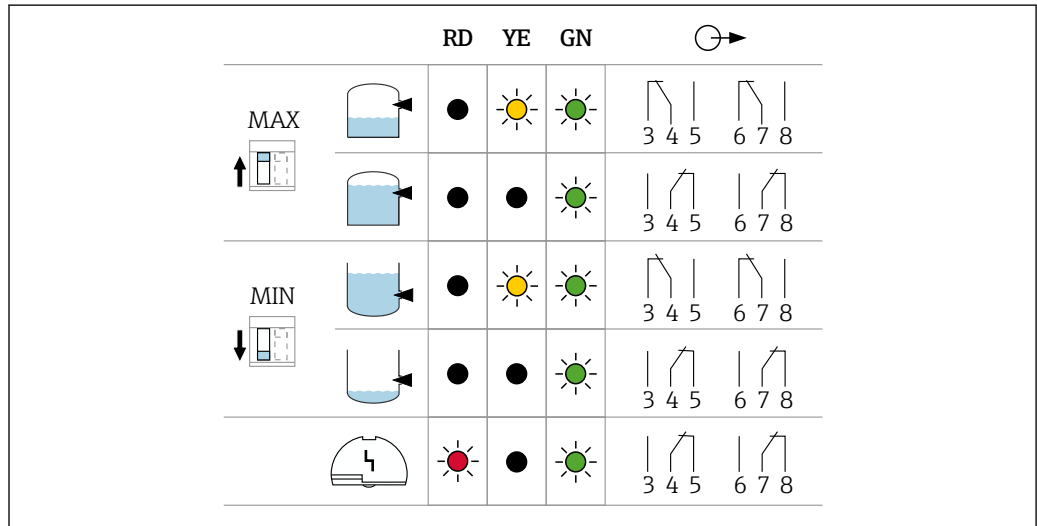


A0037685

23 DC connection with relay output, electronic insert FEL64 DC

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

Behavior of switch output and signaling



A0039513

24 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

6.3.5 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

$U = 9.5 \text{ to } 12.5 \text{ V}_{\text{DC}}$



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.

Power consumption

$P \leq 150 \text{ mW}$ with Nivotester FTL325P or FTL375P

Behavior of output signal

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

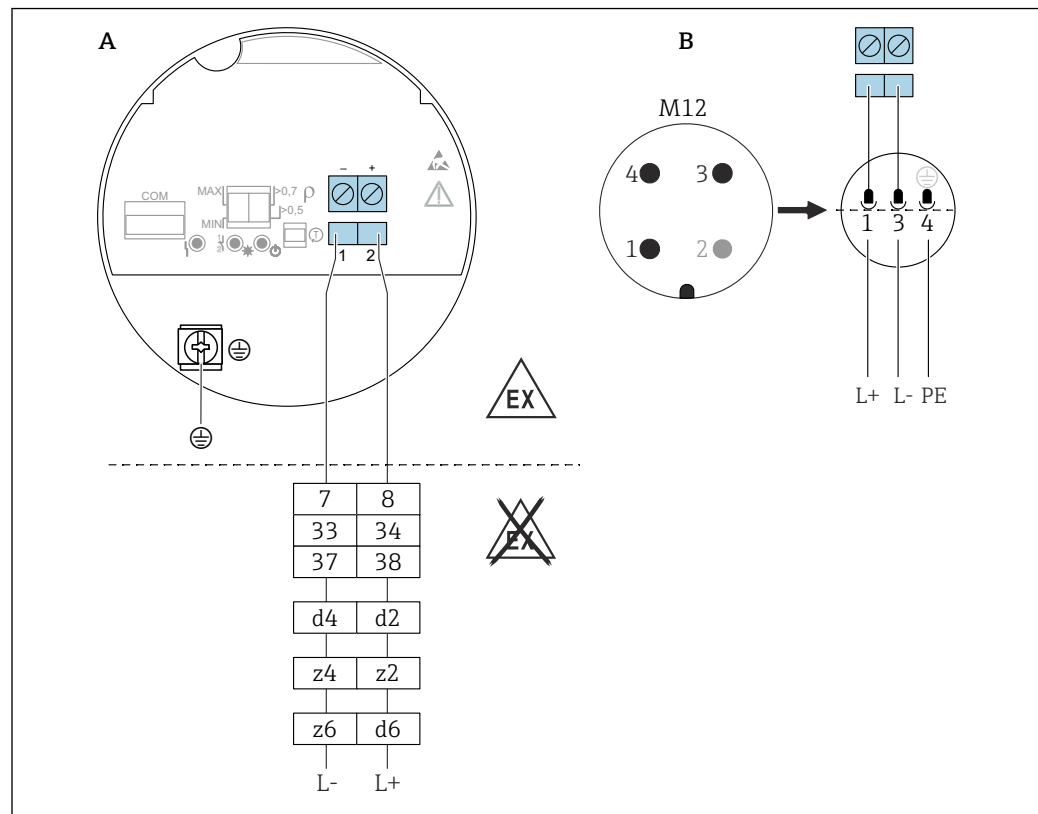
Terminals

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

Overvoltage protection

Overvoltage category I

Terminal assignment



A0036065

■ 25 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

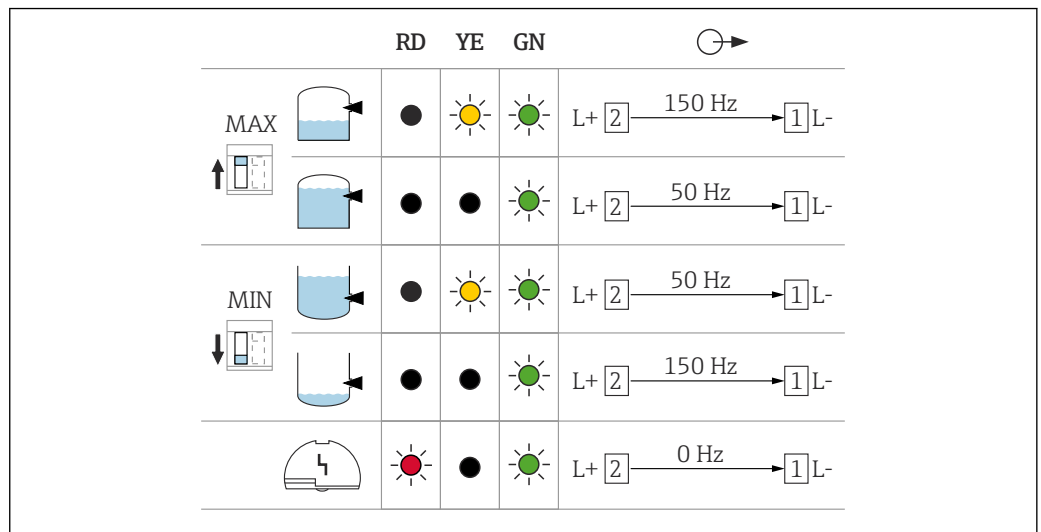
z4/ z2: Nivotester FTL375P input 2

z6/ d6: Nivotester FTL375P input 3

Connection cable

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

Behavior of switch output and signaling



26 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.

6.3.6 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

$$U = 8.2 V_{DC} \pm 20\%$$

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

i Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device.

Power consumption

NAMUR IEC 60947-5-6

< 6 mW with $I < 1 \text{ mA}$; < 38 mW with $I = 3.5 \text{ mA}$

Connection data interface

NAMUR IEC 60947-5-6

Behavior of output signal

- OK status: output current 2.2 to 3.8 mA
- Demand mode: output current 0.4 to 1.0 mA
- Alarm: output current < 1.0 mA

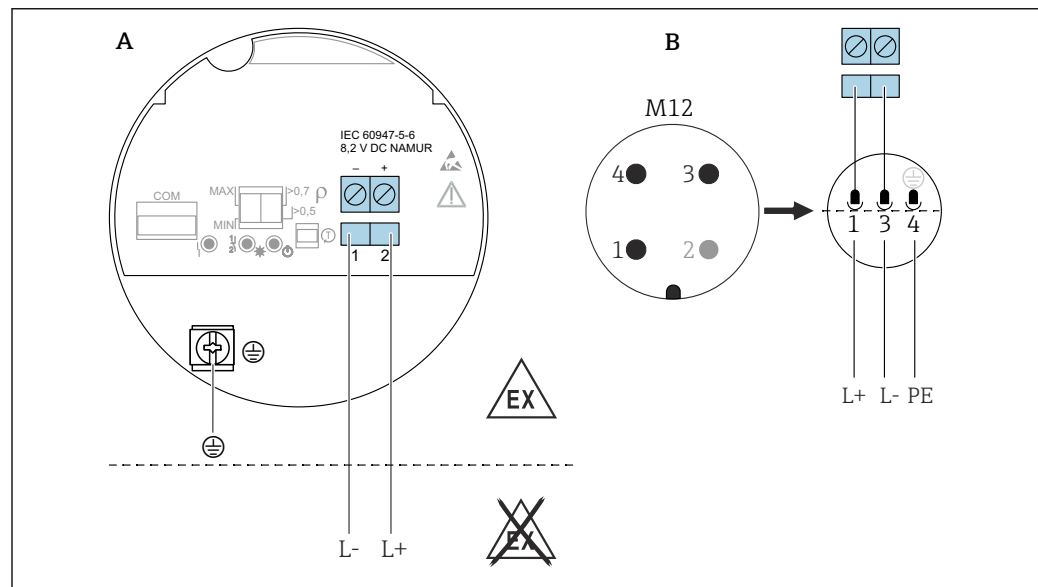
Terminals

Terminals for cable cross-section up to 2.5 mm² (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category I

Terminal assignment


























27 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

Behavior of switch output and signaling

		RD	YE	GN	
MAX 					L+ [2] $2.2...3.8 \text{ mA}$ → [1] L-
					L+ [2] $0.4...1.0 \text{ mA}$ → [1] L-
MIN 					L+ [2] $2.2...3.8 \text{ mA}$ → [1] L-
					L+ [2] $0.4...1.0 \text{ mA}$ → [1] L-
					L+ [2] $< 1.0 \text{ mA}$ → [1] L-

A0037694

 28 Behavior of switch output and signaling, electronic insert FEL68


MAX DIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

RD Red LED for alarm

YE Yellow LED, switch status

GN Green LED, operational status, device on

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

6.3.7 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 Hz/60 Hz

Power consumption


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

Current consumption

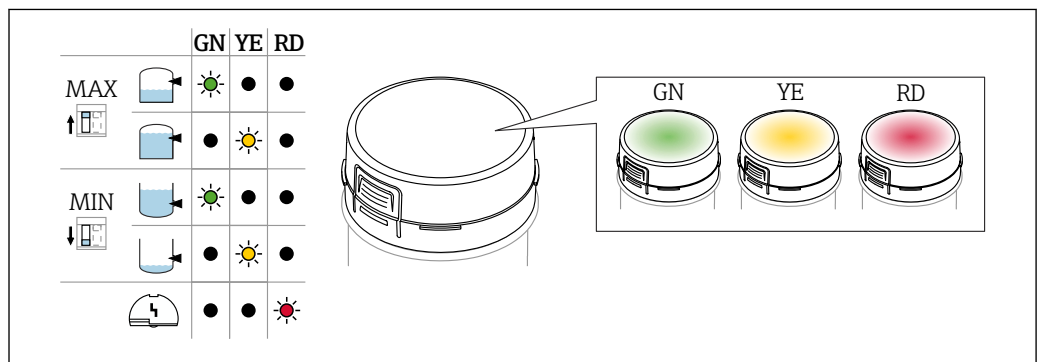
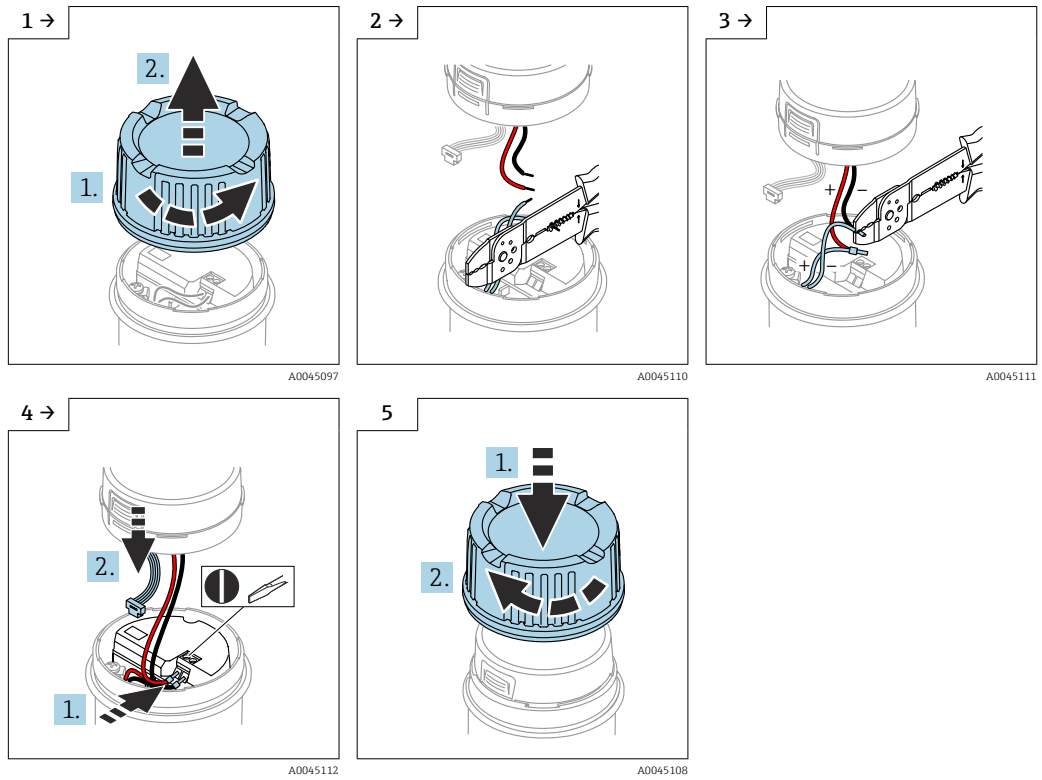
$I_{\text{max}} = 0.4 \text{ A}$

Connecting the LED module

 In the case of devices for use in the hazardous area with a certain type of protection, the cover is sealed by a securing screw.

 For more details, see the "Cover with securing screw" section.

- Required tools: crimper, flat-blade screwdriver
- Use the wire end ferrules supplied

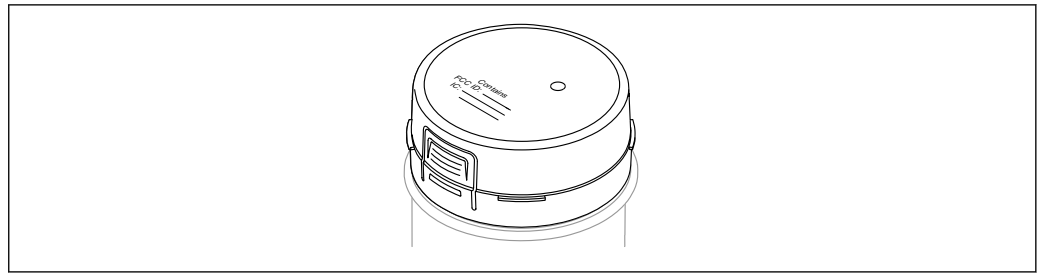


29 LED module, the LED lights up in green (GN), yellow (YE) or red (RD)

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.

The three colors of the LED flash one after another as a chaser light during the functional test.

6.3.8 Bluetooth module VU121 (optional)




A0039257

 30 Bluetooth module VU121

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

Batteries - 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)

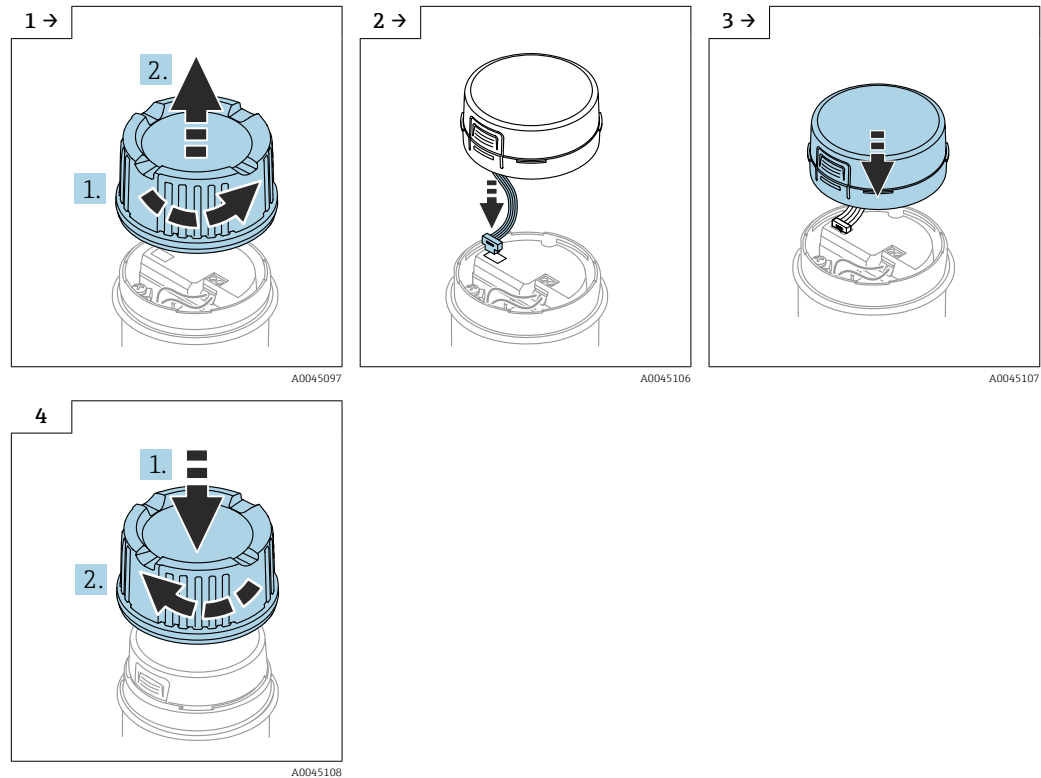
The battery life is based on a scenario where the sensor is connected and powered.

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.

Connecting the Bluetooth module

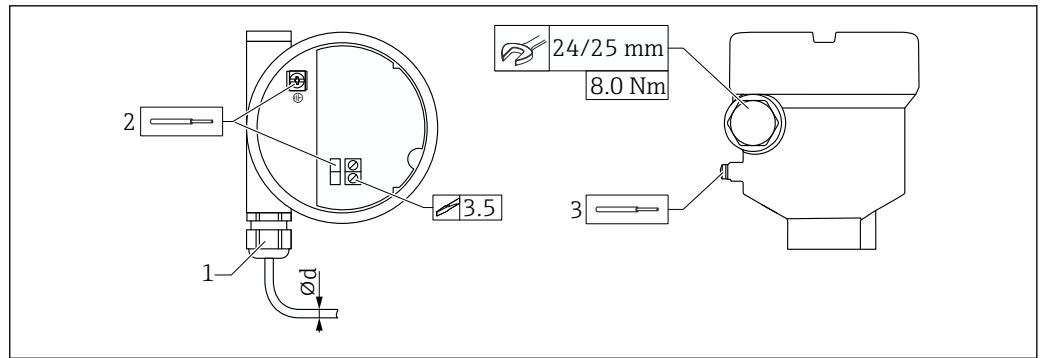
- i** In the case of devices for use in the hazardous area with a certain type of protection, the cover is sealed by a securing screw.
 -  For more details, see the "Cover with securing screw" section.



6.3.9 Connecting the cables

Required tools

- Flat-blade screwdriver (0.6 mm x 3.5 mm) for terminals
- Suitable tool with width across flats AF24/25 (8 Nm (5.9 lbf ft)) for M20 cable gland



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31 Example of coupling with cable entry, electronic insert with terminals

- 1 M20 coupling (with cable entry), example
 - 2 Conductor cross-section maximum 2.5 mm^2 (AWG14), ground terminal on inside in housing + terminals on the electronics
 - 3 Conductor cross-section maximum 4.0 mm^2 (AWG12), ground terminal on outside of the housing (example: plastic housing with outer protective ground connection (PE))
- ∅d Nickel-plated brass 7 to 10.5 mm (0.28 to 0.41 in),
 Plastic 5 to 10 mm (0.2 to 0.38 in),
 Stainless steel 7 to 12 mm (0.28 to 0.47 in)

i Pay attention to the following when using the M20 coupling

Following cable entry:

- Counter-tighten the coupling
- Tighten the union nut of the coupling with 8 Nm (5.9 lbf ft)
- Screw the enclosed coupling into the housing with 3.75 Nm (2.76 lbf ft)

6.4 Post-connection check

- Is the device or cable undamaged (visual inspection)?
- Do the cables used comply with the requirements?
- Do the mounted cables have adequate strain relief?
- Are the cable glands mounted and firmly tightened?
- Does the supply voltage match the information on the nameplate?
- No reverse polarity, is terminal assignment correct?
- If supply voltage is present, is the green LED lit?
- Are all the housing covers installed and tightened?
- Optional: Is the cover tightened with securing screw?

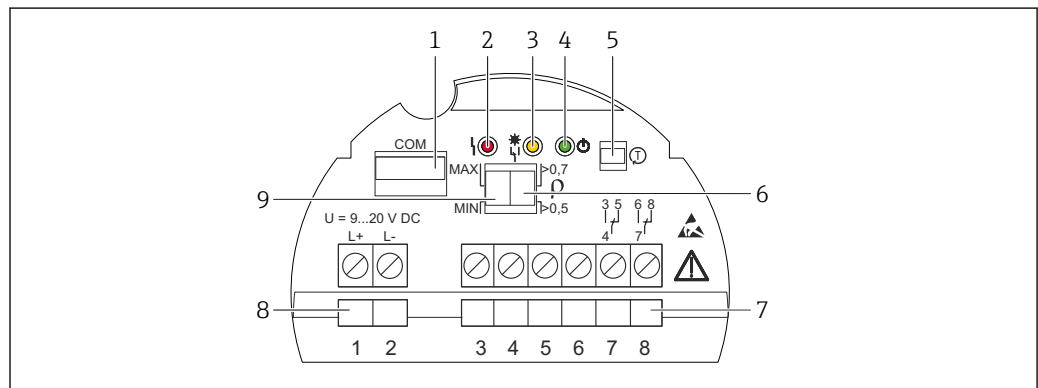
7 Operation options

7.1 Overview of operation options

7.1.1 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)

7.1.2 Elements on the electronic insert

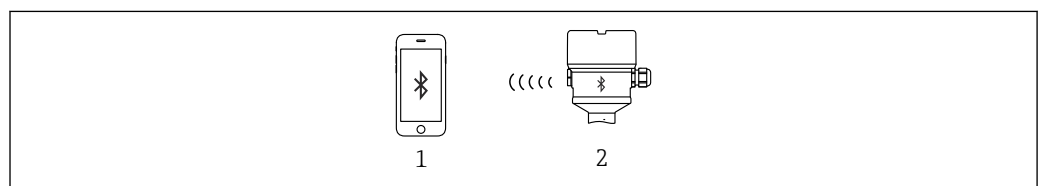


32 Example of electronic insert FEL64DC

- 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

7.1.3 Heartbeat diagnostics and verification with Bluetooth® wireless technology

Access via Bluetooth® wireless technology



33 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 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

7.1.4 LED module VU120 (optional)

Depending on the MAX/MIN setting, an LED indicates the operational status (switch status or alarm status) in green, yellow and red. The LED is lit very brightly and is clearly visible from a large distance.




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

 For more details, see the "Electrical connection" section.

8 Commissioning

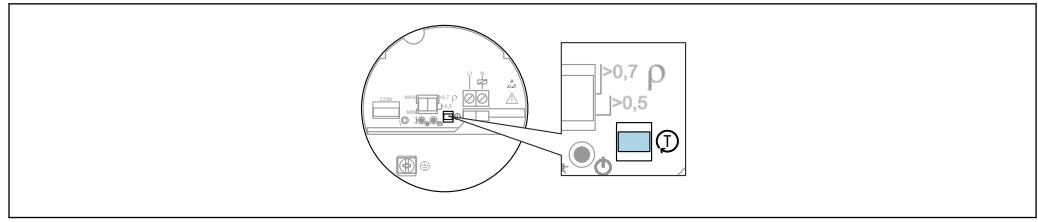
8.1 Function check

Before commissioning the measuring point, check whether the post-installation and post-connection checks have been performed.

-  ▪ →  Post-installation check
- →  Post-connection check

8.2 Functional test using key on electronic insert

- The functional test must be performed in the OK state: MAX safety and sensor free or MIN safety and sensor covered.
- The LEDs flash one after another as a chaser light during the functional test.
- When performing the proof test in safety instrumented systems according to SIL or WHG: comply with the instructions in the Safety Manual.



A0037132

34 Key for functional test (electronic inserts FEL61/62/64/64DC/67/68)

1. Make sure that no undesired switching operations are triggered!
2. Press the "T" key on the electronic insert for at least 1 s (e.g. with screwdriver).
 - ↳ The device function check is performed. The output changes from the OK state to the demand state.
 - Duration of the function check: at least 10 s or if the key is pressed for > 10 s, the check lasts until the test button is released.

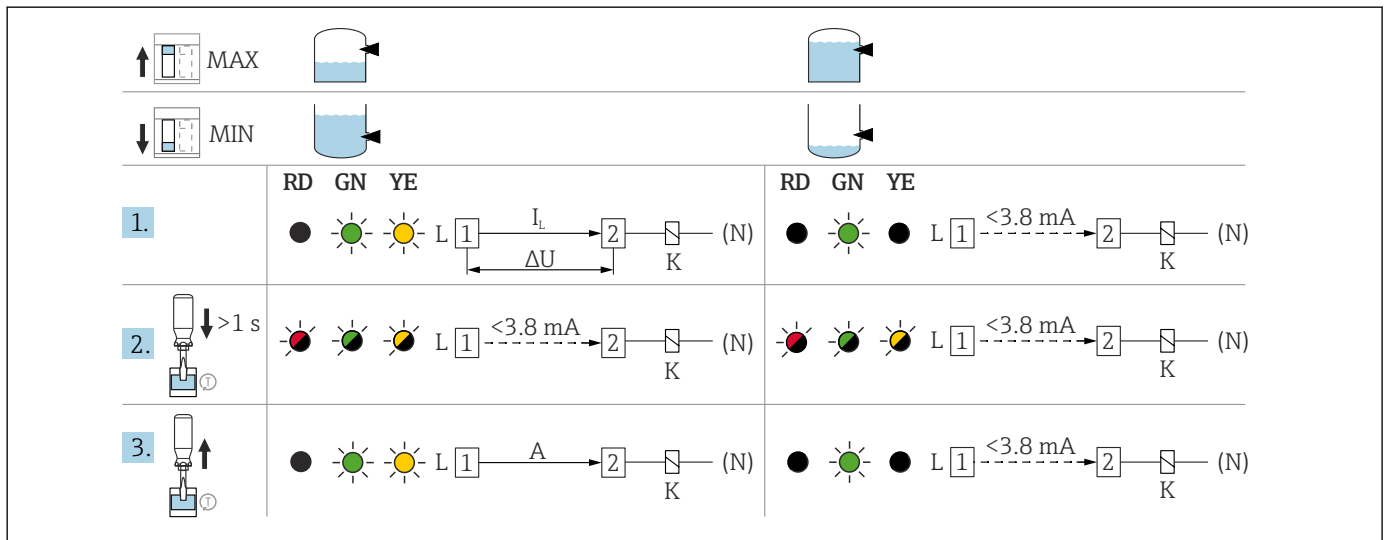
The device returns to normal operation if the internal test is successful.

i If the housing may not be opened during operation due to explosion protection requirements, e.g. Ex d /XP, the functional test can also be started from the outside with the test magnet (optionally available), (FEL62, FEL64, FEL64DC, FEL68).

The functional test of the PFM electronics (FEL67) and NAMUR electronics (FEL68) can be started at the Nivotester FTL325P/N.

A For more details, see the "Functional test of the electronic switch with a test magnet" section.

8.2.1 FEL61 switching behavior and signaling

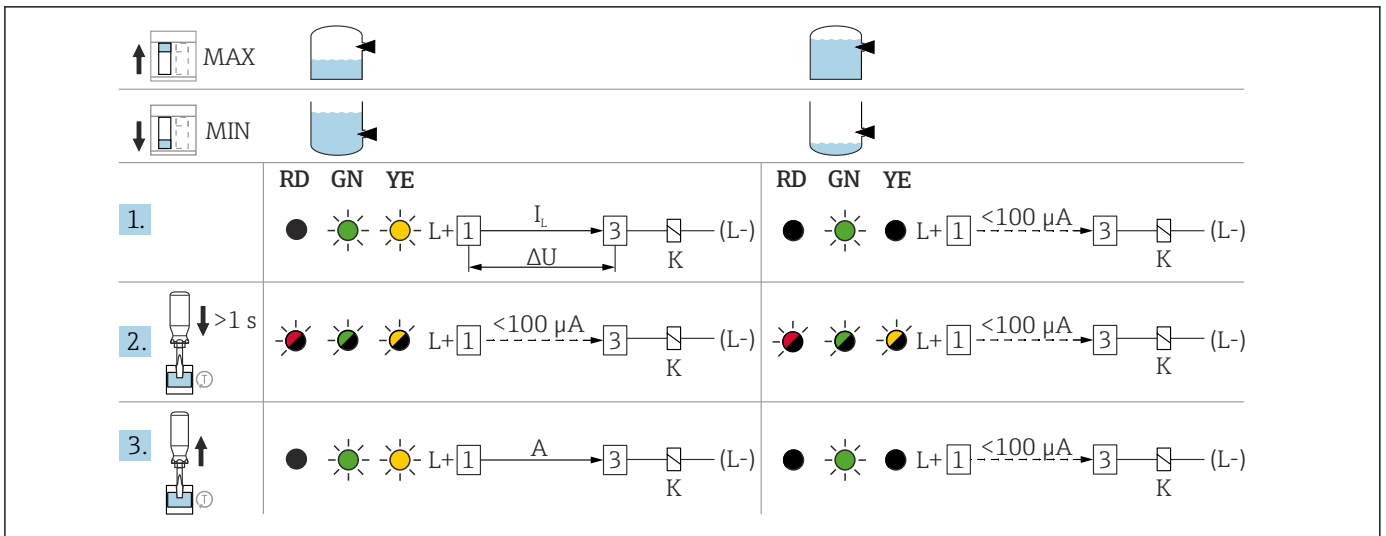


A0039210

35 FEL61 switching behavior and signaling

A After the test button is pressed, the load is switched off for at least 10 s ($I < 3.8\text{ mA}$) even if the button is pressed for < 10 s. If the test button is pressed for > 10 s the load remains switched off ($I < 3.8\text{ mA}$) until the test button is released. The load is then switched on again.

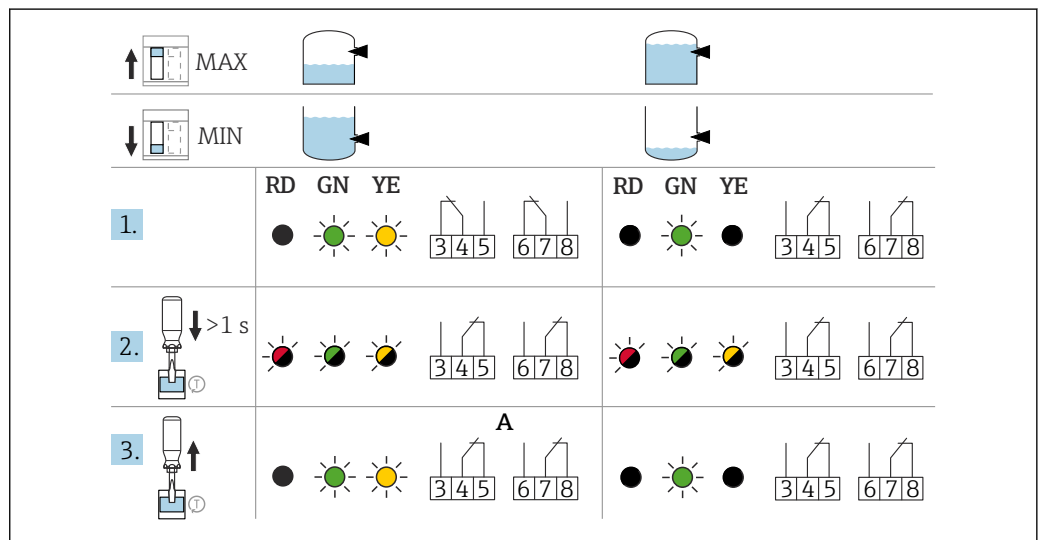
8.2.2 FEL62 switching behavior and signaling



36 FEL62 switching behavior and signaling

A After the test button is pressed, the DC-PNP output is switched off for at least 10 s ($I < 100 \mu A$) even if the button is pressed for $< 10 s$. If the test button is pressed for $> 10 s$, the DC-PNP output remains switched off ($I < 100 \mu A$) until the test button is released. The DC-PNP output is then switched on again.

8.2.3 FEL64, FEL64DC switching behavior and signaling

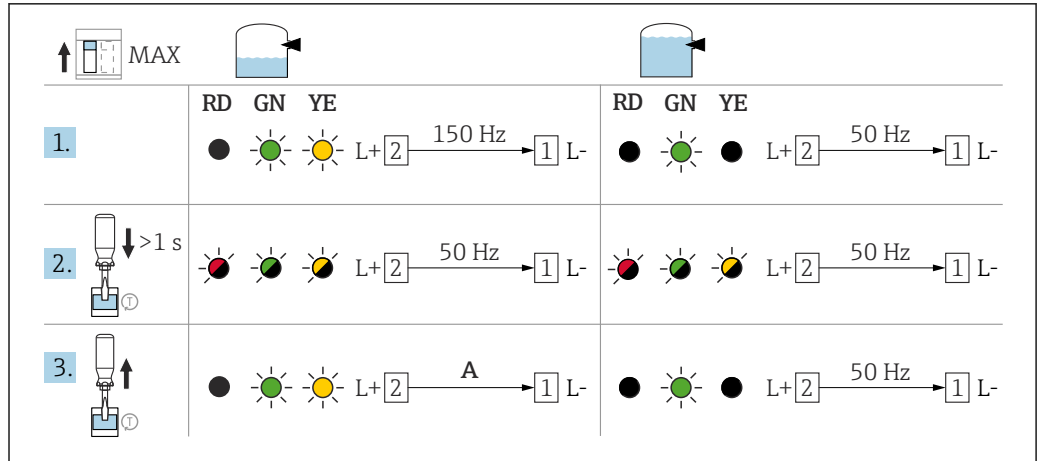


37 FEL64, FEL64DC switching behavior and signaling

A After the test button is pressed, the relay is de-energized for at least 10 s even if the button is pressed for $< 10 s$. If the test button is pressed for $> 10 s$, the relay remains de-energized until the test button is released. The relay is then energized again.

8.2.4 FEL67 switching behavior and signaling

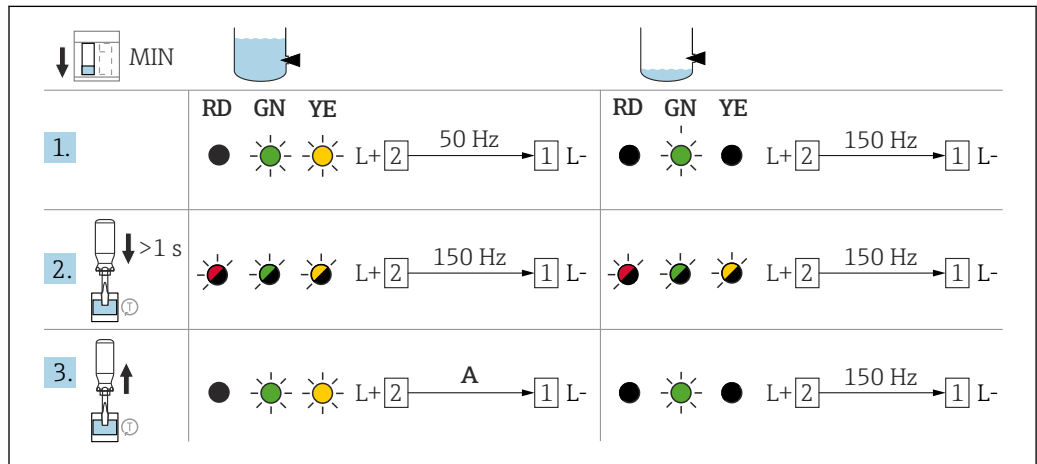
i A distinction must be made between MAX and MIN operating modes in the case of the FEL67 electronic insert!



A0039213

38 FEL67 MAX switching behavior and signaling


A After the test button is pressed, the output frequency is switched off (50 Hz) for at least 10 s even if the button is pressed for < 10 s. If the test button is pressed for > 10 s, the output frequency remains at 50 Hz until the test button is released. The output frequency is then 150 Hz again afterwards.



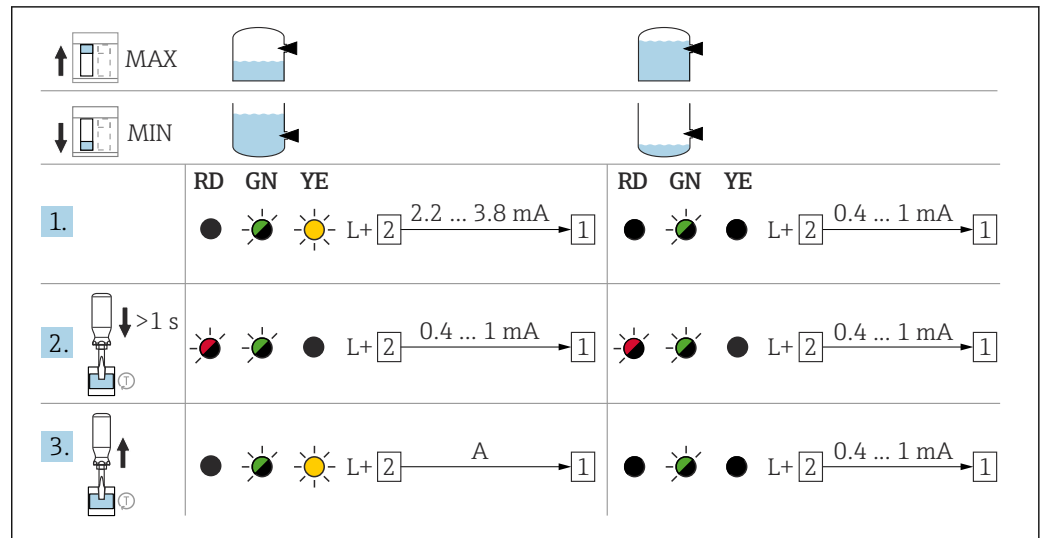
A0039214

39 FEL67 MIN switching behavior and signaling

A After the test button is pressed, the output frequency is switched off (150 Hz) for at least 10 s even if the button is pressed for < 10 s. If the test button is pressed for > 10 s, the output frequency remains at 150 Hz until the test button is released. The output frequency is then 50 Hz again afterwards.

 The PFM frequency cannot be measured on site. It is therefore recommended to proof test the functionality at the Nivotester FTL325P/FTL375P.

8.2.5 FEL68 switching behavior and signaling



40 NAMUR electronics switching behavior and signaling

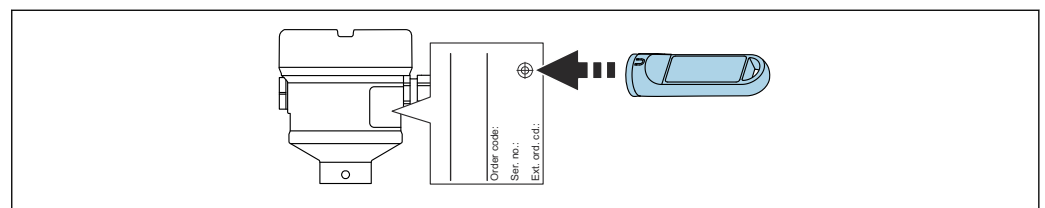
A After the test button is pressed, the current is 0.4 to 1 mA for at least 10 s even if the button is pressed for < 10 s. If the test button is pressed for > 10 s, the current remains at 0.4 to 1 mA until the test button is released. The current is then 2.2 to 3.8 mA again afterwards.

8.3 Functional test of the electronic switch with a test magnet

Perform functional test of the electronic switch without opening the device:

- ▶ Hold the test magnet against the marking on the nameplate on the outside.
 - ↳ Simulation is possible in the case of the FEL62, FEL64, FEL64DC, FEL68 electronic inserts.

The functional test with the test magnet acts in the same way as the functional test using the test button on the electronic insert.



41 Functional test with test magnet

8.4 Switching on the device

During the power-up time, the device output is in the safety-oriented state, or in the alarm state if available:

- For electronic insert FEL61, the output will be in the correct state after a maximum of 4 s following power-up.
- For electronic inserts FEL62, FEL64, FEL64DC, the output will be in the correct state after a maximum of 3 s following power-up.
- For electronic inserts FEL68 NAMUR and FEL67 PFM, a functional test is always performed upon power-up. The output will be in the correct state after a maximum of 10 s.

8.5 Establishing a connection via SmartBlue app

8.5.1 Requirements

Device requirements

Commissioning via the SmartBlue app is only possible if a Bluetooth module is installed in the device.

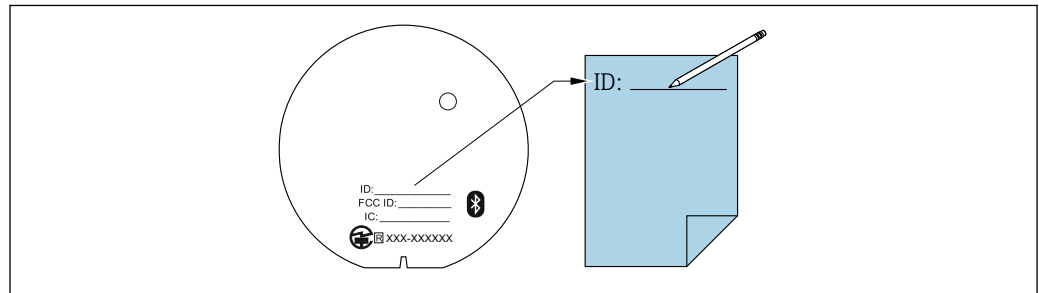
System requirements

Please see the "App Store (Apple)" or "Google Play Store" for information regarding the compatibility of the SmartBlue app with mobile terminals.

8.5.2 Preparatory steps

Note down the ID number of the Bluetooth module. The ID number on the nameplate of the Bluetooth module is used as the initial password when establishing the connection for the first time.

The high cover with the window must be used for devices that are operated with the Bluetooth module.



A0039040

8.5.3 Establishing a connection via SmartBlue app

1. Scan the QR code or enter "SmartBlue" in the search field.




A0039186

 42 [Download link](#)

2. Start SmartBlue.
3. Select device from livelist displayed.
4. Log-in:
 - ↳ User name: admin
 - Password: ID number on the Bluetooth module
5. Tap the icons for more information.

 Change the password after logging in for the first time!

 It is important to note the following if the Bluetooth module is removed from one device and installed in another device: all log-in data are only stored in the Bluetooth module and not in the device. This also applies to the password changed by the user.

Saving PDF reports

The PDF reports generated in the SmartBlue app are not saved automatically and must therefore be actively saved on the smartphone or tablet.

9 Operation

9.1 Diagnostics menu

The following data can be read out via the optional Bluetooth module and the associated Endress+Hauser SmartBlue app.

9.1.1 "Diagnostics" menu

Settings and information concerning diagnostics as well as help for troubleshooting

The screenshot shows the 'Diagnostics' menu with the following structure:

- Diagnostics** (header)
 - ▶ Active diagnostics** (sub-header)
 - Actual diagnostics
 - Timestamp
 - ▶ Diagnostic list** (sub-header)
 - Diagnostics 1
 - Timestamp
 - Diagnostics 2
 - Timestamp
 - Diagnostics 3
 - Timestamp
 - Diagnostics 4
 - Timestamp
 - Diagnostics 5
 - Timestamp

9.1.2 "Application" menu

Functions for detailed process adaptation to integrate the device optimally into your application

The screenshot shows the 'Application' menu with the following structure:

- Application** (header)

► Operating mode

MIN/MAX setting

Density setting

Switching delay uncovered to covered

Switching delay covered to uncovered

► Output

Output state

9.1.3 "System" menu

System settings concerning device management, user administration or safety

System

Electronic type

► Bluetooth configuration

BLE HW revision

► Information

Device tag

Serial number

Firmware version

Device name

Order code

Manufacturer

Manufacturer ID

ENP version

Operating time

Number of system starts

Time stamp of last proof test
Date of proof test
Frequency at delivery status
Current frequency
Upper alarm frequency
Upper warning frequency
Lower alarm frequency
Battery status
Electronics temperature
Minimum electronics temperature
Maximum electronics temperature

9.2 Heartbeat Verification

The "Heartbeat Verification" module contains **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.
- If the oscillation frequency of the fork increases, a corrosion warning appears.
- 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.

9.3 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.

10 Diagnostics and troubleshooting

The device indicates warnings and faults via Bluetooth in the SmartBlue app and via the LEDs on the electronic insert. All the device warnings and faults are for information purposes only and do not have a safety function. The faults diagnosed by the device are displayed in the SmartBlue app in accordance with NE107. Depending on the diagnostic message, the device behaves as per a warning or fault condition.

The device behaves in accordance with NAMUR Recommendation NE131 "NAMUR standard device requirements for field devices for standard applications".

If using NAMUR electronics, insert or replace the battery in the Bluetooth module.

10.1 Diagnostic information via light emitting diodes

10.1.1 LED at electronic insert

LED green not lit

Possible cause: No power supply

Troubleshooting: Check plug, cable and power supply

LED flashes red

Possible cause: Overload or short-circuit in load circuit

Troubleshooting: Clear the short-circuit

Reduce maximum load current to below 350 mA

LED red continuously lit

Possible cause: Internal sensor error or electronic fault

Troubleshooting: Replace device

No LED is lit (only applies for FEL61)

Possible cause: load current > 3.8 mA in the blocked state

Troubleshooting: replace electronics

10.1.2 SmartBlue

Device is not visible in the live list

Possible cause: No Bluetooth connection available

The device is already connected to another smartphone or tablet

No cable is connected to the Bluetooth module

Troubleshooting:

- Connect the Bluetooth module to the COM interface
- Enable Bluetooth function on smartphone or tablet
- If using NAMUR electronics, insert or replace the battery in the Bluetooth module.

Device is visible in the live list but cannot be accessed via SmartBlue

- Possible cause on Android end device

Troubleshooting:

- Check whether the location function is enabled for the app
- Check whether the location function for the app was approved the first time
- GPS or positioning function must be activated for certain Android versions in conjunction with Bluetooth®
- Activate GPS, close the app fully and restart, enable the positioning function for the app

- Possible cause on Apple end device

Troubleshooting:

- Log in as normal
- Enter the user name: admin
- Enter initial password (serial number of Bluetooth module), paying attention to lower/upper case

Login via SmartBlue not possible

Possible cause: Device is being put into operation for the first time

Troubleshooting: Enter initial password (ID number of Bluetooth module) and change it, paying attention to lower/upper case.

No communication with device via SmartBlue

- Possible cause: Incorrect password entered
Troubleshooting: Enter correct password
- Possible cause: Forgotten password
Troubleshooting: Contact Endress+Hauser Service

10.2 Firmware history

V01.01.zz (01.2019)

- Valid for electronic inserts: FEL61, FEL62, FEL64, FEL67, FEL68
- Valid from documentation version: BA02037F/00/EN/02.20
- Changes: none; 1st version (original software)

11 Maintenance

No special maintenance work is required.

11.1 Maintenance tasks

11.1.1 Cleaning

It is not permitted to use the device with abrasive media. Material abrasion on the tuning fork can result in the device malfunctioning.

- Clean the tuning fork as necessary
- Cleaning is also possible in the installed state, e. g. CIP Cleaning in Place and SIP Sterilization in Place

12 Repair

12.1 General notes

12.1.1 Repair concept

Endress+Hauser repair concept

- The devices have a modular design
- Customers can carry out repairs

 For more information on service and spare parts, please contact your Endress+Hauser sales representative.

12.1.2 Repairs to Ex-approved devices

WARNING


Incorrect repair can compromise electrical safety!

Explosion hazard!

- ▶ Only specialist personnel or the manufacturer's service team may carry out repairs on Ex-certified devices in accordance with national regulations.
- ▶ Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- ▶ Only use original spare parts from the manufacturer.
- ▶ Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- ▶ Carry out repairs according to the instructions.
- ▶ Only the manufacturer's service team is permitted to modify a certified device and convert it to another certified version.

12.2 Spare parts

- Some replaceable device components are identified by a spare part nameplate. This contains information about the spare part.
- All the spare parts for the measuring device, along with the order code, are listed in the *W@M Device Viewer* (www.endress.com/deviceviewer) and can be ordered. If available, users can also download the associated Installation Instructions.

 Device serial number or QR code:
Located on the device and spare part nameplate.

12.3 Return

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

1. Refer to the web page for information:
<http://www.endress.com/support/return-material>
↳ Select the region.
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

12.4 Disposal



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

12.5 Battery disposal

- The end user is legally obliged to return used batteries
- The end user can return old batteries or electronic assemblies containing these batteries free of charge to Endress+Hauser

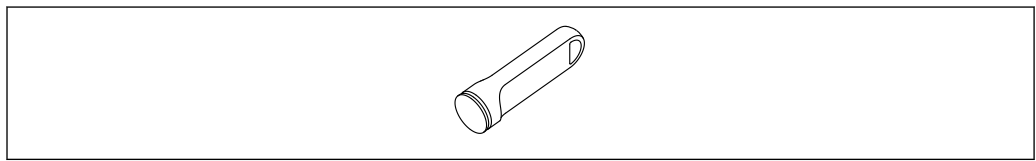


In accordance with German law regulating the use of batteries (BattG §28 Para 1 Number 3), this symbol is used to denote electronic assemblies that must not be disposed of as household waste.

13 Accessories

13.1 Test magnet

Order number: 71437508

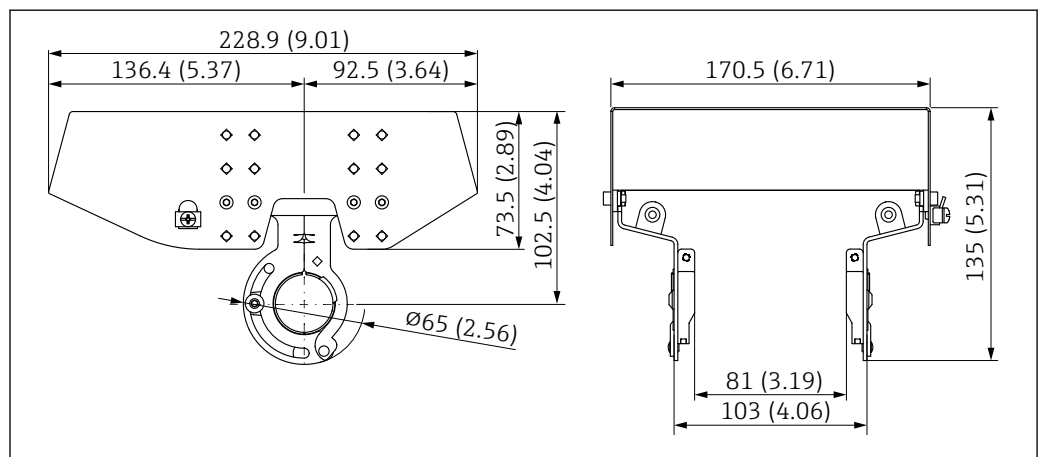


A0039209

43 Test magnet

13.2 Protective cover for aluminum dual compartment housing

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

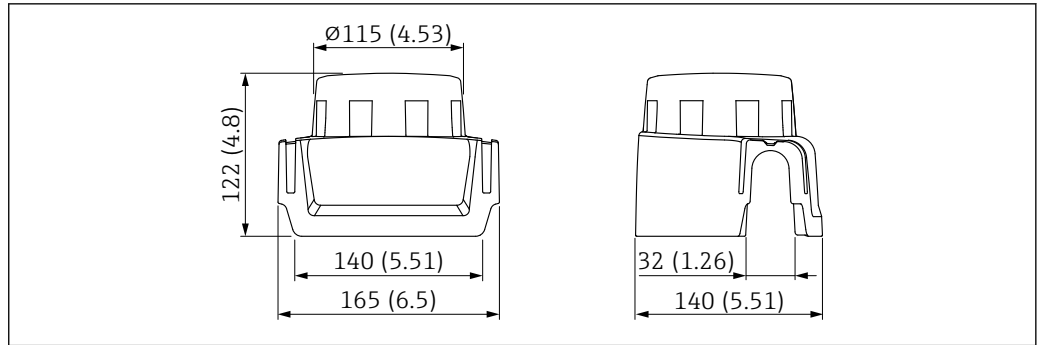


A0039231

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

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

- Material: plastic
- Order number: 71438291



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

13.4 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

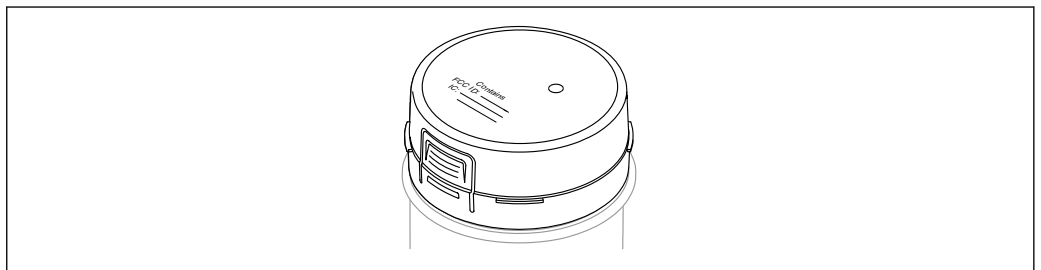
M12 socket IP67

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


13.5 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



46 Bluetooth module VU121

 More detailed information and documentation are available:

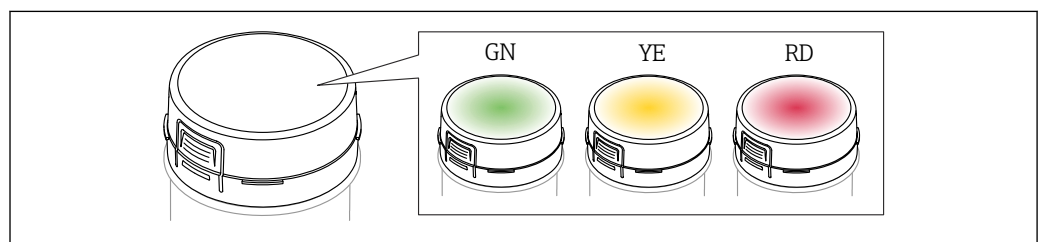
- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

 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.


13.6 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


 47 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
- Endress+Hauser sales organization www.addresses.endress.com

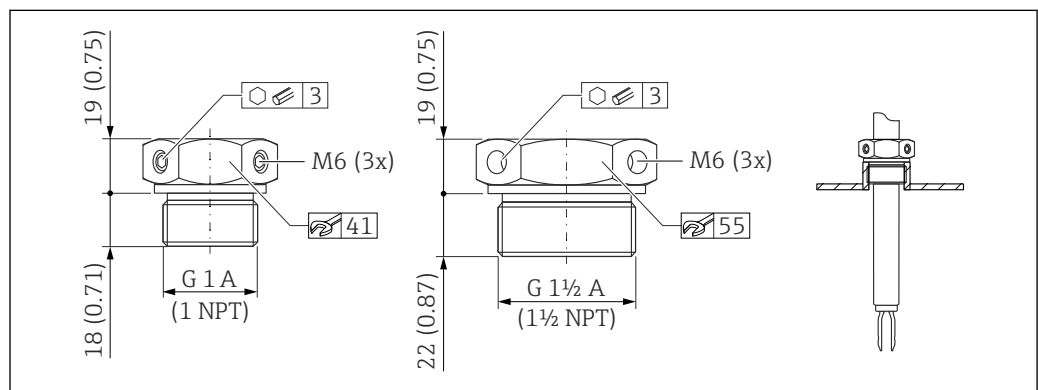
 A tall cover is required (transparent plastic cover/cover with sight glass or aluminum cover with sight glass) for using and retrofitting the LED module. The LED module cannot be used in conjunction with the single compartment 316L housing. The cover depends on the housing and approval of the device.

13.7 Sliding sleeves for unpressurized operation

 Not suitable for devices with PFA (conductive) coating.

 Not suitable for use in explosive atmospheres.

Switch point, infinitely adjustable.



A0037666

 48 Sliding sleeves for unpressurized operation $p_e = 0$ bar (0 psi). Unit of measurement mm (in)

G 1, DIN ISO 228/I

- Material: 1.4435 (AISI 316L)
- Weight: 0.21 kg (0.46 lb)
- Order number: 52003978
- Order number: 52011888, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1, ASME B 1.20.1


- Material: 1.4435 (AISI 316L)
- Weight: 0.21 kg (0.46 lb)
- Order number: 52003979
- Order number: 52011889, approval: with inspection certificate EN 10204 - 3.1 material

G 1½, DIN ISO 228/I

- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003980
- Order number: 52011890, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1½, ASME B 1.20.1


- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003981
- Order number: 52011891, approval: with inspection certificate EN 10204 - 3.1 material

 More detailed information and documentation are available:

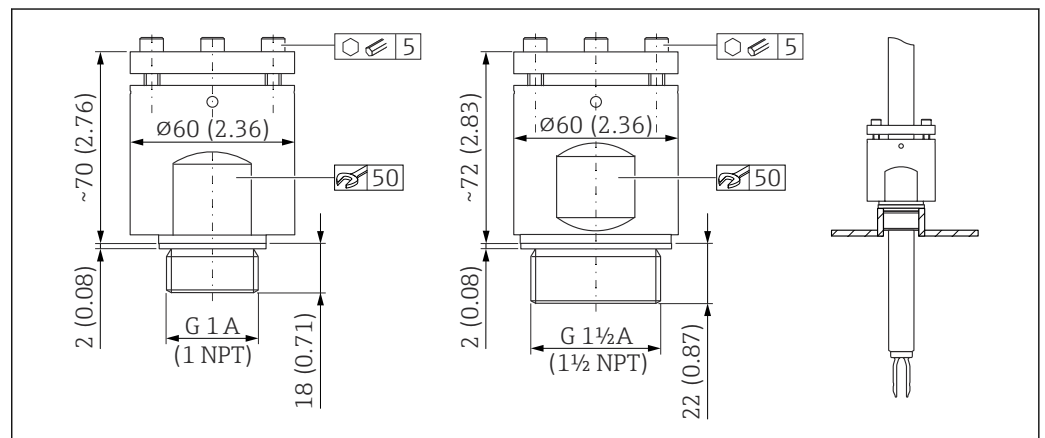
- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

13.8 High pressure sliding sleeves

 Suitable for use in explosive atmospheres.

 Not suitable for devices with PFA (conductive) coating.

- Switch point, infinitely adjustable
- Seal package made of graphite
- Graphite seal available as spare part 71078875
- For G 1, G 1½: seal is included in the delivery



 49 High pressure sliding sleeves. Unit of measurement mm (in)

A0037667

G 1, DIN ISO 228/1

- Material: 1.4435 (AISI 316L)
- Weight: 1.13 kg (2.49 lb)
- Order number: 52003663
- Order number: 52011880, approval: with inspection certificate EN 10204 - 3.1 material

G 1, DIN ISO 228/1

- Material: Alloy C22
- Weight: 1.13 kg (2.49 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118691

NPT 1, ASME B 1.20.1

- Material: 1.4435 (AISI 316L)
- Weight: 1.13 kg (2.49 lb)
- Order number: 52003667
- Order number: 52011881, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1, ASME B 1.20.1

- Material: Alloy C22
- Weight: 1.13 kg (2.49 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118694

G 1½, DIN ISO 228/1

- Material: 1.4435 (AISI 316L)
- Weight: 1.32 kg (2.91 lb)
- Order number: 52003665
- Order number: 52011882, approval: with inspection certificate EN 10204 - 3.1 material

G 1½, DIN ISO 228/1


- Material: Alloy C22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material

NPT 1½, ASME B 1.20.1

- Material: 1.4435 (AISI 316L)
- Weight: 1.32 kg (2.91 lb)
- Order number: 52003669
- Order number: 52011883, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1½, ASME B 1.20.1

- Material: Alloy C22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118695

 More detailed information and documentation are available:

- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

14 Technical data

14.1 Input

14.1.1 Measured variable

Level (point level), MAX or MIN safety

14.1.2 Measuring range

Depends on the installation location and the pipe extension ordered
Standard pipe extension up to 3 m (9.8 ft) and up to 6 m (20 ft) on request.

14.2 Output

14.2.1 Output and input variants

Electronic inserts

2-wire AC (FEL61)

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

3-wire DC-PNP (FEL62)

- Three-wire direct current version
- Switches the load via the transistor (PNP) and separate connection, e. g. in conjunction with programmable logical controllers (PLC)
- Ambient temperature -60 °C (-76 °F), optionally available to order
Low-temperature electronic inserts are marked LT

Universal current connection, relay output (FEL64)

- Switches the loads via 2 floating change-over contacts
- Ambient temperature -60 °C (-76 °F), optionally available to order
Low-temperature electronic inserts are marked LT

Direct current connection, relay output (FEL64DC)

- Switches the load via 2 potential-free changeover contacts
- Ambient temperature -60 °C (-76 °F), optionally available to order
Low-temperature electronic inserts are marked LT

PFM output (FEL67)

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

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

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

14.2.2 Output signal

Switch output

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

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

COM interface

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

Bluetooth® wireless technology (optional)

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

14.2.3 Ex connection data

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

14.3 Environment

14.3.1 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 °C (-40 °F) is limited to a maximum of 35 V DC.

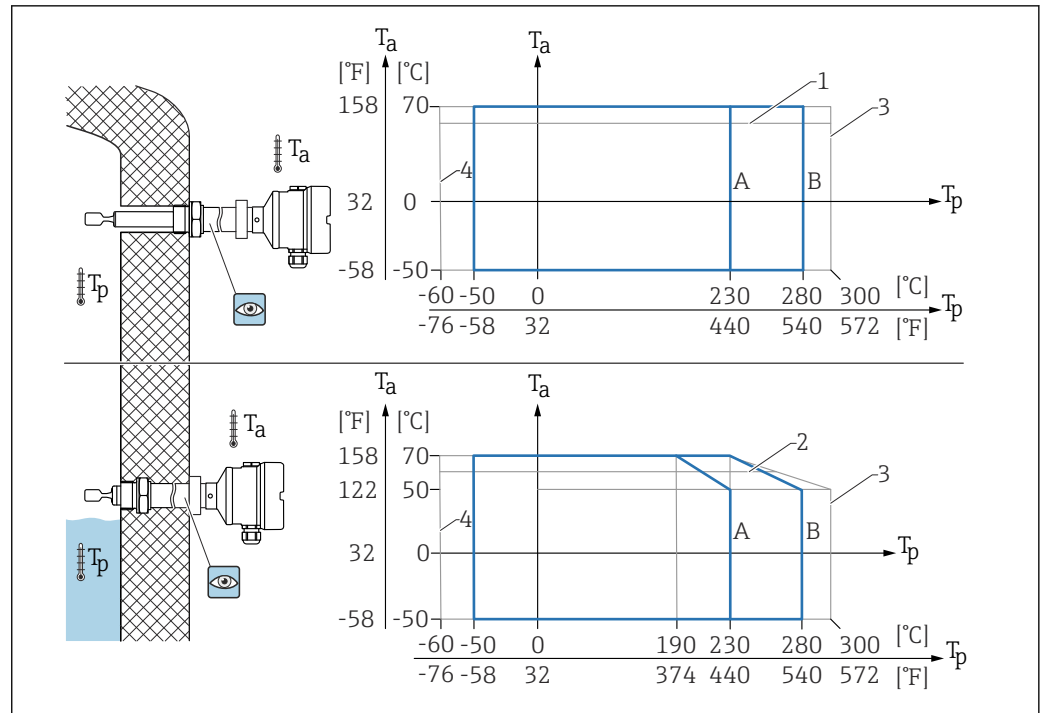
$-40\text{ to }+70\text{ °C}$ ($-40\text{ to }+158\text{ °F}$)

Optionally available to order:

- -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.



50 Permitted ambient temperature T_a at the housing as a function of the process temperature T_p in the vessel

A 230 °C (446 °F) sensor

B 280 °C (536 °F) sensor

1 Exceptions for electronic insert FEL64:

Without LED module: Relay current = 6 A, T_a max. = 60 °C (140 °F);

Relay current = 4 A, T_a max. = 65 °C (149 °F)

With LED module: T_a max. -10 K

2 Exceptions for electronic insert FEL64:

Without LED module: Relay current = 6 A, T_a max. = 65 °C (149 °F);

Relay current = 4 A, T_a max. = 70 °C (158 °F)

With LED module: T_a max. -10 K

3 Max. 50 h on cumulative basis

4 Only for ATEX and CSA certificates

- 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).

14.3.2 Storage temperature

-40 to +80 °C (-40 to +176 °F)

Optional: -50 °C (-58 °F), -60 °C (-76 °F)

14.3.3 Humidity

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

14.3.4 Operating altitude

As per IEC 61010-1 Ed.3:

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

14.3.5 Climate class

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

14.3.6 Degree of protection

Testing according to IEC 60529 and NEMA 250

IP68 test condition: 1.83 m H₂O for 24 h

Housing

See cable entries

Cable entries

- M20 threaded joint, plastic, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, nickel-plated brass, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, 316L, IP66/68 NEMA Type 4X/6P
- M20 thread, IP66/68 NEMA Type 4X/6P
- G ½ thread, NPT ½, NPT ¾ IP66/68 NEMA Type 4X/6P


Degree of protection for M12 plug

- When housing is closed and connecting cable is plugged in: IP66/67 NEMA Type 4X
- When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1

NOTICE

M12 plug: Loss of IP protection class due to incorrect installation!

- ▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.
- ▶ The degree of protection only applies if the connecting cable used is specified according to IP67 NEMA Type 4X.

 If the "M12 plug" option is selected as the electrical connection, **IP66/67 NEMA Type 4X** applies for all housing types.

14.3.7 Vibration resistance

As per IEC60068-2-64-2008

$a(\text{RMS}) = 50 \text{ m/s}^2$, $f = 5 \text{ to } 2\,000 \text{ Hz}$, $t = 3 \text{ axes} \times 2 \text{ h}$

14.3.8 Shock resistance

In accordance with IEC60068-2-27-2008: $300 \text{ m/s}^2 [= 30 g_n] + 18 \text{ ms}$

g_n : standard acceleration of gravity

14.3.9 Mechanical load

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).


 For more details, see the "Supporting the device" section.

14.3.10 Pollution degree

Pollution degree 2

14.3.11 Electromagnetic compatibility (EMC)


- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- With regard to the safety function (SIL), the requirements of EN 61326-3-x are satisfied


 For more details, refer to the EU Declaration of Conformity.

14.4 Process

14.4.1 Process temperature range

- -60 to +230 °C (-76 to +446 °F)
- -60 to +280 °C (-76 to +536 °F)/to 300 °C (572 °F) for max. 50 h on cumulative basis
- -50 to +230 °C (-58 to +446 °F) with PFA coating (conductive)

 The device can be ordered for use in very aggressive media with a highly corrosion-resistant PFA coating. At medium temperatures up to ≥ 150 °C (302 °F), pay attention to the chemical durability and the increasing risk of damage to the coating from diffusion.

Observe pressure and temperature dependency,  see the "Process pressure range of the sensors" section.

14.4.2 Medium conditions


The service life of the device can be impacted in applications where increased hydrogen diffusion through the metallic membrane can be expected.

Typical conditions from which hydrogen diffusion is relevant:

- Temperature: > 180 °C (356 °F)
- Increasing process pressures accelerate hydrogen diffusion

14.4.3 Thermal shock


Without restrictions within the process temperature range.

 With PFA coating (conductive): ≤ 120 K/s

14.4.4 Process pressure range

WARNING

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.

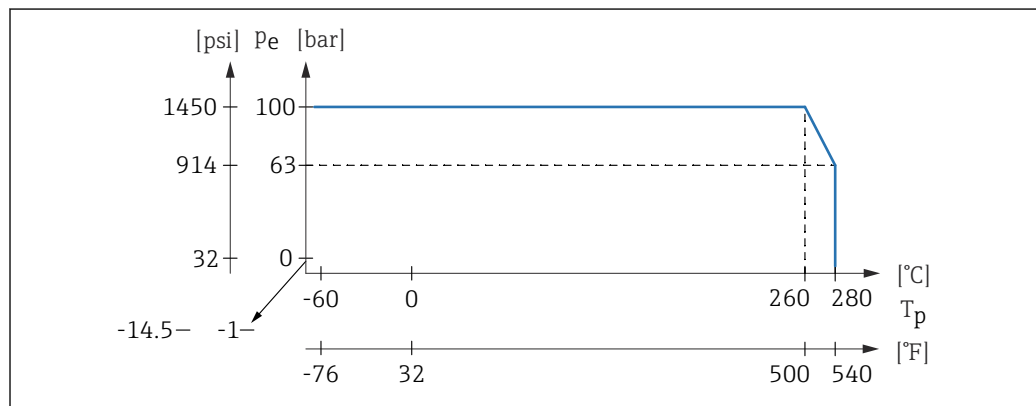
Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:

- 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

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

i Devices with CRN approval: maximum 90 bar (1 305 psi) for devices with a pipe extension. Information on the Endress+Hauser website: www.endress.com → Downloads.

Process pressure range of the sensors



Ordering information: Product Configurator, feature "Application":

- PN: max. 100 bar (1 450 psi) max. 230 °C (446 °F)
- PN: max. 100 bar (1 450 psi) max. 280 °C (536 °F)
- With PFA coating (conductive): max. 40 bar (580 psi) max. 230 °C (446 °F)

14.4.5 Overpressure limit

- Overpressure limit = 1.5 · PN
Maximum 100 bar (1 450 psi) at 230 °C (446 °F) and 280 °C (536 °F)
- 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 PN.

14.4.6 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/cm³ (25.0 lb/ft³)

- 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 → Downloads)

14.4.7 Viscosity

≤ 10 000 mPa·s

14.4.8 Pressure tightness


Up to vacuum

 In vacuum evaporation plants, select the 0.4 g/cm³ (25.0 lb/ft³)/ density setting.

14.4.9 Solids contents

∅ ≤ 5 mm (0.2 in)

14.5 Additional technical data

 Technical Documentation TI01540F.

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