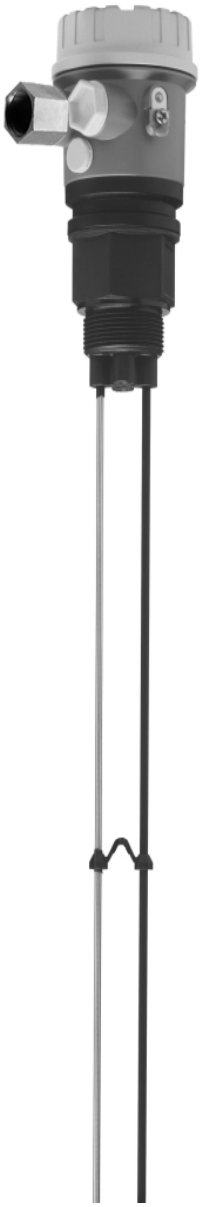
Füllstand | Druck | Durchfluss | Temperatur | Flüssigkeits-analyse | Registrierung | Systeme Komponenten | Services | Solutions

Technical Information

Liquicap T FMI21

Capacitive level measurement
Two-rod probe for continuous measurement in liquids



Application

The Liquicap T sensor is used in conductive liquids (greater than 30 µS/cm) for continuous level measurement and is preconfigured from factory 0 % to 100 % to probe length ordered.
In conductive liquids greater than 30 µS/cm, the measurement is independent of the dc-value (dielectric constant) of the liquid. It can also be used in Ex areas, Zone 2.

The Liquicap T is particularly suited to the following applications:
- Small measuring ranges (greater than 6" / 150 mm)
- Cistern measurements
- Aggressive liquids (many acids and alkalis)
- Independent of the tank material (plastic, stainless steel or concrete) or the tank shape

Used in conjunction with the Fieldgate FXA320 (remote measured value interrogation using Internet technology), Liquicap T is an ideal solution for inventorying material and optimizing logistics (inventory control).

Your benefits

- Safe function regardless of tank geometry thanks to probe design
- No calibration necessary (preconfigured from factory 0 % to 100 % to probe length ordered)
- High quality, non-corrosive materials (carbon fibre, stainless steel) for use in aggressive liquids and liquids which present a hazard to water (WHG-approved (German Water Resources Law))
- No moving parts in tank - long operating life - dependable function without wear
- Cost-effective solution for continuous measurement of levels in conductive liquids
- Optimized storage by simply shortening the probe rods on site (probe shortening kit)

TI393F/24/ae

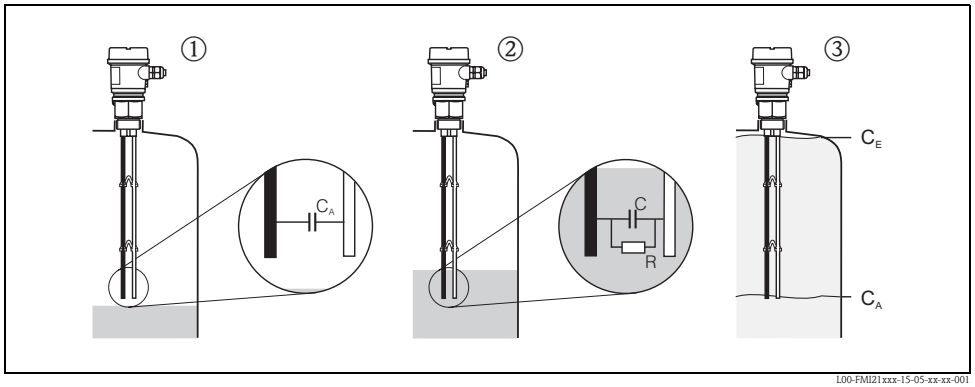
Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Measuring principle

The probe, medium and ground rod (counter electrode) form an electric capacitor.
If the probe is in the air ①, a certain low initial capacitance is measured.
When the tank is filled, the capacitance of the capacitor increases the more the probe is covered ② ③.
Conductivity greater than 30 µs/cm, the measurement does not depend on the dc-value of the liquid.
The electronic insert of the probe converts the capacitance measured to a current, in proportion to the level, in the range of 4 to 20 mA, thus making it possible to interpret the level.
All input and output channels are safely galvanically isolated from one another.



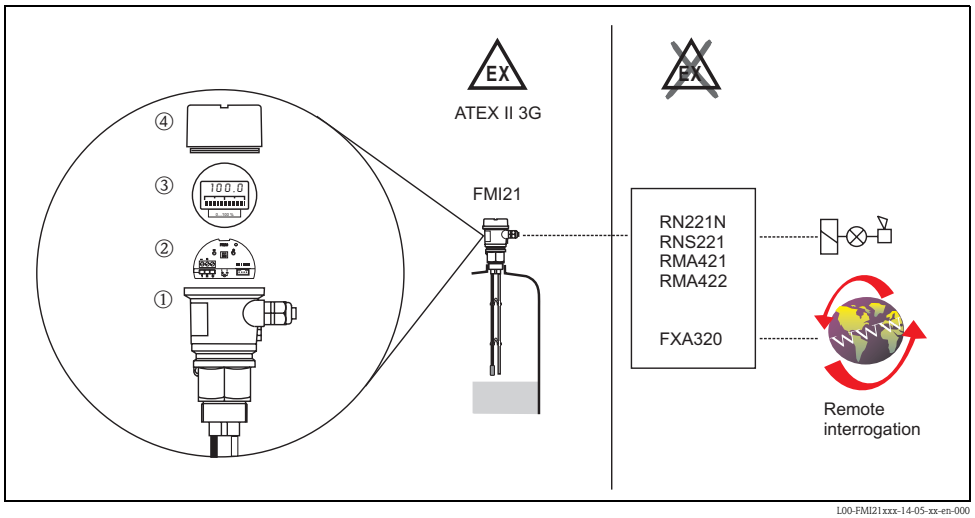
C_A : Initial capacitance (probe exposed)
C_E : Final capacitance (probe covered)

Measuring system

Probe with integrated electronic insert

The measuring system consists of:

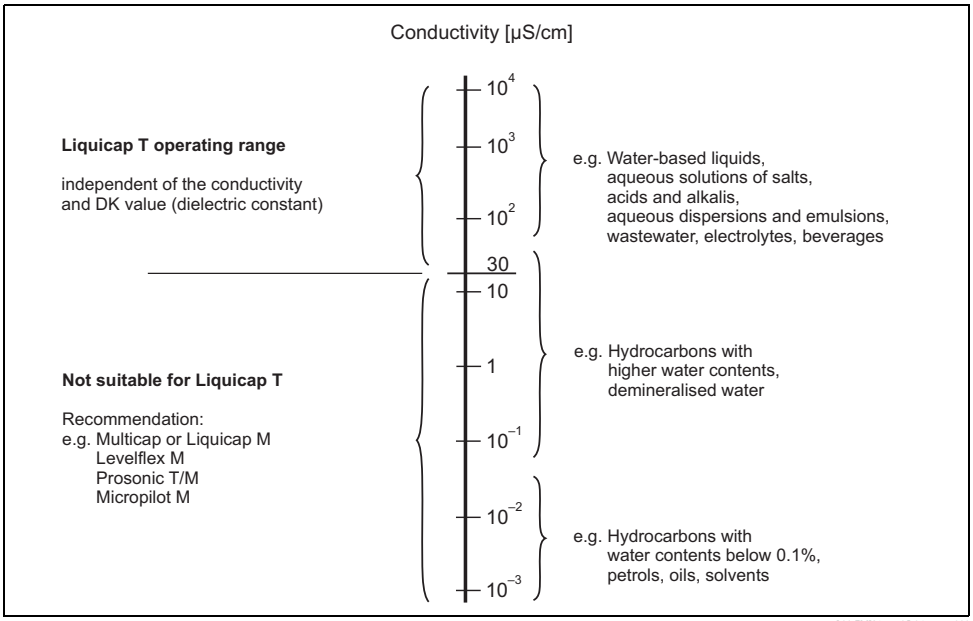
- The components of a capacitive probe Liquicap T FMI21:
  - ① Housing with two probe rods
    (one probe rod fully insulated and the second uninsulated (ground potential))
  - ② Electronic insert FEI20
  - ③ Display (optional)
  - ④ Housing cover (optional: cover with sight glass in conjunction with display)
- A transmitter power supply unit



Note!
For highly conductive media (e.g. concentrated hydrochloric acid) a modified electronics (TSPCR1794 or TSPCR1795) with build-up compensation has to be used.

Operating medium

Due to the probe design, the Liquicap T FMI21 can be used in liquids with a conductivity of 30 µs/cm. The measurement is independent of the dc-value and the conductivity of the liquid.



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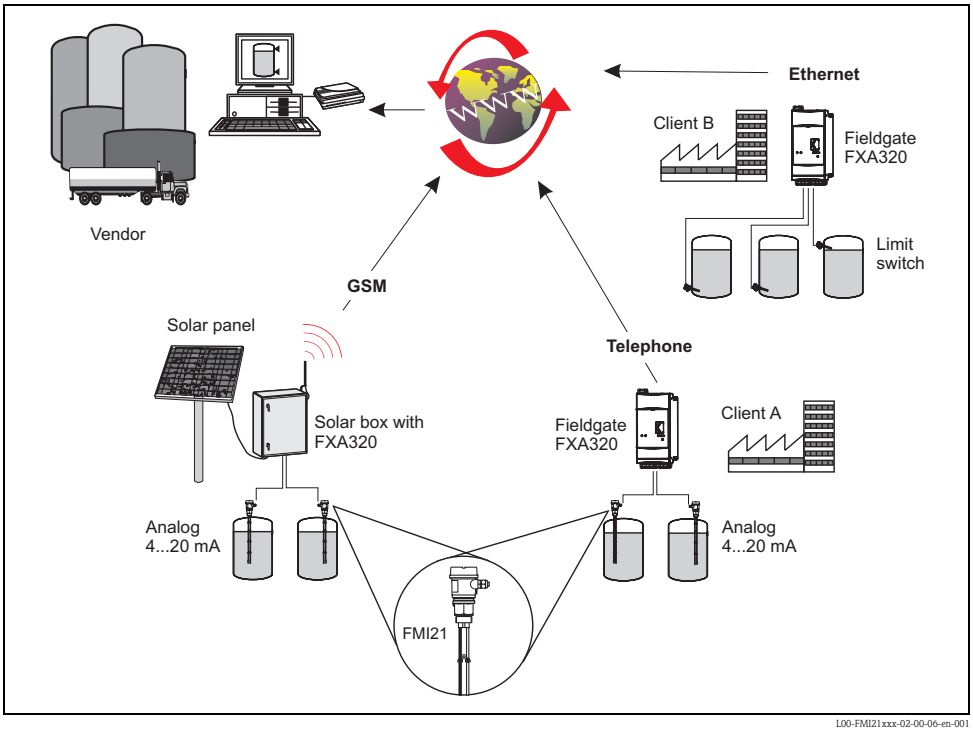
Applications

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 monitor the configured level limits and automatically trigger the next delivery as required. Here, the spectrum of possibilities ranges from a simple purchasing requisition by e-mail through to fully automatic order processing by incorporating XML data into the planning systems on both sides.



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Input

Measured variable

Continuous measurement of the change in capacitance between two probe rods depending on the level of a conductive liquid. Maximum viscosity = 2000 cst

Measuring range

The measuring range is between 6 to 98" (150 to 2500 mm), depending on the probe length ordered.

- Probe length: 6 to 98" (150 to 2500 mm)
- Adjustable initial capacitance: C_A = 0 to 2000 pF
- Permitted span: ΔC = 25 to 2000 pF
- End capacitance: C_E = max. 2100 pF
- Measuring frequency: 250 kHz

Input signal

Probes covered => high capacitance
Probes exposed => low capacitance

Output

Electronic insert FEI20 (4 to 20 mA)

Output signal

3.8 to 20.5 mA

Switch-on current

Max. 20 mA (< 500 ms)

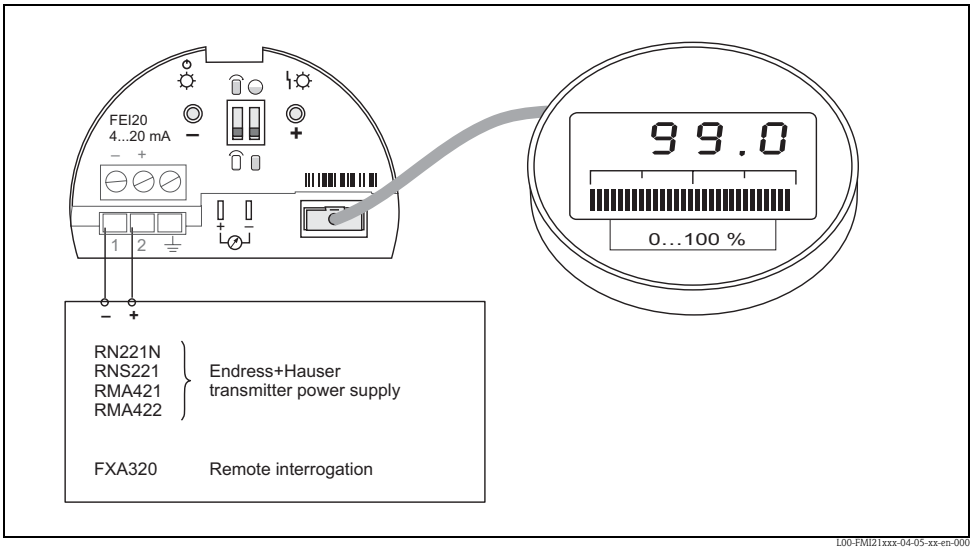
Signal on alarm

> 21 mA

Power supply

Electrical connection (wiring diagram)

FMI21 with electronic insert FEI20 for connection to transmitter power supply units from Endress+Hauser.



Connection of the electronic insert FEI20

Transmitter power supply units from Endress+Hauser

RNS221

Supply unit for supplying power to two 2-wire sensors or transmitters in the "non-Ex area".

RN221N

Active barrier with power supply for intrinsically safe separation of 4 to 20 mA standard signal circuits.

RMA421

Multi-functional 1-channel top-hat rail device with universal input, transmitter power supply, limit value monitoring and analog output.

RMA422

Multi-functional 1-2-channel top-hat rail device with intrinsically safe current inputs and transmitter power supply, limit value monitoring, mathematics functions and 1-2 analog outputs.

FXA320

Gateway to remote interrogation of sensors and actuators via Internet technology.

Supply voltage (FEI20)

- Connection voltage: U = 10 to 30 V DC
- Reverse polarity protection (integrated)

Power consumption

- P < 0.7 W

Current consumption

- I < 22 mA

Cable entries

M 20x1.5

- Degree of protection: IP66 (similar to NEMA 4X)
- Number in F16 housing: 2 cable entries (1 cable gland included in scope of delivery)

NPT ½

- Number in F16 housing: 2 cable entries with dummy plugs

Cable specifications

Use usual commercial two-core or multi-core cable (25 Ω per core).
Cable cross-section (incl. ferrule): max. 16 AWG (2.5 mm^2)

Note!
Use a shielded cable in the event of strong, electromagnetic EMC condition.

Performance characteristics with installed electronic insert

Reference operating conditions

- Ambient temperature: 74°F (23°C)
- Medium temperature: 74°F (23°C)
- Medium viscosity: medium must expose probe again (drain off < 2000 cst)
- Atmospheric pressure
- Probe installation: vertical from above

Maximum measured error

≤ 1 % of full scale value (active rod probe)

Repeatability

0.25 % of full scale value (range 0 to 2000 pF)

Start-up settling time

< 2 s (stable measured value after switch-on process)

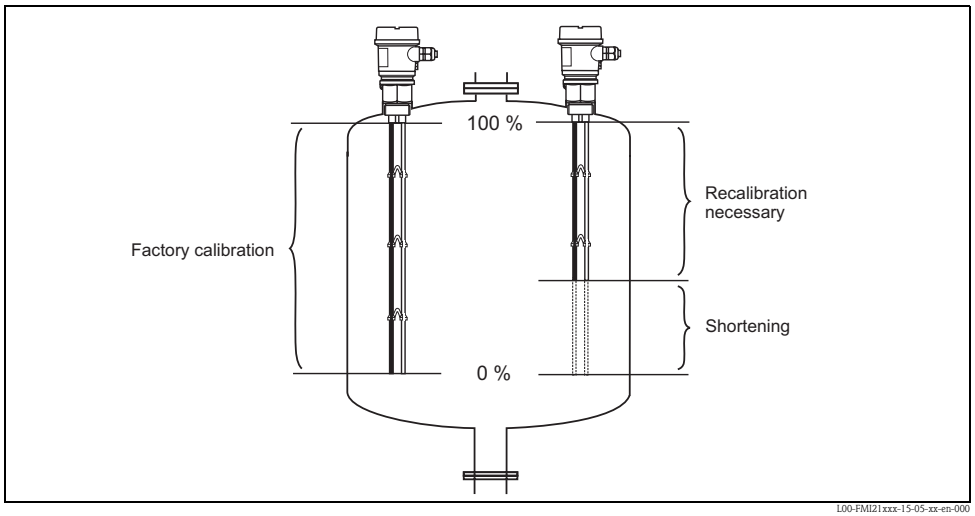
Influence of ambient temperature

< 0.01 %/K (–40 to +70°C / -40 to +158°F) probe length 1 m (3 ft)

Integration time

τ =1 s (fixed)
The integration time affects the speed at which the display and the current output react to changes in the fluid level.

Factory calibration



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Factory calibration: medium conductivity ≥ 30 µS/cm
Calibration accuracy 100 % max. -0.2" (-5 mm); 0 % max. -0.2" (-5 mm)

In an installed state, recalibration is only necessary if

- The probe rods have been shortened
- The 0 % and 100 % value should be adjusted to suit customer specifications
- The electronic insert was changed

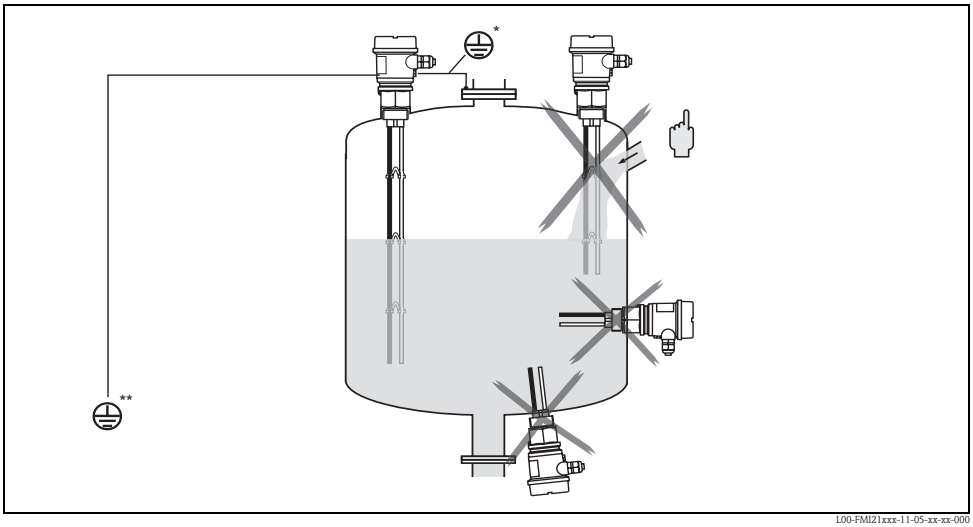
Installation

Installation instructions

Mounting location

e.g. storage area and buffer tank.

Orientation (vertical)



* Metal tank
** Plastic tank

Note!
The probe rods should never be in contact with the tank.

Note!
In the case of elevated electromagnetic radiation: protective ground should be attached to the device by a short line.

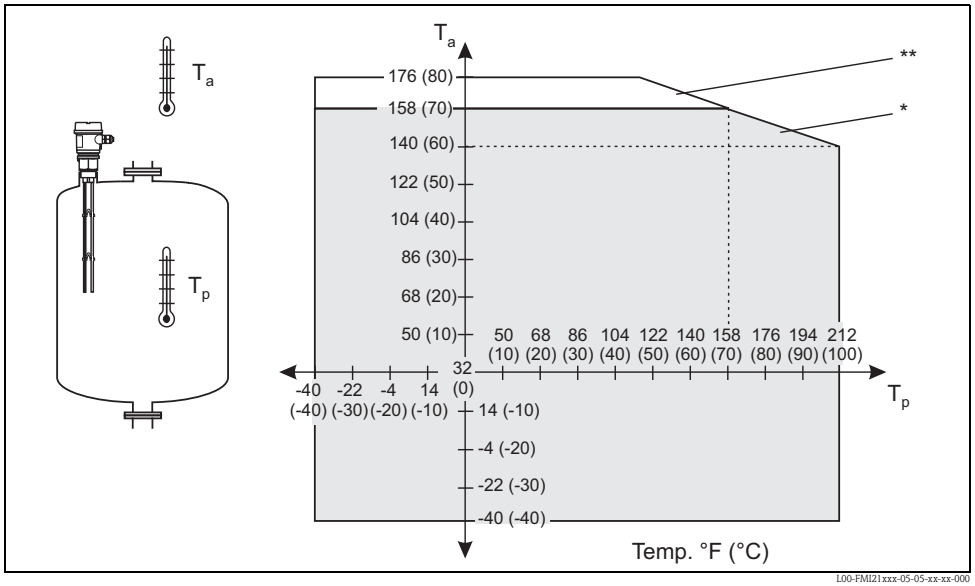
Environment

Ambient temperature range	Ambient temperature for the electronic: -40 to +158°F (-40 to 70°C) The functionality of the display may be limited for temperatures T_a < –4°F (-20°C) and T_a > +140°F (60°C)
Ambient temperature limits	-40 to +176°F (-40 to 80°C), in limit range: restricted accuracy
Storage temperature	-40 to +176°F (-40 to 80°C)
Climate class	Suitable for the tropics as per DIN IEC 68 Part 2-38
Degree of protection	IP66 (similar to NEMA 4X)
Shock resistance	DIN EN 60068-2-27 / IEC 68-2-27: 30 g
Vibration resistance (with min. rod length 6" / 150 mm)	DIN EN 60068-2-64 / IEC 68-2-64: 20 to 2000 Hz, 1 $(m/s^2)^2/Hz$
Electromagnetic compatibility	Interference emission to EN 61326, Electrical equipment Class B; Interference immunity to EN 61326, Annex A (Industrial)

Process

Environment

Permitted ambient temperature T_a at the housing depending on the process temperature T_p in the tank:



* Permitted work range
** Work range with restricted accuracy

Conductivity of medium

≥ 30 µS/cm

Process pressure

-14.5 to 145 psi (-1 to 10 bar)

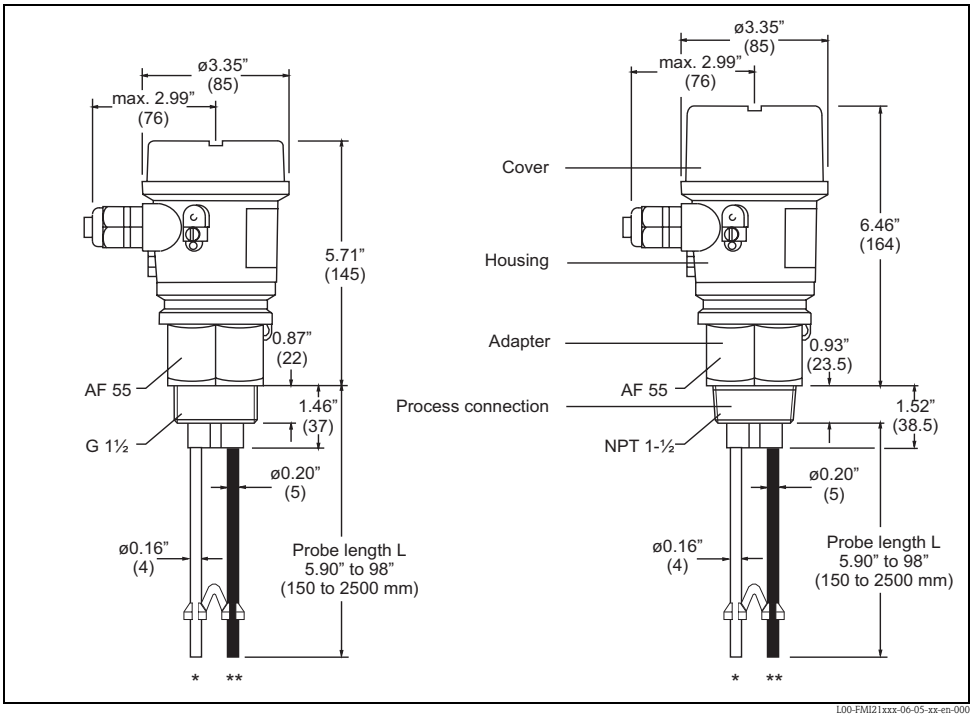
Mechanical construction

Note!
All dimensions in inches (mm)

Design, dimensions

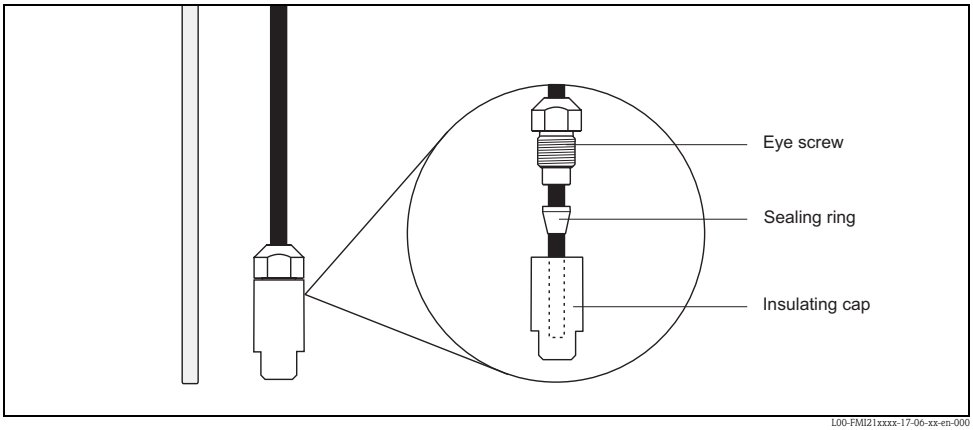
Rod probe

Process connection with parallel thread G 1½ or with tapered thread NPT 1½.



* Ground rod (uninsulated)
** Probe rod insulated

Probe shortening set



Note!
If shortening the probe rods, the insulation above the cut must not be damaged!
Recalibration is always necessary after shortening the probe. The active rod probe begins above the probe shortening set. Therefore the zero balance should be carried out at this point. Only the insulated rod must be insulated with the shortening set. The ground rod remains uninsulated.

Weight

Rod 3 ft (1 m) length

FMI21 = 1.3 lb (600 g)

Material

Probe rods

- Rod: 1.4404/316L – (use in water-based media, alkalis ...)
  Optional: carbon fiber CFC – (use in acids e.g. hydrochloric acid)
- Sealing ring: EPDM
- Insulation: PP
- Spacer: PP
- Probe shortening set: PP

Housing F16

- Housing: PBT-FR
- Cover: PBT
- Cover with sight glass: PA
- Cable gland: PA
- Adapter: PBT
- Dummy plug: PBT

Process connections

- G 1½ A (PPS, DIN ISO 228/1)
- NPT 1½ (PPS, ANSI B 1.20.1)

Seals

- Seal between housing and process connection: EPDM
- Seal for plastic housing cover F16: EPDM
- Sealing ring for process connection G 1½ A: elastomer fibre asbestos-free (resistant to oils, solvents, steam, weak acids and alkalis)

Fitted electrodes

Rod probe with two rods

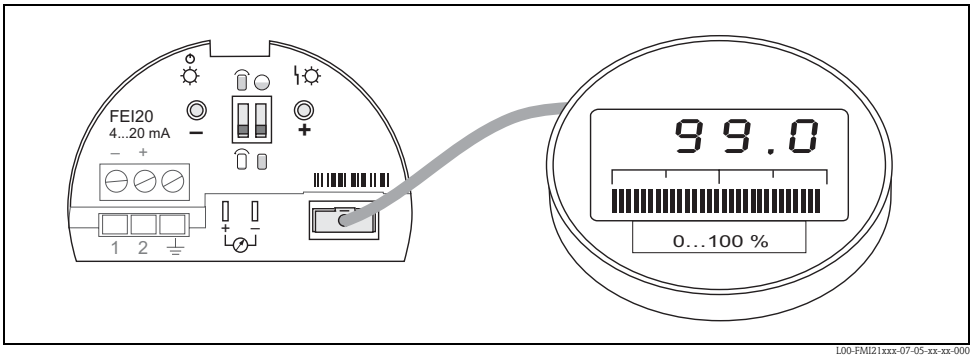
- Rod diameter without insulation: 0.16" (4 mm)
- Maximum rod length: 98" (2500 mm)
- Minimum rod length: 6" (150 mm)
- Insulation thickness: 0.02" (0.5 mm)
- Extraction forces (parallel probe rod): 225 lbf (1000 N)
- Lateral loading capacity: 1.5 lbf ft (2 Nm)

Human interface

Operating elements

Electronic insert FEI20

Note!
The display indicates no comma, if the probe length is < 8" (200 mm).



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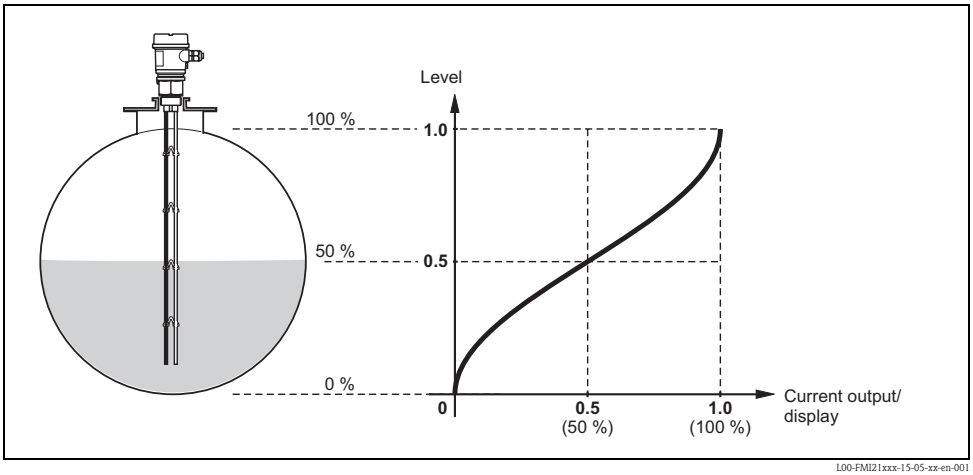
- Key (-)
- Key (+)
- 4 to 20 mA current pick-off, e.g. for full/empty calibration with multimeter. (No need to disconnect circuit!)
- Display connection
- DIL switch (left) to determine calibration type (full/empty) of probe
- DIL switch (right) to switch linearization on and off (only for horizontal cylindrical tanks)

Linearization (for cylindrical lying tanks):



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Note!
In cylindrical lying tanks the current output and display are in proportion to the volume.

Display elements

FEI20

- A red light emitting diode: as alarm or warning (flashing)
- A green light emitting diode: to indicate operational status (flashes every 5 sec. approx.) or to confirm key entries
- Display (optional) for measured value in %, bargraph for minimum and maximum probe capacitance.

Certificates and approvals

CE mark

The Liquicap T is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms that the device has been tested successfully by applying the CE mark.

CSA/US; General Purpose (GP) Kanada, USA

Overfill protection

Approvals

- German Water Resources Law (WHG) - see commissioning notes in ZE263F (Z. 65.xx - xxx)

Other standards and guidelines

- Low Voltage Directive (73/23/EEC)
- DIN EN 61010 Part 1, 2001
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.
  Part 1: General Requirements
- CAN/CSA-C22.2 No. 1010.1-92
  Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use;
  Part 1: General Requirements (Includes Amendment 1)
- UL Std No. 61010C-1
  Process Control Equipment; Part 1: General Requirements
- EN 61326
  Electrical Equipment for Measurement, Control and Laboratory Use
  EMC Requirements
- EN 50021
  Electrical Apparatus for Potentially Explosive Atmospheres
  Specification for Electrical Apparatus with Type of Protection "N"

Ex approval

ATEX II 3 G EEx nA IIC T6
All explosion protection data are given in a separate documentation (see: Documentation) which is available upon request.

Type of protection

EEx nA IIC T6 (non-sparking equipment)

Ordering information

Liquicap T FMI21

10	**Approval:**						
	A	Non-hazardous area					
	B	Non-hazardous area, WHG					
	C	ATEX II 3 G EEx nA IIC T6, WHG					
	D	CSA General Purpose, CSA C US					
	Y	Special version					
20		**Process Connection:**					
		1	Thread ISO228 G 1½, PPS				
		2	Thread ANSI NPT 1½, PPS				
		9	Special version				
30			**Probe Length; Material; 150...2500 mm (6...100 inch):**				
			A	... mm L, PP 316L			
			B	... mm L, PP carbon fiber (< 1000 mm)			
			C	... mm L, PP carbon fiber (> 1000 mm)			
			D	... inch L, PP 316L			
			E	... inch L, PP carbon fiber (< 40 inch)			
			F	... inch L, PP carbon fiber (> 40 inch)			
			Y	Special version			
40				**Housing; Cable Entry:**			
				1	F16 polyester IP66 NEMA4X; gland M20		
				2	F16 polyester IP66 NEMA4X; thread NPT ½		
				3	F16 polyester IP66 NEMA4X; thread G ½		
				9	Special version		
50					**Electronics; Output:**		
					A	None	
					B	FEI20; 4 to 20 mA *	
					C	FEI20; 4 to 20 mA + display *	
					Y	Special version	
60						**Additional Option:**	
						1	Basic version
						2	Shortening kit PP
						9	Special version
FMI21							Complete product designation

* Note!
For highly conductive media (e.g. concentrated hydrochloric acid) a modified electronics (TSPCR1794 or TSPCR1795) with build-up compensation has to be used.

Accessories

Liquicap T

- Mounting nut G 1½
  Hexagon head, AF 60
  PN 52014146
- Shortening kit FMI21
  PN 52024300

Spare parts

- Electronics FEI20
  PN 52025603
- Cover F16 high, transparent, with gasket
  PN 52025605
- Cover F16 grey, PBTP, with gasket
  PN 52025606
- Digital display, with holder
  PN 52025604
- Spacer probe rods, 5 pieces
  (5 pieces are included in the scope of delivery)
  PN 52025607

Documentation

Note!
The specified documentation is available at www.endress.com.

Technical Information

- Gateways / interfaces
  Fieldgate FXA320
  TI369F/00
- Process transmitter
  Preline RMA422
  TI072R/09
- Process transmitter
  Preline RMA421
  TI064R/09
- Transmitter power supply unit
  Preline RNS221
  TI081R/09
- Active barrier
  Preline RN221N
  TI073R/09

Operating Instructions

- Liquicap T FMI20
  KA233F/00

Certificates

WHG (German Water Resources Law)

- Liquicap T
  ZE263F/00

ATEX

- Liquicap T
  II 3 G EEx nA IIC T6
  XA320F/00

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