Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Liquicap M FMI51, FMI52

Capacitance level measurement
For continuous measurement in liquids

Application

The Liquicap M FMI5x compact transmitter is used for the continuous level measurement of 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 in the medium container of –80 °C to +200 °C.

Used in conjunction with Fieldgate (remote measured value interrogation via the Internet), Liquicap M provides an ideal solution for inventorying materials and optimizing logistics (inventory control).

Your benefits

- No adjustment necessary for media with a conductivity of 100 µS/cm and higher. The probes are adjusted to the ordered probe length on leaving the factory (0 % to 100 %). This makes easy and fast commissioning possible.
- Menu-guided local configuration via plain text display (optional)
- Universal application thanks to wide range of certificates and approvals
- Use also in safety systems requiring functional safety to SIL2 in accordance with IEC 61508
- Corrosion-resistant, FDA-listed materials in contact with the process
- Can be switched for media forming buildup
- Short reaction times
- No need for readjustment after replacing electronics
- Automatic monitoring of electronics and possible damage to insulation, as well as rod breaking or rope tearing
- Suitable for interface measurement

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People for Process Automation

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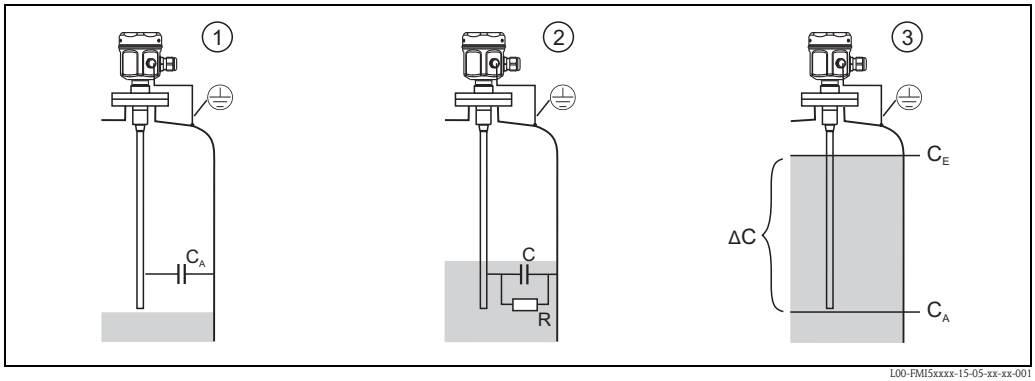
Function and system design

Measuring principle

The principle of capacitance level measurement is based on the change in capacitance of the capacitor due to the change in the level. 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 increases the more the probe is covered ②, ③.
As of a conductivity of 100 µs/cm, the measurement is independent of the value for the dielectric constant (DK) of the liquid. As a result, fluctuations in the DK value do not affect the measured value display. Furthermore, the system also prevents the effect of medium buildup or condensate near the process connection for probes with an inactive length.

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



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

Function

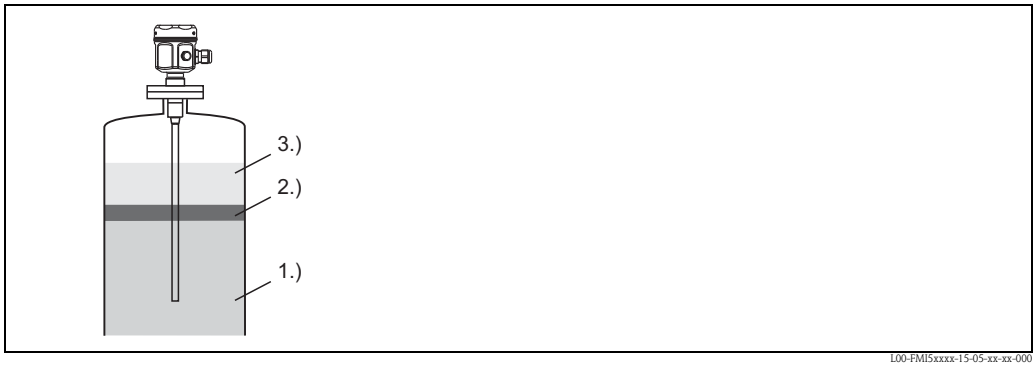
The selected electronic insert of the probe (e.g. FEI50H 4 to 20 mA HART) converts the measured change in capacitance of the liquid to a signal that is proportional to the level.

Phase-selective measurement

The evaluation of the container capacitance works along the principle of phase-selective measurement. In this process, the amount of alternating current and the phase shift between the voltage and current is measured. With these two characteristic quantities, the capacitance idle current can be calculated by the medium capacitor and the real current by the medium resistance. Conductive buildup stuck to the probe rod/rope acts like additional medium resistance and causes an error in measurement. As the size of the medium resistance can be determined with phase-selective measurement, the system compensates for the buildup on the probe.

Interface measurement

A prior adjustment also ensures a certain and definite measured value even if the emulsion layer is of varying thickness. In this process, the average value of the emulsion film is always measured.
The adjustment values for empty and full adjustment can be calculated with the FieldCare operating program from Endress+Hauser.



1.) Water, for example (the medium must be conductive ≥ 100 µS/cm)
2.) Emulsion
3.) Oil, for example (nonconductive medium <1 µS/cm)

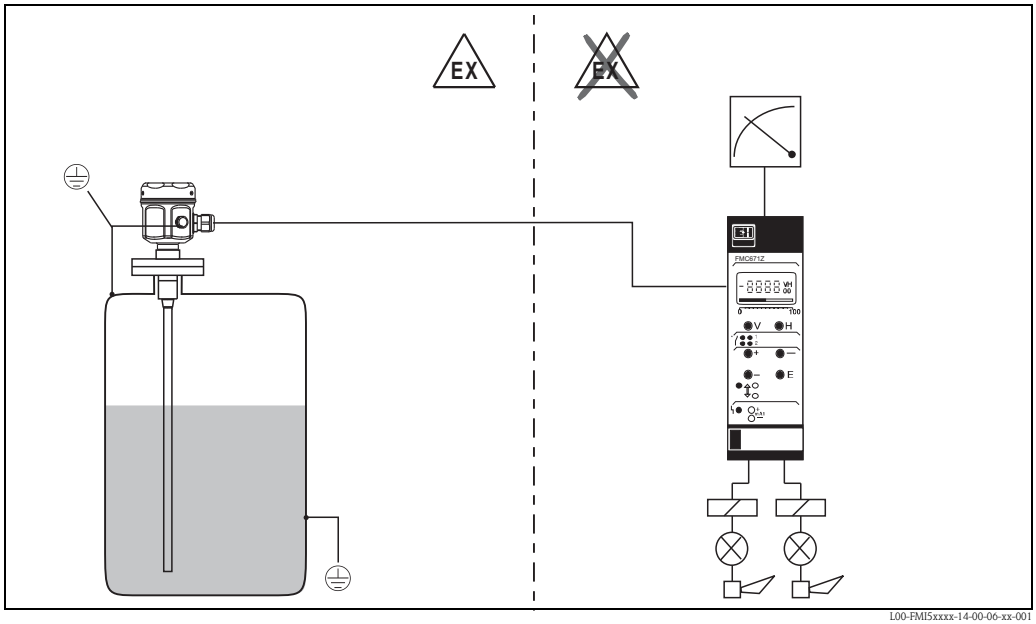
Measuring system

PFM output (FEI57C)

The complete measuring system consists of:

- The capacitance Liquicap M FMI51 or FMI52 level probe
- The FEI57C electronic insert
- A transmitter power supply unit

Note!
- The twin-core feeder is also used for PFM signal transmission.
- In combination with a power supply unit the FEC57C will only run in a 1-channel-mode and without an automatic alignment correction.



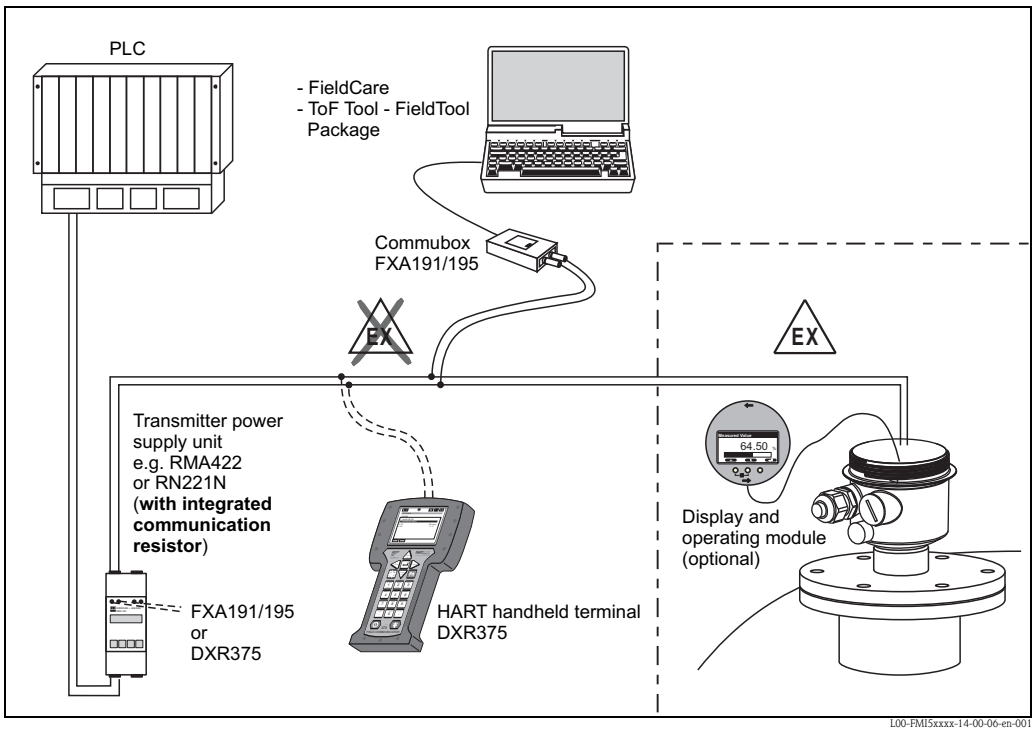
Level measurement

4 to 20 mA output with HART protocol (FEI50H)

The complete measuring system consists of:

- The capacitance Liquicap M FMI51 or FMI52 level probe
- The FEI50H electronic insert
- A transmitter power supply unit (e.g. RN221N, RNS221, RMA421, RMA422)

Note!
DC voltage must be supplied to the electronic insert. The twin-core feeder is also used for HART protocol signal transmission.



Local operation

- Standard – via keys and switches on the electronic insert
- Optional – via display and operating module

Remote operation

- With HART handheld terminal DXR375/475
- With a personal computer, Commubox FXA195 and the operating program FieldCare.

Note!
FieldCare is a graphic operating program and is used to support commissioning, data backup, signal analysis and documentation of the measuring point.

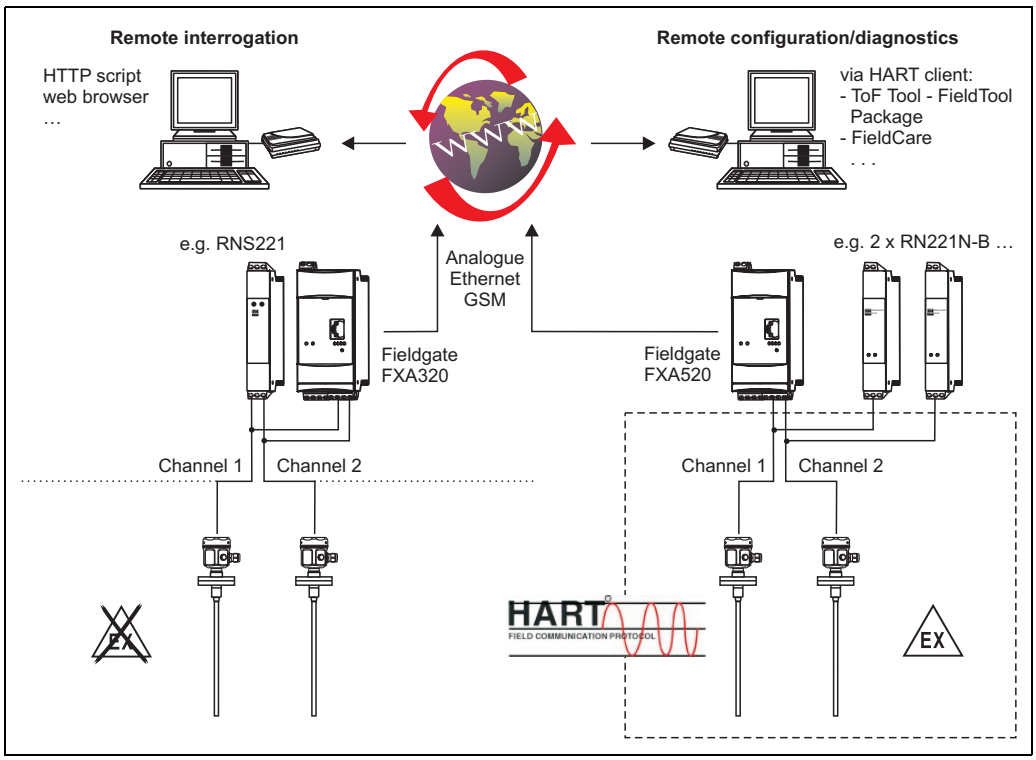
System integration via Fieldgate

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 level limits 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. Service technicians can diagnose and configure the connected HART devices remotely in the event of an alarm or also for routine checks. All that is required for this is the appropriate HART operating software (e.g. FieldCare) for the connected device. 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.



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Operating conditions: Installation

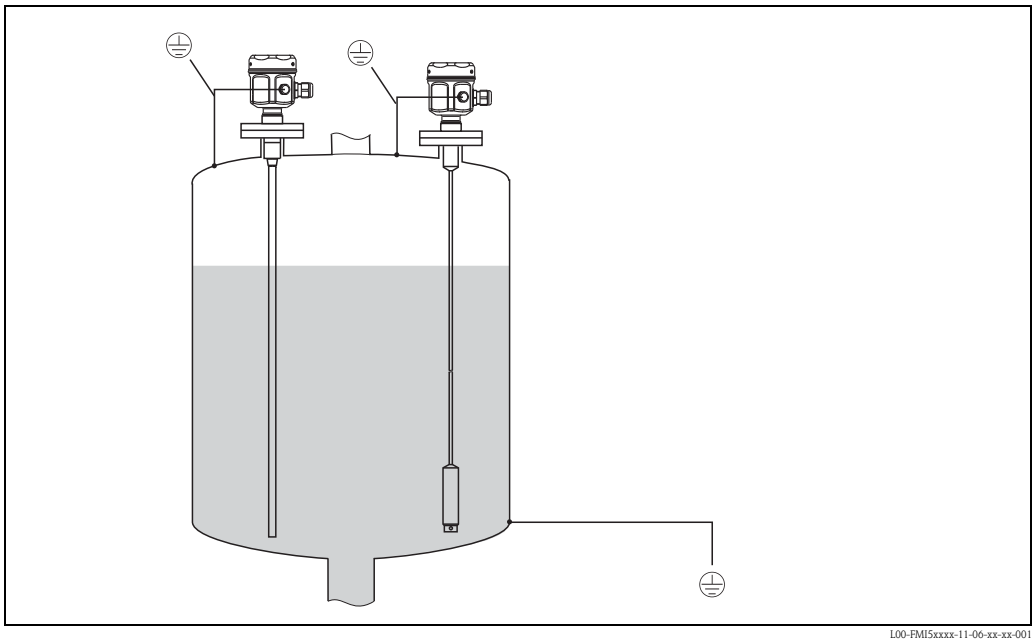
Installation instructions

Liquicap M FMI51 (rod probe) can be installed vertically from above or below.
Liquicap M FMI52 (rope probe) can be installed vertically from above.

Note!

- The probe may not come into contact with the container wall! Do not install probes in the area of the filling curtain!
- When using in agitating tanks, make sure you install at a safe distance from the agitator.
- Rod probes with a ground tube should be used in the event of severe lateral load.
- When mounting, ensure there is a good electrically conductive connection between the process connection and the tank. Use an electrically conductive sealing band for example.

For containers that conduct electricity e.g. steel tanks



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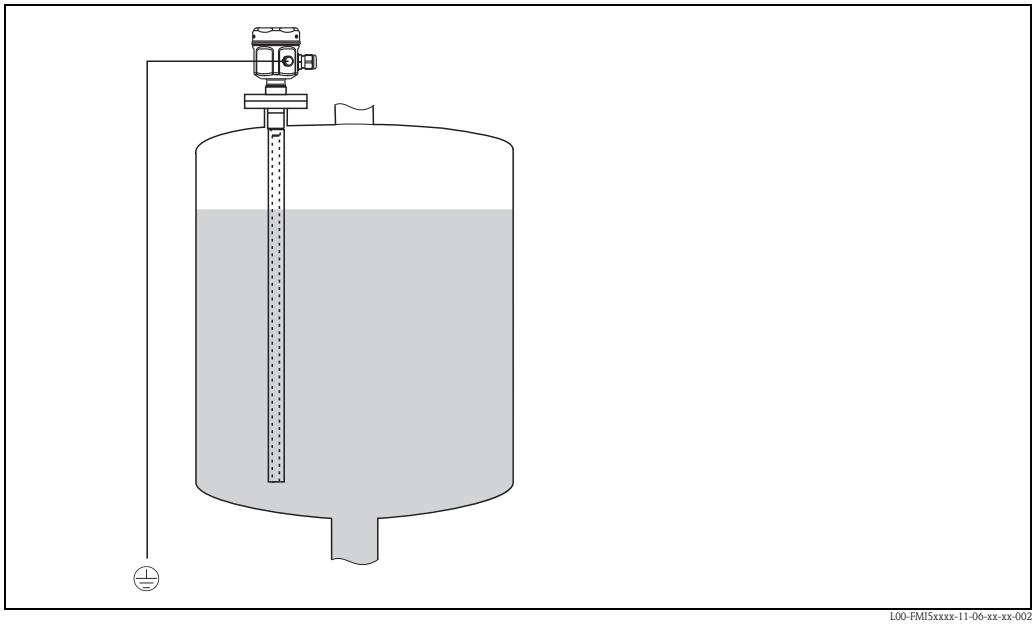
For containers that do not conduct electricity e.g. plastic tanks



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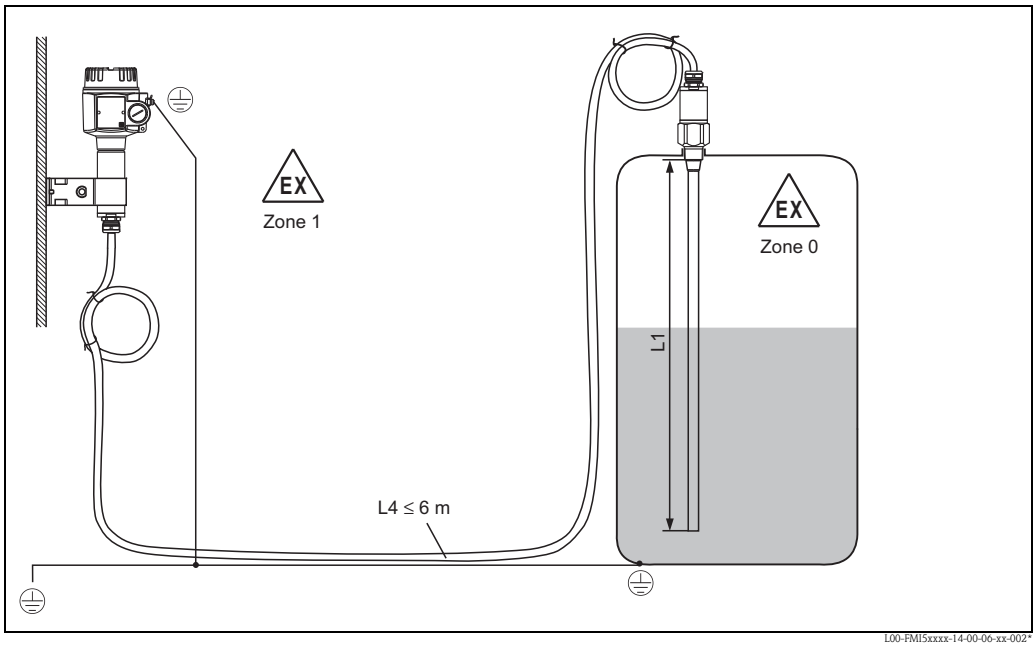
Probe with ground tube and grounding

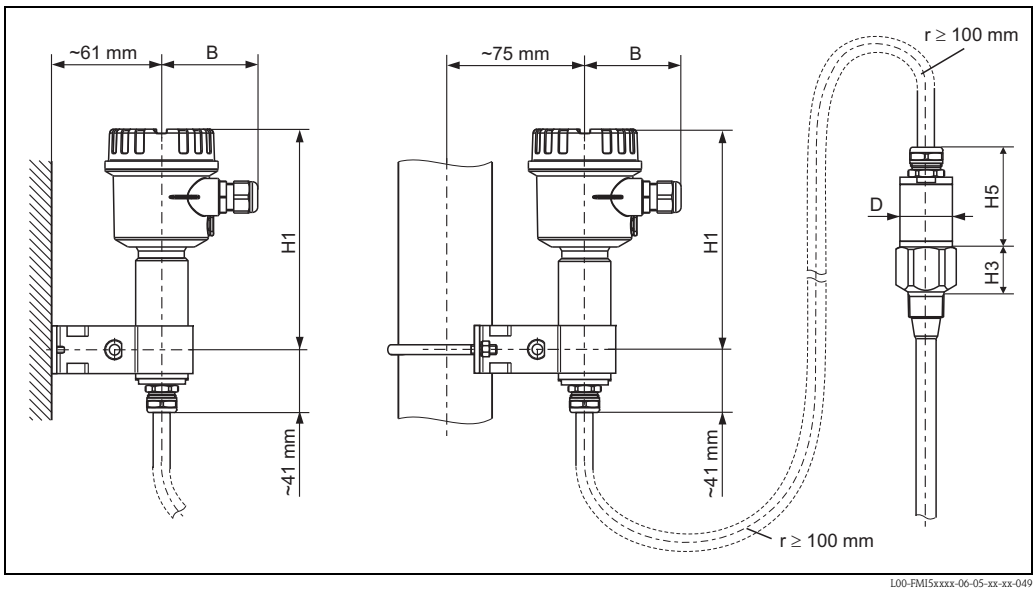
With separate housing

Note!
- The maximum connection length between the probe and the separate housing is 6 m (L4). The desired length must be quoted when ordering a Liquicap M with a separate housing.
- The overall length L = L1 + L4 may not exceed 10 m.
- If the connecting cable is to be shortened or passed through a wall, it must be separated from the process connection.



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



Note!
- The cable has a bending radius of r ≥ 100 mm
- Connecting cable: ø10.5 mm
- Outer jacket: silicone, notch-resistant

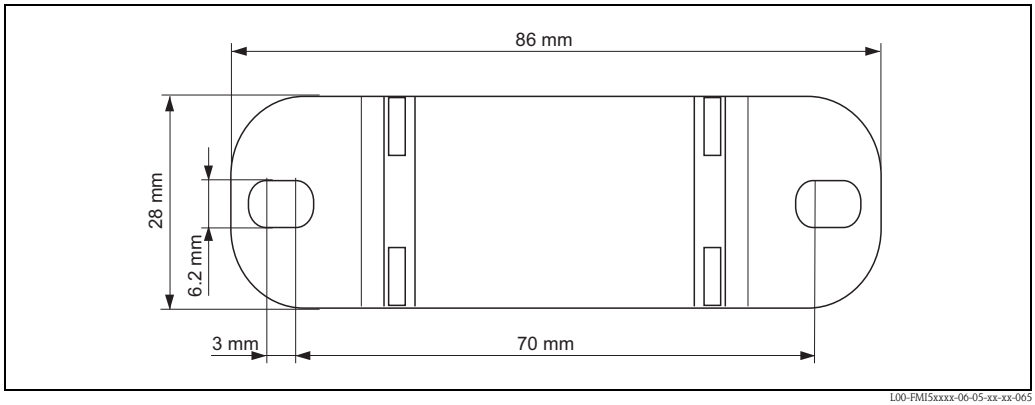
	Polyester housing (F16)	Stainless steel housing (F15)	Aluminum housing (F17)
B (mm)	76	64	65

	Polyester housing (F16)	Stainless steel housing (F15)	Aluminum housing (F17)
H1 (mm)	172	166	177

		H5 (mm)	**D** (mm)
Probes Ø10 mm rod		66	38
Probes Ø16 mm rod or rope (without fully insulated inactive length)	G¾", G1", NPT¾", NPT1", Clamp 1", Clamp 1½", Universal Ø44, flange <DN 50, ANSI 2", 10K50	66	38
	G1½", NPT1½", 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.



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Operating conditions: Environment

Ambient temperature range
- –50 to +70 °C
- –40 to +70 °C (with F16 housing)
- Observe restrictions (derating) → 🖹 11
- If operating outdoors, use a protective cover!→ 🖹 33

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 g^2/Hz

Shock resistance

DIN EN 60068-2-27/IEC 68-2-27: 30g acceleration

Cleaning

Housing:
When cleaning, make sure that the cleaning agent used does not attack or corrode the housing surface or 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.

Degree of protection

	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 with gas-tight process seal	X	X	X***	X
Aluminum housing T13 with gas-tight process seal and separate connection compartment (EEx d)	X	–	X***	X
Separate housing	X	–	X***	X

* as per EN60529
** as per NEMA 250
*** Only with M20 cable entry or G1/2 thread

Electromagnetic compatibility (EMC)

- Interference emission to EN 61326, Electrical Equipment Class B
  Interference immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC)
  Error current in accordance with Namur NE43: FEI50H = 22mA
- A usual commercial instrument cable can be used.

Operating conditions: Process

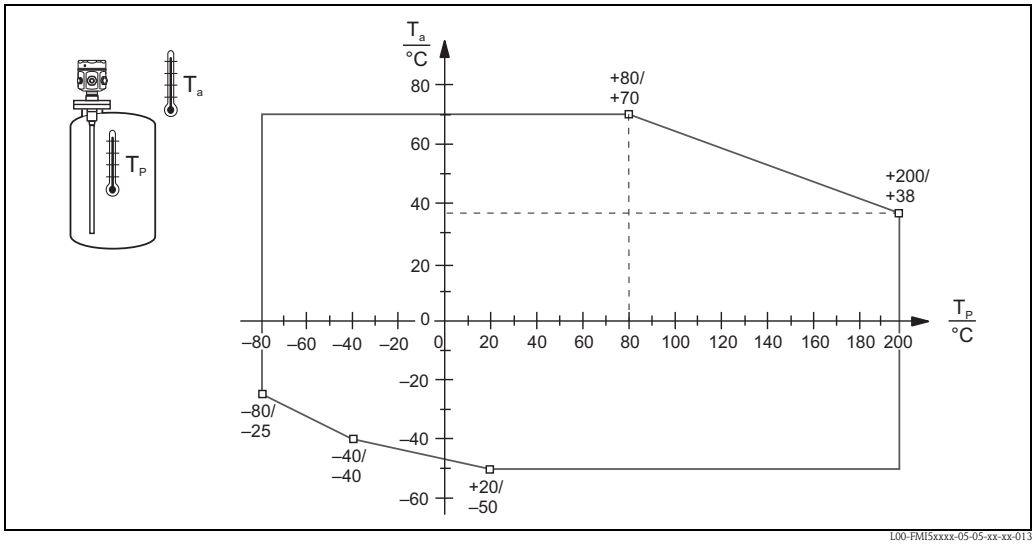
Process temperature range

The following diagrams apply for:

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

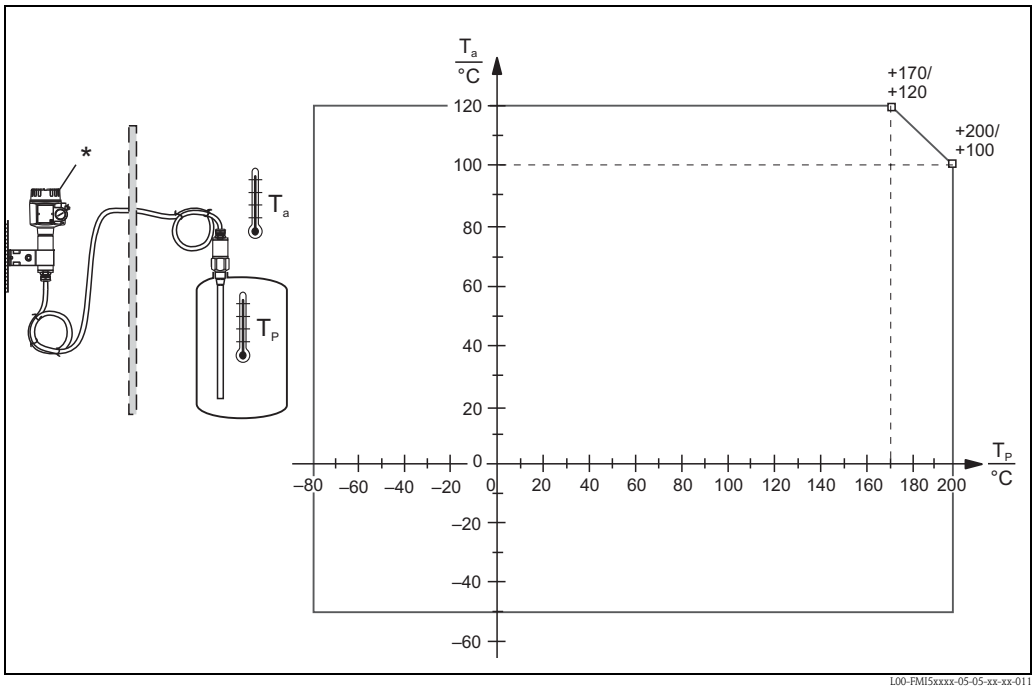
Note!
The temperature is restricted to T_a –40 °C if the polyester housing F16 is used or if additional option B is selected (free from paint-wetting impairment substances, only FMI51).

With compact housing



T_a: Ambient temperature
T_P: Process temperature

With separate housing



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 .*

Process pressure limits

Probe ø10 mm (including insulation)

–1 to 25 bar (observe dependencies: process temperature and process connection → 11 and → 17).

Probe ø16 mm (including insulation)

- –1 to 100 bar (observe dependencies: process temperature and process connection → 11 and → 17)
- 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 → 11 and → 17).

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

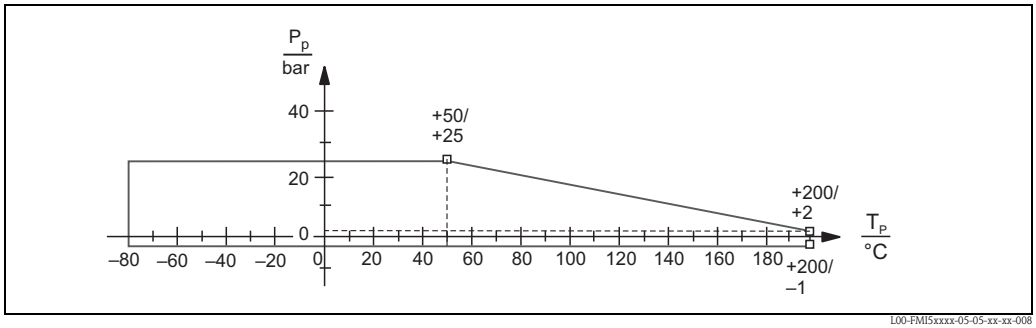
- EN 1092-1: 2005 Table, Appendix G2
  With regard to its resistance/temperature property, the material 1.4435 is identical to 1.4404 which is grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a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

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

Pressure and temperature derating

For process connections ½", ¾", 1", flanges < DN50, < ANSI 2", < JIS 50A (10 mm rod)
For process connections ¾", 1", flanges < DN50, < ANSI 2", < JIS 50A (16 mm rod)
Rod insulation: PTFE, PFA
Rope insulation: FEP, PFA

Note!
See also "Process connections" → 17.

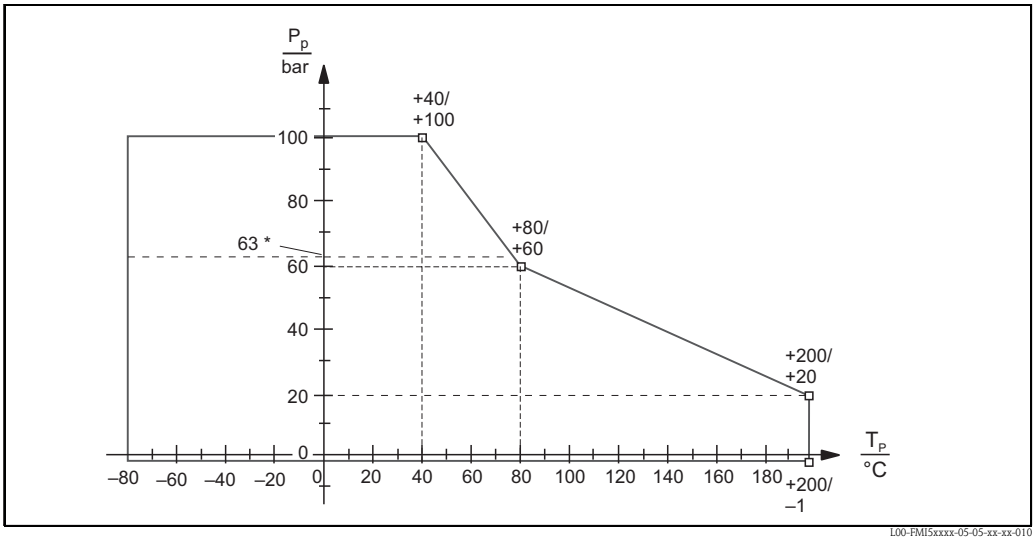


P_p: Process pressure
T_p: Process temperature

For process connections 1½", flanges ≥ DN50, ≥ ANSI 2", ≥ JIS 50A (16 mm rod)

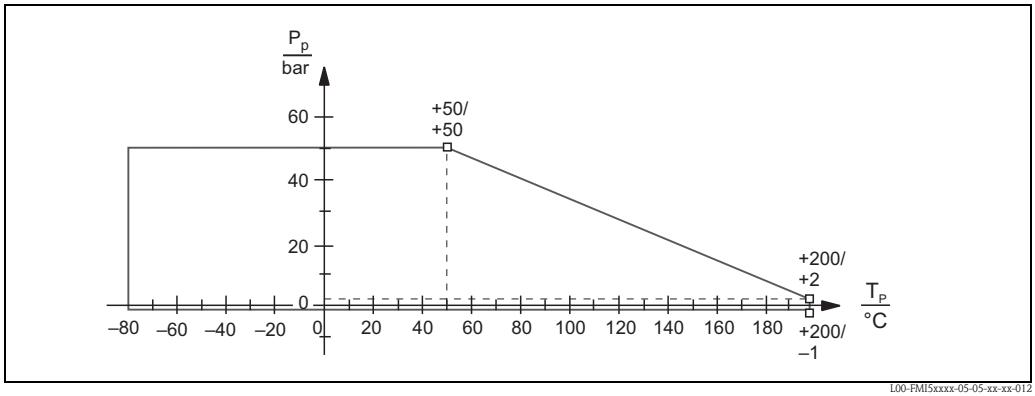
Rod insulation: PTFE, PFA
Rope insulation: FEP, PFA

Note!
See also "Process connections" → 17



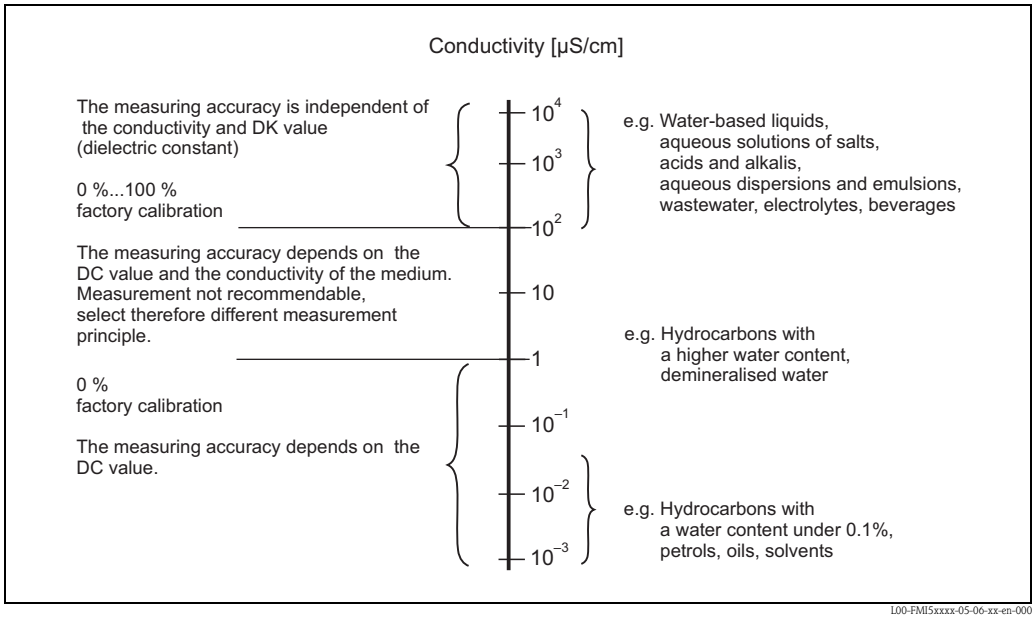
P_p: Process pressure
T_p: Process temperature
** For probes with an inactive length .*

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



P_p: Process pressure
T_p: Process temperature

Liquicap M operational range

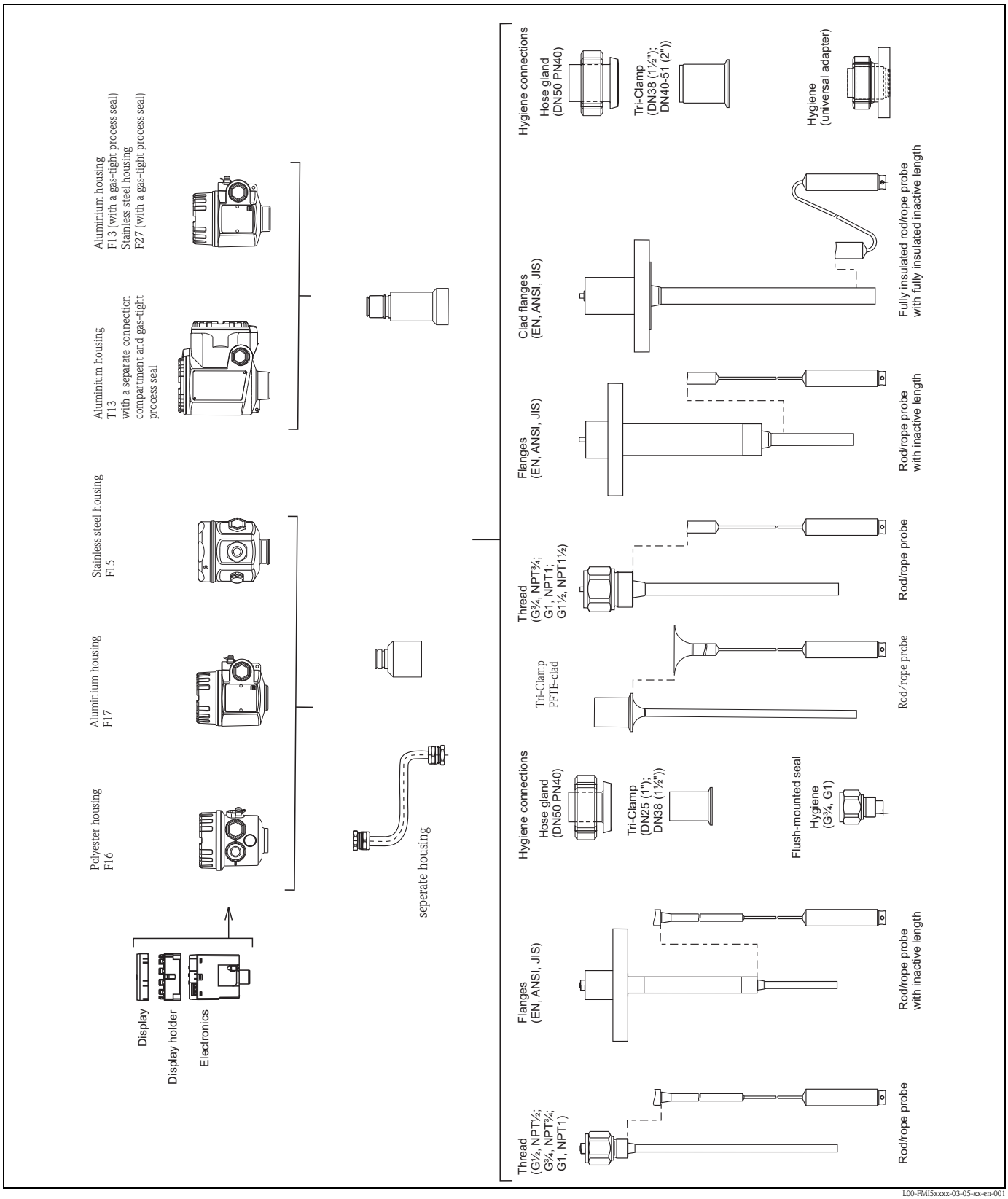


Typical DK values (dielectric constant)	
Air	1
Vacuum	1
General liquefied gases	1.2 - 1.7
Gasoline	1.9
Cyclohexane	2
Diesel fuel	2.1
General oils	2 - 4
Methyl ether	5
Butanol	11
Ammonia	21
Latex	24
Ethanol	25
Caustic soda	22 - 26
Acetone	20
Glycerine	37
Water	81

Note!
Additional DK values are listed in the document "CP00019F" which is available at:
www.endress.com → Download → Advanced → Documentation code = CP00019F → Start search

Mechanical construction

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



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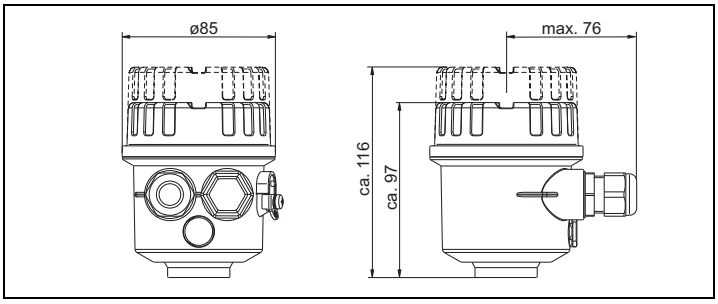
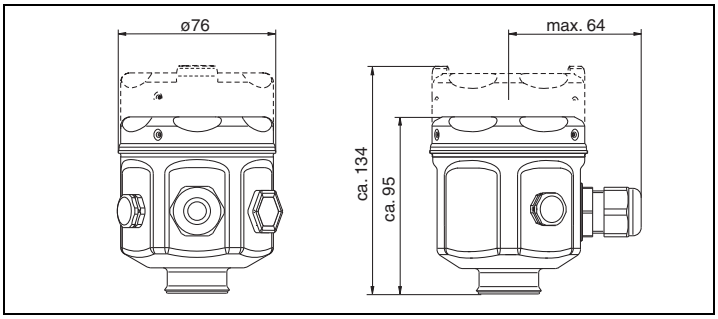
Housing

Note!
High cover for display (optional).

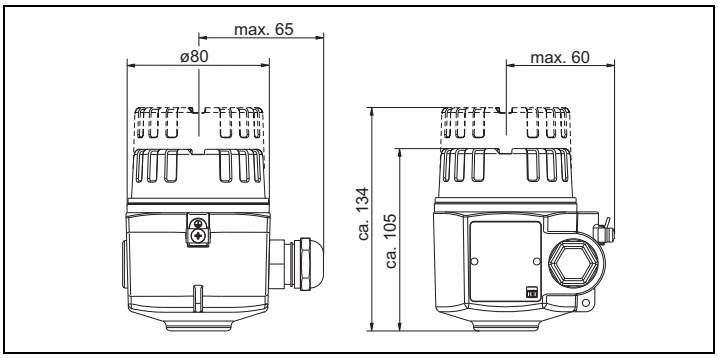
Polyester housing F16



Stainless steel housing F15

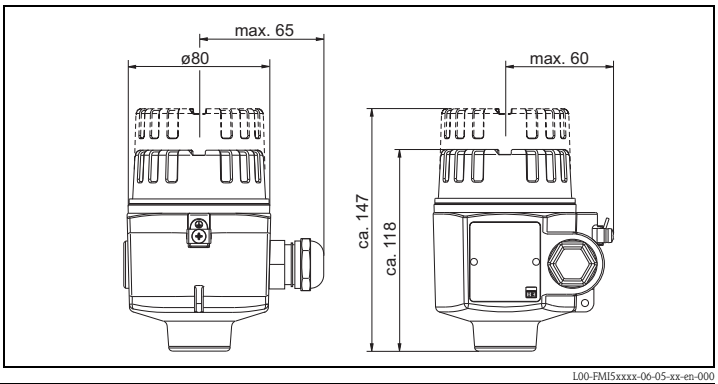


Aluminum housing F17

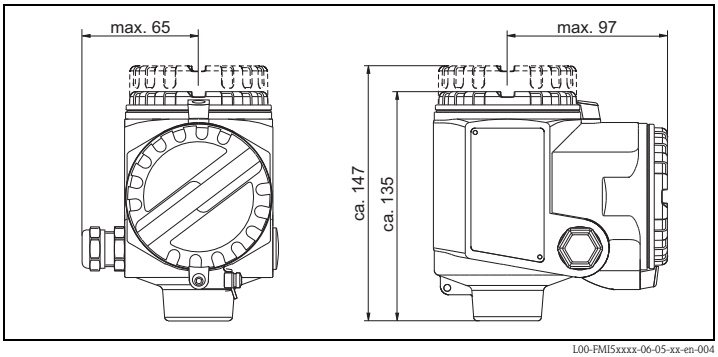


Aluminum housing F13
With gas-tight process seal

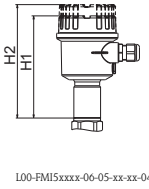
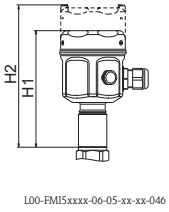
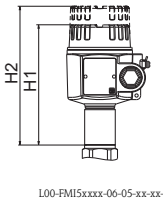
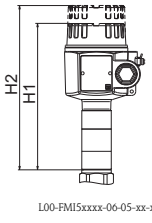
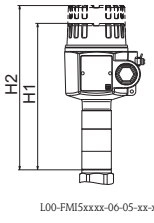
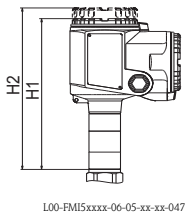
Stainless steel housing F27
with gas-tight process seal



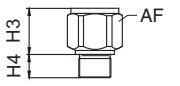
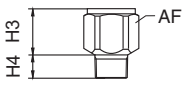
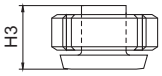
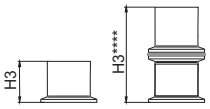
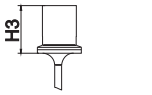
Aluminum housing T13
With separate connection compartment and gas-tight process seal



Extension height of housing with adapter

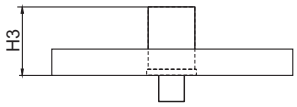
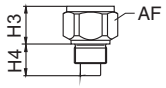
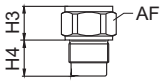
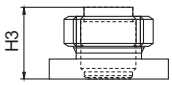
	Polyester housing F16	Stainless steel housing F15	Aluminum housing F17	Aluminum housing F13	Aluminum housing F27	Aluminum housing T13
	 L00-FMI5xxxx-06-05-xx-xx-044	 L00-FMI5xxxx-06-05-xx-xx-046	 L00-FMI5xxxx-06-05-xx-xx-045	 L00-FMI5xxxx-06-05-xx-xx-048	 L00-FMI5xxxx-06-05-xx-xx-048	 L00-FMI5xxxx-06-05-xx-xx-047
Order code	2	1	3	4	6	5
H1 (without display)	143	141	150	194	194	210
H2 (with display)	162	179	179	223	223	223

Process connections

	Thread G		Thread NPT		Threaded pipe joint	Tri-Clamp		Tri-Clamp clad	
	 L00-FMI5xxxx-06-05-xx-en-007 (DIN EN ISO 228-1)		 L00-FMI5xxxx-06-05-xx-en-008 (ANSI B 1.20.1)		 L00-FMI5xxxx-06-05-xx-xx-040 (DIN11851)	 L00-FMI5xxxx-06-05-xx-xx-111 (ISO2852)		 L00-FMI5xxxx-06-05-xx-xx-103 (ISO2852)	
Rod probes Ø 10, rope probes									
For pressures up to	25 bar		25 bar		25 bar	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	H3 = 38 H4 = 19 AF = 41		H3 = 38 H4 = 19 AF = 41		H3 = 57	H3 = 57		–	
Surface roughness***	–		–		≤ 0.8 µm	≤ 0.8 µm		–	
Additional information	Seal: elastomer		–		–	EHEDG*, 3A*		–	
Rod probes Ø16, rope probes									
For pressures up to	25 bar	100 bar	25 bar	100 bar	40 bar	25 bar**	40 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	H3 = 38 H4 = 19 AF = 41	H3 = 41 H4 = 25 AF = 55	H3 = 38 H4 = 19 AF = 41	H3 = 41 H4 = 25 AF = 55	H3 = 66	H3 = 98****	H3 = 66	H2 = 66	
Surface roughness***	–		–		≤ 0.8 µm	≤ 0.8 µm		≤ 0.8 µm	
Additional information	Seal: elastomer		–		–	EHEDG*, 3A*		EHEDG, 3A*	
Rod probes Ø 22, rope probes									
For pressures up to	50 bar		50 bar		–	–			
Version / order code	G1½ / GGJ		NPT1½ / RGJ		–	–			

	Thread G	Thread NPT	Threaded pipe joint	Tri-Clamp	Tri-Clamp clad	
Dimensions	H3 = 85 H4 = 25 AF = 55	H3 = 85 H4 = 25 AF = 55	–	–		
Additional information	Seal: elastomer	–	–	–		

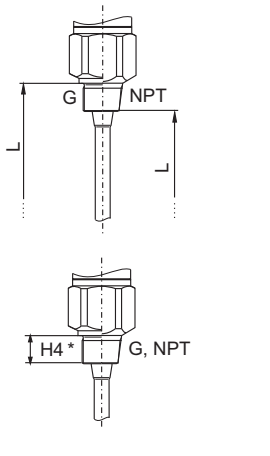
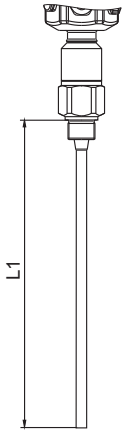
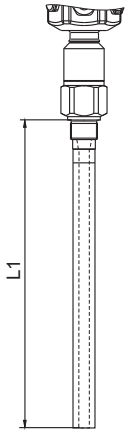
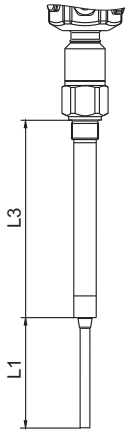
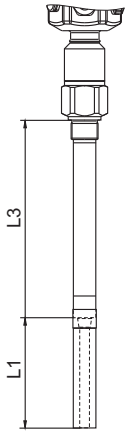
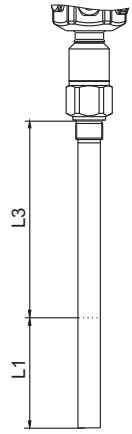
* EHEDG, 3A: Certificate only applies for probes without an inactive length and with a fully insulated probe rod.
** In the event of CRN approval, the maximum permitted process pressure is 11 bar.
*** Not in conjunction with inactive length.
**** Process connection: Tri-Clamp (47 mm) with seal (2 mm) and removable clamp (49 mm).

	Flanges	Hygiene connection	Hygiene connection	Hygiene connection
	 L00-FMI5xxxx-06-05-xx-xx-042	 L00-FMI5xxxx-06-05-xx-en-009	 L00-FMI5xxxx-06-05-xx-en-010	 L00-FMI5xxxx-06-05-xx-xx-043
	(EN1092-1) (ANSI B 16.5) (JIS B2220)	Thread with flush-mounted seal	Thread with flush-mounted seal	Adapter 44 mm with flush-mounted seal
Rod probes ∅10, rope probes				
For pressures up to	Max. 25 bar (depends on flange)	25 bar	25 bar	–
Version / order code	EN / B## ANSI / A## JIS / K##	G¾ / GQJ	G1 / GWJ	–
Dimensions	H3 = 57	H3 = 31 H4 = 26 AF = 41	H3 = 30 H4 = 27 AF = 41	–
Additional information	Also clad (PTFE)	Weld-in adapter see "Accessories"Seite 33 EHEDG*, 3A*	Weld-in adapter see "Accessories"Seite 33 EHEDG*, 3A*	–
Rod probes ∅16, rope probes				
For pressures up to	Max. 100 bar (depends on flange)	–	–	16 bar (tightening torque 10 Nm)
Version / order code	EN / B## ANSI / A## JIS / K##	–	–	Universal adapter / UPJ
Standard dimensions: Dimensions with inactive length:	H3 = 66 H3 = 56	– –	– –	H3 = 57 –
Additional information	Also clad (PTFE)	–	–	Universal adapter see "Accessories"→ 🖹 34
Rod probes ∅22, rope probes				
For pressures up to	Max. 50 bar (depends on flange)	–	–	–
Version / order code	EN / B## ANSI / A## JIS / K##	–	–	–
Dimensions	H3 = 111	–	–	–
Additional information	Only clad (PTFE)	–	–	–

* EHEDG, 3A: Certificate only applies for probes without an inactive length and with a fully insulated probe rod.

Rod probes FMI51

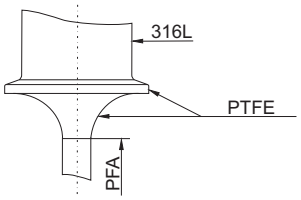
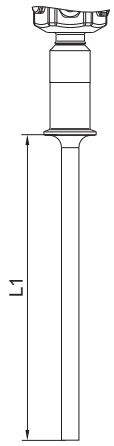
Note!
- The active probe rod is always fully insulated (dimension L1).
- Total length of probe from sealing surface: L = L1 + L3
- Thickness of insulation for probe rod diameter: 10 mm = 1 mm; 16 mm = 2 mm; 22 mm = 2 mm
- The insulation is welded at the tip of the probe. Measurement cannot be performed in this area.
  Probe rod diameter 10 mm: approx. 10 mm
  Probe rod diameter 16 and 22 mm: approx.15 mm
- For conductive liquids (>100 µS/cm), the probe is adjusted at the factory to the probe length ordered (0 % to 100 %). For nonconductive liquids (<1 µS/cm), 0% adjustment is performed at the factory. The 100% adjustment has to be carried out on site.
- 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**
 L00-FMI5xxxx-06-05-xx-xx-102									 L00-FMI5xxxx-06-05-xx-xx-051
Total length (L)	100...4000		100...4000		200...6000		200...6000		300...4000
Active rod length (L1)	100...4000		100...4000		100...4000		100...4000		150...3000
Inactive rod length (L3)	–		–		100...2000		100...2000		150...1000
∅ Probe rod	10	16	10	16	10	16	10	16	22**
Height of the cone at the end of the active rod length (L1), depending on the probe diameter	10	13	10	13	10	13	10	13	–
∅ Ground tube with or without inactive length	–	–	22	43	22	43	22	43	22**
Lateral loading capacity (Nm) at 20 °C	<15	<30	<40	<300	<30	<60	<40	<300	<25
For use in agitating tanks	–		–	X	–		–	X	–
For conductive liquids >100 µS/cm	X		–		X		–		X
For nonconductive liquids <1 µS/cm	–		X		–		X		–
For aggressive liquids	X		–		–		–		X
For high-viscosity liquids	X		–		X		–		X
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

* H4 = Thread height (important for calculating the exact probe length for process connections with a thread.) → 🖹 17
** Probe tube

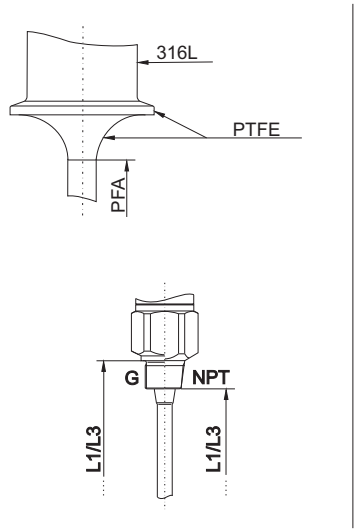
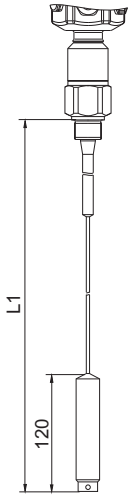
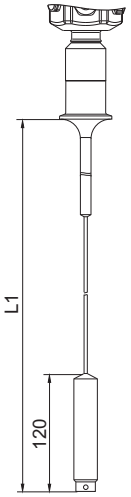
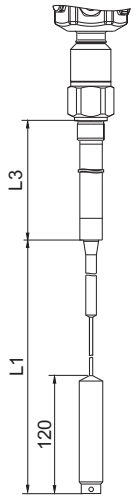
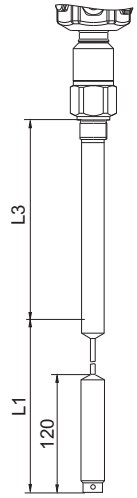
Rod probes FMI51 for hygiene applications

Note!
- Total length of probe from sealing surface: L = L1
- Thickness of insulation with probe rod diameter 16 mm = 2 mm
- Length tolerances L1: <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
	
Total length (L)	100...4000
Active rod length (L1)	100...4000
Probe rod diameter	16
∅ Ground tube	–
∅ Inactive length	–
Lateral loading capacity (Nm) at 20 °C	<30
For use in agitating tanks	–
For conductive liquids >100 µS/cm	X
For high-viscosity conductive liquids	–
For nonconductive liquids <1 µS/cm	X
For aggressive liquids	X
For high-viscosity liquids	X
For use in plastic tanks	–
For use in mounting nozzles	–
In the event of condensate on tank ceiling	–

FMI52 rope probes

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)
- For conductive liquids (>100 µS/cm), the probe is adjusted at the factory to the probe length ordered (0 % to 100 %). For nonconductive liquids (<1 µS/cm), 0% adjustment is performed at the factory. Only the 100% adjustment must be carried out on site.
- Not suitable for agitator tanks, high-viscosity liquids and plastic tanks.
- Thickness of rope insulation 0.75 mm
- In the range of the anchor weight the measurement is not linear.
- Length tolerances L1, L3: <1 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

	Rope probe	**Rope probe with clad Tri-Clamp**	**Rope 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...10000	570...10000
Active rope length (L1)	420...10000		420...9850	420...9850
Inactive length (L3)	–		150...2000	150...1000
∅ Inactive length	–		22/43*	22**
∅ Probe rope	4		4	4
∅ Anchor weight	22		22	22
∅ 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 µS/cm	X		X	X
For aggressive liquids	X		–	X
For high-viscosity liquids	–		–	–
For nonconductive liquids <1 µS/cm	–		X	X
In the event of condensate on tank ceiling	–		X	X

* The ∅ value of the inactive length depends on the process connection selected → 🖹 33+
** 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 ∅ 10 mm: 0.5 kg/m,
+ Probe rod ∅ 22 mm: 0.8 kg/m
+ Probe rod ∅ 16 mm: 1.1 kg/m
+ Probe rope: 0.04 kg/m

Technical data: probe

Capacitance values of probe

- Basic capacitance: approx. 18 pF

Additional capacitance

- Mount the probe with 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. 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: in air approx. 6.4 pF/100 mm
  – Insulated probe rod: in water approx. 38 pF/100 mm (16 mm rod)
  – Insulated probe rod: in water approx. 45 pF/100 mm (10 mm rod)

Probe lengths for continuous measurement in conductive liquids

- Rod probe (range 0 to 2000 pF for ≤ 4000 mm)
- Rope probe <6 m (range 0 to 2000 pF)
- Rope probe >6 m (range 0 to 4000 pF)

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
  – If PFA selected: PFA (FDA 21 CFR 177.1550)
  – If PTFE selected: PTFE and PFA (FDA 21 CFR 177.1550)
- Probe rope insulation
  – If FEP selected: FEP, PTFE and PFA (FDA 21 CFR 177.1550)
  – If PFA selected: PTFE and PFA (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 (→ 🖹 33 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

Continuous measurement of change in capacitance between probe rod and container wall or ground tube, depending on the level of a liquid.

Probe covered => high capacitance
Probe not covered => low capacitance

Measuring range

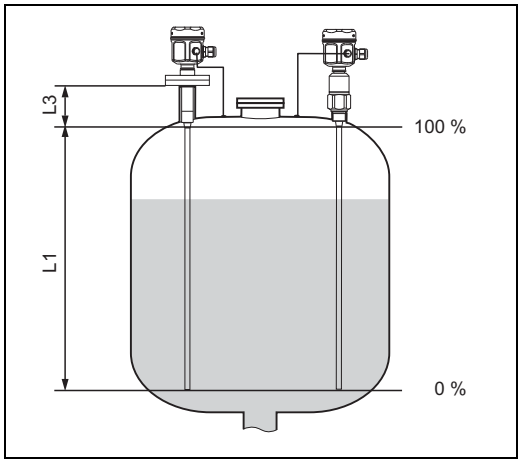
- Measuring frequency: 500 kHz
- Span: ΔC = 25 to 4000 pF recommended (2 to 4000 pF possible)
- Final capacitance: C_E = max. 4000 pF
- Adjustable initial capacitance:
  - C_A = 0 to 2000 pF (<6 m probe length)
  - C_A = 0 to 4000 pF (>6 m probe length)

Measuring condition

- Measuring range L1 possible from the tip of the probe to the process connection.
- Particularly suited for small containers.

Note!
When installing in a nozzle, use inactive length (L3).

The 0 %, 100 % adjustment can be inverted.



L00-FMI5xxxx-15-05-xx-xx-002

Output

Output signal

FEI50H (4 to 20mA/HART Version 5.0)

3.8 to 20.5 mA with HART protocol

FEI57C (PFM)

The transmitter superimposes current pulses (PFM signal 60 to 2800 Hz) with a pulse width of approx. 100 µs and a current strength of approx. 8 mA on the supply current (approx. 8 mA).

Signal on alarm

FEI50H

Fault diagnosis can be called up as follows:
- Via the local display: Red LED
- Via the local display showing:
  – Error symbol
  – Plain text display
- Via the current output: 22 mA (in accordance with NE43)
- Via the digital interface (HART status error message)

FEI57C

Fault diagnosis can be called up as follows:
- Via the local display: Red LED
- Local display at switching unit

Linearization

FEI50H

The Liquicap M linearization function enables conversion of the measured value into any desired length or volume units. Linearization tables for volume calculation of horizontal cylindrical tanks and spherical tanks are pre-programmed. Any other tables with up to 32 value pairs can be input manually or semi-automatically.

FEI57C

With FEI57C, linearization takes place in the switching units.

Power supply

Electrical connection

Connection compartment

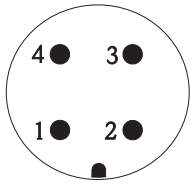
Six housings with the following protection classes are available:

Housing	Standard	EEx ia	EEx 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

M12 connector

For the version with an M12 connector, the housing does not have to be opened to connect the signal line.

PIN assignment for M12 connector

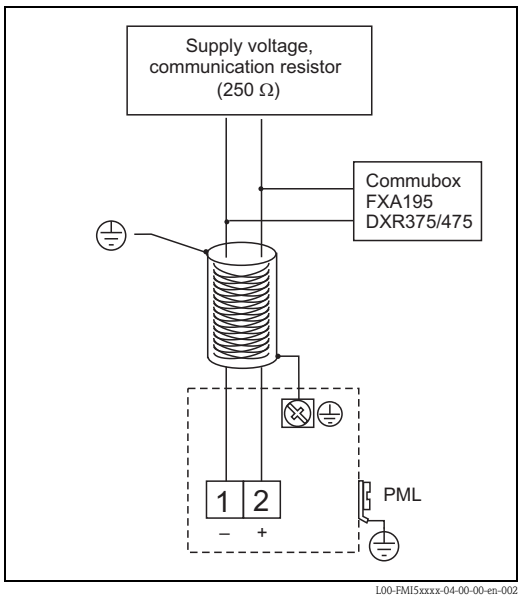


PIN	2-wire electronic inserts: FEI50H, FEI57C
1	+
2	Not assigned
3	–
4	Ground

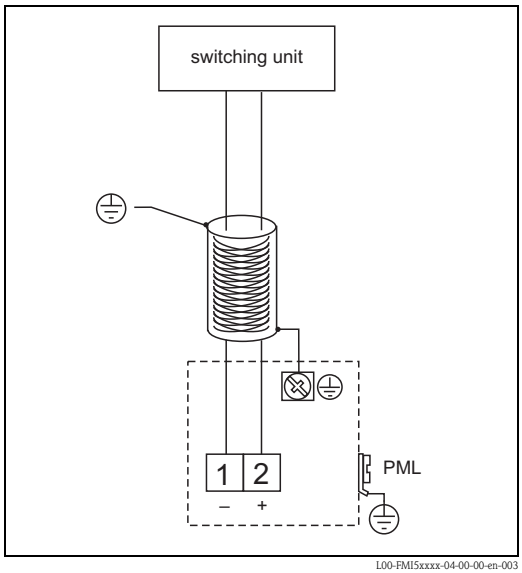
Terminal assignment

2-wire, 4 to 20 mA with HART

The twin-core connecting cable is connected to the screw terminals (conductor cross-section 0.5 to 2.5 mm) in the connection compartment at the electronic insert. If the superimposed communication signal (HART) is used, a shielded cable must be used and the shielding connected at the sensor and power supply.
Protective circuits against reverse polarity, HF-influences and overvoltage peaks are integrated (see TI241F "EMC test procedures").



2-wire, PFM
The twin-core, shielded connecting cable with a cable resistance of max. 25 Ω per core is connected to the screw terminals (conductor cross-section 0.5 to 2.5 mm) in the connection compartment. The shielding must be connected at the sensor and power supply.
Protective circuits against reverse polarity, HF-influences and overvoltage peaks are integrated (see TI241F "EMC test procedures").



L00-FMI5xxxx-04-00-00-en-003

Supply voltage

All of the following voltages are terminal voltages directly at the device:

FEI50H:

- 12.0 to 36 VDC (in the non-hazardous area)
- 12.0 to 30 VDC (in hazardous areas EEx ia)
- 14.4 to 30 VDC (in hazardous areas EEx d)

FEI57C:

14.8 VDC from associated supply unit.

Note!
Both electronic inserts have integrated reverse polarity protection.

Cable entry

- Cable gland: M20x1.5 (for EEx d only cable entry)
  Two cable glands are included in scope of delivery.
- Cable entry: G ½ or ½ NPT

Power consumption

FEI50H

Min. 40 mW, max. 800 mW

FEI57C

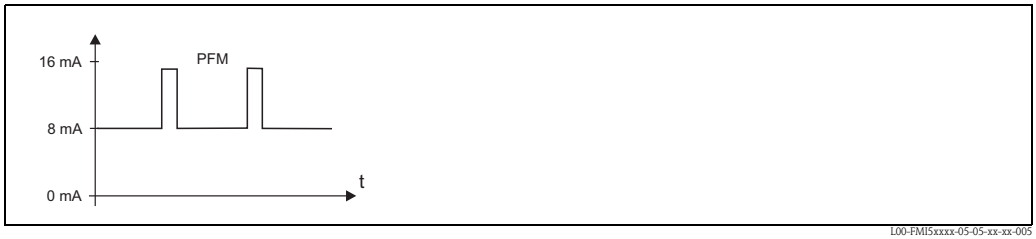
Max. 250 mW

Current consumption

FEI50H (4 to 20 mA/HART)

- Current consumption: 3.8 to 22 mA
- HART multidrop operation: 4 mA
- Residual ripple HART: 47 to 125 Hz: Uss = 200 mV (with 500 Ω)
- Noise HART (FEI50H): 500 Hz to 10 kHz: Ueff <2.2 mV (with 500 Ω)

FEI57C



L00-FMI5xxxx-05-05-xx-xx-005

Frequency: 60 to 2800 Hz

Performance characteristics

Reference operating conditions

- Room temperature: +20 °C ±5 °C
  - Span: ΔC = 25 to 4000 pF recommended (2 to 4000 pF possible)

Maximum measured error

- Non-repeatability (reproducibility) as per DIN 61298-2: max. ±0.1 %
- Non-linearity for limit point setting (linearity) as per DIN 61298-2: max. ±0.5 %

Influence of ambient temperature

Electronic insert

<0.06 % / 10 K related to the full scale value

Separate housing

Change in capacitance of connecting cable 0.015 pF/m per K

Influence of process pressure

In the case of fully insulated probes in conductive liquids: <10.0 % related to the full scale value

Switch-on behavior

FEI50H
14 s (stable measured value after switch-on procedure). Start-up in safe state (22 mA).

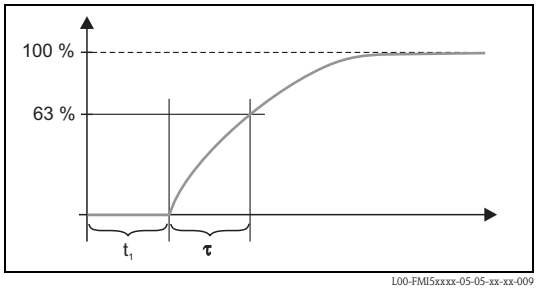
FEI57C
1.5 s (stable measured value after switch-on procedure). Start-up in safe state (22 mA).

Measured value reaction time

FEI50H
$t_1 \leq 0.3$ s
$t_1 \leq 0.5$ s for operating mode SIL

FEI57C
$t_1 = 0.3$ s

Note!
Observe integration time of switching unit



L00-FMI5xxxx-05-05-xx-xx-009

τ = *Integration time*
t_1 = *Dead time*

Integration time

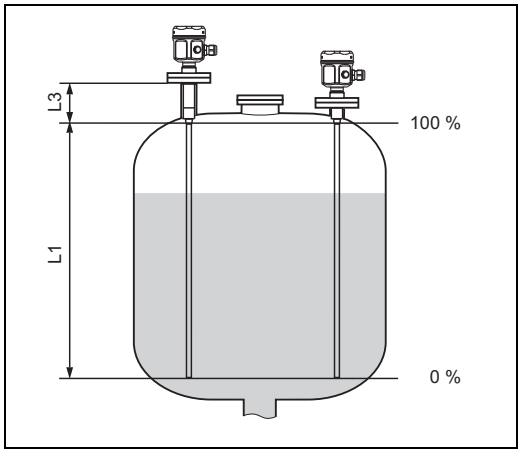
FEI50H
τ = 1 s (factory setting) 0 to 60 s can be set.
The integration time affects the speed at which the display and the current output react to changes in the level.

Accuracy of factory adjustment

	Probe length <2 m	Probe length >2 m
Empty adjustment (0 %)	≤ 5 mm	Approx. 2 %
Full adjustment (100 %)	≤ 5 mm	Approx. 2 %

Medium conductivity ≥ 100 µS/cm
Minimum distance to container wall = 250 mm

Note!
In an installed state, readjustment is only necessary if:
- The 0 % or the 100 % value have to be adjusted specifically for the customer.
- The liquid is not conductive.
- The distance from probe to tank wall is <250 mm



L00-FMI5xxxx-15-05-xx-xx-002

Resolution

FEI50H

Analog in % (4 to 20 mA)
- FMI51, FMI52: 11 bit/2048 steps, 8 µA
- The resolution of the electronics can be directly converted to units of length of the probe FMI51 or FMI52.
  e.g. active probe rod 1000 mm
  Resolution = 1000 mm/2048 = 0.48 mm

FEI57C

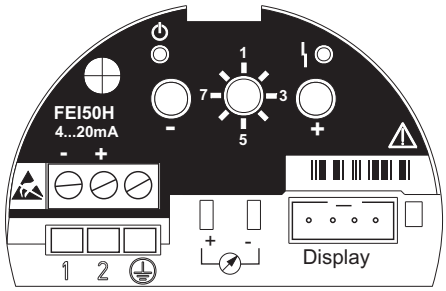
- Zero frequency f_0 60 Hz:
  Sensitivity of the electronic insert = 0.685 Hz/pF
  Entry in switching unit FMC671 under V3H5 and V3H6 or V7H5 and V7H6

Human interface

Electronic inserts

FEI50H

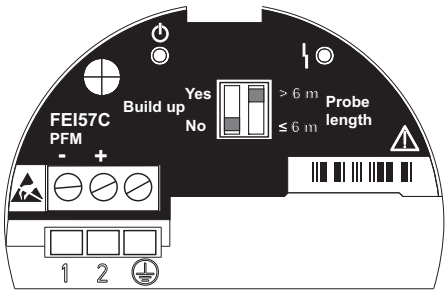
- Green LED (⏻ operational status)
- Red LED (ϟ fault message)
- Key (-)
- Key (+)
- Mode switch
  - 1 : Operation
  - 2 : Empty adjustment
  - 3 : Full adjustment
  - 4 : Measuring modes (buildup)
  - 5 : Measuring range
  - 6 : Self-test
  - 7 : Reset (factory settings)
  - 8 : Upload sensor EEPROM
- 4 to 20 mA current pick-off, e.g. for full/empty adjustment with multimeter.
- Display connection



L00-FMI5xxxx-07-05-xx-xx-000

FEI57C

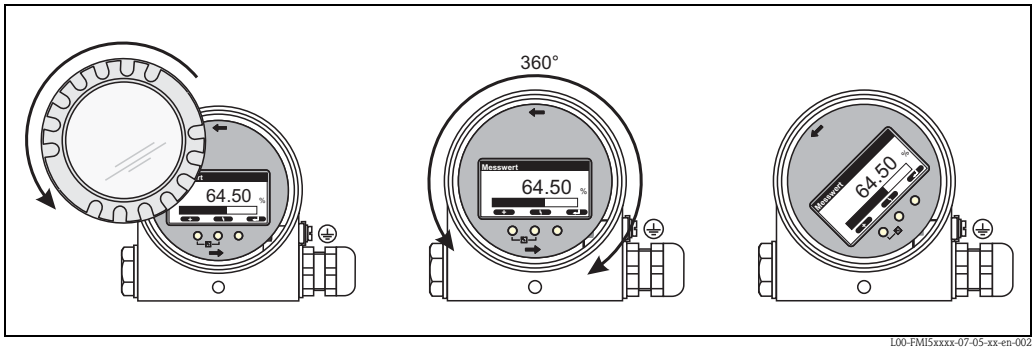
- Green LED (⏻ operational status)
- Red LED (ϟ fault message)
- DIP switch, buildup (YES/NO)
- DIP switch, probe length (probe length >6 m/≤6 m)



L00-FMI5xxxx-07-05-xx-xx-002

Local operation with display

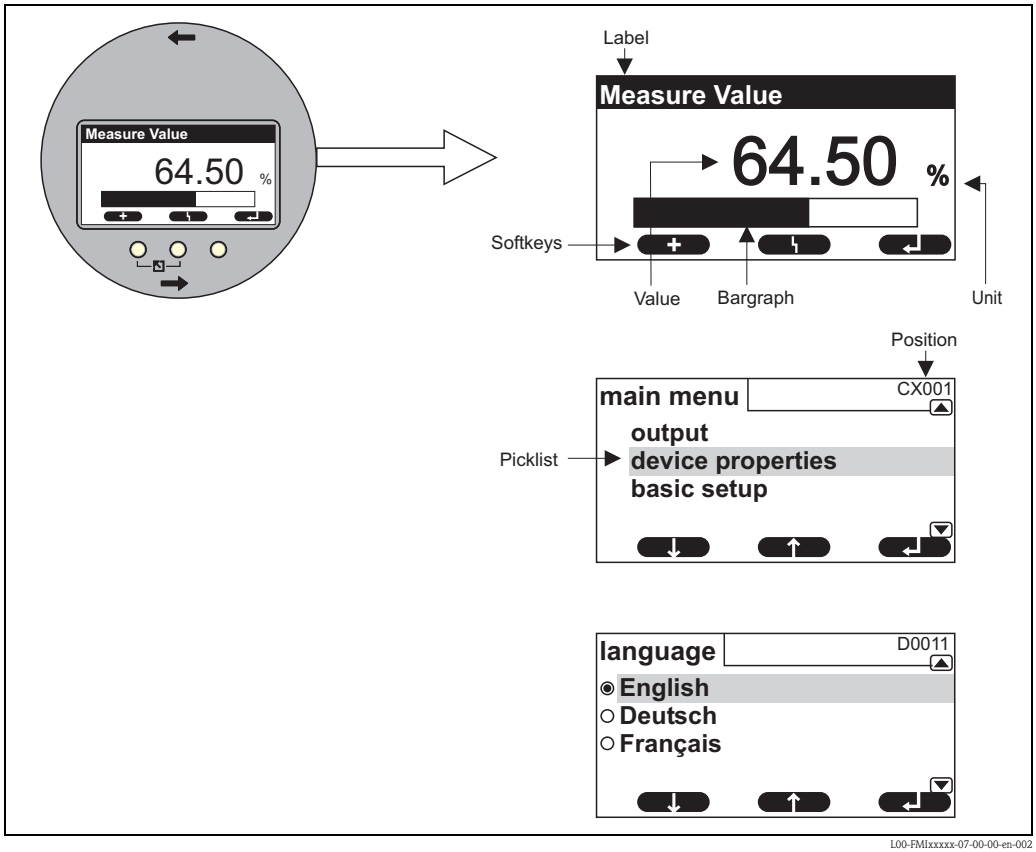
The optional display can be used to configure via 3 keys directly at the device. All device functions can be set via menu operation. The menu consists of function groups and functions. Application parameters can be read or set in the functions.



L00-FMI5xxxx-07-05-xx-en-002

Graphic display with operating keys: can be rotated 360°

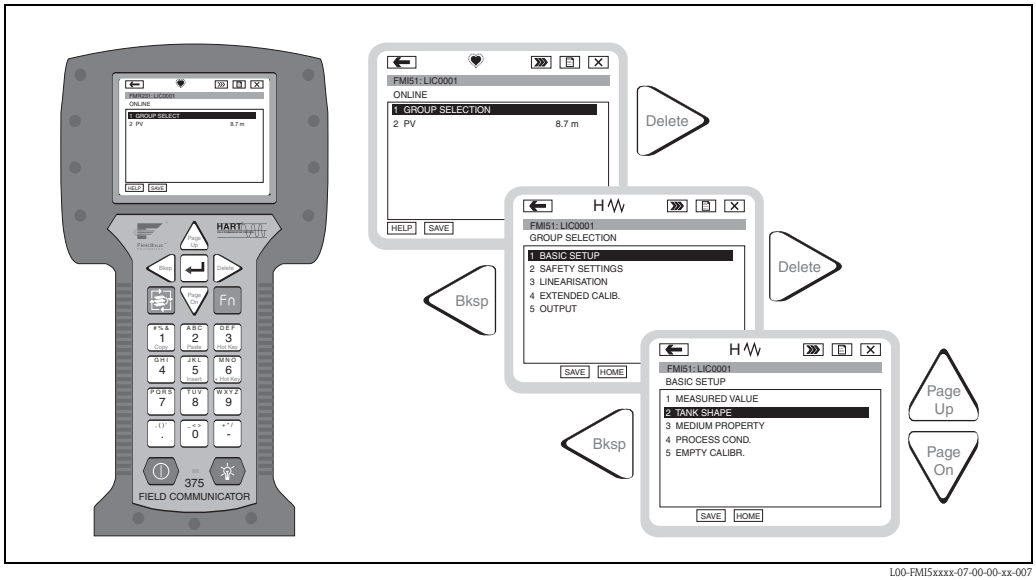
The menu guidance with integrated help texts ensures quick and safe commissioning.
For accessing the display, the cover of the electronics compartment can also be opened in hazardous areas (EEx ia).



L00-FMIxxxxx-07-00-00-en-002

Remote operation with handheld terminal

The handheld terminals FieldXpert SFX100 or Field Communicator DXR375/475 can be used to set all device functions via menu operation.



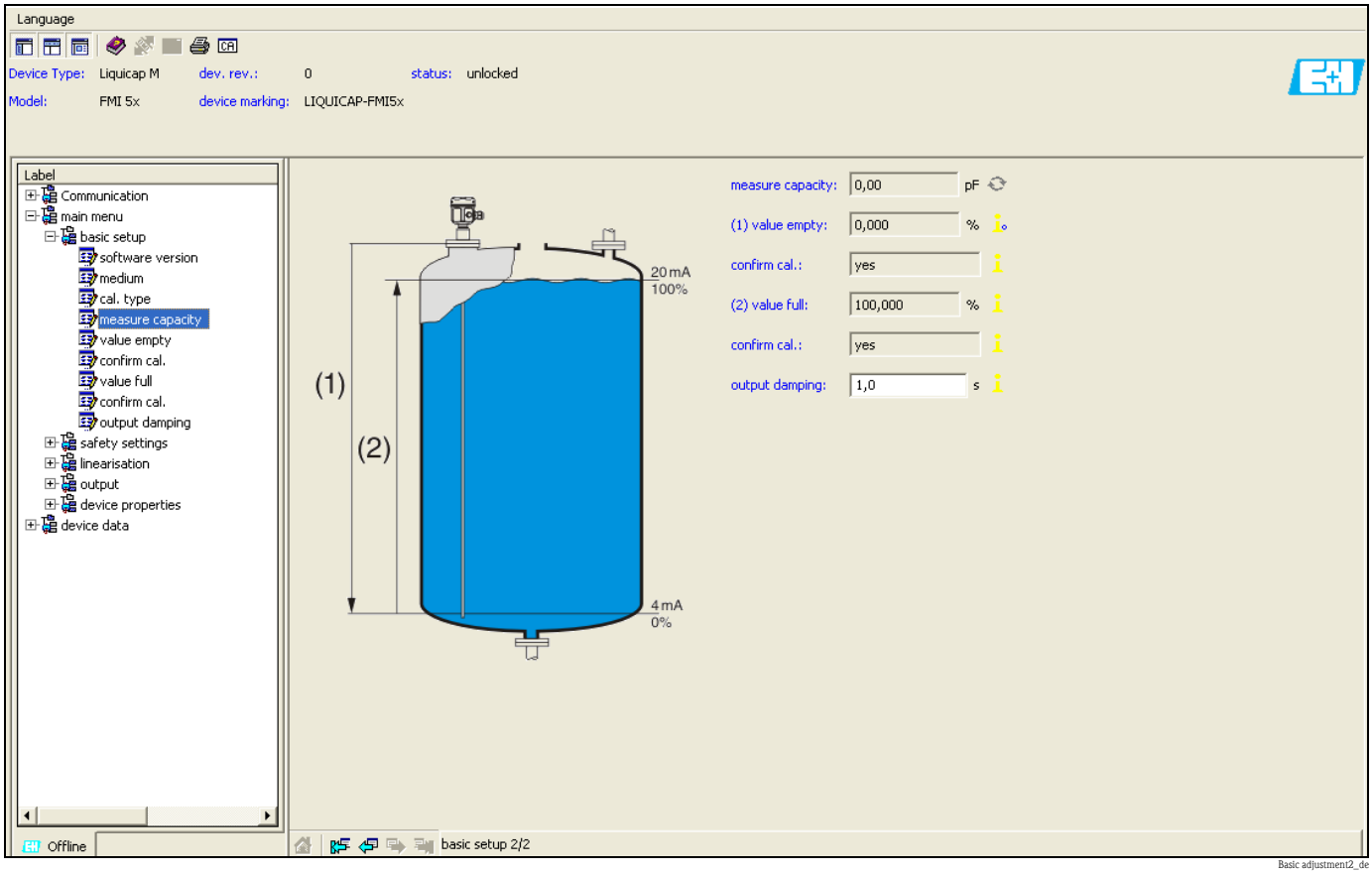
L00-FMI5xxxx-07-00-00-xx-007

Remote operation via FieldCare Device Setup

FieldCare is a graphic operating program and is used to support commissioning, data backup, signal analysis and documentation of the devices. The following operating systems are supported:
Windows 2000, Windows XP, Windows Vista and Windows 7.

FieldCare supports the following functions:
- Configuration of transmitters in online operation
- Tank linearization
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Menu guided commissioning



Connection options

- HART with Commubox FXA195

Note!
The latest version of FieldCare is available at: www.de.endress.com → Search for: FieldCare.

Certificates and approvals

CE mark

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations that are listed in the EC Declaration of Conformity and thus meet the legal requirements of the EC Directives. Endress+Hauser confirms the conformity of the device by affixing to it the CE mark.

Ex approval

See "Ordering information" from → 33

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 "Ordering information: approval" → 33 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" (→ 15 ff) and "Ordering information" (→ 33 ff) sections.
- AD2000
  The wetted material (316L) corresponds to AD2000 – W0/W2

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

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

Accessories

Protective cover

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

For F16 housing
Order number: 71127760

Shortening kit for FMI52

Once the rope is shortened, the device loses its hygiene approval: EHEDG, 3A.
Order number: 942901-0001

Commubox FXA195 HART

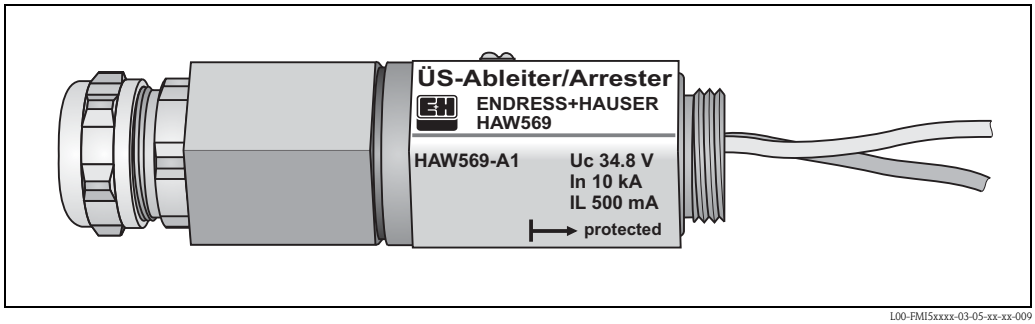
For intrinsically safe HART communication with FieldCare via a USB port.

Overvoltage protection HAW56x

Surge arrester for limiting overvoltage in signal lines and components.

Overvoltage protection (installation on housing M20x1.5)

- HAW569-A11A (non-hazardous)
- HAW569-B11A (hazardous area)



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Overvoltage protection (installation in cabinet)

- HAW562Z (hazardous area)

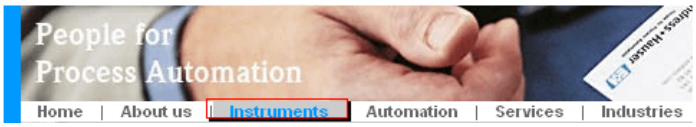
Weld-in adapter

All the weld-in adapters available are described in the document TI426F.
www.endress.com => Country => Download => Advanced => Documentation code => TI426F.

Spare parts

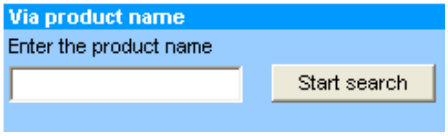
Information on the spare parts that are available for your measuring device is provided at "www.endress.com". To retrieve the information, process as follows:

1. Select "www.endress.com" and then select the country.
2. Click "Instruments"

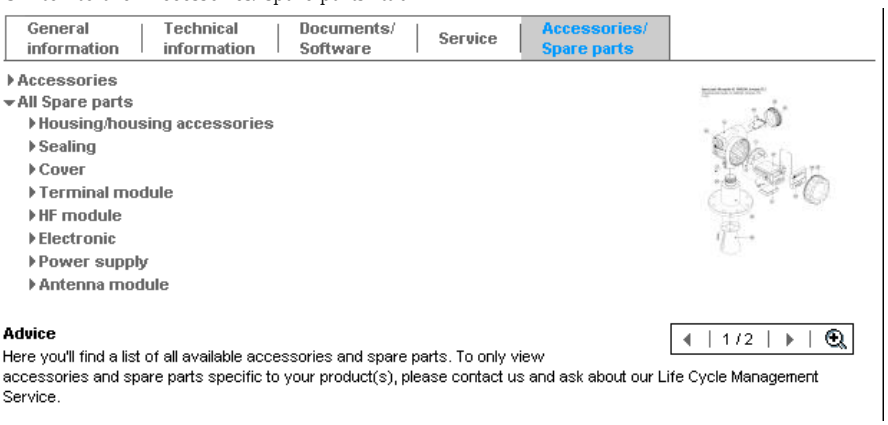


3. Enter the product name in the "Product name" field.

Endress+Hauser product search



4. Select the device.
5. Switch to the "Accessories/spare parts" tab



6. Select the spare parts (also use the overview drawings on the right-hand side of the screen).

When ordering a spare part, always quote the serial number that is indicated on the nameplate. Where necessary, replacement instructions are provided with the spare parts.

Documentation

Note!
The following documentation is available on the product pages at www.endress.com

Technical Information

- Fieldgate FXA320, FXA520
  TI369F/00/en

Operating Instructions

- Liquicap M FMI51, FMI52 (PFM)
  BA00297F/00/en
- Liquicap M FMI51, FMI52 (HART)
  BA00298F/00/en

Certificates

ATEX safety instructions

- Liquicap M FMI51, FMI52
  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 FMI51, FMI52

ATEX II 1/2 G EEx d [ia] IIC/IIB T3 to T6
XA00328F/00/a3

- Liquicap M FMI51, FMI52
  Ga/Gb Ex ia IIC T6-T3; Ex ia D 20 / Ex tD A21 IP65 T90°C
  XA00423F/00/a3

NEPSI safety instructions

- Liquicap M FMI51, FMI52
  Ex ia IIC/IIB T3 to T6
  XA00417F/00/a3
- Liquicap M FMI51, FMI52
  EEx d [ia] IIC/IIB T3 to T6
  XA00418F/00/a3
- Liquicap M FMI51, FMI52
  Ex nA II T3-T6, Ex nC IIC T3-T6
  XA00430F/00/a3

Overfill protection DIBt (WHG)

- Liquicap M FMI51, FMI52
  ZE00265F/00/de

Functional safety (SIL2)

- Liquicap M FMI51, FMI52
  SD00198F/00/en

Control Drawings (CSA and FM)

- Liquicap M FMI51, FMI52
  FM
  ZD00220F/00/en
- Liquicap M FMI51, FMI52
  CSA
  ZD00221F/00/en

CRN registration

- CRN 0F1988.75

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