

Operating Instructions

Liquiphant FTL51B

Vibronic

Point level switch for liquids



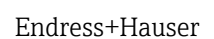


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1 About this document

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 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


   Series of steps

1.2.5 Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

 Hazardous area

 Safe area (non-hazardous area)

1.2.6 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 personal 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.

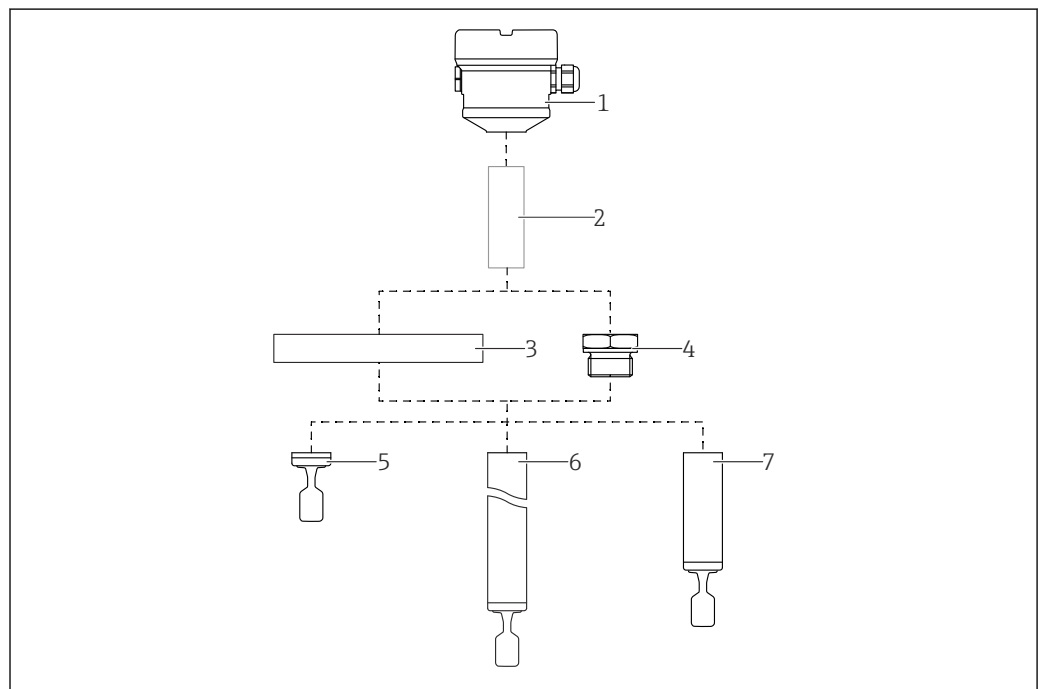
Provide additional protection for the device and data transfer to/from the device

- 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 all liquids, for minimum or maximum detection in tanks, vessels and pipes.

3.1 Product design



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1 Product design

- 1 Housing with electronic insert and cover; optional Bluetooth module or LED module
- 2 Temperature spacer, pressure-tight feedthrough (second line of defense), optional
- 3 Process connection with flange (optional)
- 4 Process connection with thread (optional)
- 5 Compact probe version with tuning fork
- 6 Pipe extension probe with tuning fork
- 7 Short tube version of 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.

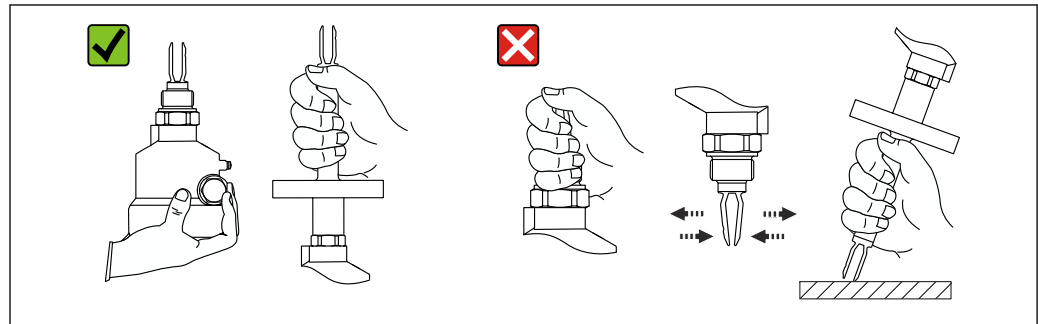
Storage temperature

–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
- Do not bend, shorten or extend the tuning fork



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2 Handling the device during transportation

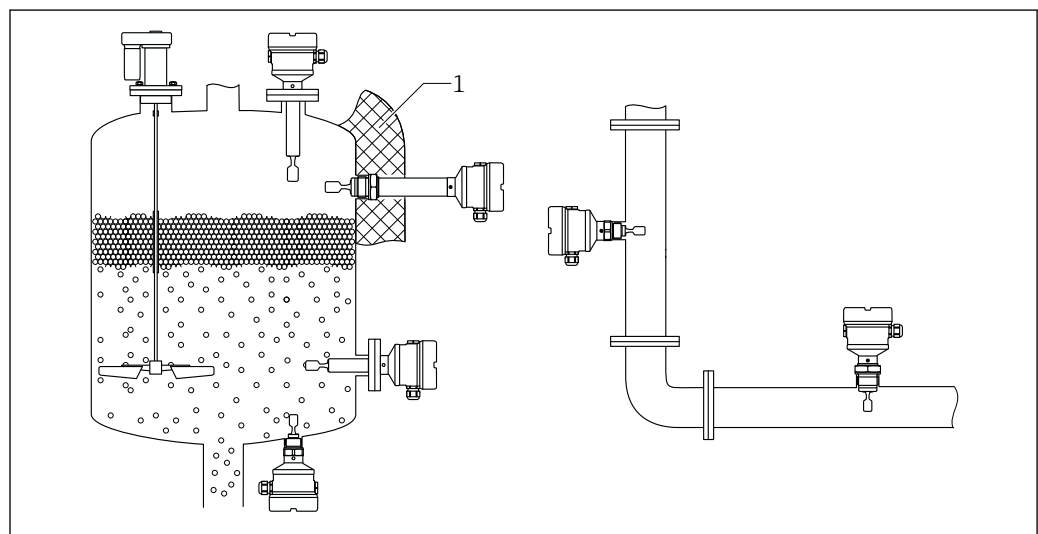
5 Mounting**⚠ WARNING**

Loss of protection rating if the device is opened in a wet environment.

- Only open the device in a dry environment!

Mounting instructions

- Any orientation for device with short pipe up to approx. 500 mm (19.7 in)
- Vertical orientation from above for device with long pipe
- Minimum distance between the fork tip 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

1 Vessel insulation (example with temperature spacer/pressure-tight feedthrough)

If process temperatures are high, the device should be included in a vessel insulation system to prevent the electronics from heating as a result of thermal radiation or convection.

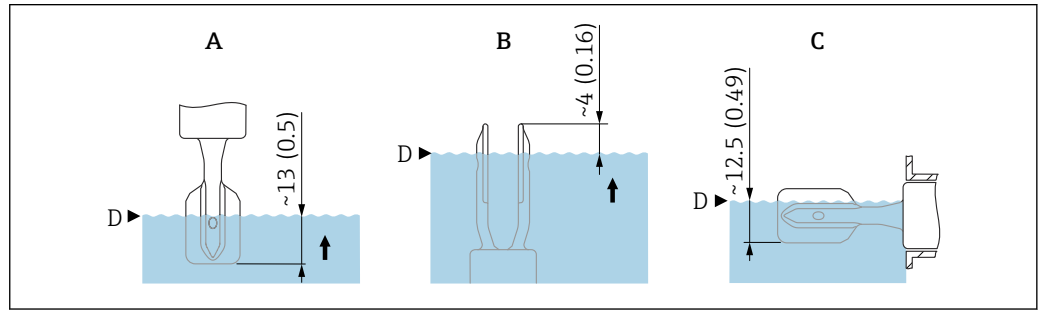
5.1 Mounting requirements

5.1.1 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 fork tip and the tank wall or pipe wall:
10 mm (0.39 in)



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

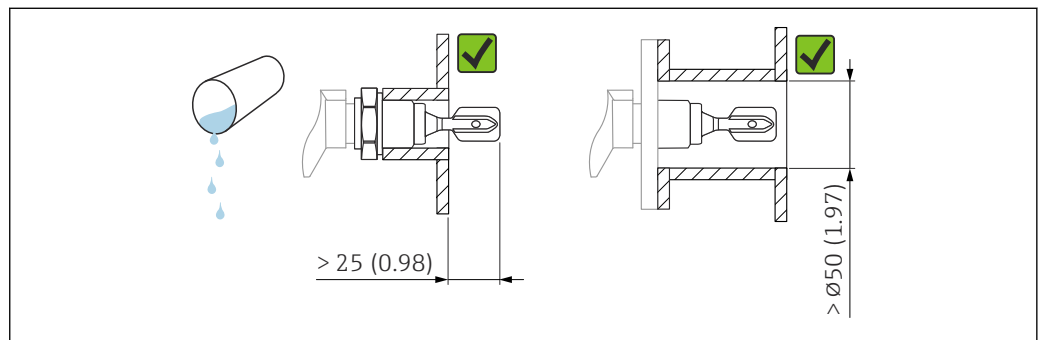
- A Installation from above
B Installation from below
C Installation from the side
D Switch point

5.1.2 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.



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

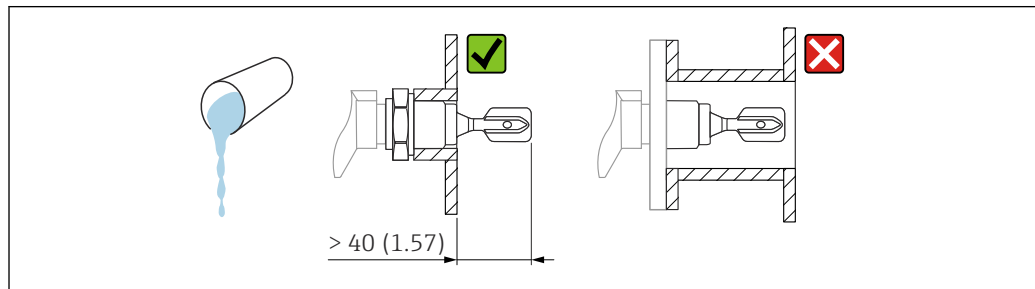
High viscosity**NOTICE**

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: $\leq 10\,000\text{ mPa}\cdot\text{s}$

The tuning fork must be located outside the installation socket!

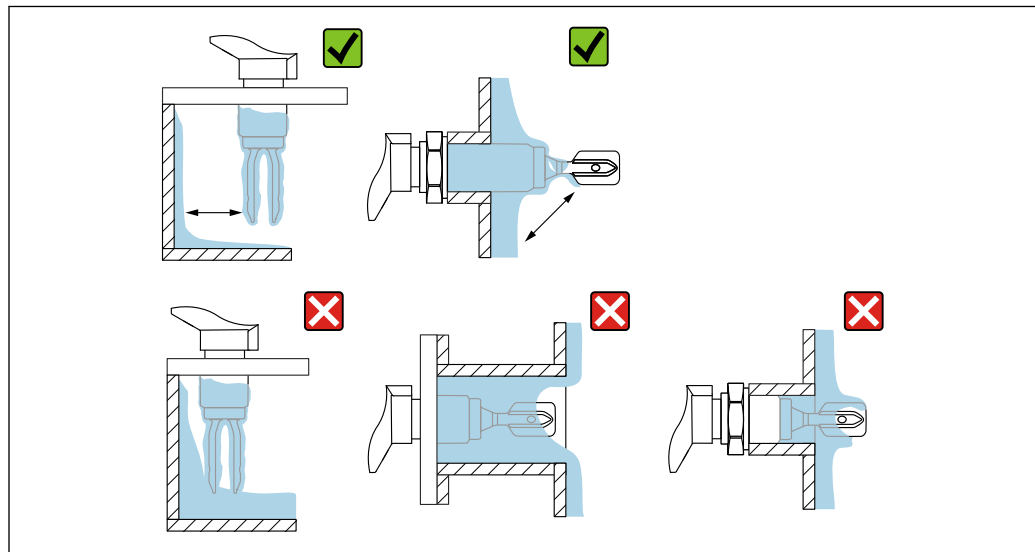


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6 Installation example for a highly viscous liquid. Unit of measurement mm (in)

5.1.3 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

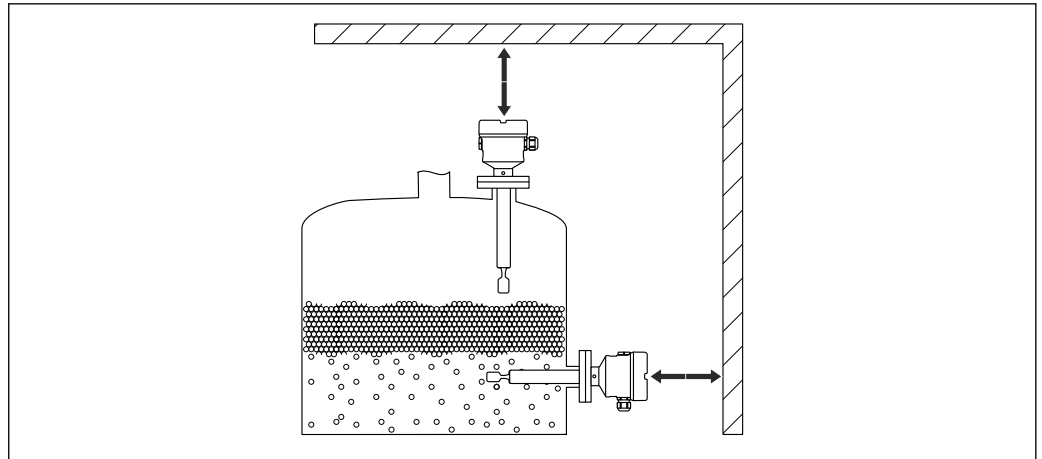


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7 Installation examples for a highly viscous process medium

5.1.4 Take clearance into consideration

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

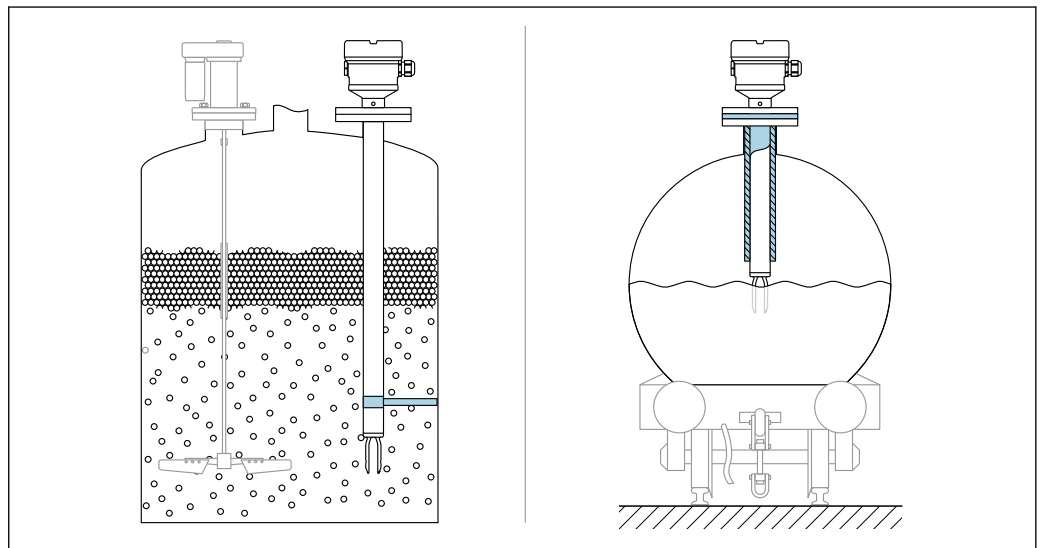


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 8 Take clearance into consideration


5.1.5 Support the device

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).



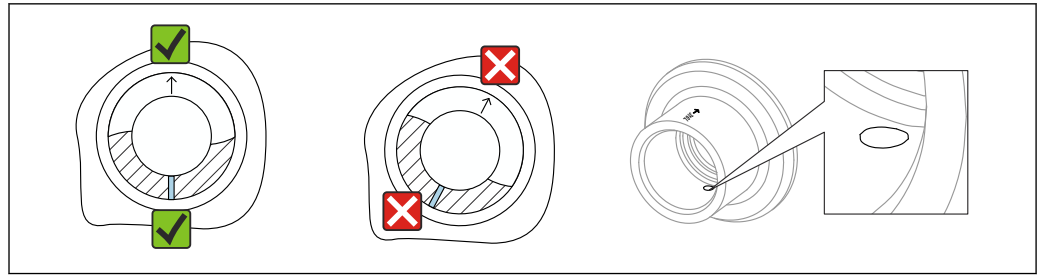
A0031874

 9 Examples of support in the event of dynamic load

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

5.1.6 Weld-in adapter with leakage hole

Weld in the weld-in adapter in such a way that the leakage hole is pointing downwards. This enables any leaks to be detected quickly.



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10 Weld-in adapter with leakage hole

5.2 Mounting the device

5.2.1 Required tool

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

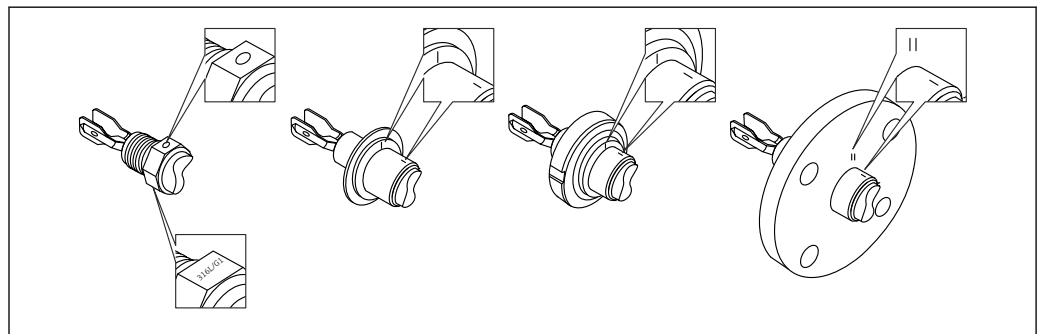
5.2.2 Installation

Align the tuning fork using the marking

The tuning fork can be aligned using the marking. Medium can thus run off easily and buildup is avoided.

Markings may include the following:

- Material information, thread name or circle on the hexagonal nut or on the weld-in adapter
- II symbol on the back of the flange or Tri-Clamp

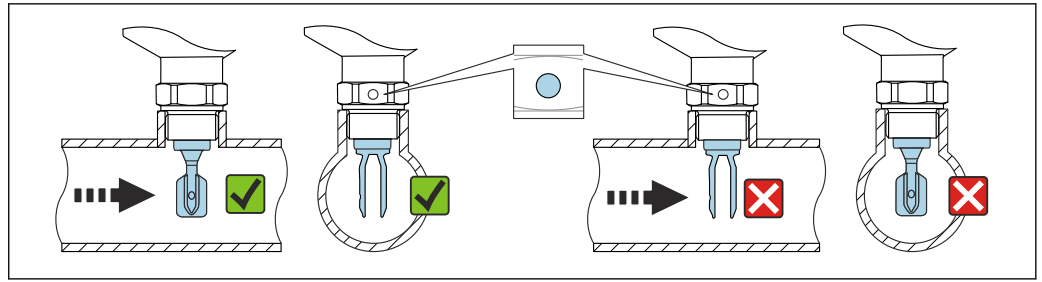


A0039125

11 Markings to align the tuning fork

Installing in pipes

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

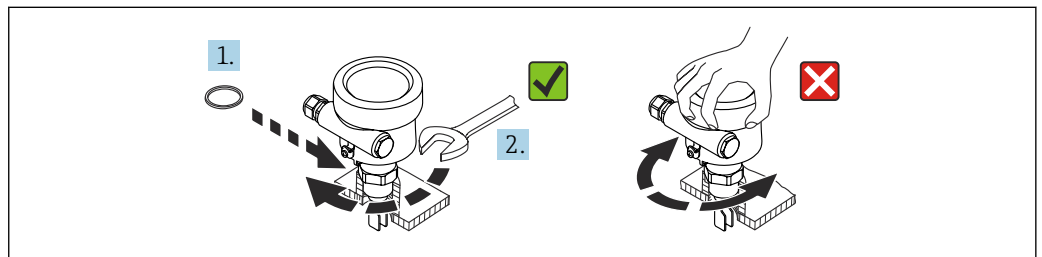


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12 Installation in pipes (take fork position and marking into consideration)

Screwing in the device

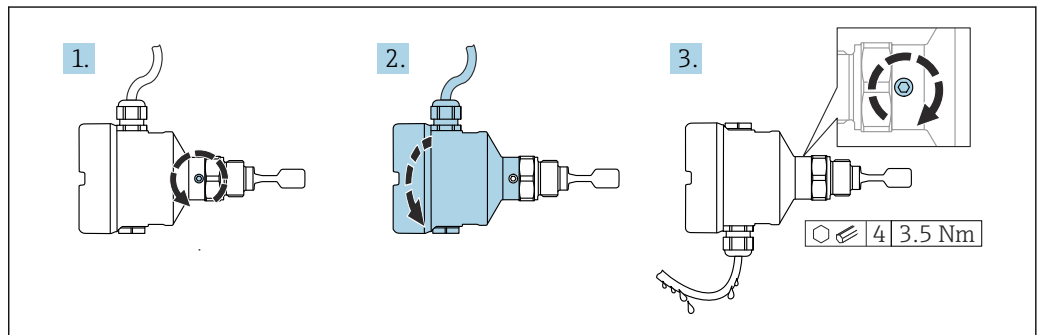
- Turn by the hex bolt only, 15 to 30 Nm (11 to 22 lbf ft)
- Do not turn at the housing!



A0034852

13 Screwing in the device

Aligning the cable entry




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14 Housing with external locking screw and drip loop

i 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.

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

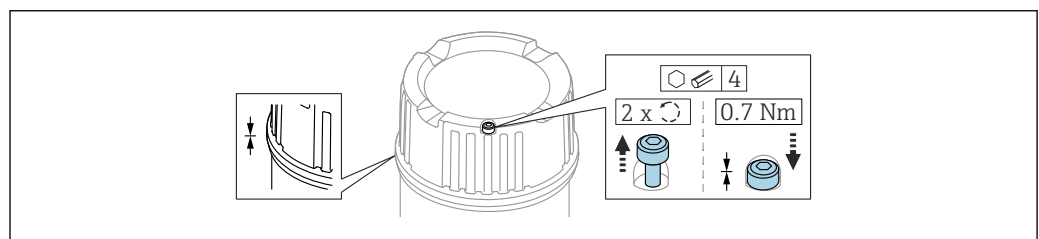
6.2.1 Cover with securing screw

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.

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

A0039520

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 $\geq 35 \text{ V}_{\text{DC}}$ or $\geq 16 \text{ V}_{\text{ACeff}}$.

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.



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

6.3 Connecting the device



Housing thread

The thread of the electronics and connection compartment is coated with lubricant varnish.



Avoid additional lubrication.

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

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

Residual voltage when switched through: typically 12 V



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

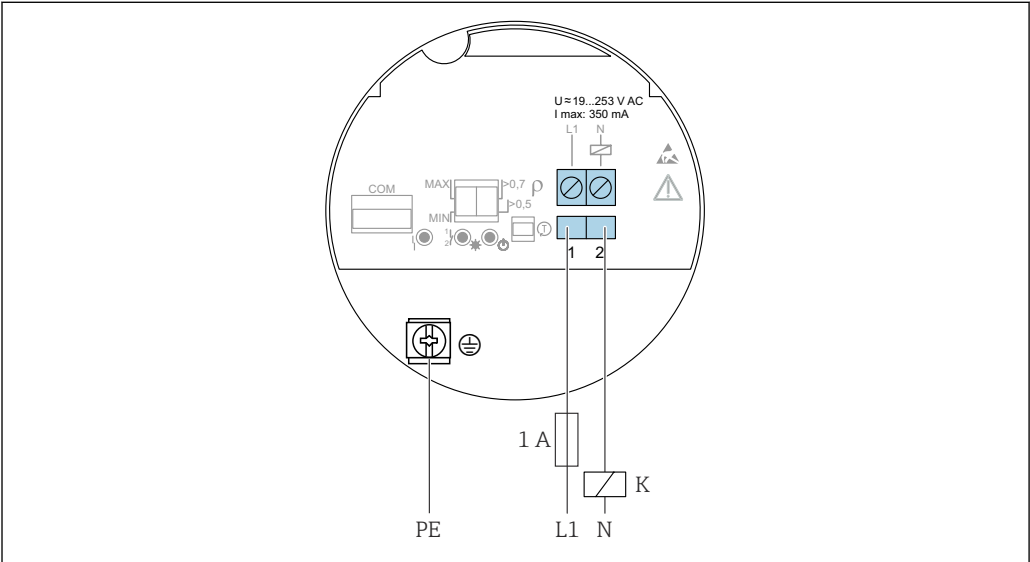
Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category II

Terminal assignment

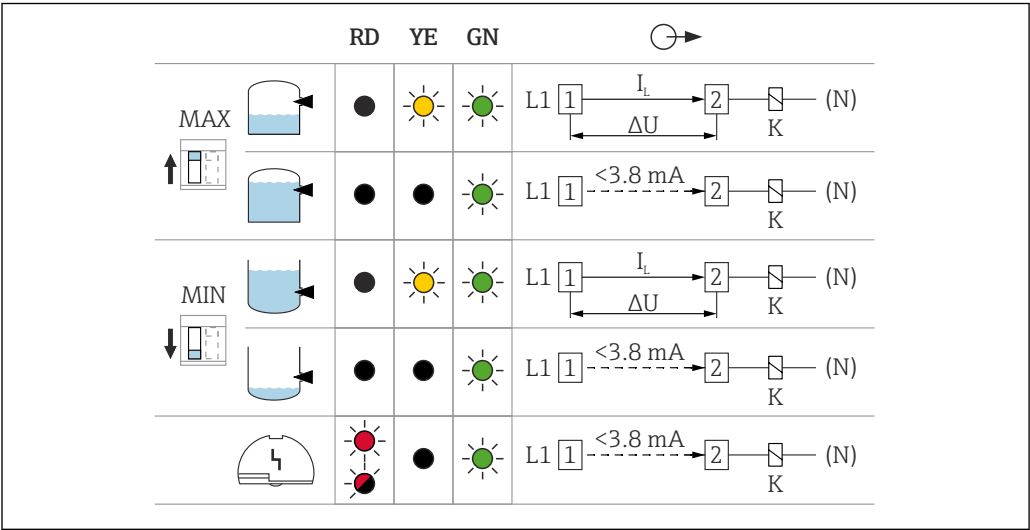
Always connect an external load. The electronic insert has integrated short-circuit protection.



16 2-wire AC, electronic insert FEL61

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Behavior of switch output and signaling



17 Behavior of switch output and signaling, electronic insert FEL61

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MAXDIP switch for setting MAX safety mode

MIN DIP switch for setting MIN safety mode

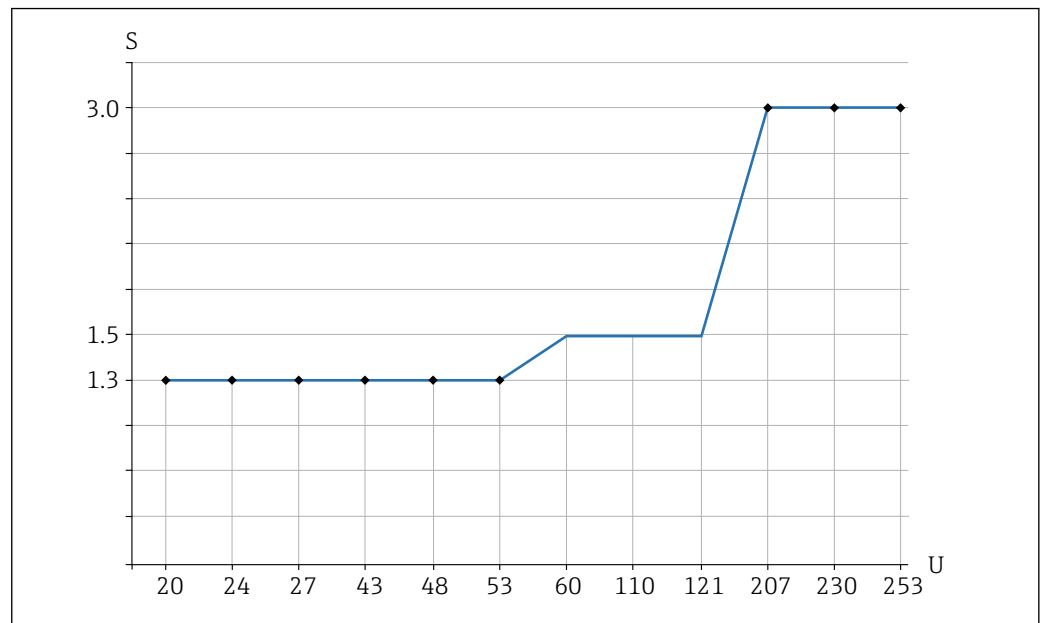
RD LED red for warning or alarm

YE LED yellow, switch status

GN LED green, operational status, device on

I_L Load current switched through

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.

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



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

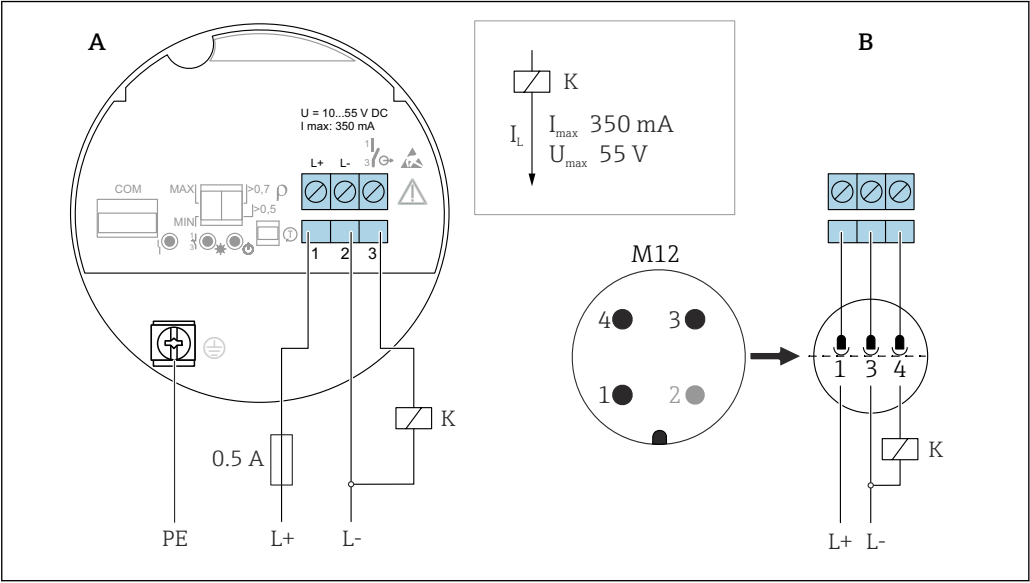
Terminals

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

Overvoltage protection

Overvoltage category II

Terminal assignment

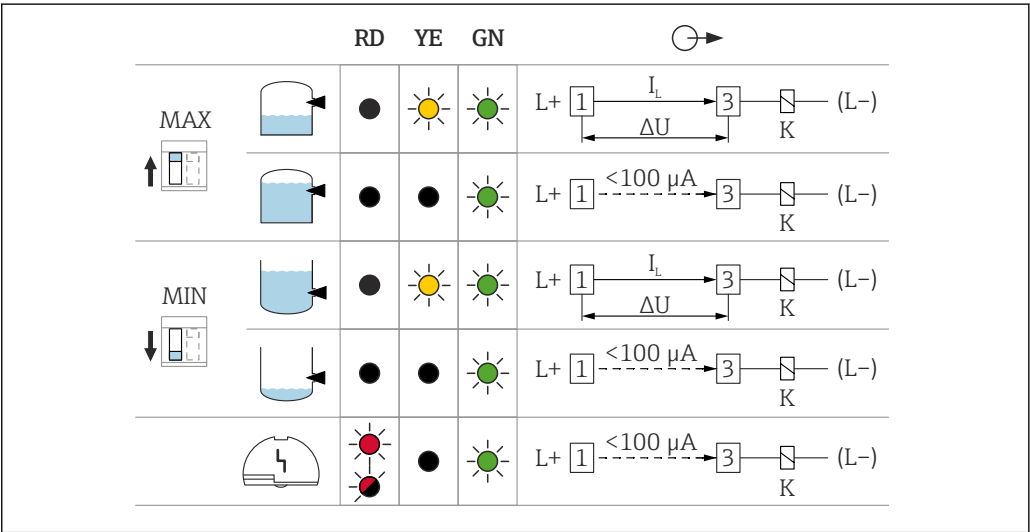


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19 3-wire DC-PNP, electronic insert FEL62

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

Behavior of switch output and signaling



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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)

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

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

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

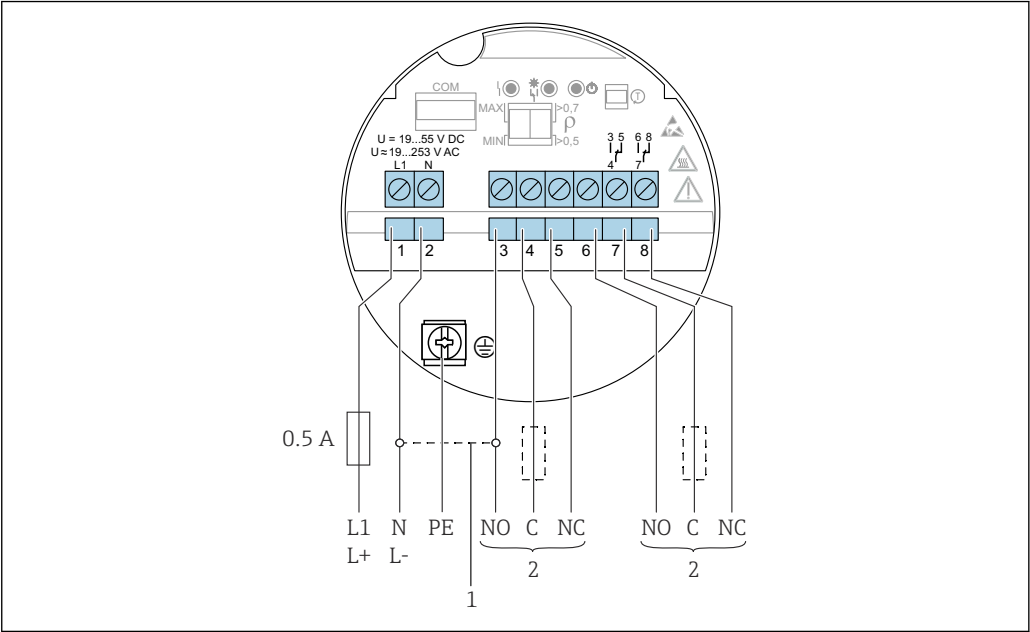
Terminals

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

Overvoltage protection

Overvoltage category II

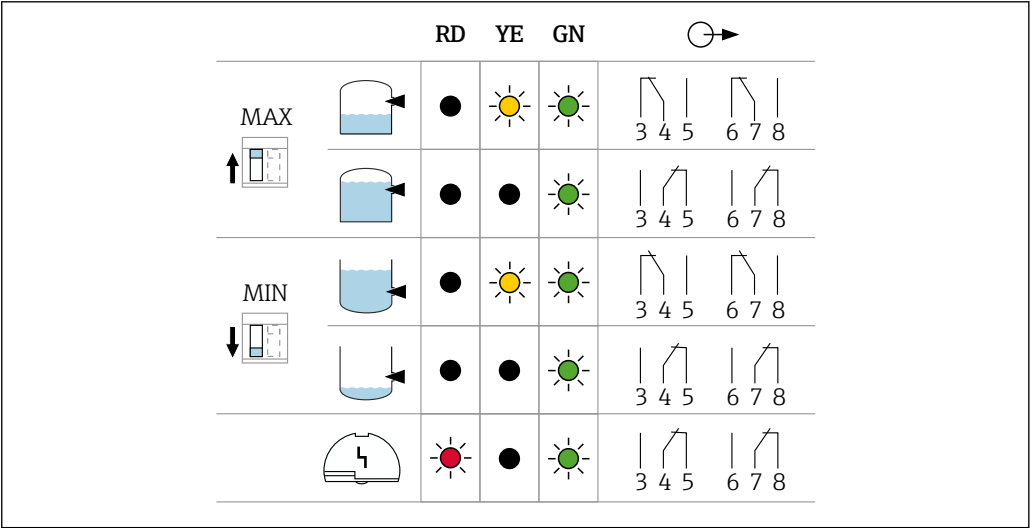
Terminal assignment



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



22 Behavior of switch output and signaling, electronic insert FEL64


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

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

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

 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 changeover contacts (DPDT)

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

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

Preferably use electronic insert FEL62 DC PNP for 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

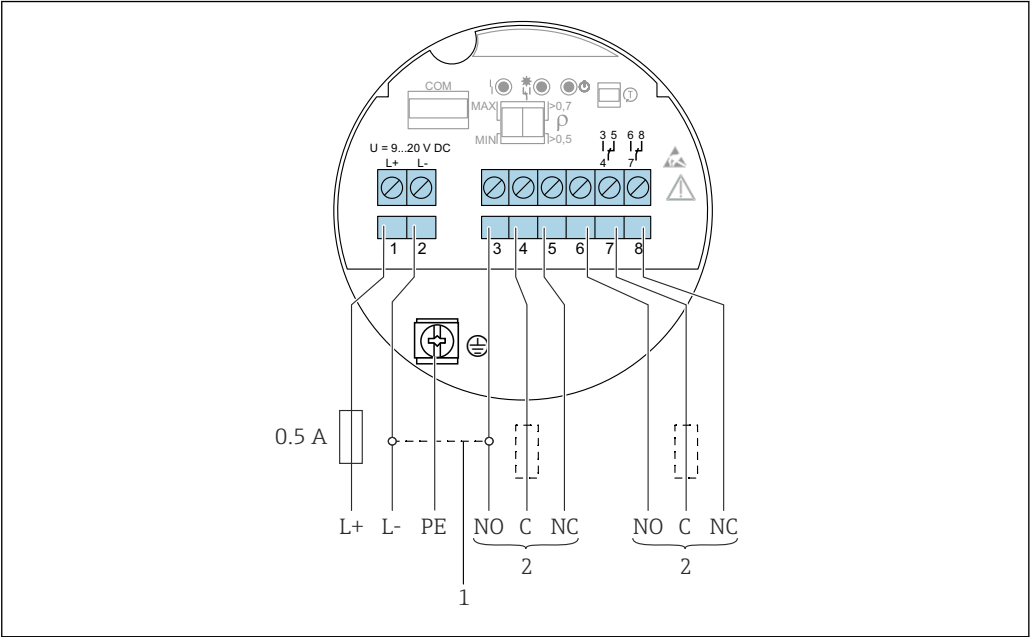
Terminals

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

Overvoltage protection

Overvoltage category II

Terminal assignment



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

		RD	YE	GN	
MAX					
MIN					

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

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

6.3.5 PFM output (electronic insert FEL67)

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

Supply voltage

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

Reverse polarity protection



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

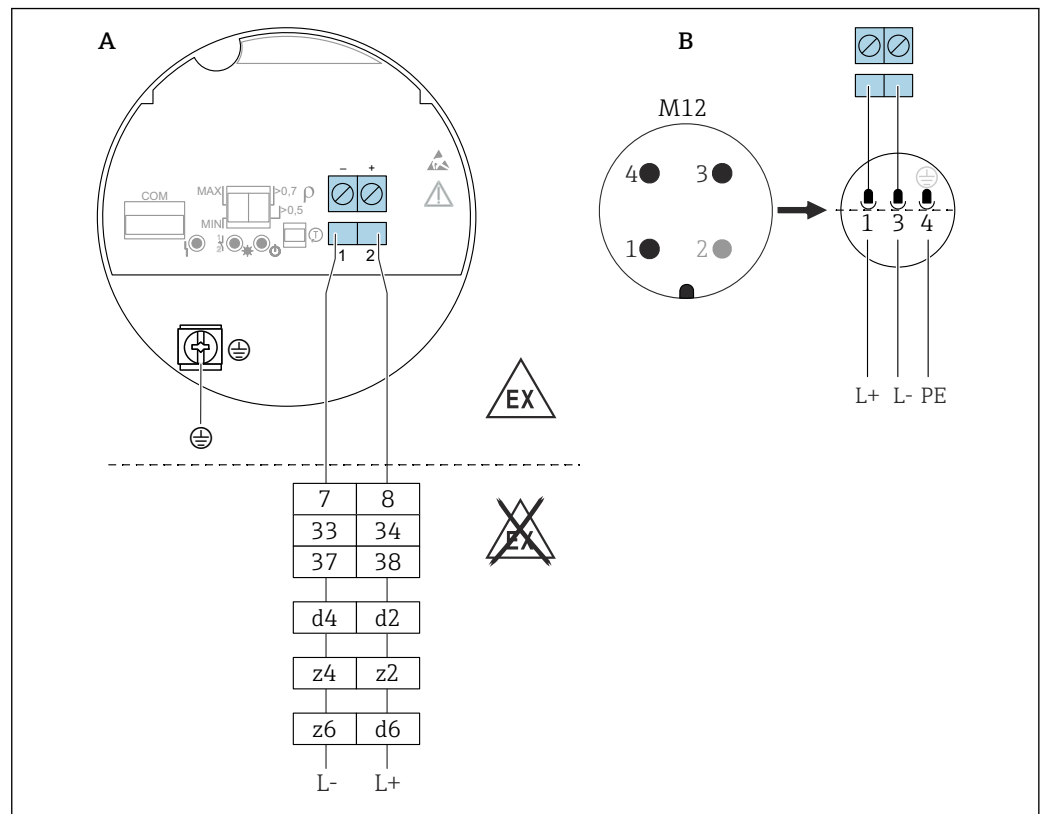
Terminals

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

Overvoltage protection

Overvoltage category II

Terminal assignment



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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

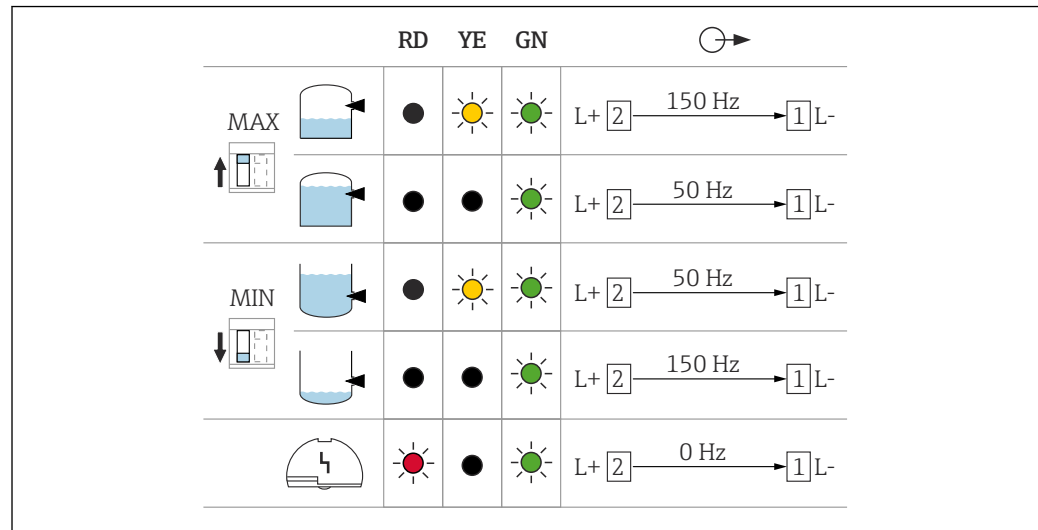
d4/ d2: Nivotester FTL375P input 1

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

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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

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

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

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

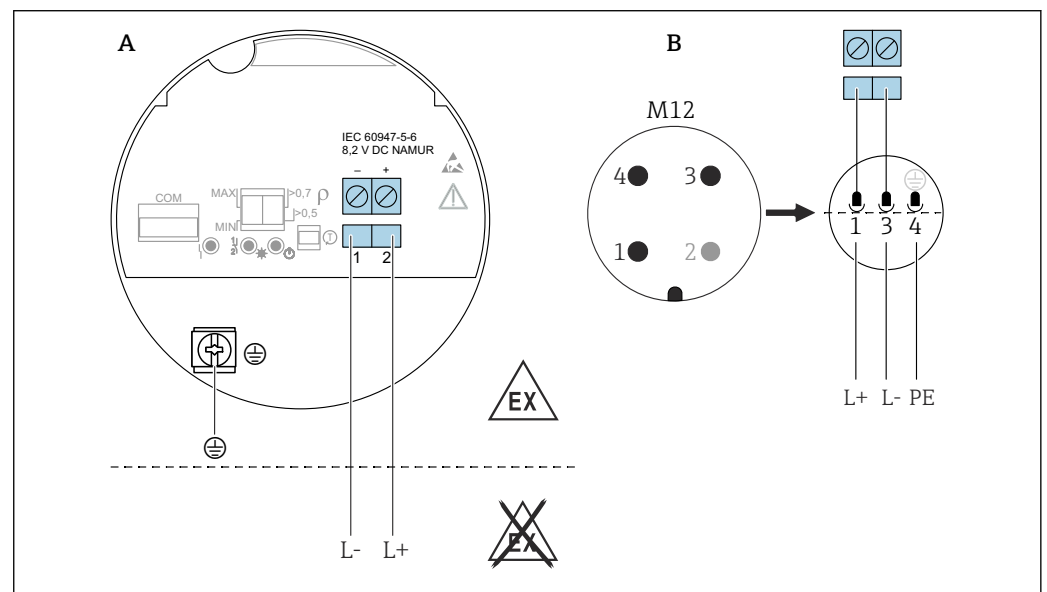
Terminals

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

Overvoltage protection

Overvoltage category II

Terminal assignment



27 2-wire NAMUR ≥ 2.2 mA / ≤ 1.0 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	
					$L+ \begin{matrix} \boxed{2} \end{matrix} \xrightarrow{2.2 \dots 3.8 \text{ mA}} \begin{matrix} \boxed{1} \end{matrix} L-$
					$L+ \begin{matrix} \boxed{2} \end{matrix} \xrightarrow{0.4 \dots 1.0 \text{ mA}} \begin{matrix} \boxed{1} \end{matrix} L-$
					$L+ \begin{matrix} \boxed{2} \end{matrix} \xrightarrow{2.2 \dots 3.8 \text{ mA}} \begin{matrix} \boxed{1} \end{matrix} L-$
					$L+ \begin{matrix} \boxed{2} \end{matrix} \xrightarrow{0.4 \dots 1.0 \text{ mA}} \begin{matrix} \boxed{1} \end{matrix} L-$
					$L+ \begin{matrix} \boxed{2} \end{matrix} \xrightarrow{< 1.0 \text{ mA}} \begin{matrix} \boxed{1} \end{matrix} L-$

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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

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

Power consumption

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

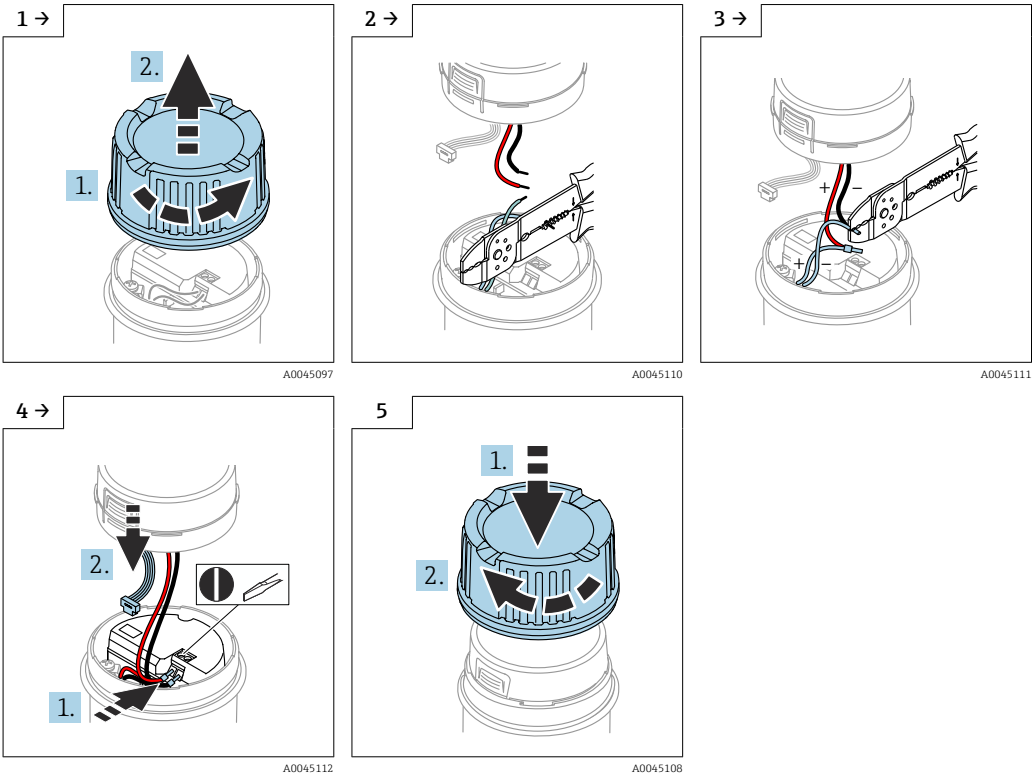
Current consumption

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

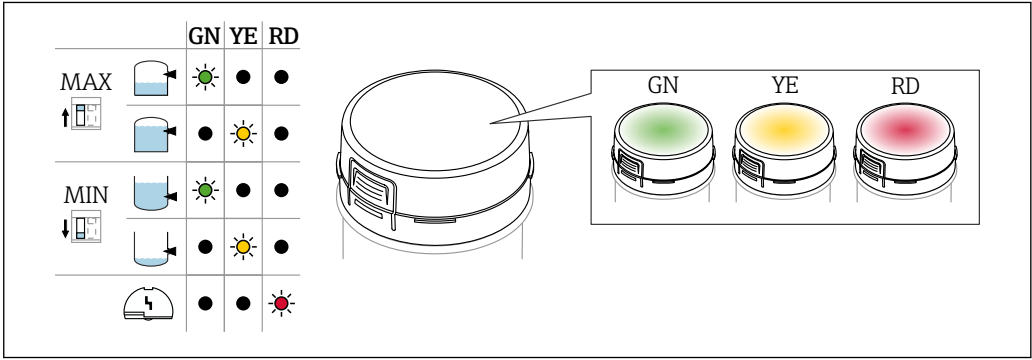
Connecting the LED module

- 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



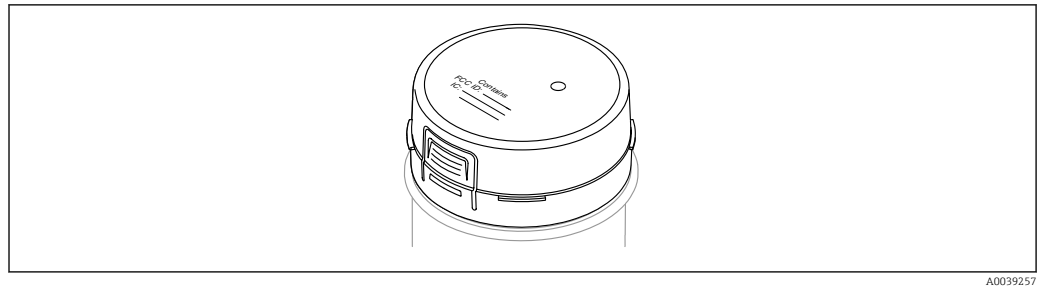
Operational status signaling



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)



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 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

Use of a special battery in conjunction with electronic insert FEL68 (2-wire NAMUR):

- For energy reasons, the Bluetooth module VU121 requires a special battery when operated with the electronic insert FEL68 (2-wire NAMUR)
- Service life: 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
The battery service life is calculated based on the scenario that the sensor is connected and powered.

Additional information

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

Replacement batteries can be purchased from a specialist retailer.

Only the following types of AA 3.6 V lithium batteries made by the manufacturers listed below are suitable as replacement batteries:

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


Isolation lug in battery compartment

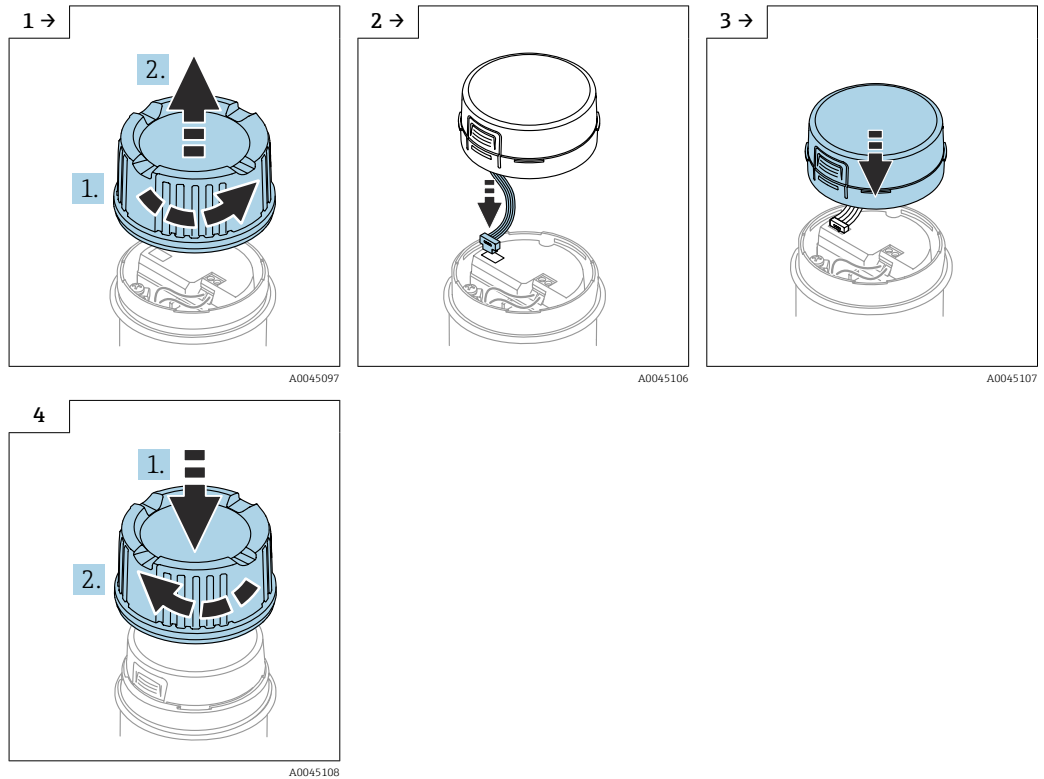
NOTICE

The removal of the isolation lug in the battery compartment of the Bluetooth module results in early discharging of the battery irrespective of whether the sensor is powered or not.

- When the sensors are in storage, the isolation lug must remain in the battery compartment of the Bluetooth module.

Connecting the Bluetooth module

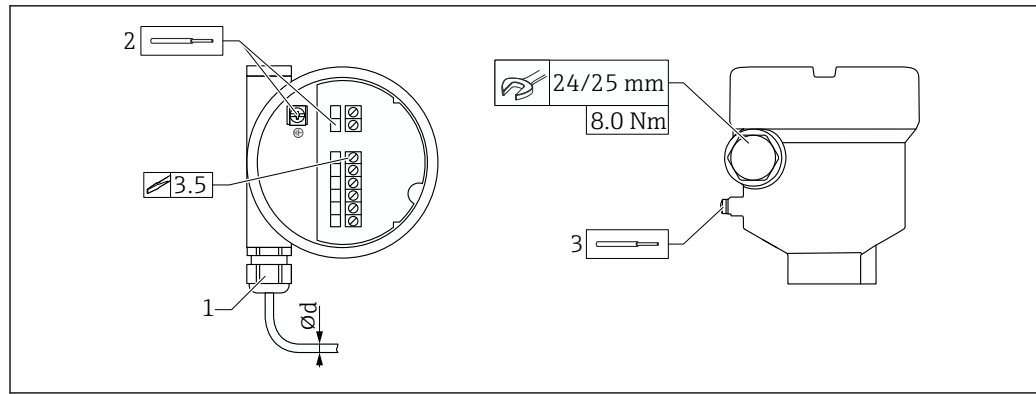
- i** In the case of devices for use in the hazardous area with a certain type of protection, the cover is sealed by a securing screw.
-  For more details, see the "Cover with securing screw" section.



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 mm² (AWG14), ground terminal on inside in housing + terminals on the electronics
 - 3 Conductor cross-section maximum 4.0 mm² (AWG12), ground terminal on outside of the housing (example: plastic housing with outer protective ground connection (PE))
- Ød Nickel-plated brass 7 to 10.5 mm (0.28 to 0.41 in)
 Ød Plastic 5 to 10 mm (0.2 to 0.38 in)
 Ød 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

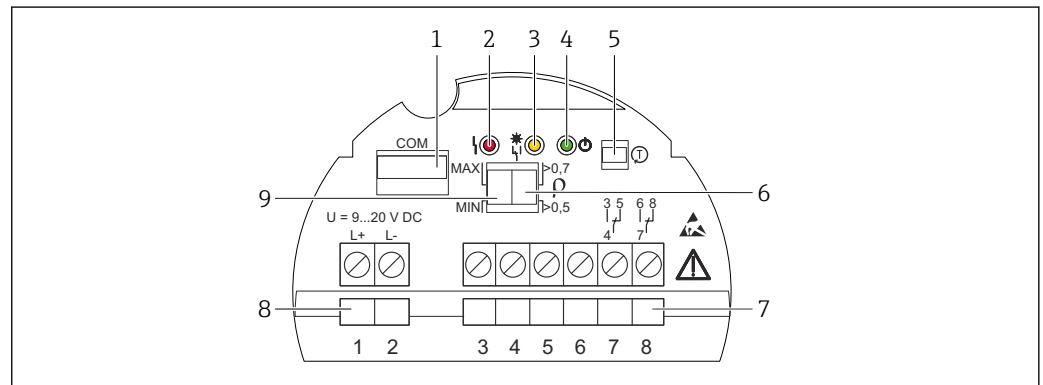
7.1 Overview of operation options

7.1.1 Operating concept

- Operation with button and DIP switches on the electronic insert
- Display with optional Bluetooth module and SmartBlue app via Bluetooth® wireless technology
- Indication of operational status (switch status or alarm status) with optional LED module (signal lights visible from the outside)

For plastic housing and aluminum housing (standard and Ex d) in conjunction with DC-PNP (electronic insert FEL62) and relay electronics (electronic inserts FEL64, FEL64DC)

7.1.2 Elements on the electronic insert

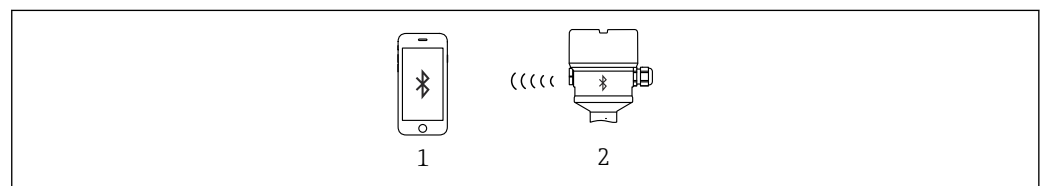


32 Example of electronic insert FEL64DC

- 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)
- User guidance (wizard) for SIL/WHG proof testing
- 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 vibration frequency and the switching state of the device

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

Heartbeat Technology*Heartbeat Technology module***Heartbeat Diagnostics**

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

Heartbeat Verification

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


Heartbeat Monitoring

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

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

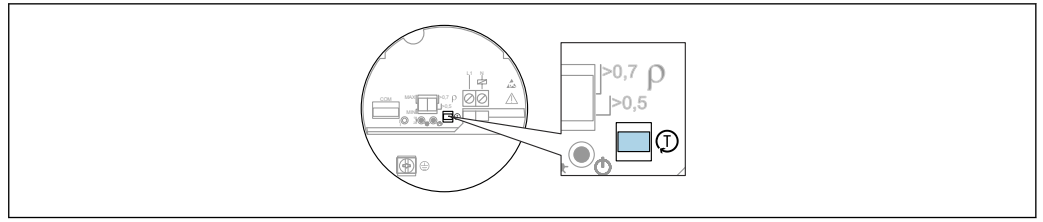
8.1 Function check

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

-  Checklist in "Post-mounting check" section
-  Checklist in "Post-connection check" section

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.



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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.

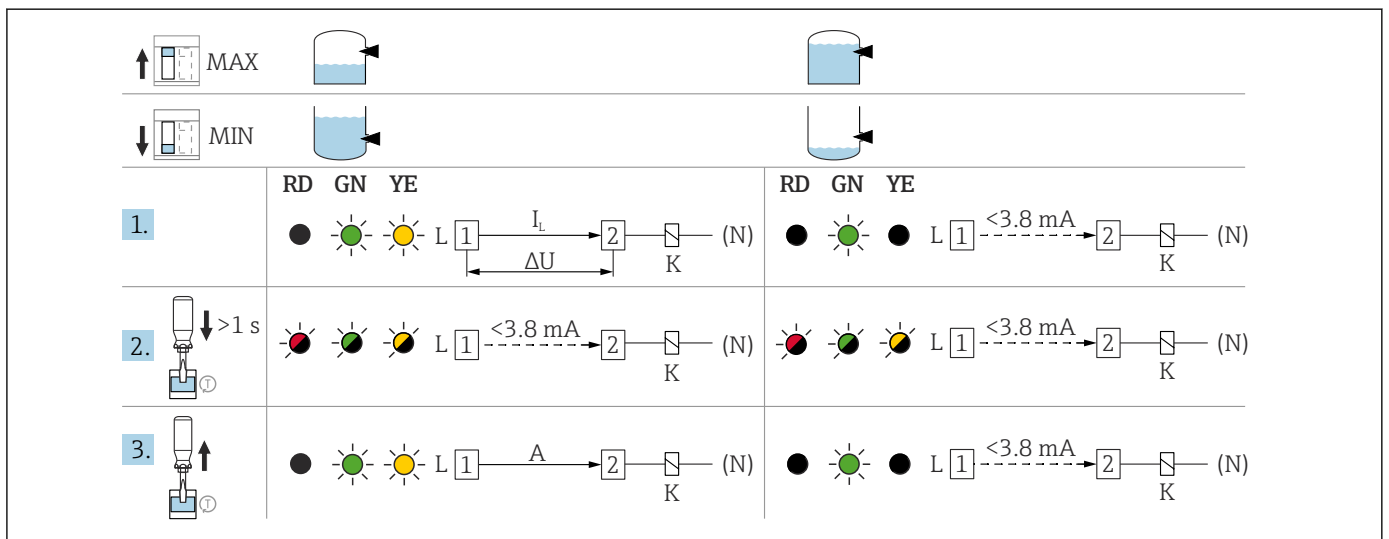
The device returns to normal operation if the internal test is successful.

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.

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

8.2.1 FEL61 switching behavior and signaling

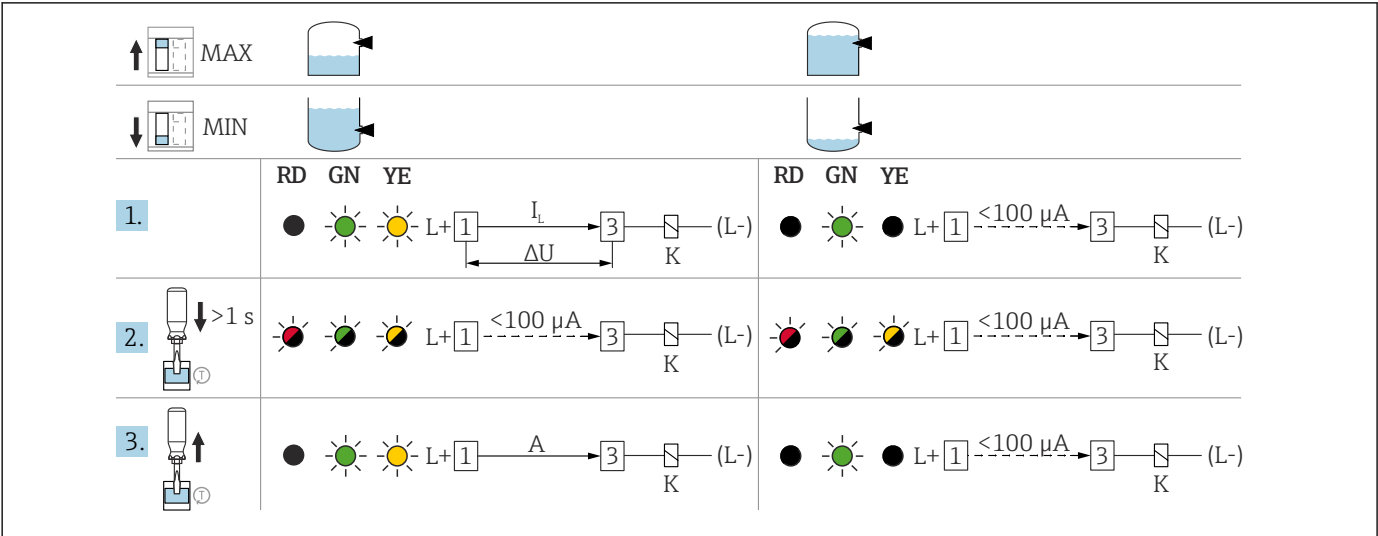


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35 FEL61 switching behavior and signaling

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.

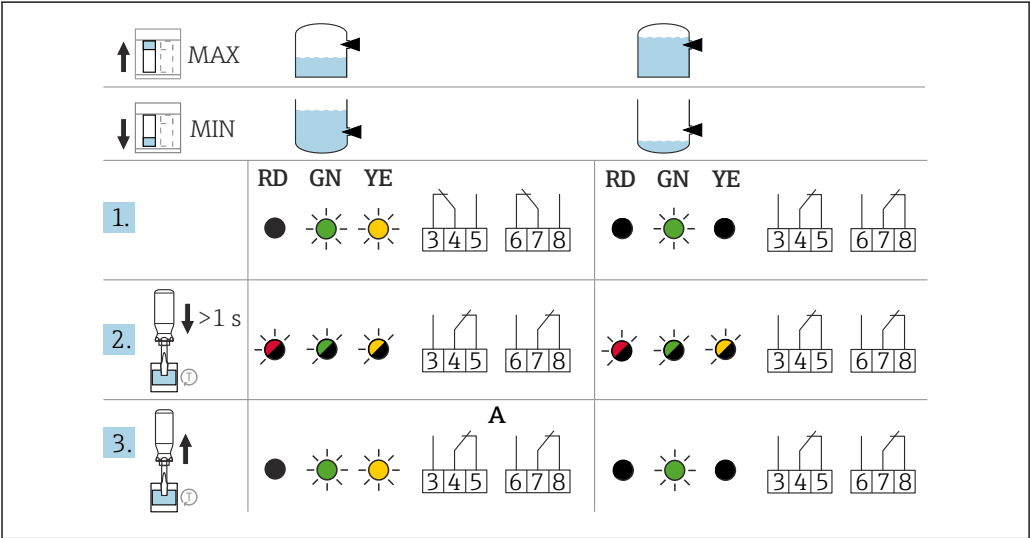
8.2.2 FEL62 switching behavior and signaling



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

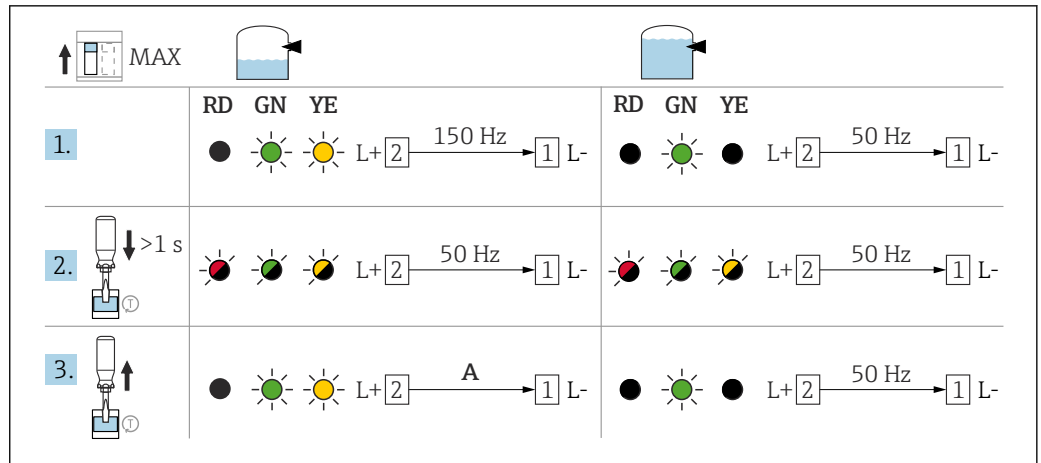


37 FEL64, FEL64DC switching behavior and signaling

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

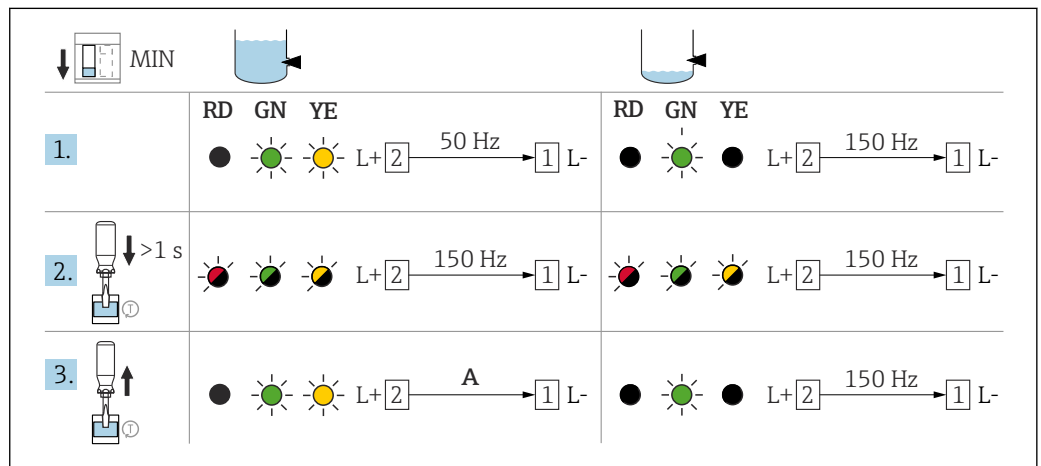
i A distinction must be made between MAX and MIN operating modes in the case of the FEL67 electronic insert!



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.



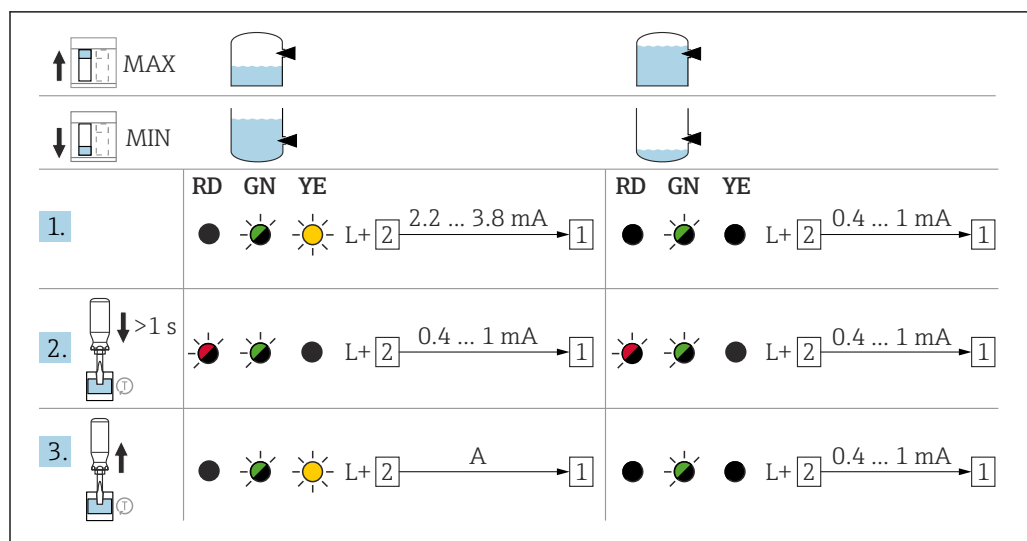
A0039214

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



A0033543

40 NAMUR electronics switching behavior and signaling

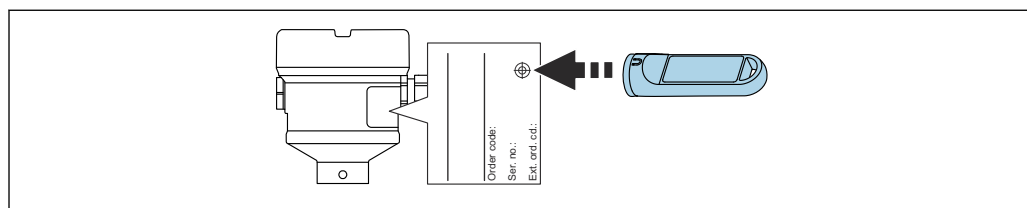
A After the test button is pressed, the current is 0.4 to 1 mA for at least 10 s even if the button is pressed for < 10 s. If the test button is pressed for > 10 s, the current remains at 0.4 to 1 mA until the test button is released. The current is then 2.2 to 3.8 mA again afterwards.

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.



A0033419

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 Prerequisites

Device requirements

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

System requirements

The SmartBlue app is available for download for mobile smartphone or tablet devices in the Google Play Store for Android, and in the App Store for iOS.

- Devices with iOS: iPhone 5S or higher as of iOS11; iPad 5th generation or higher as of iOS11; iPod Touch 6th generation or higher as of iOS11
- Devices with Android: from Android 6.0 and *Bluetooth*® 4.0

Initial password

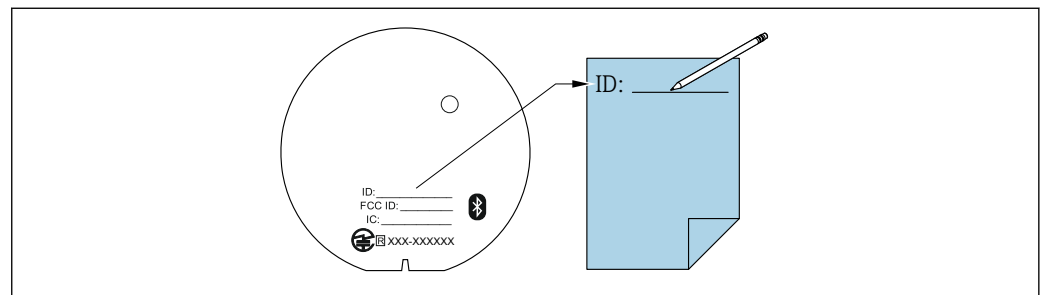
The ID number on the nameplate of the Bluetooth module is used as the initial password when establishing the connection for the first time.

i 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.

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.

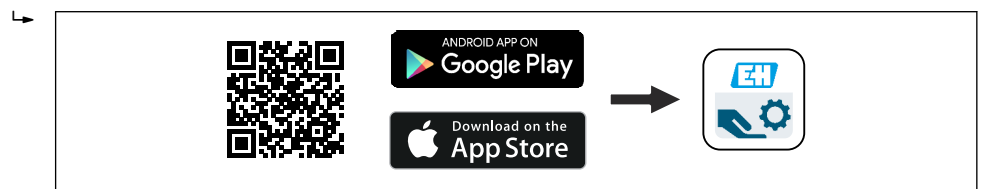
The high cover with the window must be used for devices that are operated with the Bluetooth module.



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!

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

Diagnostics

▶ Active diagnostics

Actual diagnostics

Timestamp

▶ Diagnostic list

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

Application

► 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 includes the Heartbeat Verification wizard, which performs a verification of the current device condition and generates the Heartbeat Technology verification report:

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

9.3 Proof testing for SIL/WHG devices ¹⁾

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

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

¹⁾ Available only for devices with SIL or WHG approval

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: BA01894F/00/EN/01.19
- 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 Repair of Ex-certified devices

WARNING


Incorrect repair can affect electrical safety!

Explosion Hazard!

- ▶ Only specialist personnel or the Endress+Hauser service team may carry out repairs on Ex-certified devices.
- ▶ Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- ▶ Use only original Endress+Hauser spare parts.
- ▶ 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 Endress+Hauser service team is permitted to modify a certified device and convert it to another certified version.
- ▶ All repairs and modifications must be documented.

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.

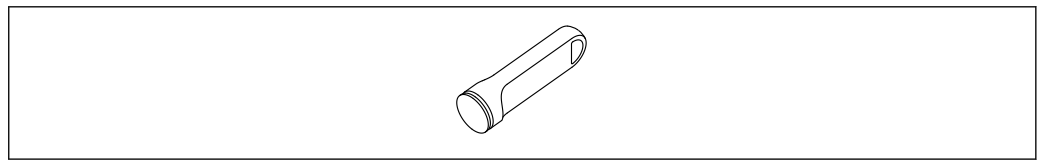
13 Accessories

13.1 Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer).

13.2 Test magnet

Order number: 71437508

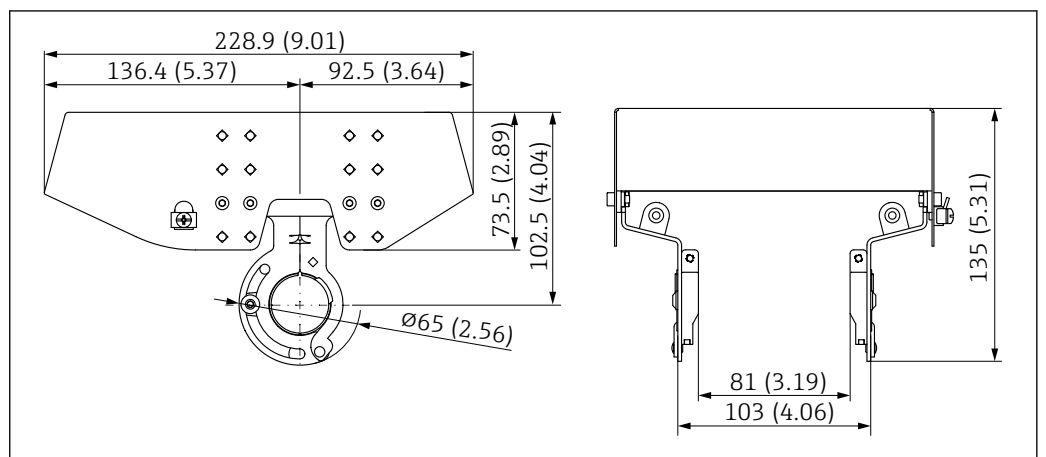


A0039209

43 Test magnet

13.3 Weather protection cover for dual compartment housing, aluminum

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

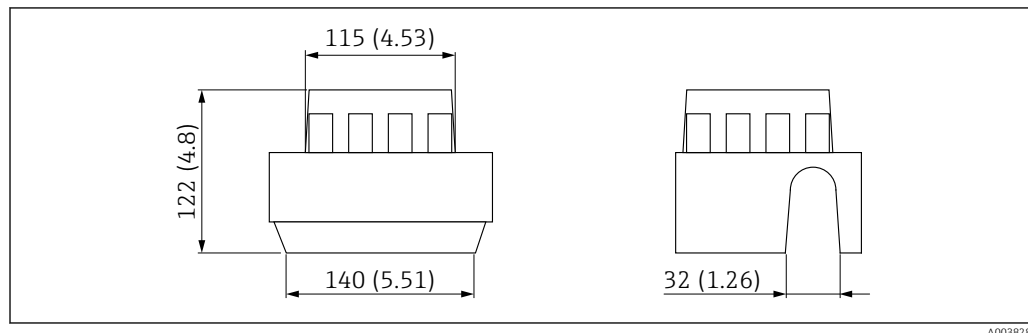


A0039231

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

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

- Material: plastic
- Order number: 71438291



A0038280

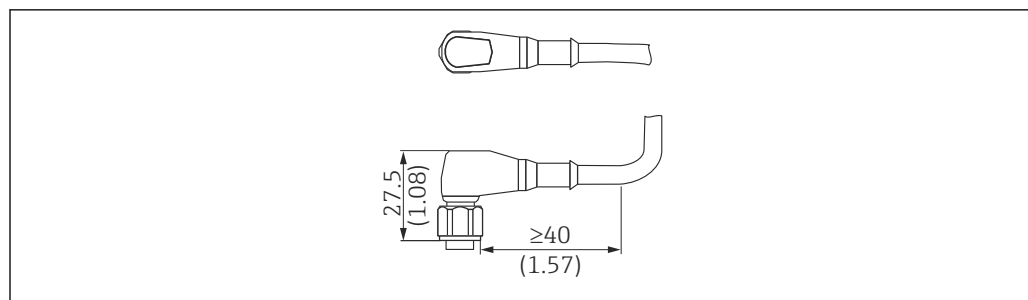
45 Protective cover for single compartment housing, aluminum or 316L. Unit of measurement mm (in)

13.5 Plug-in jack

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

Plug-in jack M12 IP69

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

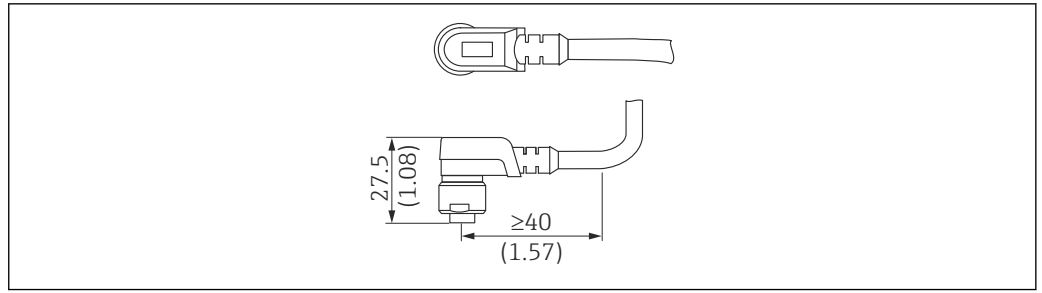


A0023713

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

Plug-in jack M12 IP67

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



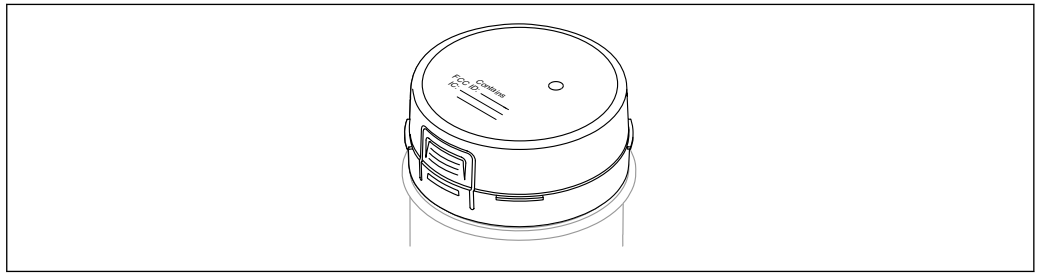
A0022292

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

13.6 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

48 Bluetooth module VU121

More detailed information and documentation are available:

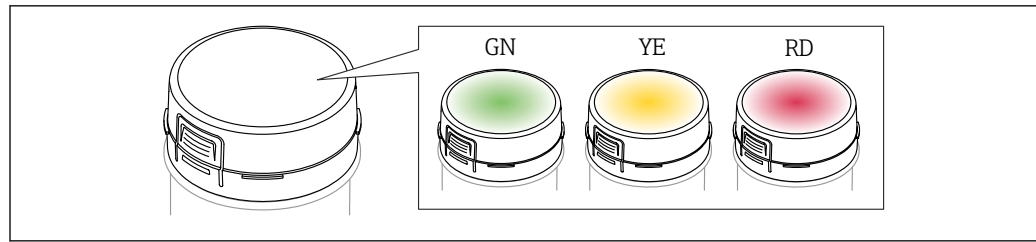
- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

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

13.7 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

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

More detailed information and documentation are available:

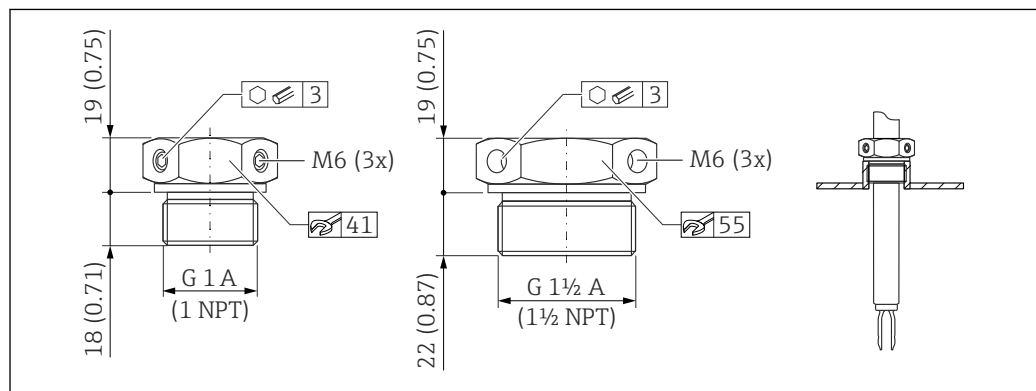
- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

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

13.8 Sliding sleeves for unpressurized operation

i Not suitable for use in explosive atmospheres.

Switch point, infinitely adjustable.



A0037666

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

G 1, DIN ISO 228/1

- 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 228/1

- 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

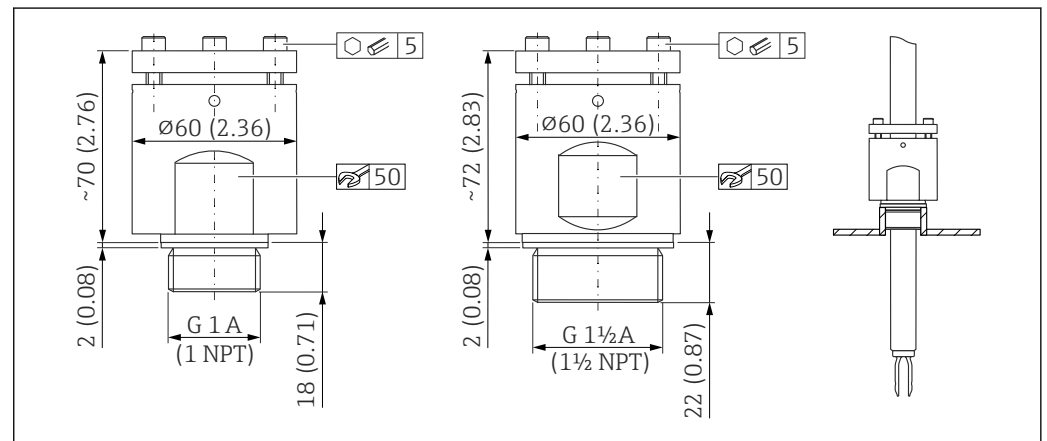


More detailed information and documentation are available:

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

13.9 High pressure sliding sleeves

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



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

G 1, DIN ISO 228/I

- 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/I

- Material: AlloyC22
- 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: AlloyC22
- 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: AlloyC22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118693

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: AlloyC22
- 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
Maximum sensor length 6 m (20 ft)

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

Universal current connection, relay output (FEL64)

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

Direct current connection, relay output (FEL64DC)

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

PFM output (FEL67)

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

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

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

2-wire density (FEL60D) for density measurement

Connection to Density Computer FML621



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

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 (fastest configuration)
- 1.5 s when the tuning fork is covered and 1.5 s when it is uncovered
- 5.0 s when the tuning fork is covered and 5.0 s when it is uncovered

COM interface

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

Bluetooth® wireless technology (optional)

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

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 Ex devices.

14.3 Environment

14.3.1 Ambient temperature range

WARNING

Permitted connection voltage exceeded!

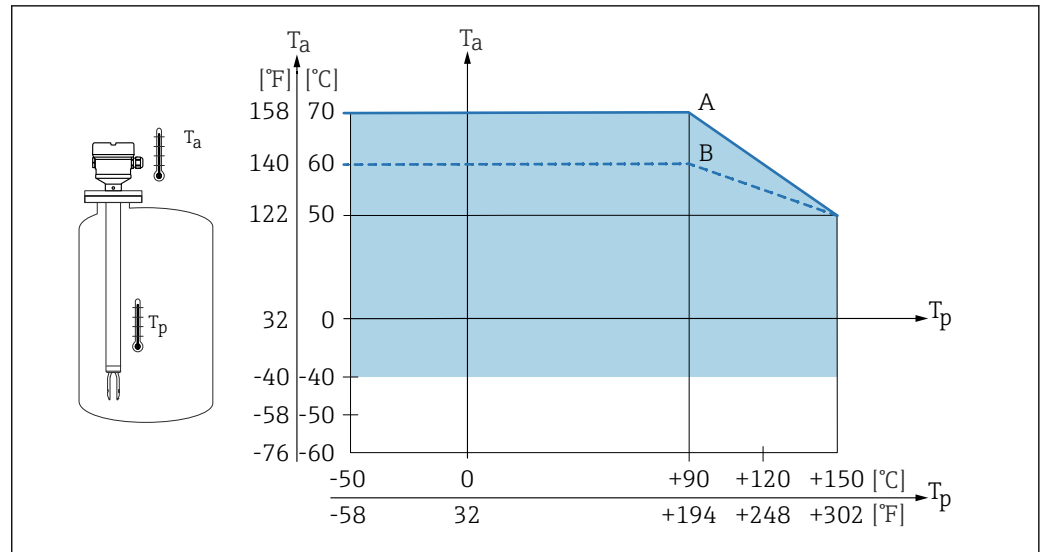
- For electrical safety reasons, the maximum connection voltage for all electronic inserts at ambient temperatures below -40 °C (-40 °F) is limited to a maximum of 35 V DC.

-40 to +70 °C (-40 to +158 °F)

Optionally available:

- -50 °C (-58 °F)
- -60 °C (-76 °F)

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



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

- A Device without LED module; at process temperature and FEL64 $T_p > 90$ °C max. load current 4 A
 B Device with LED module; at process temperature and FEL64 $T_p > 90$ °C max. load current 2 A

For devices with a temperature spacer, the following ambient temperatures apply across the entire process temperature range:

A: 70 °C (158 °F)

B: 60 °C (140 °F)

Outdoor operation in strong sunlight:

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

- i** ■ 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

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


In accordance with DIN EN 60529, NEMA 250

IP66/IP68 NEMA 4X/6P

Types of housing:

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

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

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

14.3.7 Vibration resistance

As per IEC60068-2-64-2008

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

For increased oscillations or vibrations, the additional option of the order code for "Application" option "B" 100 bar (1 450 psi) pressure is recommended.


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


- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- The requirements of EN 61326-3-1 for the safety function (SIL) are fulfilled

 For more details, see the Functional Safety Manual.

14.4 Process

14.4.1 Process temperature range

$-50 \text{ to } +150 \text{ }^\circ\text{C}$ ($-58 \text{ to } +302 \text{ }^\circ\text{F}$)

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

14.4.2 Thermal shock

≤ 120 K/s

14.4.3 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.

- ▶ For pressure specifications, see the "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.

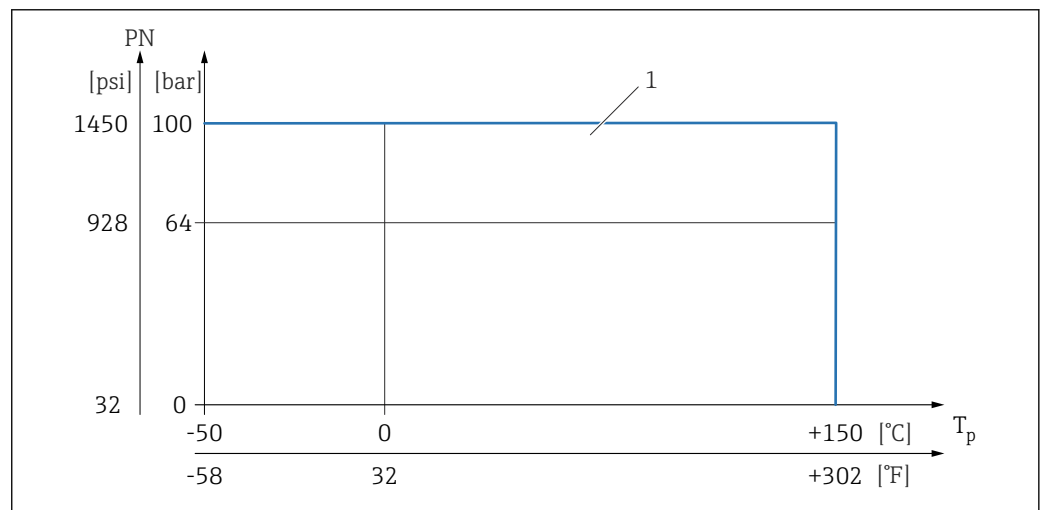
Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:

- 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



- 1 Permitted pressure rating when the "100 bar (1 450 psi)" option is selected. For exceptions, see the "Process connections" section. Canadian CRN approval: The maximum permitted process pressure is limited to 90 bar (1 305 psi) only in combination with the CRN approval. More details on the maximum pressure values are available in the download area of the product page under "www.endress.com".

Optionally available:

- PN: 64 bar (928 psi) at max. 150 °C (302 °F)
- PN: 100 bar (1 450 psi) at max. 150 °C (302 °F)

14.4.4 Overpressure limit

- PN = 64 bar (928 psi): overpressure limit = 1.5·PN maximum 100 bar (1 450 psi) depending on process connection selected
- Membrane burst pressure at 200 bar (2 900 psi)
- PN = 100 bar (1 450 psi): overpressure limit = 1.5·PN maximum 150 bar (2 175 psi) depending on process connection selected
- Membrane burst pressure at 400 bar (5 800 psi)

The device function is limited during the pressure test.

The mechanical integrity is guaranteed at pressures up to 1.5 times the process nominal pressure (PN).

14.4.5 Density

Liquids with density > 0.7 g/cm³

Switch position > 0.7 g/cm³ (as-delivered state)


Liquids with density 0.5 g/cm³

Switch position > 0.5 g/cm³ (can be set via DIP switch)

Liquids with density > 0.4 g/cm³

- Optionally available, not suitable for SIL applications
- Fixed value that cannot be edited

The function of the DIP switch is interrupted


 For distinguishing between media/density detection, use the Liquiphant Density (FEL60D) with a density computer.

14.4.6 Viscosity

≤ 10 000 mPa·s

14.4.7 Pressure tightness


Up to vacuum

 In vacuum evaporation plants, select the 0.4 g/cm³ density setting.

14.4.8 Solids contents

Ø ≤ 5 mm (0.2 in)

14.5 Additional technical data

 Technical Information TI01403F.
Current Technical Information: Endress+Hauser website: www.endress.com → Downloads.

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