

Technical Information

Liquicap M FTI51, FTI52

Capacitance

Point level switch for liquids



Application

The Liquicap M FTI5x is used for point level detection. It is preferably used for the following measuring tasks:

- Detection of liquids and pastes that are highly viscous and tend to form buildup
- Interface detection of different liquids (e.g. oil on water)
- Two-point control (e.g. pump control) with just one process connection
- Foam detection of conductive liquids

Thanks to its robust and tried-and-tested construction, the probe can be used both in vacuums and in overpressure up to 100 bar. The materials used allow operating temperatures from -80 °C to +200 °C.

Your benefits

- Active buildup compensation for high-viscosity media
- Easy and fast commissioning at the press of a button
- Universal application thanks to wide range of certificates and approvals
- Corrosion-resistant, FDA-listed materials in contact with the process
- Two-stage overvoltage protection against discharge from the container
- Short reaction times
- No need for recalibration after replacing electronics
- Use in safety systems with specific requirements in terms of functional safety to SIL2/SIL3
- Automatic monitoring of electronics

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Function and system design

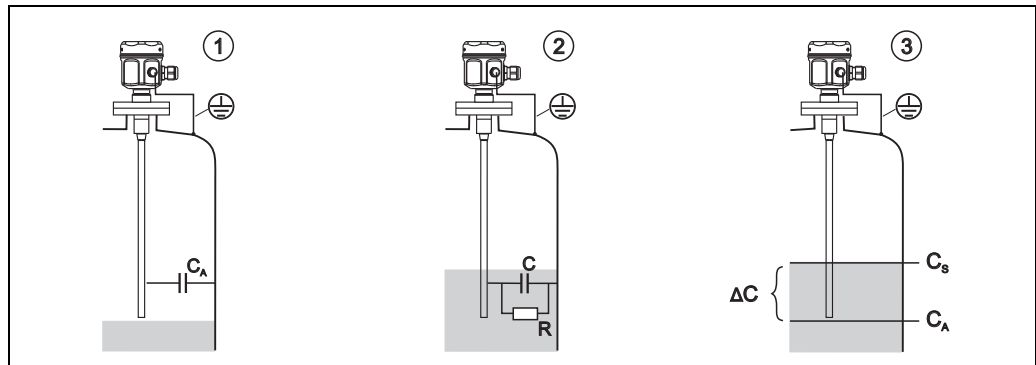
Measuring principle

The principle of capacitance point level detection is based on the change in capacitance of the capacitor due to the probe being covered by liquid. The probe and container wall (conductive material) form an electric capacitor. When the probe is in air (1), a certain low initial capacitance is measured. When the container is filled, the capacitance of the capacitor increases the more the probe is covered (2), (3). The point level switch switches when the capacitance C_S specified during calibration is reached. In addition, a probe with inactive length ensures that the effects of medium buildup or condensate near the process connection are avoided. Active buildup compensation compensates influences resulting from buildup on the probe.



Note!

A ground tube is used as a counterelectrode for containers made of nonconductive materials.



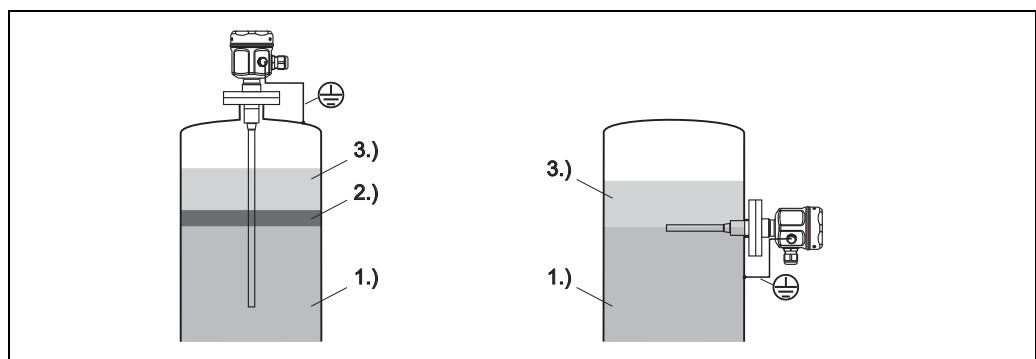
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R : Conductivity of the liquid
 C : Capacitance of the liquid
 C_A : Initial capacitance (probe not covered)
 C_S : Switching capacitance
 ΔC : Change in capacitance

Function

The selected electronic insert of the probe determines the change in capacitance of the liquid depending on how much the probe is covered and thereby allows precise switching at the point level calibrated for this.

Interface detection



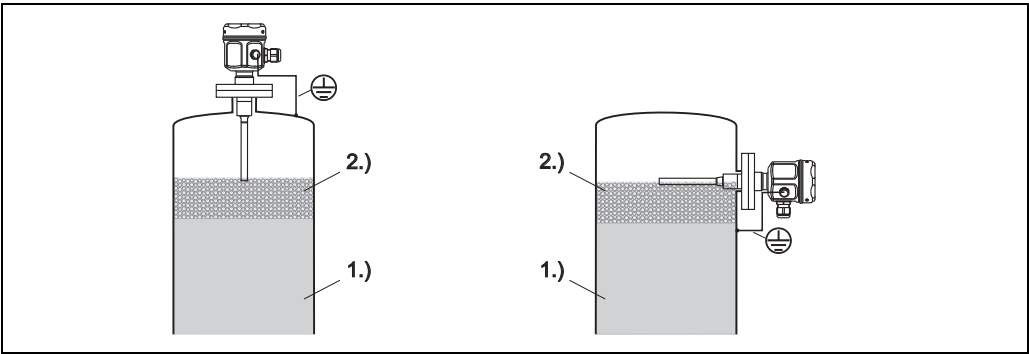
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1.) Water, for example (the medium must be conductive $\geq 100 \mu S/cm$)
 2.) Emulsion
 3.) Oil, for example (nonconductive medium $< 1 \mu S/cm$)

A prior adjustment also ensures a certain and definite switch point even if the emulsion layer is of varying thickness.

Foam detection

Foam detection for conductive liquids.



1.) Liquid
2.) Foam



Note!
Preferably use partially insulated probes.

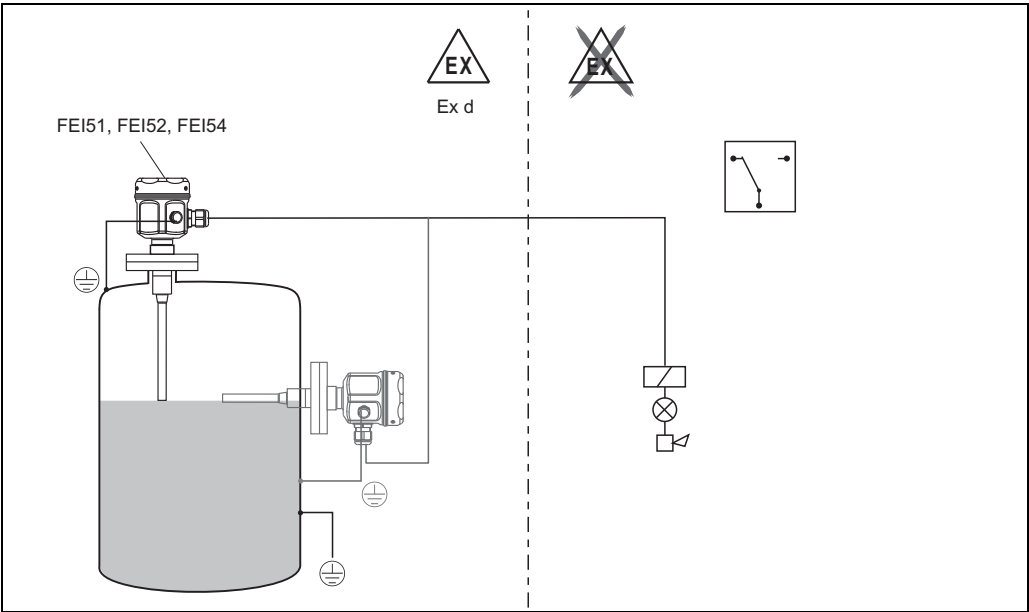
Measuring system

The make-up of the measuring system depends on the electronic insert selected.

Point level switch

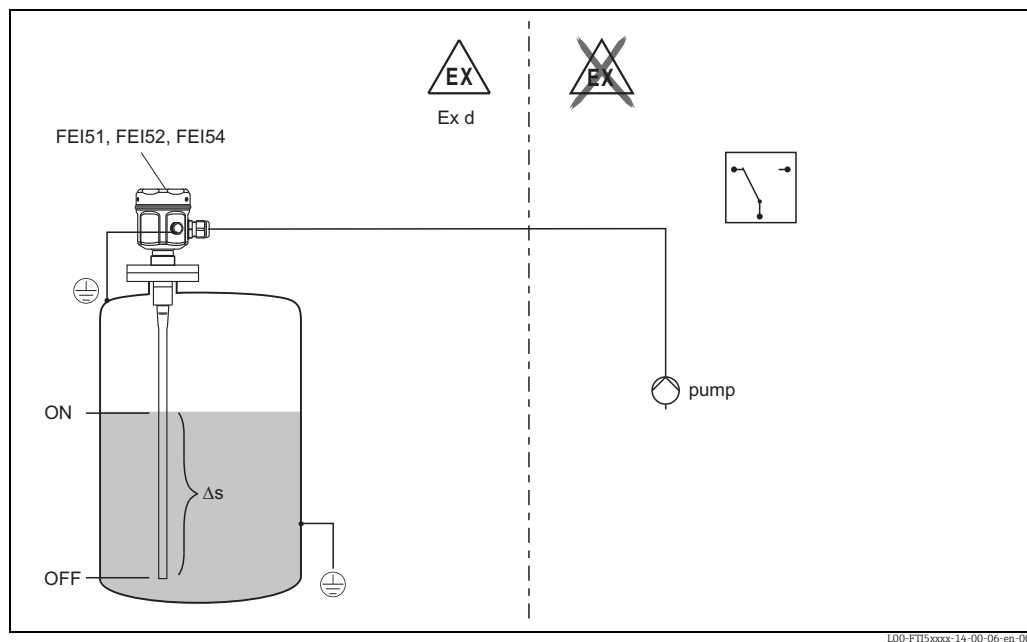
The compact measuring system consists of:

- The Liquicap M FTI51 or FTI52 point level switch
- An electronic insert FEI51, FEI52, FEI54



Pump control (Δs)

Note!
Only possible with a fully insulated probe.



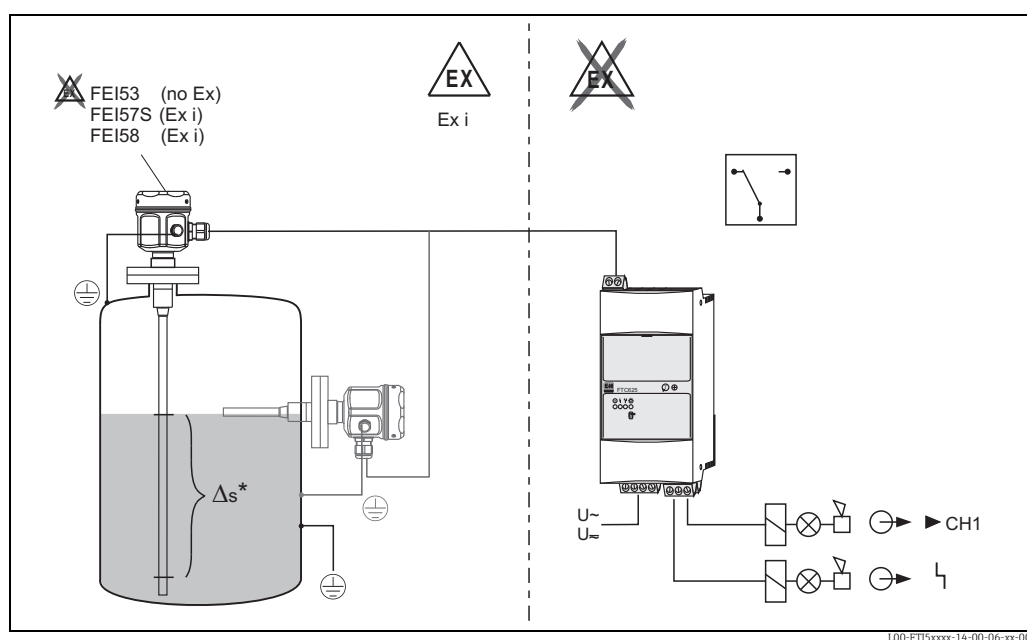
The point level switch can also be used to control a pump, for example, where the switch-on and switch-off point can be freely defined.

Point level switch

Liquicap M FTI5x with electronic versions FEI53, FEI57S and FEI58 for connecting to a separate switching unit.

The complete measuring system consists of:

- The capacitance Liquicap M FTI51 or FTI52 point level switch
- An electronic insert FEI53, FEI57S, FEI58
- A transmitter power supply unit (see table below)



* Only possible with FEI53

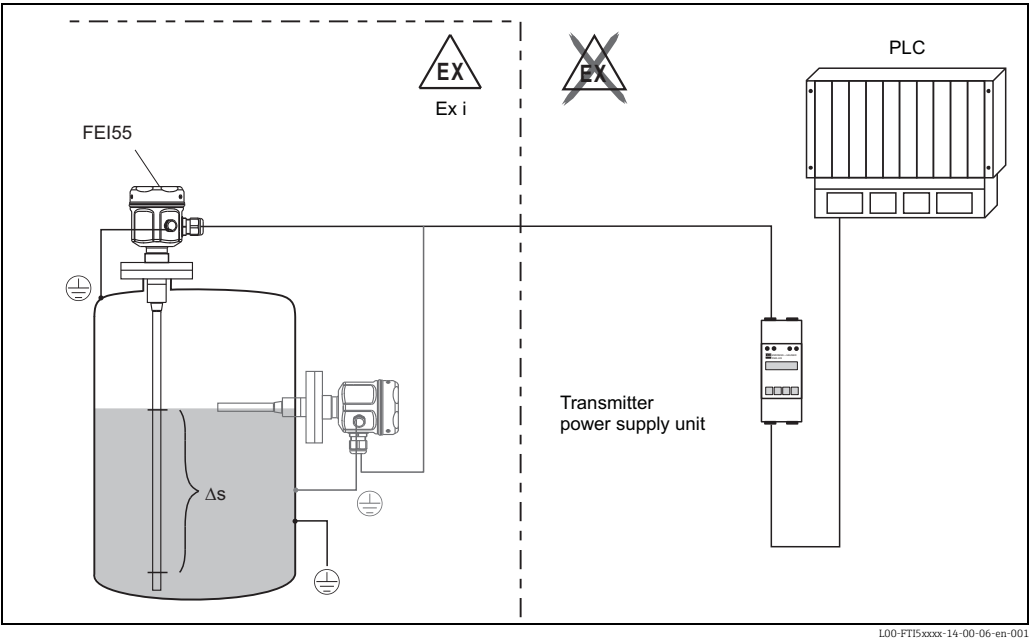
The following table shows the transmitter power supply units available which can be operated with electronic inserts FEI53, FEI57S and FEI58.

Electronic insert	FEI57S	FEI53	FEI58
Transmitter power supply unit			
FTC625 (from SW V1.4)	x	–	–
FTC325	x	x	–
FTL325N	–	–	x
FTL375N	–	–	x
FTC470Z	x	–	–
FTC471Z	x	–	–

Point level switch 8/16 mA

The complete measuring system consists of:

- The Liquicap M FTI51 or FTI52 point level switch
- The FEI55 electronic insert
- A transmitter power supply unit, e.g. RN221N, RNS221, RMA421, RMA422



Electronic inserts**FEI51**

Two-wire AC connection

- Load switched directly into the power supply circuit via the thyristor
- Point level adjustment at the touch of a button

FEI52

3-wire direct current version:

- Switch the load via the transistor (PNP) and separate supply voltage connection
- Point level adjustment at the touch of a button

FEI53

3-wire direct current version with 3 to 12 V signal output:

- For separate switching unit, Nivotester FTC325 3-WIRE
- Self-test from the switching unit without changing levels
- Point level adjustment at the touch of a button

FEI54

Universal current version with relay output:

- Switch the loads via 2 floating changeover contacts (DPDT)
- Point level adjustment at the touch of a button

FEI55

Signal transmission 8/16 mA on two-wire cabling:

- SIL2 approval for the hardware
- SIL3 approval for the software
- For separate switching unit (e.g. RN221N, RNS221, RMA421, RMA422)
- Point level adjustment at the touch of a button

FEI57S

PFM signal transmission (current pulses are superimposed on the supply current):

- For separate switching unit with PFM signal transmission e.g. FTC325 PFM, FTC625 PFM and FTC470Z/471Z
- Self-test from the switching unit without changing levels
- Point level adjustment at the touch of a button
- Cyclical checking (function check) from the switching unit.

FEI58 (NAMUR)

Signal transmission H-L edge 2.2 to 3.5 / 0.6 to 1.0 mA as per IEC 60947-5-6 on two-wire cable:

- For a separate switching unit (e.g. Nivotester FTL325N and FTL375N)
- Point level adjustment at the touch of a button
- Connection cables and slaves tested at the touch of a button



Note!

For additional information see → 31 ff.

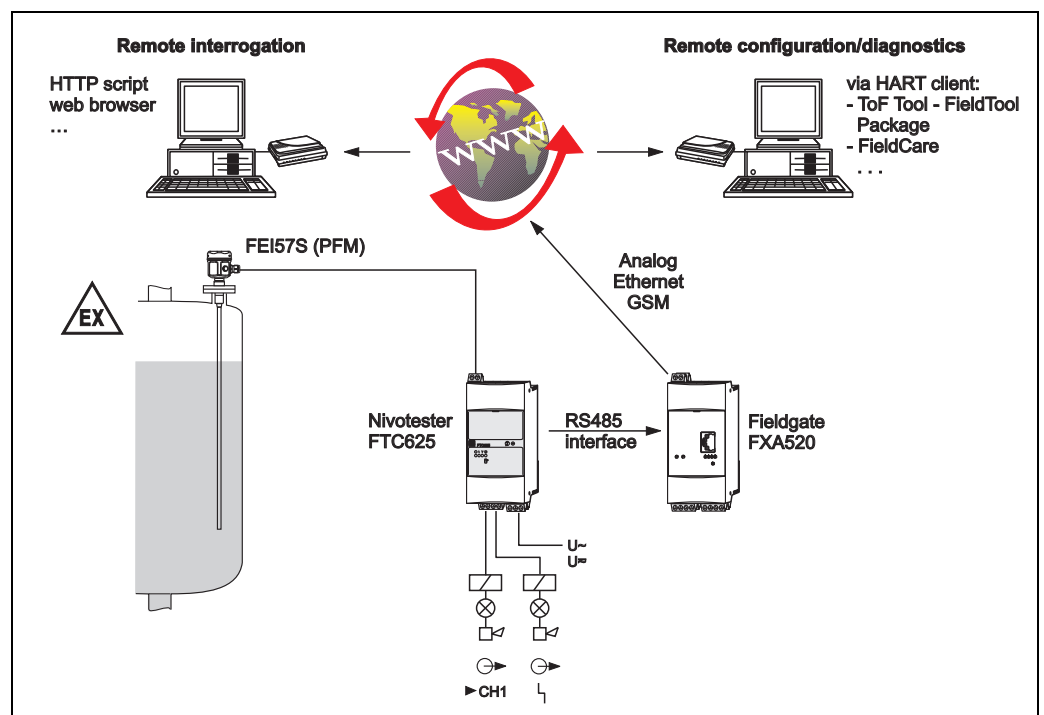
System integration via Fieldgate

Vendor managed inventory

The remote interrogation of tank or silo levels via Fieldgate enables suppliers of raw materials to gather information about the current inventories of their regular customers at any time and, for example, take this into account in their own production planning. The Fieldgate monitors the configured point levels and automatically triggers the next order as required. Here, the range of possibilities ranges from simple requisitioning by e-mail through to fully automatic order processing by incorporating XML data into the planning systems on both sides.

Remote maintenance of measuring systems

Not only does Fieldgate transmit the current measured values, it also alerts the standby personnel responsible by e-mail or SMS as required. Fieldgate forwards the information transparently. In this way, all options of the operating software in question are available remotely. By using remote diagnosis and remote configuration some onsite service operations can be avoided and all others can at least be planned and prepared better.



Operating conditions: Installation

Installation instructions

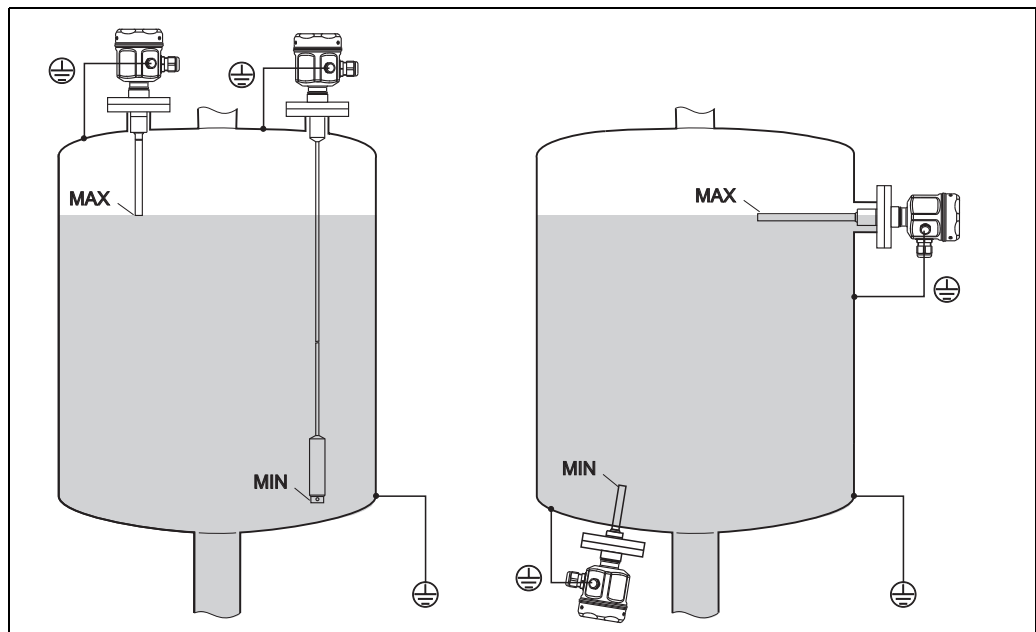


Liquicap M FTI51 (rod probe) can be installed from above, from below and from the side.
Liquicap M FTI52 (rope probe) can be installed vertically from above.

Note!

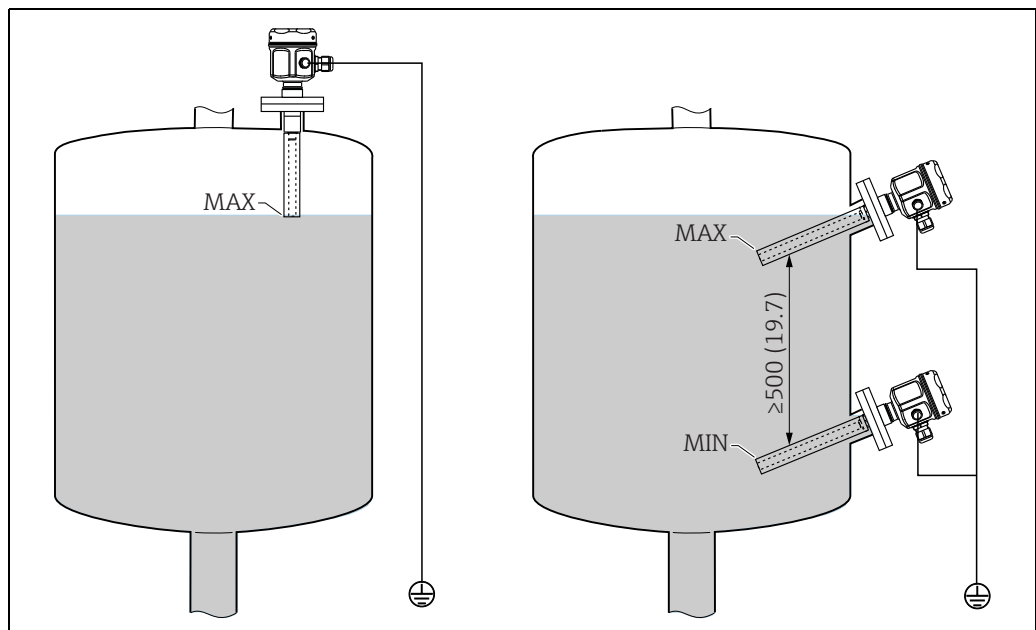
- The probe may not come into contact with the container wall!
- Recommended distance from the container floor: ≥ 10 mm.
- Do not install probes in the area of the filling curtain!
- Make sure the probe is at a sufficient distance from the agitator.
- If multiple probes are mounted next to each other, a minimum distance of 500 mm (19.7 in) between the probes must be observed.
- In the event of severe lateral loads, use rod probes with a ground tube.

For containers that conduct electricity e.g. steel tanks



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For containers that do not conduct electricity e.g. plastic tanks



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Probes with ground tube and grounding (Dimensions mm (in))

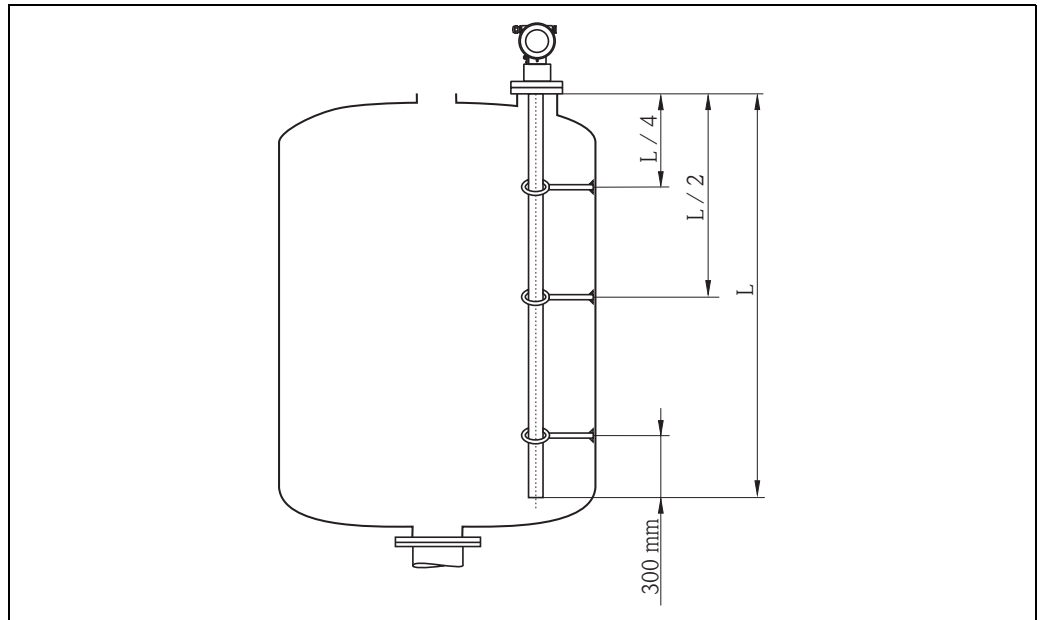
Support for marine approval (GL)

Fully insulated rod probes can be supported conductively or non-conductively.
Partially insulated rod probes may only be supported with insulation at the uninsulated probe end.



Note!

Rod probes with a diameter of 10 mm and 16 mm have to be supported with a length ≥ 1 m (see drawing).



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Example for calculating distances:

Probe length $L = 2000$ mm.

$L/4 = 500$ mm

$L/2 = 1000$ mm

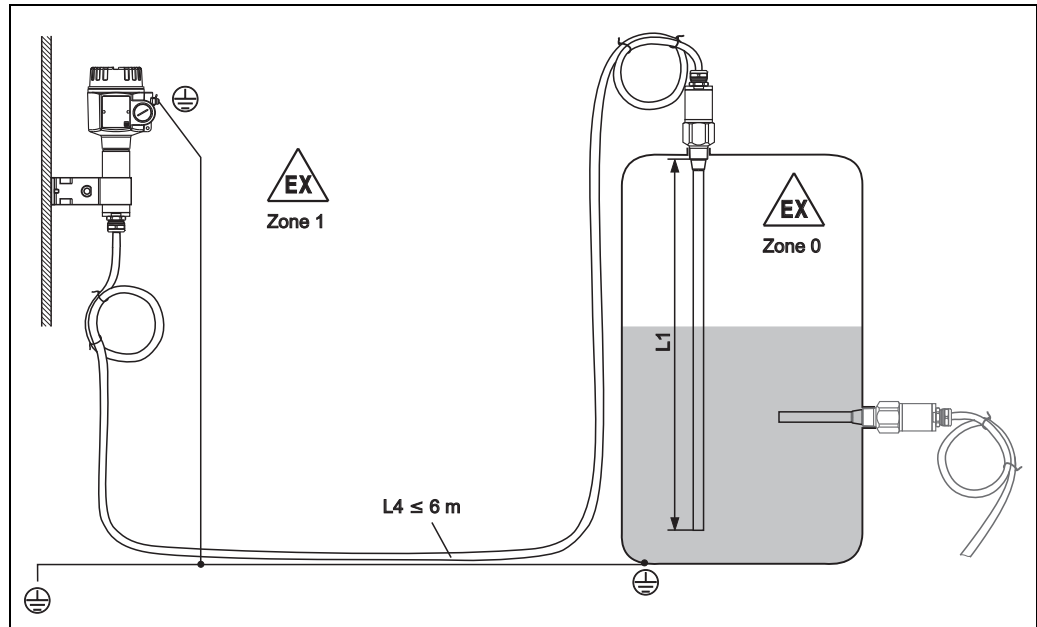
Measured from the end of the probe rod = 300 mm.

With separate housing



Note!

- The maximum connection length between the probe and the separate housing is 6 m (L4). When ordering a device with a separate housing, the desired length must be specified.
- Maximum total length: $L1 + L4 = 10$ m
- If the connecting cable is to be shortened or passed through a wall, it must be separated from the process connection.



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Rod length L1 max. 4 m

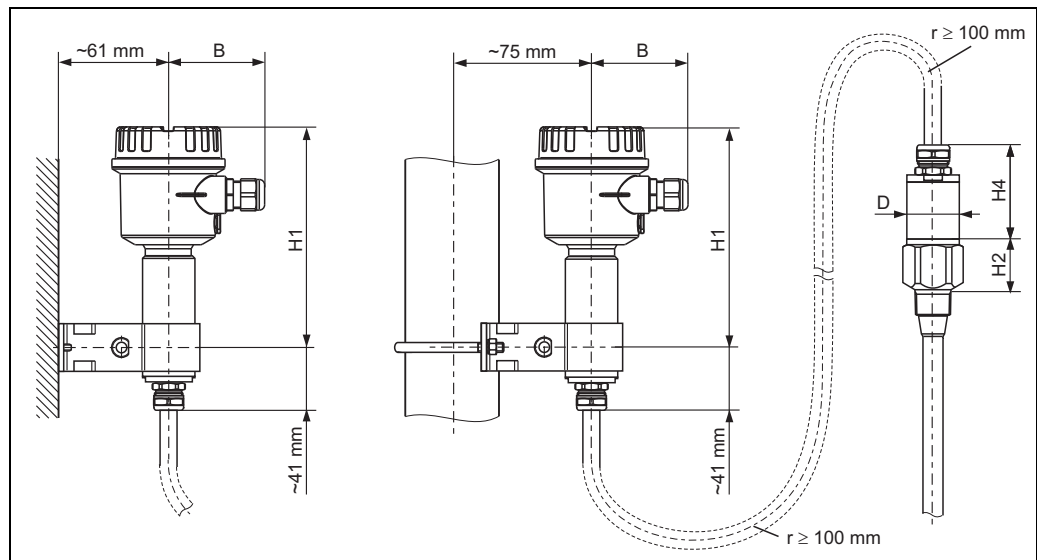
Rope length L1 max. 9.7 m (the maximum total length of L1 + L4 should not exceed 10 m).

Extension heights: separate housing

Housing side: wall mounting

Housing side: pipe mounting

Sensor side



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Note!

- The cable has a bending radius of $r \geq 100$ mm
- Connecting cable: $\varnothing 10.5$ mm
- Outer jacket: silicone, notch-resistant

	Polyester housing (F16)	Stainless steel housing (F15)	Aluminum housing (F17)
B (mm)	76	64	65
H1 (mm)	172	166	177

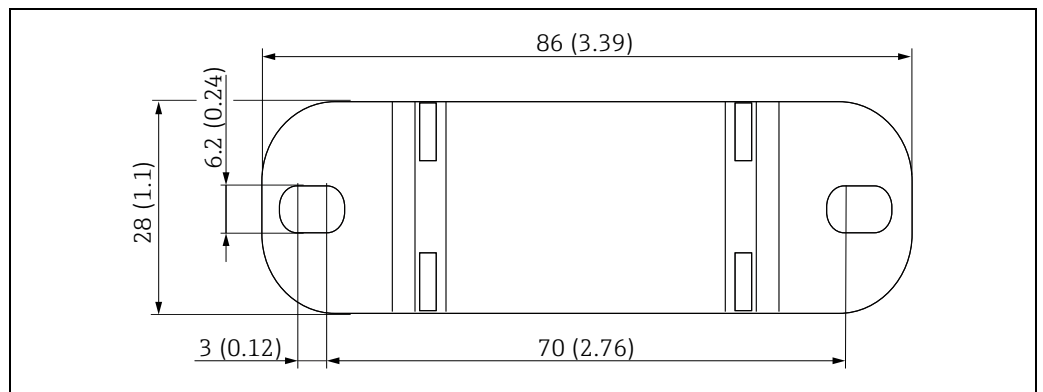
		H4 (mm)	D (mm)
Probes Ø10 mm rod		66	38
Probes Ø16 mm rod or rope (without fully insulated inactive length)	G 1/2", G 3/4", G 1", NPT 1/2", NPT 3/4", NPT 1", Clamp 1", Clamp 1 1/2", Universal Ø44, flange < DN 50, ANSI 2", 10K50	66	38
	G1 1/2", NPT1 1/2", Clamp 2", DIN 11851, flanges ≥ DN 50, ANSI 2", 10K50	89	50
Probes Ø 22 mm rod or rope (with fully insulated inactive length)		89	38

Wall holder unit



Note!

- The wall holder unit is part of the scope of supply for device versions with a separate housing.
- The wall holder unit first has to be screwed to the separate housing before you can use it as a drilling template. The distance between the holes is reduced by screwing it to the separate housing.



A0033881

Dimensions mm (in)

Operating conditions: Environment

Ambient temperature range	■ -50 to +70 °C ■ -40 to +70 °C (with F16 housing) ■ Observe derating →  15 ■ If operating outdoors, use a protective cover! →  44.																																												
Storage temperature	-50 to +85 °C																																												
Climate class	DIN EN 60068-2-38/IEC 68-2-38: test Z/AD																																												
Vibration resistance	DIN EN 60068-2-64/IEC 68-2-64: 20 Hz– 2000 Hz; 0.01 g²/Hz																																												
Shock resistance	DIN EN 60068-2-27/IEC 68-2-27: 30 g acceleration																																												
Cleaning	Housing: When cleaning, make sure that the cleaning agent used does not corrode the housing surface or the seals. Probe: Depending on the application, buildup (contamination and soiling) can form on the probe rod. A high degree of material buildup can affect the measurement result. If the medium tends to create a high degree of buildup, regular cleaning is recommended. When cleaning, it is important to make sure that the insulation of the probe rod is not damaged. If cleaning agents are used make sure the material is resistant to them!																																												
Degree of protection	<table><tr><th></th><th>IP66*</th><th>IP67*</th><th>IP68*</th><th>NEMA4X**</th></tr><tr><td>Polyester housing F16</td><td>X</td><td>X</td><td>-</td><td>X</td></tr><tr><td>Stainless steel housing F15</td><td>X</td><td>X</td><td>-</td><td>X</td></tr><tr><td>Aluminum housing F17</td><td>X</td><td>X</td><td>-</td><td>X</td></tr><tr><td>Aluminum housing F13 with gas-tight process seal</td><td>X</td><td>–</td><td>X***</td><td>X</td></tr><tr><td>Stainless steel housing F27</td><td>X</td><td>X</td><td>X***</td><td>X</td></tr><tr><td>Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)</td><td>X</td><td>–</td><td>X***</td><td>X</td></tr><tr><td>Separate housing</td><td>X</td><td>–</td><td>X***</td><td>X</td></tr></table> * As per EN60529 ** As per NEMA 250 *** Only with M20 cable entry or G1/2 thread						IP66*	IP67*	IP68*	NEMA4X**	Polyester housing F16	X	X	-	X	Stainless steel housing F15	X	X	-	X	Aluminum housing F17	X	X	-	X	Aluminum housing F13 with gas-tight process seal	X	–	X***	X	Stainless steel housing F27	X	X	X***	X	Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)	X	–	X***	X	Separate housing	X	–	X***	X
	IP66*	IP67*	IP68*	NEMA4X**																																									
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Stainless steel housing F27	X	X	X***	X																																									
Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)	X	–	X***	X																																									
Separate housing	X	–	X***	X																																									
Electromagnetic compatibility (EMC)	■ Interference emission to EN 61326, Electrical Equipment Class B Interference immunity in accordance with EN 61326, Appendix A (Industrial) and NAMUR Recommendation NE 21 (EMC) ■ A usual commercial instrument cable can be used.																																												

Operating conditions: Process

Process temperature range

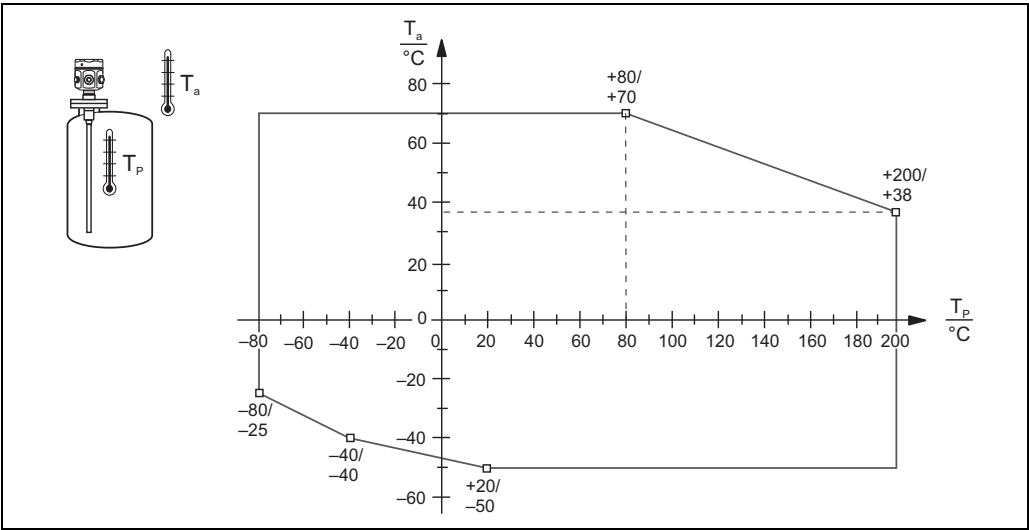
The following diagrams apply for:

- Rod and rope version
- Insulation: PTFE, PFA, FEP
- Standard applications outside hazardous areas



Note!
The temperature is restricted to $T_a -40\text{ }^{\circ}\text{C}$ if the polyester housing F16 is used or if additional option B is selected (free from paint-wetting impairment substances, only FTI51).

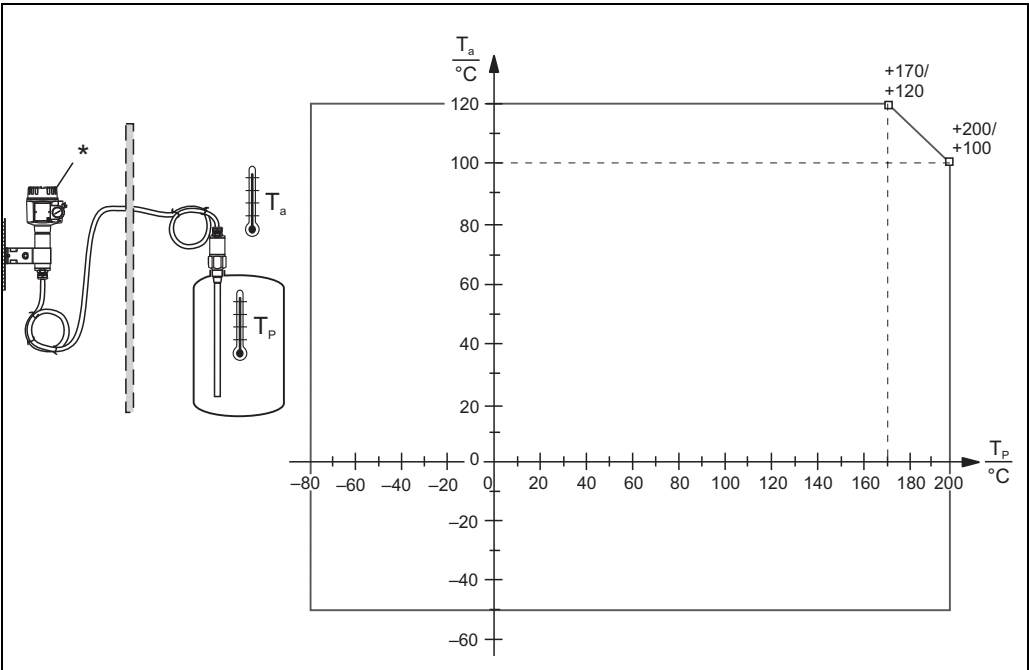
With compact housing



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T_a : Ambient temperature
 T_p : Process temperature

With separate housing



L00-FMI5xxxx-05-05-xx-xx-011

T_a = Ambient temperature
 T_p = Process temperature

* The permitted ambient temperature at the separate housing is the same as indicated for the compact housing → 15.

Influence of process temperature

Error in case of fully insulated probes typically 0.13%/K related to the full scale value.

Process pressure limits**Probe ø10 mm, ø14 mm (including insulation)**

-1 to 25 bar (observe dependencies: process temperature and process connection → 15 and → 21).

Probe ø16 mm (including insulation)

- -1 to 100 bar (observe dependencies: process temperature and process connection → 15 and → 21).
- In the event of an inactive length, the maximum permitted process pressure is 63 bar
- In the event of CRN approval and inactive length, the maximum permitted process pressure is 32 bar.

Probe ø22 mm (including insulation)

-1 to 50 bar (observe dependencies: process temperature and process connection → 15 and → 21).

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

- EN 1092-1: 2005 Table, Appendix G2
With regard to its resistance/temperature property, the material 1.4435 is identical to 1.4404 (AISI 316L) which is grouped under 13E0 in EN 1092-1 Tab. 18. The chemical makeup of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

The lowest value from the derating curves of the device and the selected flange applies.

Pressure and temperature derating

For process connections ½", ¾", 1", flanges < DN50, < ANSI 2", < JIS 10K (10 and 14 mm rod)

For process connections ¾", 1", flanges < DN50, < ANSI 2", < JIS 10K (16 mm rod)

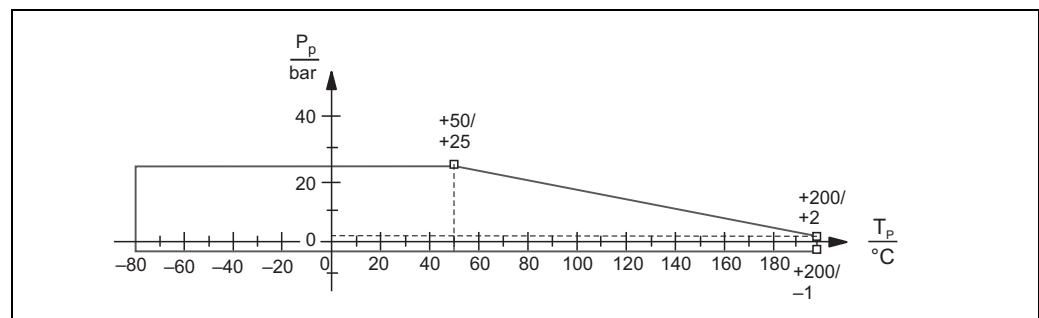
Rod insulation: PTFE, PFA

Rope insulation: FEP, PFA



Note!

See also "Process connections" → 21.



P_p : Process pressure
 T_p : Process temperature

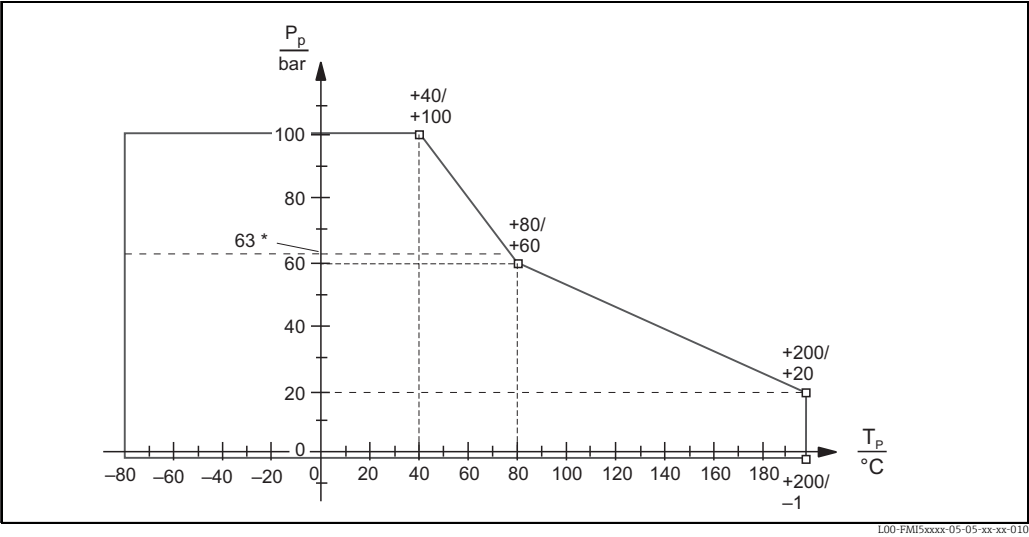
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For process connections 1½", flanges ≥ DN50, ≥ ANSI 2", ≥ JIS 10K (16 mm rod)

Rod insulation: PTFE, PFA
Rope insulation: FEP, PFA

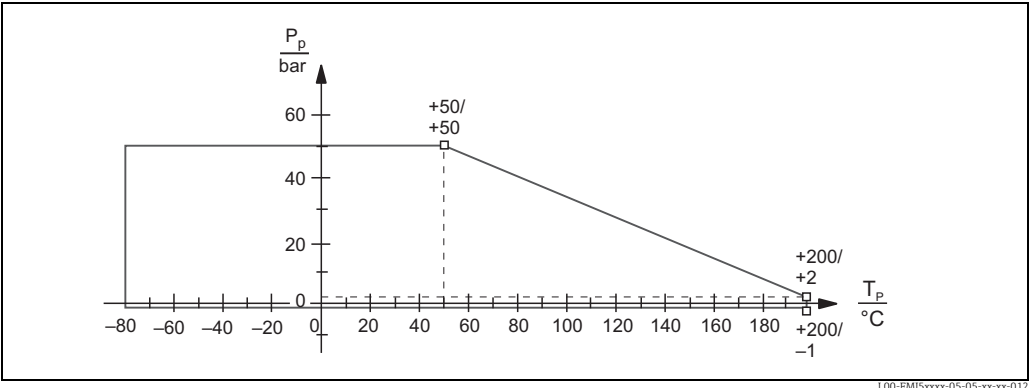


Note!
See also "Process connections" → 21



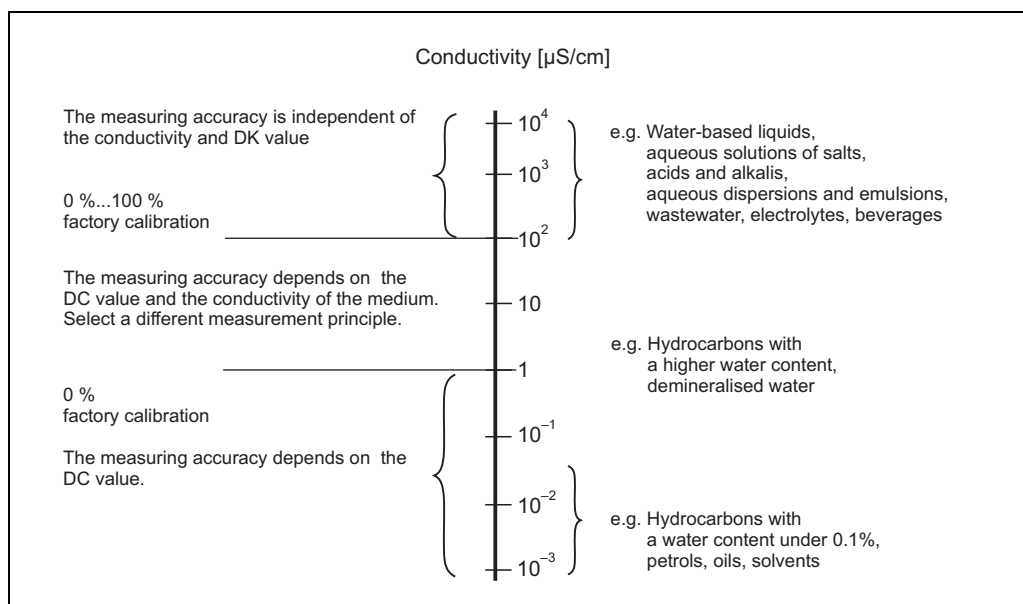
P_p : process pressure
 T_p : process temperature
* For probes with an inactive length .

With a fully insulated inactive length (22 mm rod):



P_p : Process pressure
 T_p : Process temperature

Liquicap M operational range



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Typical DK values (dielectric constant)

Air	1
Vacuum	1
Liquefied gases, general	1.2 - 1.7
Gasoline	1.9
Cyclohexane	2
Diesel fuel	2.1
Oils, general	2 - 4
Methyl ether	5
Butanol	11
Ammonia	21
Latex	24
Ethanol	25
Caustic soda	22 - 26
Acetone	20
Glycerine	37
Water	81



Note!

Further information and dielectric constants (DC values) in the Download Area of the Endress+Hauser web site:

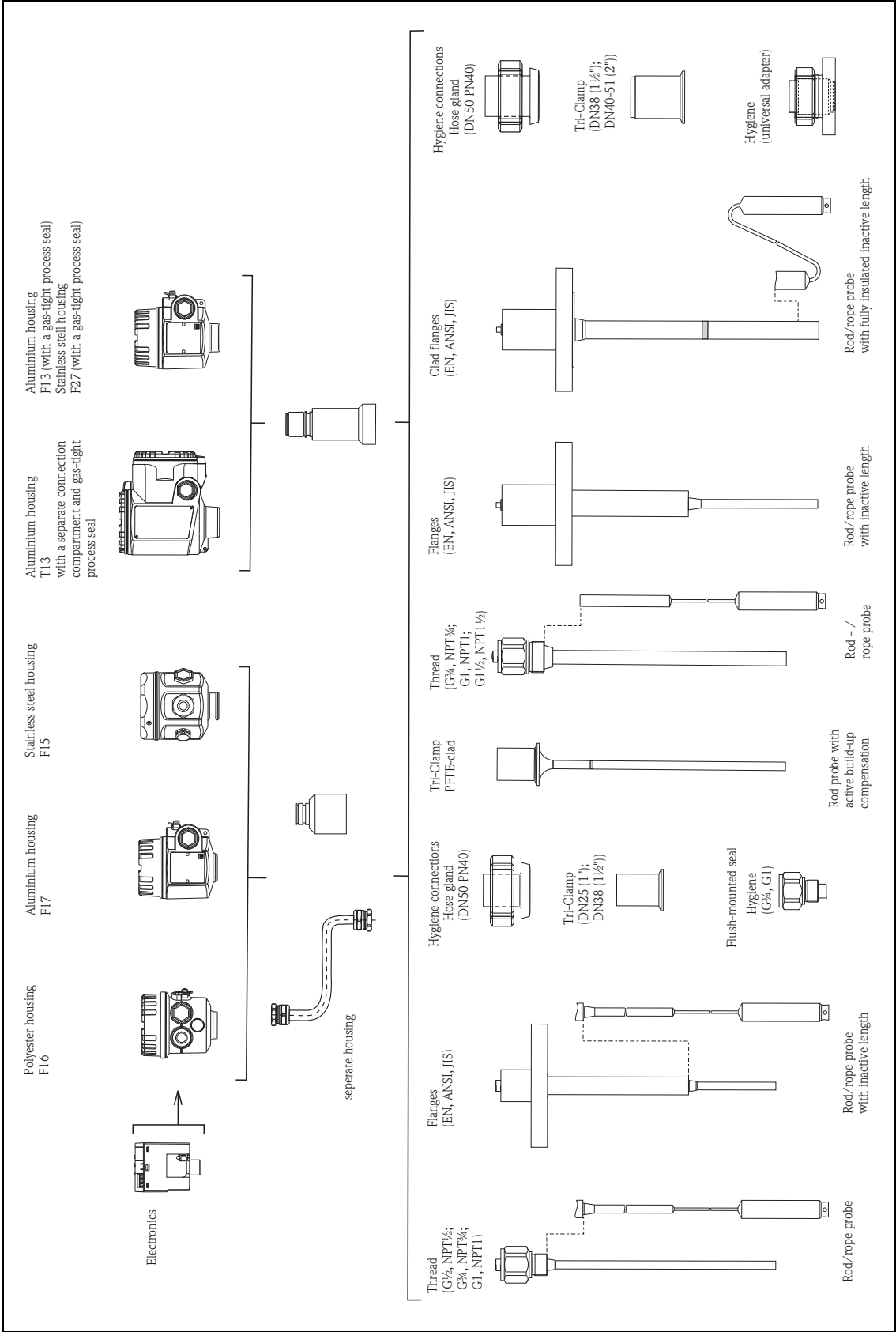
- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

Mechanical construction



Note!
The dimensions on the following pages are indicated in mm.

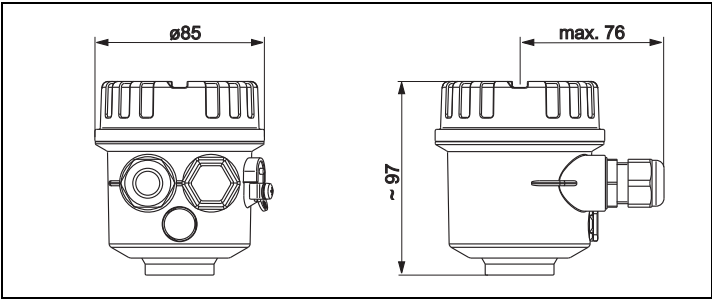
Overview



TI418Fen24

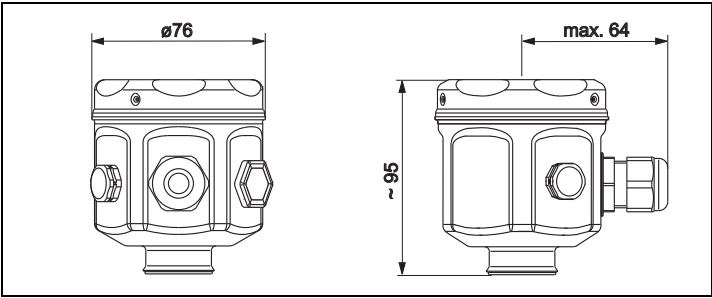
Housing

Polyester housing F16



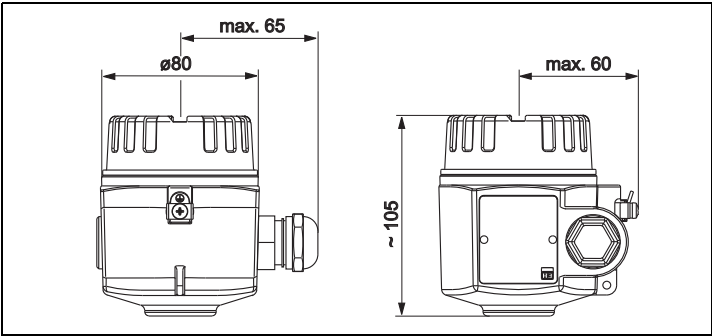
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Stainless steel housing F15



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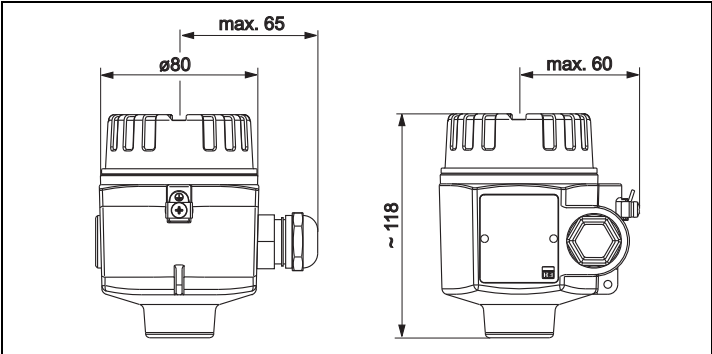
Aluminum housing F17



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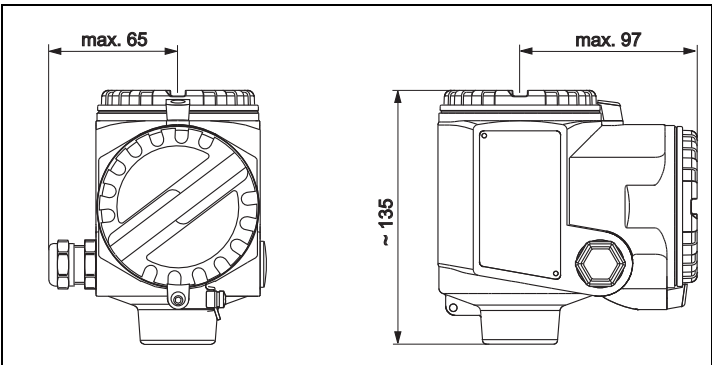
*Aluminum housing F13
with gas-tight process seal*

*Stainless steel housing F27
with gas-tight process
seal*



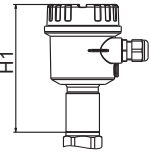
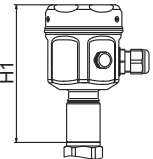
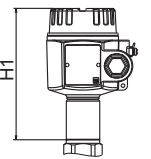
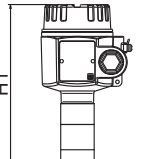
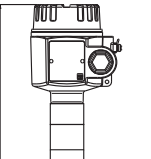
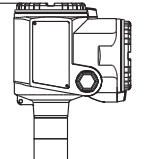
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*Aluminum housing T13
with separate connection
compartment and gas-tight
process seal*

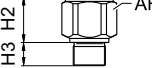
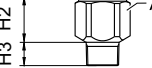
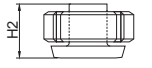


L00-FTI5xxxx-06-05-xx-xx-004

Housing heights with adapter

	Polyester housing F16	Stainless steel housing F15	Aluminum housing F17	Aluminum housing F13	Stainless steel housing F27	Aluminum housing T13
	 L00-FTI5xxxx-06-05-xx-xx-044	 L00-FTI5xxxx-06-05-xx-xx-046	 L00-FTI5xxxx-06-05-xx-xx-045	 L00-FTI5xxxx-06-05-xx-xx-048	 L00-FTI5xxxx-06-05-xx-xx-048	 L00-FTI5xxxx-06-05-xx-xx-047
Order code	2	1	3	4	4	5
H1	143	141	150	194	194	210

Process connections

	Thread G	Thread NPT	Threaded pipe joint	Tri-Clamp	Tri-Clamp clad
	 L00-FMI5xxxx-06-05-xx-xx-007 (DIN EN ISO228-1)	 L00-FMI5xxxx-06-05-xx-xx-007 (ANSI B 1.20.1)	 L00-FMI5xxxx-06-05-xx-xx-040 (EN 11851)	 L00-FMI5xxxx-06-05-xx-xx-041 (ISO2852)	 L00-FMI5xxxx-06-05-xx-xx-069 (ISO2852)

Rod probes Ø10, rope probes

For pressures up to	25 bars	25 bars	25 bars	25 bar**	--
Version / order code	G ½ / GCJ G ¾ / GDJ G 1 / GEJ	NPT ½ / RCJ NPT ¾ / RDJ NPT 1 / REJ	DN50 PN40 / MRJ	DN25 (1") / TCJ DN38 (1½") / TJJ	--
Dimensions	H2 = 38 H3 = 19 AF = 41	H2 = 38 H3 = 19 AF = 41	H2 = 57	H2 = 57	--
Surface roughness***	--	--	≤ 0.8 µm	≤ 0.8 µm	--
Additional information	Elastomer flat seal	--	--	EHEDG*, 3A*	--

Rod probes Ø14

For pressures up to	25 bars	25 bars	25 bars	25 bar**	16 bar**	16 bar**
Version / order code	G ¾ / GDJ G 1 / GEJ	NPT ¾ / RDJ NPT 1 / REJ	DN50 PN40 / MRJ	DN25 (1") / TCJ DN38 (1½") / TJJ DN40-51 (2") / TDJ	DN38 / TJK (1½")	DN40-51 TDK (2")
Dimensions	H2 = 38 H3 = 19 AF = 41	H2 = 38 H3 = 19 AF = 41	H2 = 66	H2 = 66	H2 = 66	
Surface roughness***	--	--	≤ 0.8 µm	≤ 0.8 µm	≤ 0.8 µm	
Additional information	Elastomer flat seal	--	--	EHEDG, 3A	EHEDG, 3A	

* The EHEDG, 3A certificate only applies to probes with a fully insulated probe rod. It does not apply to probes with an inactive length or active buildup compensation.

** In the event of CRN approval, the maximum permitted process pressure is 11 bar.

*** Does not apply for inactive lengths.

	Thread G		Thread NPT		Threaded pipe joint	Tri-Clamp		Tri-Clamp clad	
Rod probes Ø16, rope probes									
For pressures up to	25 bars	100 bar	25 bars	100 bar	40 bar	16 bar**	16 bar**	16 bar**	16 bar**
Version / order code	G ¾ / GDJ G 1 / GEJ	G 1½ / GGJ	NPT ¾/ RDJ NPT 1 / REJ	NPT 1½/ RGJ	DN50 PN40 / MRJ	DN38 / TNJ (1½")	DN40-51 / TDJ (2")	DN38 / TJK (1½")	DN40-51 TDK (2")
Dimensions	H2 = 38 H3 = 19 AF = 41	H2 = 41 H3 = 25 AF = 55	H2 = 38 H3 = 19 AF = 41	H2 = 41 H3 = 25 AF = 55	H2 = 66	H2 = 98****	H2 = 66	H2 = 66	
Surface roughness***	--		--		≤ 0.8 µm	≤ 0.8 µm		≤ 0.8 µm	
Additional information	Elastomer flat seal		--		--	EHEDG*, 3A*	--	EHEDG, 3A	

Rod probes Ø22, rope probes

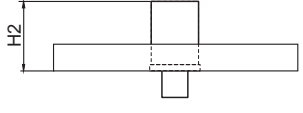
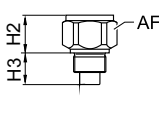
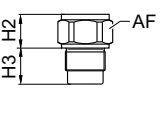
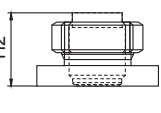
For pressures up to	50 bar	50 bar	--	--	--
Version / order code	G 1½ / GGJ	NPT 1½ / RGJ	--	--	--
Dimensions	H2 = 85 H3 = 25 AF = 55	H2 = 85 H3 = 25 AF = 55	--	--	--
Additional information	Elastomer flat seal	--	--	--	--

* The EHEDG, 3A certificate only applies to probes with a fully insulated probe rod. It does not apply to probes with an inactive length or active buildup compensation.

** In the event of CRN approval, the maximum permitted process pressure is 11 bar.

*** Does not apply for inactive lengths.

**** Process connection: Tri-Clamp (47 mm) with deattachable clamp (49 mm) and seal (2 mm).

	Flanges	Hygiene connection	Hygiene connection	Hygiene connection
	 L00-FMI5xxxx-06-05-xx-xx-042 (EN1092-1) (ANSI B 16.5) (JIS B2220)	 L00-FMI5xxxx-06-05-xx-en-009 With flush-mounted seal	 L00-FMI5xxxx-06-05-xx-en-010 With flush-mounted seal	 L00-FMI5xxxx-06-05-xx-xx-043 Adapter 44 mm with flush-mounted seal

Rod probes Ø10, rope probes

For pressures up to	Max. 25 bar (depends on flange)	25 bars	25 bars	--
Version / order code	EN / B## → 44+ ANSI / A## → 44+ JIS / K## → 44+	G ¾ / GQJ	G 1 / GWJ	--
Dimensions	H2 = 57	H2 = 31 H3 = 26 AF = 41	H2 = 27 H3 = 30 AF = 41	--
Additional information	Also clad (PTFE) for aggressive process media	Weld-in adapter see "Accessories" EHEDG*, 3A*	Weld-in adapter see "Accessories" EHEDG, 3A	--

Rod probes Ø14

For pressures up to	Max. 25 bar (depends on flange)	--	25 bars	16 bar (tightening torque 10 Nm)
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	Flanges	Hygiene connection	Hygiene connection	Hygiene connection
Version / order code	EN / B## → 44+ ANSI / A## → 44+ JIS / K## → 44+	--	G 1 / GWJ	Universal adapter / UPJ
Dimensions	H2 = 57	--	H2 = 27 H3 = 30 AF = 41	H2 = 57
Additional information	Also clad (PTFE)	--	Weld-in adapter see "Accessories" EHEDG, 3A	Universal adapter see "Accessories"
Rod probes Ø16, rope probes				
For pressures up to	Max. 100 bar (depends on flange) Max. 50 bar (with active buildup compensation)	--	--	16 bar (tightening torque 10 Nm)
Version / order code	EN / B## → 44+ ANSI / A## → 44+ JIS / K## → 44+	--	--	Universal adapter / UPJ
Dimensions	H2 = 66	--	--	H2 = 57
Additional information	Also clad (PTFE)	--	--	Universal adapter see "Accessories"
Rod probes Ø22, rope probes				
For pressures up to	Max. 50 bar (depends on flange)	--	--	--
Version / order code	EN / B## → 44+ ANSI / A## → 44+ JIS / K## → 44+	--	--	--
Dimensions	H2 = 111	--	--	--
Additional information	Only clad (PTFE)	--	--	--

* The EHEDG, 3A certificate only applies to probes with a fully insulated probe rod. It does not apply to probes with an inactive length or active buildup compensation.



1. Fully insulated rod probes FTI51

Note!

- The active rod probe is always fully insulated (dimension L1).
- Total length of probe from sealing surface: $L = L1 + L3$ (+ 125 mm with active buildup compensation + H3*)
- Thickness of insulation with probe rod diameter 10 mm = 1 mm; 16 mm = 2 mm; 22 mm = 2 mm
- Length tolerances L1, L3: < 1 m: 0 to -5 mm, 1 to 3 m: 0 to -10 mm, 3 to 6 m: 0 to -20 mm

	Rod probe		Rod probe with ground tube		Rod probe with inactive length		Rod probe with inactive length and ground tube		Rod probe with fully insulated inactive length		Rod probe with active buildup compensation		Rod probe with inactive length + active buildup compensation	
L00-FMI5xxxx-06-05-xx-xx-061 L00-FMI5xxxx-06-05-xx-xx-060														
Total length (L)	100...4000		100...4000		200...6000		200...6000		300...4000		225...4125		325...6000	
Active rod length (L1)	100...4000		100...4000		100...4000		100...4000		150...3000		100...4000		100...4000	
Inactive rod length (L3)	--		--		100...2000		100...2000		150...1000		--		100...2000	
ø Probe rod	10	16	10	16	10	16	10	16	22**	10	16	10	16	
ø Ground tube	--	--	22	43	--	--	22	43	--	--	--	--	--	
ø Inactive length	--	--	--	--	22	43	22	43	22**	--	--	22	43	
ø Active buildup compensation	--	--	--	--	--	--	--	--	--	19	26	19	26	
Length (mm) active buildup compensation	--		--		--		--		--		125		125	
Lateral loading capacity (Nm) at 20 °C	<15	<30	<40	<300	<30	<60	<40	<300	<25	<30	<60	<30	<60	
For use in agitating tanks	--		--	X	--		--	X	--		--		--	
For aggressive liquids	X		--		--		--		X		--		--	
For high-viscosity liquids	X		--		X		--		X		X		X	
For use in plastic tanks	--		X		--		X		--		--		--	
For use in mounting nozzles	--		--		X		X		X		--		X	
In the event of condensate on tank ceiling	--		--		X		X		X		--		X	
For high-viscosity conductive liquids	--		--		--		--		--		X		X	

* H3 = Thread height (important for calculating the exact probe length for process connections with a thread.) → 21

** Probe tube

2. Fully insulated rod probes FTI51 for hygiene applications



Note!

- Total length of probe from sealing surface: $L = L1$ (+ 125 mm with active buildup compensation)
- Thickness of insulation with probe rod diameter 14 mm = 1 mm; 16 mm = 2 mm
- Length tolerances $L1, L3$: < 1 m: 0 to -5 mm, 1 to 3 m: 0 to -10 mm, 3 to 6 m: 0 to -20 mm

	Rod probe with clad Tri-Clamp	Rod probe with fully insulated active buildup compensation and clad Tri-Clamp
Total length (L)	100...4000	200...2125
Active rod length (L1)	100...4000	75...2000
Probe rod diameter	16	14
ø Ground tube	--	--
ø Inactive length	--	--
ø Active buildup compensation	--	14
Length, active buildup compensation	--	125
Lateral loading capacity (Nm) at 20 °C	<30	<15
For use in agitating tanks	--	--
For aggressive liquids	X	X
For high-viscosity liquids	X	X
For use in plastic tanks	--	--
For use in mounting nozzles	--	X
In the event of condensate on tank ceiling	--	X
For high-viscosity conductive liquids	--	X

3. Partially insulated rod probes FTI51

For a switch point with millimeter accuracy in conductive liquids



Note!

- Total length of probe from sealing surface: $L = L1 + L3$ (+ 125 mm with active buildup compensation + H3*)
- Thickness of partial insulation with probe rod diameter 10 mm = 1 mm; 16 mm = 2 mm
- Length tolerances L1, L3: < 1 m: 0 to -5 mm, 1 to 3 m: 0 to -10 mm, 3 to 6 m: 0 to -20 mm

	Rod probe		Rod probe with ground tube		Rod probe with inactive length		Rod probe with inactive length and ground tube		Rod probe with active buildup compensation		Rod probe with inactive length and active buildup compensation	
L00-FMI5xxxx-06-05-xx-xx-061 L00-FMI5xxxx-06-05-xx-xx-062												
Total length (L)	100...4000		100...4000		200...6000		200...6000		225...4000		100...6000	
Active rod length (L1)	100...4000		100...4000		100...4000		100...4000		100...4000		100...4000	
Inactive rod length (L3)	-		-		100...2000		100...2000		-		100...2000	
Length of partial insulation (L2)	75...3950		75...3950		75...3950		75...3950		75...3950		75...3950	
Probe rod diameter	10	16	10	16	10	16	10	16	10	16	10	16
∅ Inactive length / ground tube	-	-	22	43	22	43	22	43	-	-	22	43
∅ Active buildup compensation	-	-	-	-	-	-	-	-	19	26	19	26
Length, active buildup compensation	-		-		-		-		125		125	
Lateral loading capacity (Nm) at 20 °C	<15	<30	<40	<300	<30	<60	<40	<300	<30	<60	<30	<60
For use in agitating tanks	-		-	X	-		-	X	-		-	
For aggressive liquids	-		-		-		-		-		-	
For use in plastic tanks	-		X		-		X		-		-	
For use in mounting nozzles	-		-		X		X		-		X	
In the event of condensate on tank ceiling	-		-		X		X		-		X	
For high-viscosity liquids	X		-		X		-		X		X	
For high-viscosity conductive liquids	-		-		-		-		X		X	

* H3 = Thread height (important for calculating the exact probe length for process connections with a thread.) → 21

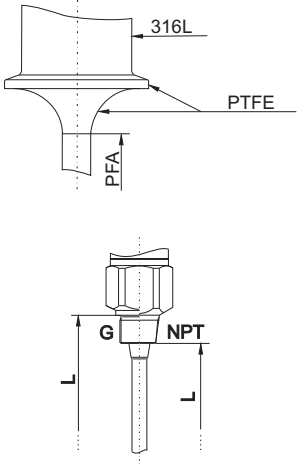
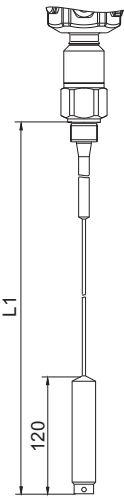
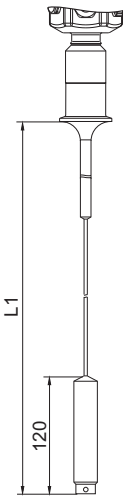
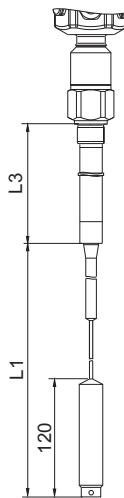
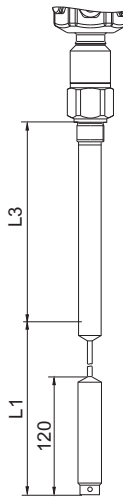
** L2 must be >25 mm shorter than L1.

Rope probes FTI52 (fully insulated)



Note!

- The active probe length is always fully insulated (dimension L1).
- Total length of probe from sealing surface: $L = L1 + L3$
- All rope probes are prepared for tensioning in containers (tensioning weight / anchor hole)
 - In case of media $< 1 \text{ mS/cm}$, appropriate measures must be taken, e.g. a metallic reference point or a metallic tank.
 - Back-and-forth swinging of the rope directly influences the switch point. The probe must therefore be tightened.
- Not suitable for agitator tanks, high-viscosity liquids and plastic tanks
- Thickness of rope insulation 0.75 mm
- Length tolerances L1, L3: $< 1 \text{ m}$: 0 to -10 mm, 1 to 3 m: 0 to -20 mm, 3 to 6 m: 0 to -30 mm, 6 to 12 m: 0 to -40 mm,

	Rod probe	Rope probe with clad Tri-Clamp	Rod probe with inactive length (uninsulated)	Rope probe with fully insulated inactive length
 L00-FMI5xxxx-06-05-xx-xx-070				 L00-FMI5xxxx-06-05-xx-xx-036
Total length (L)	420...10000		570...12000	570...11000
Active rope length (L1)	420...10000		420...10000	420...10000
Inactive length (L3)*	--		100...2000	150...1000
Ø Inactive length	--		22/43*	22**
Probe rope diameter	4		4	4
Ø Anchor weight	22		22	22
Ø Anchor hole	5		5	5
Tensile loading capacity (N) of probe rope at 20 C	200		200	200
For aggressive liquids	X		--	X
For use in mounting nozzles	--		X	X
For conductive liquids $> 100 \mu\text{S/cm}$	--		X	X
For non-conductive liquids $< 1 \mu\text{S/cm}$	--		X	X
In the event of condensate on tank ceiling	--		X	X
For high-viscosity liquids	--		--	--

* The Ø value of the inactive length depends on the process connection selected, see product configurator → 44

** Probe tube

Weight	Housing with process connection: ■ F15, F16, F17, F13 approx. 4.0 kg ■ T13 approx. 4.5 kg ■ F27 approx. 5.5 kg + Flange weight + Probe rod Ø 10 mm: 0.5 kg/m, + Probe rod Ø 22 mm: 0.8 kg/m + Probe rod Ø 14 mm, Ø 16 mm: 1.1 kg/m + Probe rope: 0.04 kg/m
Technical data: probe	Capacitance values of the probe Basic capacitance: approx. 18 pF Additional capacitance Mount the probe at a minimum distance of 50 mm from a conductive container wall: ■ Probe rod: approx. 1.3 pF/100 mm in air ■ Probe rope: approx. 1.0 pF/100 mm in air Fully insulated probe rod in water: ■ Approx. 38 pF/100 mm (16 mm rod) ■ Approx. 74 pF/100 mm (14 mm rod) ■ Approx. 45 pF/100 mm (10 mm rod) ■ Approx. 50 pF/100 mm (22 mm rod) Insulated probe rope in water: approx. 19 pF/100 mm Rod probe with ground tube: ■ Insulated probe rod: approx. 6.4 pF/100 mm in air ■ Insulated probe rod: approx. 38 pF/100 mm in water (16 mm rod) ■ Insulated probe rod: approx. 45 pF/100 mm in water (10 mm rod)
Material	Material specifications as per AISI and DIN-EN. In contact with the process ■ Probe rod, ground tube, inactive length, tensioning weight for rope probe: 316L (1.4435) ■ Probe rope: 316 (1.4401) ■ Probe rod insulation: PFA or PTFE (FDA: 21 CFR 177.1550) ■ Probe rope insulation: PFA or FEP (FDA: 21 CFR 177.1550) ■ Process connection: 316L (1.4435 or 1.4404) ■ Flat seal for process connection G ¾ or G 1: elastomer fiber, asbestos-free ■ Sealing ring for process connection G ½, G ¾, G 1, G 1½: Elastomer fiber, asbestos-free, resistant to lubricants, solvents, steam, weak acids and alkalis; to 300 C and to 100 bar Not in contact with the process ■ Ground terminals on housing (exterior): 304 (1.4301) ■ Nameplate on housing (exterior): 304 (1.4301) ■ Cable glands – Housing F13, F15, F16, F17, F27: polyamide (PA) With C, D, E, F, H, M, J, P, S, 1, 4, 5 approval (→ 44 ordering information): nickel-plated brass – Housing T13: nickel-plated brass ■ Polyester housing F16: PBT-FR with cover made of PBT-FR or with sight glass made of PA12, – Cover seal: EPDM – Adhesive nameplate: polyester foil (PET) – Pressure compensation filter: PBT-GF20 ■ Stainless steel housing F15: 316L (1.4404) – Cover seal: silicone – Cover clamp: 304 (1.4301) – Pressure compensation filter: PBT-GF20, PA ■ Aluminum housing F17/F13/T13: EN-AC-ALSi10Mg, plastic-coated, – Cover seal: EPDM – Cover clamp: nickel-plated brass – Pressure compensation filter: silicone (not T13)

- Stainless steel housing F27: 316L (1.4435)
 - Cover seal: FVMQ (optional: EPDM seal available as spare part)
 - Cover clamp: 316L (1.4435)

Input

Measured variable	Measurement of change in capacitance between probe rod and tank wall or ground tube; depends on the level of a liquid. Probe covered => high capacitance Probe not covered => low capacitance
--------------------------	---

Measuring range	■ Measuring frequency: 500 kHz ■ Span: – $\Delta C = 5$ to 1600 pF – $\Delta C = 5$ to 500 pF (with FEI58) ■ Final capacitance: $C_E = \text{max. } 1600 \text{ pF}$ ■ Adjustable initial capacitance: – $C_A = 5$ to 500 pF (range 1 = factory setting) – $C_A = 5$ to 1600 pF (range 2; not with FEI58) ■ The minimum change in capacitance for point level detection must be $\geq 5 \text{ pF}$.
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Minimum probe length for nonconductive media ($<1\mu\text{s/cm}$)

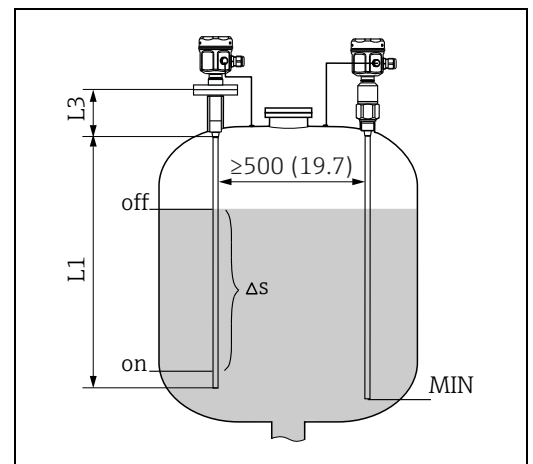
$$l_{\min} = \Delta C_{\min} / (C_s * [\epsilon_r - 1])$$

$l_{\min}$	=	Minimum probe length (m)
$\Delta C_{\min}$	=	5 pF
C_s	=	Probe capacitance in air → 28 "Technical data: Probe"
ϵ_r	=	Dielectric constant e.g. oil = 2.0

Measuring conditions

Notes!

- When installing in a nozzle, use inactive length (L3).
- Probes with active buildup compensation must be used for high-viscosity liquids that tend to form buildup.
- Fully insulated rod and rope probes have to be used for pump control (ΔS operation). The switch-on and switch-off points are determined by the empty and full calibration.
 - The maximum length depends on the probe used.
A 16 mm rod, for example, generates a capacitance of 380 pF/m in a conductive liquid.
With a maximum span of 1600 pF, this gives $1600\text{pF}/380\text{pF per m} = 4 \text{ m}$ total length.
- In the case of nonconductive media: use a ground tube.



L00-FTI5xxxx-15-05-xx-xx-002

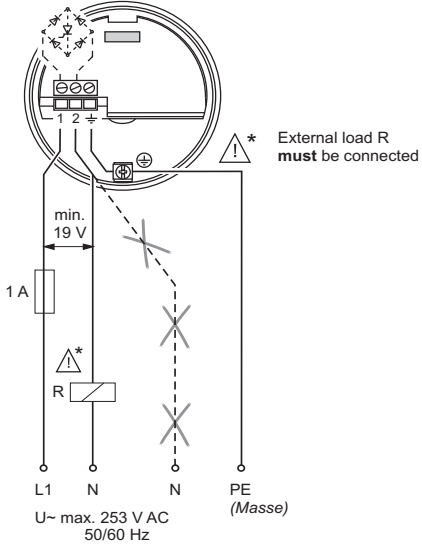
Dimensions mm (in)

Output

Switch behavior	Binary or Δs operation (pump control, not with FEI58)
Fail-safe mode	Minimum/maximum quiescent current safety can be switched at the electronic insert (for FEI53 and FEI57S only on the associated Nivotester: FTC325 3-WIRE, FTC325 PFM and FTC625 MIN = minimum safety: The output switches safety-oriented when the probe is uncovered (signal on alarm). For use for dry running protection and pump protection for example MAX = maximum safety: The output switches safety-oriented when the probe is covered (signal on alarm). For use with overfill protection for example
Switching delay	FEI51, FEI52, FEI54, FEI55 Can be adjusted incrementally at the electronic insert: 0.3 to 10 s FEI53, FEI57S Depends on the connected Nivotester (transmitter): FTC325, FTC625, FTC470Z or FTC471Z FEI58 Can be adjusted alternately at the electronic insert: 1 s / 5 s
Galvanic isolation	FEI51, FEI52 between rod probe and power supply FEI54: between rod probe, power supply and load FEI53, FEI55, FEI57S, FEI58 see connected switching device (functional galvanic isolation in the electronic insert)

Electronic insert FEI51 (AC 2-wire)

Power supply	- Supply voltage: 19 to 253 V AC - Power consumption: < 1.5 W - Residual current consumption: < 3.8 mA - Short-circuit protection - Overvoltage category II
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Electrical connection	Notes! Always connect in series with a load! Check the following: - the residual current consumption in blocked stat. - that for low voltage: - the voltage drop across the load is such that the minimum terminal voltage at the electronic insert (19 V) when blocked is not undershot. - the voltage drop across the electronics when switched through is observed (up to 12 V). - that a relay cannot de-energize with holding power below 1 mA. If this is the case, a resistor should be connected parallel to the relay (RC module available on request). When selecting the relay, pay attention to the holding power / rated power (see below: "Connectable load").  L00-FMI5xxxx-06-05-xx-en-071
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Signal on alarm

Safety mode	Level	Output signal	LEDs gn gn rd gn gn ye
MAX		$L+ \xrightarrow{I_L} +$ 1 ————— 3	
		$1 \xrightarrow{< 3,8 \text{ mA}} 3$	
MIN		$L+ \xrightarrow{I_L} +$ 1 ————— 3	
		$1 \xrightarrow{< 3,8 \text{ mA}} 3$	
Maintenance required		$I_L / < 3,8 \text{ mA}$ 1 ----- 3	
Instrument failure		$1 \xrightarrow{< 3,8 \text{ mA}} 3$	

BA300Fen017

Output signal	Output signal on power failure or in the event of damage to the sensor: < 3.8 mA
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Connectable load	- For relays with a minimum holding power or rated power > 2.5 VA at 253 V AC (10 mA) or > 0.5 VA at 24 V AC (20 mA) - Relays with a lower holding power or rated power can be operated by means of an RC module connected in parallel. - For relays with a maximum holding power or rated power < 89 VA at 253 V AC or < 8.4 VA at 24 V AC - Voltage drop across FEI51 max. 12 V - Residual current with blocked thyristor max. 3.8 mA - Load switched directly into the power supply circuit via the thyristor.
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Electronic insert FEI52 (DC PNP)

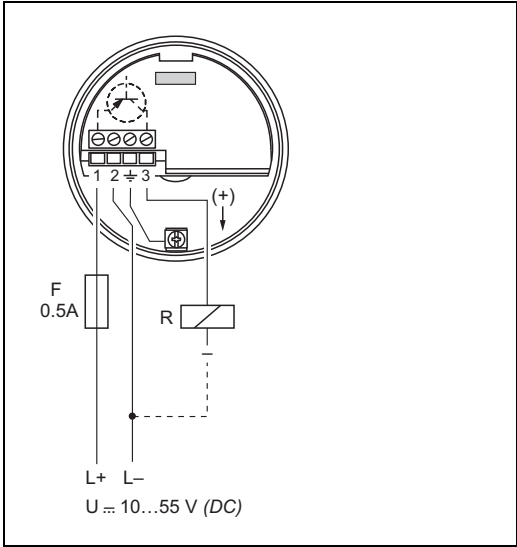
Power supply

- Supply voltage: 10 to 55 V DC
- Ripple: max. 1.7 V, 0 to 400 Hz
- Current consumption: < 20 mA
- Power consumption without load: max. 0.9 W
- Power consumption with full load (350 mA): 1.6 W
- Reverse polarity protection: yes
- Separation voltage: 3.7 kV
- Overvoltage category II

Electrical connection

Three-wire DC connection

Preferably in conjunction with programmable logic controllers (PLC),
DI modules in accordance with EN 61131-2.
Positive signal present at the switch output of the electronic system (PNP).



TI418F42

Output signal

Safety mode	Level	Output signal	LEDs gn gn rd gn gn ye
MAX		$L+ \xrightarrow{I_L} +$ 1 $\xrightarrow{I_L}$ 3	
		$1 \xrightarrow{I_R} 3$	
MIN		$L+ \xrightarrow{I_L} +$ 1 $\xrightarrow{I_L}$ 3	
		$1 \xrightarrow{I_R} 3$	
Maintenance required		$1 \xrightarrow{I_L / I_R} 3$	
Instrument failure		$1 \xrightarrow{I_R} 3$	

TI418Fen43

TI418F44

I_L = Load current
(switched through)
 I_R = Residual current
(blocked)

Lit
 Flashes
 Unlit

Signal on alarm

Output signal on power failure or in the event of device failure: $I_R < 100 \mu A$

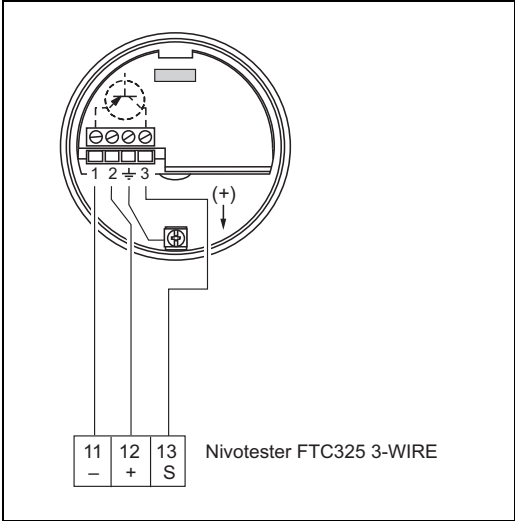
Connectable load

- Load switched via transistor and separate PNP connection, max. 55 V
- Load current max. 350 mA (cyclical overload and short-circuit protection)
- Residual current < 100 μA (with transistor blocked)
- Capacitance load max. 0.5 μF at 55 V; max. 1.0 μF at 24 V
- Residual voltage < 3 V (for transistor switched through)

Electronic insert FEI53 (3-wire)

- Power supply
- Supply voltage: 14.5 V DC
 - Current consumption: < 15 mA
 - Power consumption: max. 230 mW
 - Reverse polarity protection: yes
 - Separation voltage: 0.5 kV

- Electrical connection
- Three-wire DC connection
- 3 to 12 V signal
- For connecting to the switching unit, Nivotester FTC325 3-WIRE from Endress+Hauser.
- Switching between minimum/maximum Safety in the Nivotester FTC325 3-WIRE.
- Point level adjustment directly at the Nivotester.



TI418F45

Output signal

Mode	Output signal	LEDs green red
Normal operation	3...12 V at terminal 3	 
Maintenance required * 	3...12 V at terminal 3	 
Instrument failure 	< 2,7 V at terminal 3	 

TI418Fen46

-  Lit
-  Flashes
-  Unlit

TI418F44

- Signal on alarm
- Voltage at terminal 3 vis-à-vis terminal 1: < 2.7 V

- Connectable load
- Floating relay contacts in the connected switching unit Nivotester FTC325 3-WIRE
 - For the contact load capacity, refer to the technical data of the switching device.

Electronic insert FEI54 (AC/DC with relay output)

Power supply

- Supply voltage: 19 to 253 V AC, 50/60 Hz or 19 to 55 V DC
- Power consumption: max. 1.6 W
- Reverse polarity protection: yes
- Separation voltage: 3.7 kV
- Overvoltage category II

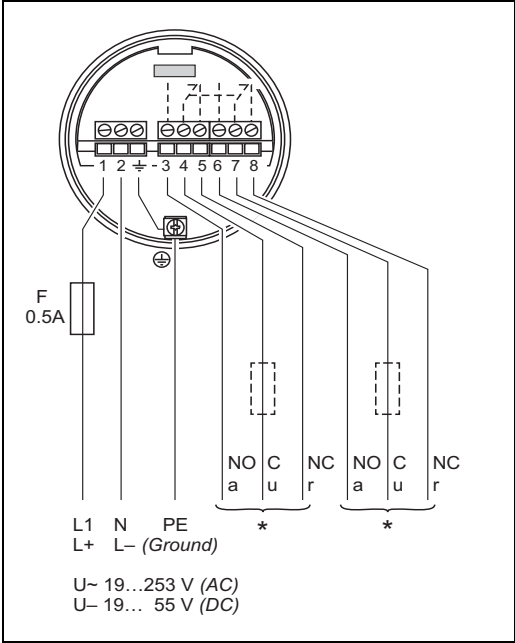
Electrical connection

Universal current connection with relay output (DPDT)

Power supply:
Please note the different
voltage ranges for AC and DC.
Alternating current.

Output:
When connecting an instrument with
high inductance, provide a spark arrester
to protect the relay contact.
A fine-wire fuse (depending on the
load connected) protects the relay
contact on short-circuiting.
Both relay contacts switch simultaneously.

* See below "Connectable load"



TI418F47

Output signal

Safety mode	Level	Output signal	LEDs gn gn rd gn gn ye
MAX			
MIN			
Maintenance required			
Instrument failure			

TI418Fen48

TI418F49

- Relay energized
- Relay de-energized
- Lit
- Flashes
- Unlit

Signal on alarm

Output signal on power failure or in the event of device failure: relay de-energized

Connectable load

- Loads switched via 2 floating changeover contacts (DPDT)
- I~ max. 6 A, U~ max. 253 V; P~ max. 1500 VA at cos φ = 1, P~ max. 750 VA at cos φ > 0.7
- I- max. 6 A to 30 V, I- max. 0.2 A to 125 V
- The following applies when connecting a functional low-voltage circuit with double isolation as per IEC 1010: Sum of voltages of relay output and power supply max. 300 V

Electronic insert FEI55 (8/16 mA; SIL2/SIL3)

Power supply	- Supply voltage: 11 to 36 V DC - Power consumption: < 600 mW - Reverse polarity protection: yes - Separation voltage: 0.5 kV
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Electrical connection	Two-wire connection for separate switching unit For connecting to programmable logic controllers (PLC), AI modules 4 to 20 mA in accordance with EN 61131--2. The point level signal is sent via an output signal jump from 8 mA to 16 mA.
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Output signal

Safety mode	Level	Output signal	LEDs gn gn rd gn gn ye
MAX		+ 2 $\xrightarrow{\sim 16 \text{ mA}}$ 1	
		+ 2 $\xrightarrow{\sim 8 \text{ mA}}$ 1	
MIN		+ 2 $\xrightarrow{\sim 16 \text{ mA}}$ 1	
		+ 2 $\xrightarrow{\sim 8 \text{ mA}}$ 1	
Maintenance required *		+ 2 $\xrightarrow{8/16 \text{ mA}}$ 1	
Instrument failure		+ 2 $\xrightarrow{< 3.6 \text{ mA}}$ 1	

Lit

Flashes

Unlit

~ 16 mA = 16 mA ± 5 %

~ 8 mA = 8 mA ± 6 %

TI418Fen51

TI418F44

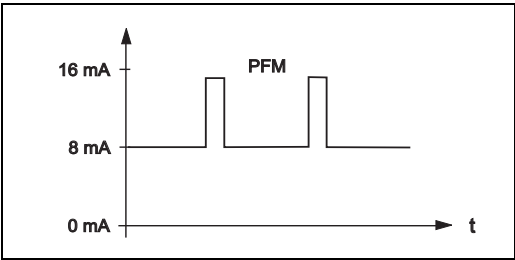
Signal on alarm	Output signal on power failure or in the event of device failure: < 3.6 mA
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Connectable load	- U = Connection DC voltage: - 11 to 36 V DC (non-hazardous area and Ex ia) - 14.4 to 30 V DC (Ex d) - I_{max} = 16 mA
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Electronic insert FEI57S (PFM)

Power supply

Supply voltage: 9.5 to 12.5 VDC
Power consumption: < 150 mW
Reverse polarity protection: yes
Separation voltage: 0.5 kV



TI418F52

Frequency: 17 to 185 Hz

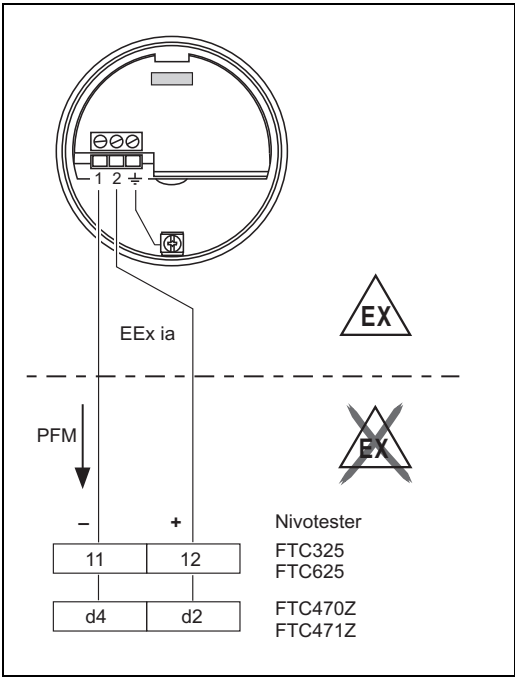
Electrical connection

Two-wire connection for separate switching unit

For connecting to switching units
Nivotester FTC325, FTC625, FTC470Z, FTC471Z
from Endress+Hauser.

PFM signal 17 to 185 Hz

Switching between minimum/maximum
safety in the Nivotester.



TI418F53

Output signal

PFM 60 to 185 Hz (Endress+Hauser)

Signal on alarm

Mode	Output signal	LEDs green red
Normal operation	60...185 Hz 1 -----> 2	
Maintenance required *	60...185 Hz 1 -----> 2	
Instrument failure	< 20 Hz 1 -----> 2	

TI418Fen54

TI418F44

Lit
 Flashes
 Unlit

Connectable load

- Floating relay contacts in the connected switching unit Nivotester FTC325, FTC625, FTC470Z, FTC471Z
- For the contact load capacity, refer to the technical data of the switching device.

Electronic insert FEI58 (NAMUR H-L edge)

Power supply

- Power consumption: < 6 mW at I < 1 mA; < 38 mW at I = 2.2 to 4 mA
- Interface connection data: IEC 60947-5-6

Electrical connection **Two-wire connection for separate switching unit**

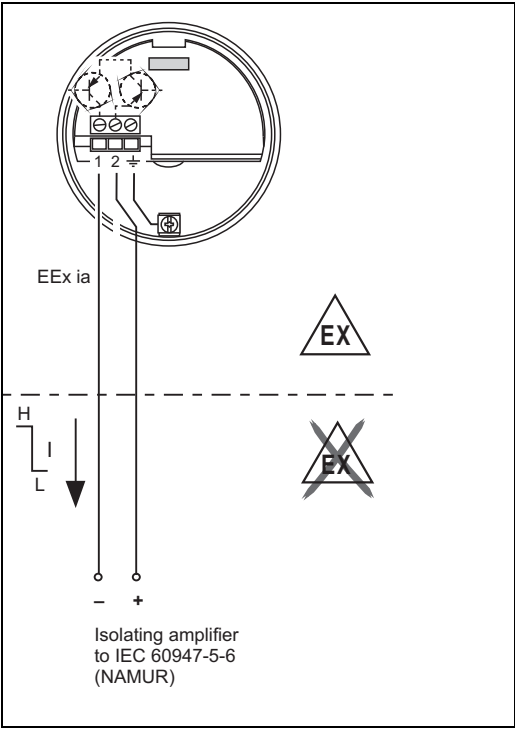
For connecting to isolating amplifiers as per NAMUR (IEC 60947-5-6), e.g. FXN421, FXN422, FTL325N, FTL375N from Endress+Hauser. Change in output signal from high to low current in event of point level detection.

(H-L edge)

Additional function:
Test key on the electronic insert.
Pressing the key interrupts the connection to the isolating amplifier.

 **Note!**
In the case of Ex-d operation, the additional function can only be used if the housing is not exposed to an explosive atmosphere.

Connection to Multiplexer: set 3 s as the cycle time at least.



L00-FTL5xxxx-04-05-xx-en-002

Output signal

 = Lit
 = Flashes
 = Unlit

L00-FTL5xxxx-07-05-xx-xx-002

Fail-safe mode	Level	Output signal	LEDs green yellow
Max.		$\begin{matrix} + & 2.2 \dots & 3.5 \text{ mA} \\ 2 & \xrightarrow{\hspace{1cm}} & 1 \end{matrix}$	 
		$\begin{matrix} + & 0.6 \dots & 1.0 \text{ mA} \\ 2 & \xrightarrow{\hspace{1cm}} & 1 \end{matrix}$	 
Min.		$\begin{matrix} + & 2.2 \dots & 3.5 \text{ mA} \\ 2 & \xrightarrow{\hspace{1cm}} & 1 \end{matrix}$	 
		$\begin{matrix} + & 0.6 \dots & 1.0 \text{ mA} \\ 2 & \xrightarrow{\hspace{1cm}} & 1 \end{matrix}$	 

L00-FTL5xxxx-04-05-xx-xx-002

Signal on alarm Output signal in the event of damage to the sensor: < 1.0 mA

Connectable load

- See the technical data of the connected isolating amplifier as per IEC 60947-5-6 (NAMUR)
- Connection also to isolating amplifiers which have special safety circuits (I > 3.0 mA)

Power supply

Electrical connection

Connection compartment

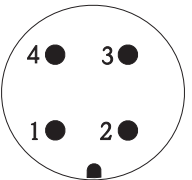
Six housings with the following protection classes are available:

Housing	Standard	Ex ia	Ex d	Gas-tight process seal
Polyester housing F16	X	X	-	-
Stainless steel housing F15	X	X	-	-
Aluminum housing F17	X	X	-	-
Aluminum housing F13	X	X	X	X
Stainless steel housing F27	X	X	X	X
Aluminum housing T13 (with separate connection compartment)	X	X	X	X

Connector

For the version with a connector M12, the housing does not have to be opened for connecting the signal line.

PIN assignment for M12 connector

	PIN	2-wire-electronic insert FEI55, FEI57, FEI58, FEI50H, FEI57C	3-wire-electronic insert FEI52, FEI53
	1	+	+
	2	not used	not used
	3	-	-
	4	ground	external load / signal

Cable entry

- Cable gland: M20x1.5 (for Ex d only cable entry M20)
Two cable glands included in scope of delivery.
- Cable entry: G ½, NPT ½ and NPT ¾.

Performance characteristics

Uncertainty: DIN 61298-2: max ±0.3%
Non-repeatability (reproducibility): DIN 61298-2: max. ±0.1 %

Reference operating conditions	■ Room temperature: +20 °C ±5 °C ■ Span: – ΔC = 5...1600 pF – ΔC = 5...500 pF (with FEI58)
Switch-on behavior	When the power supply is switched on, the switching status of the outputs corresponds to the signal on alarm. The correct switch condition is reached after max. 3 seconds.
Ambient temperature effect	Electronic insert < 0.06 % / 10 K related to the full scale value Separate housing Capacitance change of connecting cable per meter 0.15 pF/10K

Human interface

Electronic inserts	FEI51, FEI52, FEI54, FEI55
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Green LED 1 (⏻ ready for operation), red LED 3 (⚡ error indicated), yellow LED 6 (⚙ R switching state)

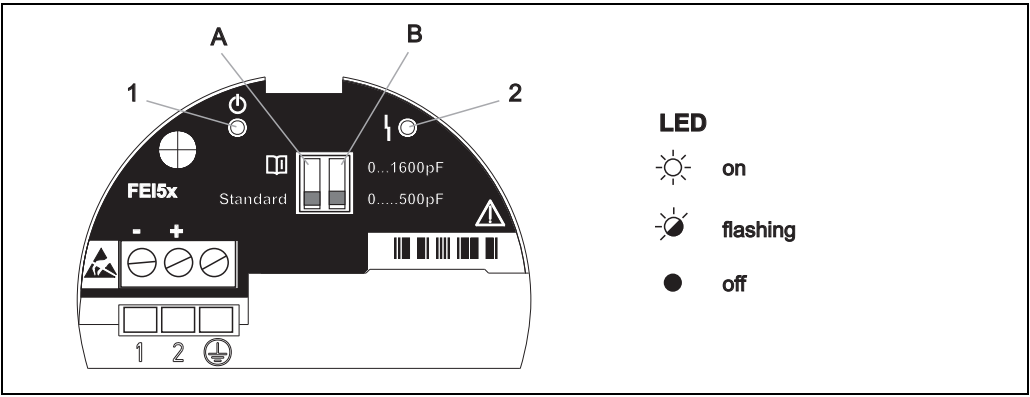
Function switch position	Function	– key	+ key	Light emitting diodes (LED signals)					
				⏻	⚡	⚙			
1	Operation			Flashes	On (MIN-SIL)	Flashes (warning/ alarm)	On (MAX-SIL)		On/off/ flashes
	Restore factory setting	Press both keys for approx. 20 s		On	->	->	->	->	On/off/ flashes

Function switch position	Function	– key	+ key	Light emitting diodes (LED signals)					
									
				 1 (green)	 2 (green)	 3 (red)	 4 (green)	 5 (green)	 6 (yellow)
2 	Empty calibration	Press		On (present)					On/off/ flashes
	Full calibration		Press					On (present)	On/off/ flashes
	Reset: Calibration and switchpoint adjustment	Press both keys for approx. 10 s		On	–>	–>	–>	–>	On/off/ flashes
3 	Switch point shift	Press for <	Press for >	On (2 pF)	Off (4 pF)	Off (8 pF)	Off (16 pF)	Off (32 pF)	On/off/ flashes
4 	Measuring range	Press for <		On (500 pF)	Off (1600 pF)				On/off/ flashes
	Two-point control Δs		Press once					On	On/off/ flashes
	buildup mode		Press twice				On	On	On/off/ flashes
5 	Switching delay	Press for <	Press for >	Off (0.3 s)	On (1.5 s)	Off (5 s)	Off (10 s)		On/off/ flashes
6 	Self-test (function test)	Press both keys		Off (inactive)				Flashes (active)	On/off/ flashes
7	MIN-/MAX Fail-safe mode	Press for MIN	Press for MAX	Off (MIN)				On (MAX)	On/off/ flashes
	SIL mode* lock/unlock	Press both keys			On (MIN-SIL)		On (MAX-SIL)		On/off/ flashes
8 	Upload/download sensor DAT (EEPROM)	Press for download	Press for upload	Flashes (download)				Flashes (upload)	On/off/ flashes

* Only in conjunction with FEI55 electronic insert (SIL).

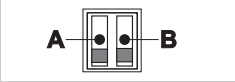
Electronic inserts

FEI53, FEI57S



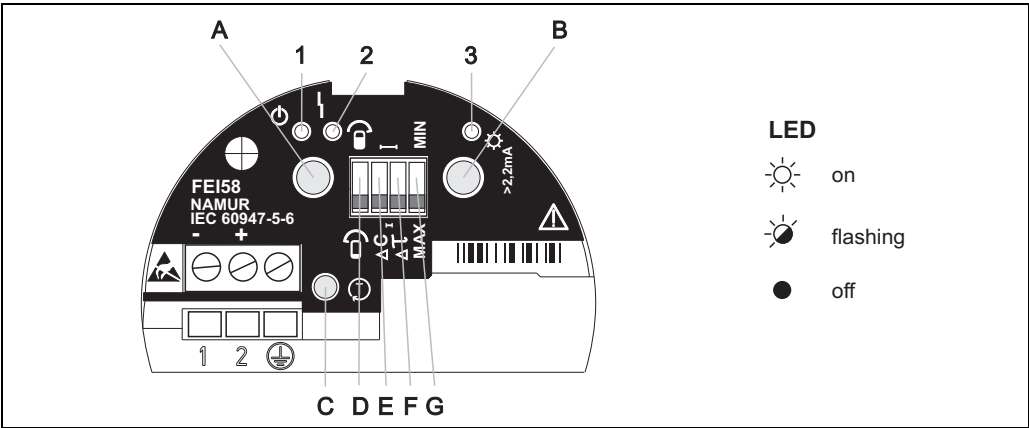
Green LED (⏻ ready for operation), red LED (⚡ error indicated)

BA300Fen016

DIP switch	Function
	
A  Standard	Standard ¹⁾ : If the measuring range is exceeded no alarm is output.
A 	 : If the measuring range is exceeded an alarm is output.
B  0....500pF	Measuring range: The measuring range is between 0 and 500 pF Span: The span is between 5 and 500 pF.
B  0...1600pF	Measuring range: The measuring range is between 0 and 1600 pF Span: The span is between 5 and 1600 pF.

Electronic insert

FEI58



BA299Fen016

Green LED 1 (☀ ready for operation), red LED 2 (⚡ error indicated), yellow LED 3 (R switching state)

DIP switches (C, D, E, F)		Function
D		The probe is covered during calibration.
D		The probe is uncovered during calibration.
E		Switchpoint adjustment: 10 pF
E		Switchpoint adjustment: 2 pF
F		Switching delay: 5 s
F		Switching delay: 1 s
G		Fail-safe mode: MIN The output switches safety-oriented when the probe is uncovered (signal on alarm). For use for dry running protection and pump protection for example
G		Fail-safe mode: MAX The output switches safety-oriented when the probe is covered (signal on alarm). For use with overfill protection for example

Key			Function
A	B	C	
X			Display diagnostic code
	X		Display calibration situation
X	X		Perform calibration (during operation)
X	X		Delete calibration points (during startup)
		X	Test key ⏏, (disconnects the transmitter from the switching unit)

Certificates and approvals

CE mark	The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
RoHS	The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).
RCM-Tick marking	The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.
Ex approval	■ ATEX ■ IECEx ■ CSA ■ FM ■ NEPSI ■ INMETRO ■ EAC See "Certificates" →  45.
EAC conformity	The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.
Other standards and guidelines	EN 60529 Degrees of protection by housing (IP code) EN 61010 Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures EN 61326 Interference emission (Class B equipment), interference immunity (Annex A - Industrial). NAMUR Association for Standards for Control and Regulation in the Chemical Industry IEC 61508 Functional safety
Additional approvals	■ See also Certificates →  45 ff. ■ TSE Certificate of Suitability (FMI51) The following applies to wetted device components: – They do not contain any materials derived from animals. – No additives or operating materials derived from animals are used in production or processing.  Note! The wetted device components are listed in the "Mechanical construction" (→  19 ff). ■ AD2000 The wetted material (316L) corresponds to AD2000 – W0/W2
CRN approval	Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are labeled with registration number CRN 0F1988.7C on the nameplate. You can find further details on the maximum pressure values in the Download Area of the Endress+Hauser website.

Pressure Equipment Directive 2014/68/EU (PED)**Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)**

Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.

Reasons:

According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings". If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser web site: www.endress.com → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Accessories

Protective cover

For F13, F17 and F27 housing (without display)
Order number: 71040497

For F16 housing
Order number: 71127760

Shortening kit for FTI52

Order number: 942901-0001

Overvoltage protection HAW56x

Surge arrester for limiting overvoltage in signal lines and components.

Note!

For detailed information about overvoltage protection please refer to the following documents::

- TI01012K: HAW562 Overvoltage protective for installation on housing M20x1,5
- TI01013K: HAW569 Overvoltage protective for installation on housing in cabinet

Weld-in adapter

All the weld-in adapters available are described in the document TI426F.

This is available in the Download Area of the Endress+Hauser web site: www.endress.com → Download

Documentation



Note!

This documentation is available on the product pages at www.endress.com

Technical Information

- Nivotester FTL325N
TI00353F/00/en
- Nivotester FTL375N
TI00361F/00/en
- EMC test procedures
TI00241F/00/en

Operating Instructions

- Liquicap M FTI51, FTI52
BA00299F/00/en

Certificates

ATEX safety instructions

- Liquicap M FTI51, FTI52
ATEX II 1/2 G EEx ia IIC/IIB T3 to T6, II 1/2 D IP65 T 85 °C
XA00327F/00/a3
- Liquicap M FTI51, FTI52
ATEX II 1/2 G Ex d [ia] IIC/IIB T3...T6, Ex de [ia Ga] IIC/IIB T3...T6 Ga/Gb,
Ex iaD 20 Txx°C/Ex tD A21 IP6x Txx°C
XA00328F/00/A3

INMETRO safety instructions

- Liquicap M FMI51, FMI52
Ex d [ia Ga] IIC/IIB T3...T6 Ga/Gb; Ex de [ia Ga] IIC T3...T6 Ga/Gb
XA01171F/00/A3
- Liquicap M FMI51, FMI52
Ex ia IIC/IIB T3...T6 Ga/Gb; Ex ia IIIC T90°C Da/Db IP65
XA01172F/00/A3

NEPSI safety instructions

- Liquicap M FTI51, FTI52
Ex ia IIC/IIB T3 to T6 Ga/Gb
XA00417F/00/a3
- Liquicap M FTI51, FTI52
EEx d [ia] IIC/IIB T3/T4/T6 Ga/Gb, Ex de ia IIC/IIB T3/T4/T6
XA00418F/00/a3

Overfill protection DIBt (WHG)

- Liquicap M FTI51, FTI52
ZE00268F/00/en

Functional safety (SIL2/SIL3)

- Liquicap M FTI51, FTI52
SD00278F/00/en

Control Drawings (FM and CSA)

- Liquicap M FTI51, FTI52
CSA: ZD00221F/00/en
- Liquicap M FTI51, FTI52
FM: ZD00220F/00/en



71365408

www.addresses.endress.com
