



Füllstand



Druck



Durchfluss



Temperatur



Flüssigkeits-
analyse



Registrierung



Systeme
Komponenten



Services

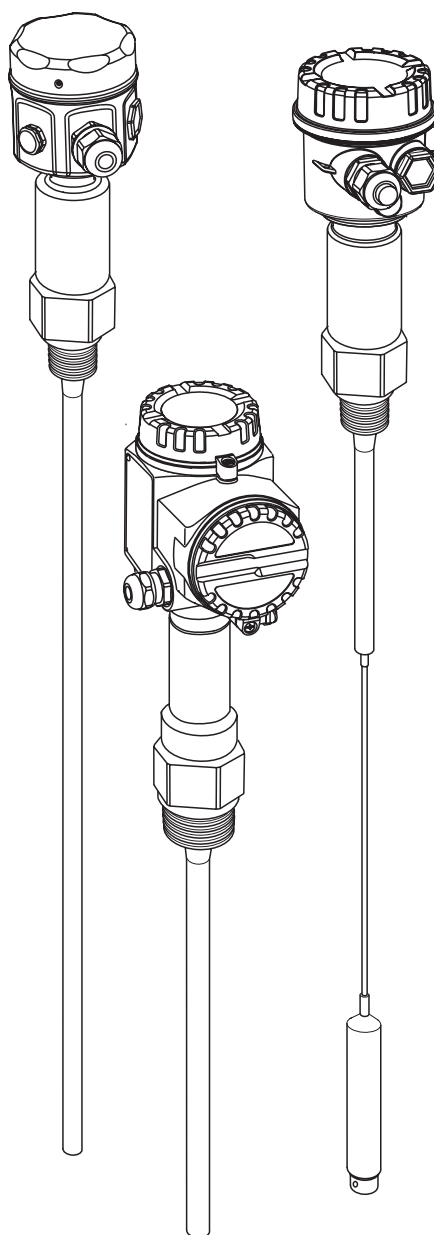


Solutions

Operating Instructions

Liquicap M FMI51, FMI52 FEI50H HART

Capacitive Level Measurement



BA298F/00/en/04.07
71039049

Valid as of software version:
FW: V 01.03.00
HW: V 02.00

Endress+Hauser

People for Process Automation

Brief overview

For quick and easy commissioning:

Safety instructions	
Explanation of the warning symbols You can find special instructions at the appropriate position in the chapter in question. The positions are indicated with the icons Warning  , Caution  and Note  .	→ Page 6 ff.



Installation	
Here you can find the steps for installing the device and the installation conditions (such as the dimensions etc.).	→ Page 16 ff.



Wiring	
The device is delivered ready-wired as far as is possible.	→ Page 34 ff.



Display and operating elements	
Here you can find an overview of the layout of the device's display and operating elements.	→ Page 39 ff.

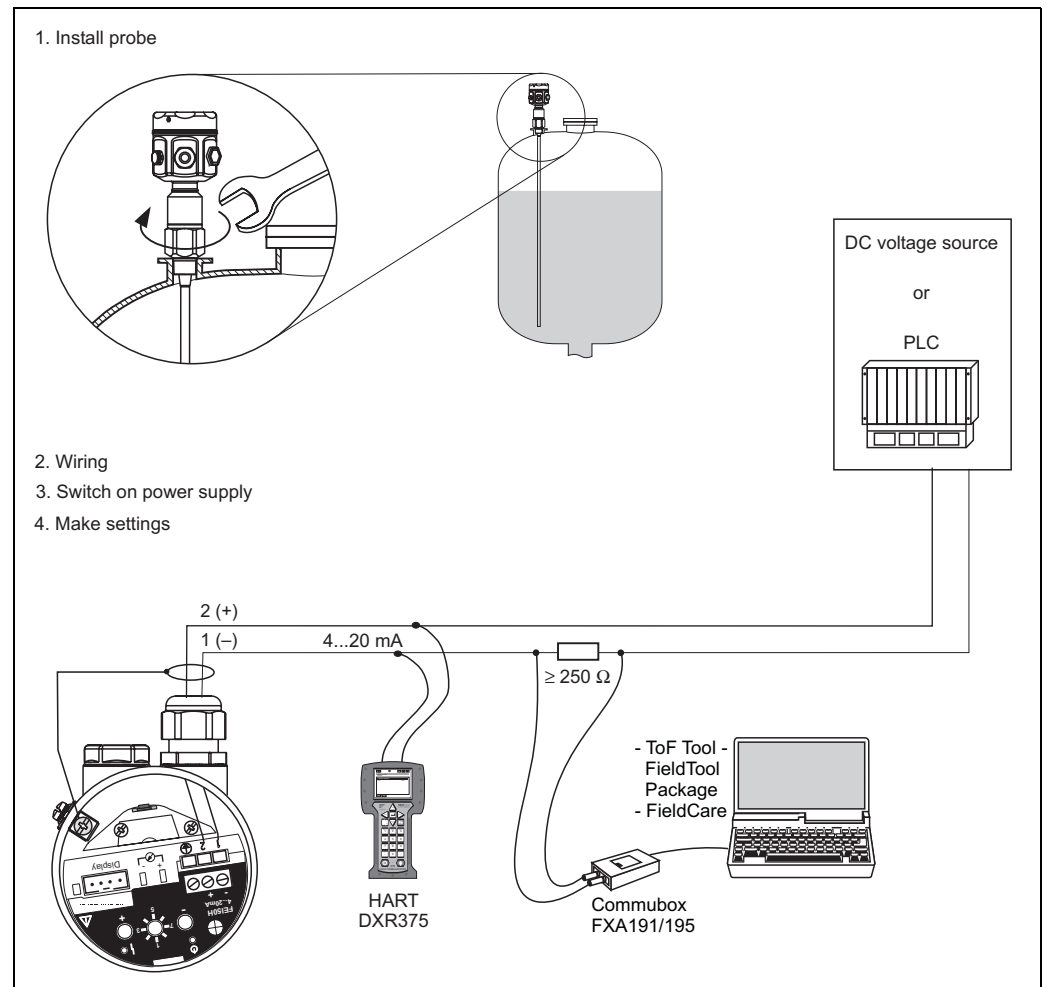


Commissioning	
The "Commissioning" section tells you how to switch on the device and check the functions.	→ Page 55 ff.



Troubleshooting	
If faults and malfunctions occur during operation, use the checklist to find the cause. Here you can find measures you can take yourself to rectify any errors that may occur.	→ Page 91 ff.

Brief operating instructions



Note!

These Operating Instructions describe how to install and commission the level transmitter. All the functions required for normal measuring tasks have been taken into consideration.

An **overview of the configuration options at the FEI50H** is provided on Page 40 ff.

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1 Safety instructions

1.1 Designated use

Liquicap M FMI51, FMI52 are compact, capacitance level transmitters for the continuous measurement of liquids.

1.2 Installation, commissioning and operation

Liquicap M is designed to meet state-of-the-art safety regulations and complies with the applicable requirements and EC Directives. If used improperly or other than intended, the device can, however, be a source of application-related danger, e.g. product overflow as a result of incorrect installation or configuration. For this reason, installation, electrical connection, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel authorized to perform such work by the owner-operator. The technical personnel must have read and understood these Operating Instructions and must follow the instructions they contain. The device may only be repaired or modified if expressly permitted in the Operating Instructions.

1.3 Operational safety

1.3.1 Ex area

When using the measuring system in Ex-areas, the appropriate national standards and regulations have to be observed. Separate Ex documentation, which constitutes an integral part of this documentation, is supplied with the device. The installation procedures, connection data and safety instructions it contains must be observed.

- Make sure that the technical staff has adequate training.
- The special measuring and safety-related requirements for the measuring points must be observed.

1.4 Notes on safety conventions and icons

To highlight safety-related or alternative processes, we have designed the following safety instructions where every instruction is indicated by a corresponding pictogram.

Safety instructions	
	Warning! Draws attention to activities or procedures that can result in serious injuries to persons, a safety risk or the destruction of the device if not carried out properly.
	Caution! Draws attention to activities or procedures that can result in injuries to persons or the defective operation of the device if not carried out properly.
	Note! Draws attention to activities or procedures that have an indirect effect on operation, or can trigger an unforeseen device reaction if not carried out properly.
Type of protection	
	Explosion-protected equipment tested for type examination If this sign can be found on the nameplate of the device, the device can be operated in hazardous areas or non-hazardous areas in accordance with the approval
	Ex-area This symbol in the drawings in these Operating Instructions indicates Ex-areas. Devices located in Ex-areas, or cables for such devices, must have appropriate explosion protection.
	Safe area (non-hazardous area) This symbol in the drawings in these Operating Instructions indicates non-Ex areas. Devices in non-hazardous areas must also be certified if connecting cables lead into hazardous areas.
Electrical symbols	
	Direct current A terminal to which direct voltage is applied or through which the direct current flows.
	Alternating current A terminal to which alternating voltage (sine wave) is applied or through which the alternating current flows.
	Ground connection A grounded terminal which, from a user's point of view, is grounded via a grounding system.
	Protective earth connection A terminal that has to be grounded before any other connections may be established.
	Equipotential connection A connection that has to be connected to the grounding system of the plant. This can be a potential matching line or a star grounding system, depending on national or company codes of practice.
	Immunity to temperature change of the connecting cables Means that the connecting cables have to withstand a temperature of 85 °C at least.

2 Identification

2.1 Device designation

2.1.1 Nameplate

You can take the following technical data from the nameplate of the device:

Order number
(see ordering information)

Serial number

Electronic insert

Ambient temperature
at housing

Max. permissible pressure
in tank

Functional
safety

WHG approval
(German Water Resources Act)

Approval No.
ATEX

Safety information

Made in Germany, D- 79689 Maulburg

Liquicap M

Order Code.: FMI51-xxxxxxxxxxxxxx
Ser.No.: XXXXXXXXXXXXXXXX

FEI50H U: 12...36 V DC
Output: 4...20 mA (HART)

-40°C ≤ Ta ≤ +60°C | MWP: 25bar

L1 = 1000 mm
L3 = 500 mm
L = 1500 mm

IP66/ IP67
NEMA4X

BVS 05 ATEX E 103 X
ATEX II 1/2 G EEx ia IIC T6
ATEX II 1/2 G EEx ia IIB T6

Z 65.13.xxx
 XA327F Dat.:10/04

 250002075 - -

Information on the nameplate of Liquicap M (example)

L00-FMI5xxxx-18-00-00-en-002

2.1.2 Liquicap M FMI51

10	Approval:			
	A	Non-hazardous area		
	B	Non-hazardous area,		WHG
	C	ATEX II 1/2 GD	EEx ia IIC T6	
	D	ATEX II 1/2 GD	EEx ia IIC T6,	WHG
	E	ATEX II 1/2 GD	EEx ia IIB T6	
	F	ATEX II 1/2 GD	EEx ia IIB T6,	WHG
	G	ATEX II 1/2 G	EEx d (ia) IIB T6,	WHG
	H	ATEX II 1/2 GD	EEx ia IIC T6,	
		XA, observe safety instructions (electrostatic charge)!		
	J	ATEX II 1/2 GD	EEx ia IIC T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	K	ATEX II 1/2 G	EEx ia IIC T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	L	ATEX II 1/2 G	EEx d (ia) IIC T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	M	ATEX II 3 GD	EEx nA II T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	N	CSA General Purpose, CSA C US		
	P	CSA/FM IS Cl. I, II, III	Div. 1+2 Gr. A-G	
	R	CSA/FM XP Cl. I, II, III	Div. 1+2 Gr. A-G	
	S	TIIIS Ex ia IIC T3		
	T	TIIIS Ex d IIC T3		
	1	NEPSI Ex ia IIC T6		
	2	NEPSI Ex d(ia) IIC T6		
	Y	Special version, to be specified		

20	Inactive Length L3:			
		Price per 100 mm/1 inch		
		L3: 100 to 2000 mm/4 to 80 inch for 316L		
		L3: 150 to 1000 mm/6 to 40 inch for PTFE fully insulated		
		Protection against condensate + bypassing container nozzles		
	1	Not selected		
	2	mm L3,	316L	
	3	mm L3,	316L + fully insulated PTFE	
	5	inch L3,	316L	
	6	inch L3,	316L + fully insulated PTFE	
	9	Special version, to be specified		

30	Active Probe Length L1; Insulation:			
		Price per 100 mm/1 inch		
		L1: 100 to 4000 mm/4 to 160 inch for Ø10 mm, Ø16 mm		
		L1: 150 to 3000 mm/6 to 120 inch for Ø22 mm (fully insulated)		
	A	mm L1, 10 mm rod,	316L; PTFE	
	B	mm L1, 16 mm rod,	316L; PTFE	
	C	mm L1, 22 mm rod,	316L; PTFE	
	D	mm L1, 16 mm rod,	316L; PFA	
	E	mm L1, 10 mm rod,	316L; PTFE + ground tube	
	F	mm L1, 16 mm rod,	316L; PTFE + ground tube	
	G	mm L1, 16 mm rod,	316L; PFA + ground tube	
	H	inch L1, 0.4 inch rod,	316L; PTFE	
	K	inch L1, 0.6 inch rod,	316L; PTFE	
	M	inch L1, 0.9 inch rod,	316L; PTFE	
	N	inch L1, 0.6 inch rod,	316L; PFA	
	P	inch L1, 0.4 inch rod,	316L; PTFE + ground tube	
	R	inch L1, 0.6 inch rod,	316L; PTFE + ground tube	
	S	inch L1, 0.6 inch rod,	316L; PFA + ground tube	
	Y	Special version, to be specified		

50	Process Connection:			
		Threaded connection		
	GCJ	G ½,	316L, 25 bar	Thread ISO228
	GDJ	G ¾,	316L, 25 bar	Thread ISO228
	GEJ	G 1,	316L, 25 bar	Thread ISO228
	GGJ	G 1½,	316L, 100 bar	Thread ISO228

50				Process Connection:			
				RCJ	NPT 1/2,	316L, 25 bar	Thread ANSI
				RDJ	NPT 3/4,	316L, 25 bar	Thread ANSI
				REJ	NPT 1,	316L, 25 bar	Thread ANSI
				RGJ	NPT 1 1/2,	316L, 100 bar	Thread ANSI
				Hygiene connection			
				GQJ	G 3/4,	316L, 25 bar, EHEDG	Thread ISO2852
				Accessories installation, Weld-in adapter			
				GWJ	G 1	316L, 25 bar, EHEDG	Thread ISO2852
				Accessories installation, Weld-in adapter			
				MRJ	DN50 PN40,	316L	DIN11851
				UPJ	Universal adapter 44 mm	316L, 16 bar	
				Tri-Clamp connection			
				TCJ	DN25 (1"), EHEDG	316L,	Tri-Clamp ISO2852
				TJJ	DN38 (1 1/2"), EHEDG	316L,	Tri-Clamp ISO2852
				TDJ	DN40-51 (2"),	316L,	Tri-Clamp ISO2852
				TNJ	DN38 (1 1/2"),	316L, 3A	Tri-Clamp ISO2852
				Tri-Clamp removable			
				EN flanges			
				B0J	DN25 PN25/40 A,	316L	Flange EN1092-1 (DIN2527 B)
				B1J	DN32 PN25/40 A,	316L	Flange EN1092-1 (DIN2527 B)
				B2J	DN40 PN25/40 A,	316L	Flange EN1092-1 (DIN2527 B)
				B3J	DN50 PN25/40 A,	316L	Flange EN1092-1 (DIN2527 B)
				CRJ	DN50 PN25/40 B1,	316L	Flange EN1092-1 (DIN2527 C)
				DRJ	DN50 PN40 C,	316L	Flange EN1092-1 (DIN2512 F)
				ERJ	DN50 PN40 D,	316L	Flange EN1092-1 (DIN2512 N)
				BSJ	DN80 PN10/16 A,	316L	Flange EN1092-1 (DIN2527 B)
				CGJ	DN80 PN10/16 B1,	316L	Flange EN1092-1 (DIN2527 C)
				DGJ	DN80 PN16 C,	316L	Flange EN1092-1 (DIN2512 F)
				EGJ	DN80 PN16 D,	316L	Flange EN1092-1 (DIN2512 N)
				BTJ	DN100 PN10/16 A,	316L	Flange EN1092-1 (DIN2527 B)
				CHJ	DN100 PN10/16 B1,	316L	Flange EN1092-1 (DIN2527 C)
				PTFE clad			
				B0K	DN25 PN25/40,	PTFE >316L	Flange EN1092-1 (DIN2527)
				B1K	DN32 PN25/40,	PTFE >316L	Flange EN1092-1 (DIN2527)
				B2K	DN40 PN25/40,	PTFE >316L	Flange EN1092-1 (DIN2527)
				B3K	DN50 PN25/40,	PTFE >316L	Flange EN1092-1 (DIN2527)
				BSK	DN80 PN10/16,	PTFE >316L	Flange EN1092-1 (DIN2527)
				BTk	DN100 PN10/16,	PTFE >316L	Flange EN1092-1 (DIN2527)
				ANSI flanges			
				ACJ	1" 150 lbs RF,	316/316L	Flange ANSI B16.5
				ANJ	1" 300 lbs RF,	316/316L	Flange ANSI B16.5
				AEJ	1 1/2" 150 lbs RF,	316/316L	Flange ANSI B16.5
				AQJ	1 1/2" 300 lbs RF,	316/316L	Flange ANSI B16.5
				AFJ	2" 150 lbs RF,	316/316L	Flange ANSI B16.5
				ARJ	2" 300 lbs RF,	316/316L	Flange ANSI B16.5
				AGJ	3" 150 lbs RF,	316/316L	Flange ANSI B16.5
				ASJ	3" 300 lbs RF,	316/316L	Flange ANSI B16.5
				AHJ	4" 150 lbs RF,	316/316L	Flange ANSI B16.5
				ATJ	4" 300 lbs RF,	316/316L	Flange ANSI B16.5
				AJJ	6" 150 lbs RF,	316/316L	Flange ANSI B16.5
				AUJ	6" 300 lbs RF,	316/316L	Flange ANSI B16.5
				PTFE clad			
				ACK	1" 150 lbs,	PTFE >316/316L	Flange ANSI B16.5
				ANK	1" 300 lbs,	PTFE >316/316L	Flange ANSI B16.5
				AEK	1 1/2" 150 lbs,	PTFE >316/316L	Flange ANSI B16.5
				AQK	1 1/2" 300 lbs,	PTFE >316/316L	Flange ANSI B16.5
				AFK	2" 150 lbs,	PTFE >316/316L	Flange ANSI B16.5
				ARK	2" 300 lbs,	PTFE >316/316L	Flange ANSI B16.5
				AGK	3" 150 lbs,	PTFE >316/316L	Flange ANSI B16.5
				AHK	4" 150 lbs,	PTFE >316/316L	Flange ANSI B16.5
				JIS flanges			

Endress+Hauser

2.1.3 Liquicap M FMI52

10	Approval:			
	A	Non-hazardous area		
	B	Non-hazardous area,		WHG
	E	ATEX II 1/2 GD	EEx ia IIB T6	
	F	ATEX II 1/2 GD	EEx ia IIB T6,	WHG
	G	ATEX II 1/2 G	EEx d (ia) IIB T6,	WHG
	H	ATEX II 1/2 GD	EEx ia IIC T6,	
		XA, observe safety instructions (electrostatic charge)!		
	J	ATEX II 1/2 GD	EEx ia IIC T6,	
		XA, observe safety instructions (electrostatic charge)!		
	K	ATEX II 1/2 G	EEx ia IIC T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	L	ATEX II 1/2 G	EEx d (ia) IIC T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	M	ATEX II 3 GD	EEx nA II T6,	WHG
		XA, observe safety instructions (electrostatic charge)!		
	N	CSA General Purpose, CSA C US		
	P	CSA/FM IS Cl. I, II, III	Div. 1+2 Gr. A-G	
	R	CSA/FM XP Cl. I, II, III	Div. 1+2 Gr. A-G	
	S	TIIS Ex ia IIC T3		
	T	TIIS Ex d IIC T3		
	1	NEPSI Ex ia IIC T6		
	2	NEPSI Ex d(ia) IIC T6		
	Y	Special version, to be specified		

20	Inactive Length L3:			
		Price per 100 mm/1 inch		
		L3: 100 to 2000 mm/4 to 80 inch for 316L		
		L3: 150 to 1000 mm/6 to 40 inch for PFA fully insulated		
		Protection against condensate + bypassing container nozzles		
	1	Not selected		
	2	... mm L3,	316L	
	3	... mm L3,	316L + fully insulated PFA	
	5	... inch L3,	316L	
	6	... inch L3,	316L + fully insulated PFA	
	9	Special version, to be specified		

30	Active Probe Length L1; Insulation:			
		Price per 1000 mm/10 inch		
		L1: 420 to 10000 mm/17 to 400 inch; fully insulated		
	A	... mm L1,	316; FEP	
	B	... mm L1,	316L; PFA	
	C	... inch L1,	316; FEP	
	D	... inch L1,	316L; PFA	
	Y	Special version, to be specified		

50	Process Connection:			
		Threaded connection		
	GDJ	G ¾,	316L, 25 bar	Thread ISO228
	GEJ	G 1,	316L, 25 bar	Thread ISO228
	GGJ	G 1½,	316L, 100 bar	Thread ISO228
	RDJ	NPT ¾,	316L, 25 bar	Thread ANSI
	REJ	NPT 1,	316L, 25 bar	Thread ANSI
	RGJ	NPT 1½,	316L, 100 bar	Thread ANSI
		Hygiene connection		
	GWJ	G 1	316L, 25 bar, EHEDG	Thread ISO2852
		Accessories installation, Weld-in adapter		
	MRJ	DN50 PN40,	316L	DIN11851
	UPJ	Universal adapter 44 mm	316L, 16 bar, EHEDG	
		Tri-Clamp connection		
	TCJ	DN25 (1"), EHEDG	316L,	Tri-Clamp ISO2852
	TJJ	DN38 (1½"), EHEDG	316L,	Tri-Clamp ISO2852
	TDJ	DN40-51 (2").	316L,	Tri-Clamp ISO2852

50					Process Connection:
					EN flanges
				BOJ	DN25 PN25/40 A, 316L Flange EN1092-1 (DIN2527 B)
				B1J	DN32 PN25/40 A, 316L Flange EN1092-1 (DIN2527 B)
				B2J	DN40 PN25/40 A, 316L Flange EN1092-1 (DIN2527 B)
				B3J	DN50 PN25/40 A, 316L Flange EN1092-1 (DIN2527 B)
				CRJ	DN50 PN25/40 B1, 316L Flange EN1092-1 (DIN2527 C)
				DRJ	DN50 PN40 C, 316L Flange EN1092-1 (DIN2512 F)
				ERJ	DN50 PN40 D, 316L Flange EN1092-1 (DIN2512 N)
				BSJ	DN80 PN10/16 A, 316L Flange EN1092-1 (DIN2527 B)
				CGJ	DN80 PN10/16 B1, 316L Flange EN1092-1 (DIN2527 C)
				DGJ	DN80 PN16 C, 316L Flange EN1092-1 (DIN2512 F)
				EGJ	DN80 PN16 D, 316L Flange EN1092-1 (DIN2512 N)
				BTJ	DN100 PN10/16 A, 316L Flange EN1092-1 (DIN2527 B)
				CHJ	DN100 PN10/16 B1, 316L Flange EN1092-1 (DIN2527 C)
					PTFE clad
				BOK	DN25 PN25/40, PTFE >316L Flange EN1092-1 (DIN2527)
				B1K	DN32 PN25/40, PTFE >316L Flange EN1092-1 (DIN2527)
				B2K	DN40 PN25/40, PTFE >316L Flange EN1092-1 (DIN2527)
				B3K	DN50 PN25/40, PTFE >316L Flange EN1092-1 (DIN2527)
				BSK	DN80 PN10/16, PTFE >316L Flange EN1092-1 (DIN2527)
				BTK	DN100 PN10/16, PTFE >316L Flange EN1092-1 (DIN2527)
					ANSI flanges
				ACJ	1" 150 lbs RF, 316/316L Flange ANSI B16.5
				ANJ	1" 300 lbs RF, 316/316L Flange ANSI B16.5
				AEJ	1½" 150 lbs RF, 316/316L Flange ANSI B16.5
				AQJ	1½" 300 lbs RF, 316/316L Flange ANSI B16.5
				AFJ	2" 150 lbs RF, 316/316L Flange ANSI B16.5
				ARJ	2" 300 lbs RF, 316/316L Flange ANSI B16.5
				AGJ	3" 150 lbs RF, 316/316L Flange ANSI B16.5
				ASJ	3" 300 lbs RF, 316/316L Flange ANSI B16.5
				AHJ	4" 150 lbs RF, 316/316L Flange ANSI B16.5
				ATJ	4" 300 lbs RF, 316/316L Flange ANSI B16.5
				AJJ	6" 150 lbs RF, 316/316L Flange ANSI B16.5
				AUJ	6" 300 lbs RF, 316/316L Flange ANSI B16.5
					PTFE clad
				ACK	1" 150 lbs, PTFE >316/316L Flange ANSI B16.5
				ANK	1" 300 lbs, PTFE >316/316L Flange ANSI B16.5
				AEK	1½" 150 lbs, PTFE >316/316L Flange ANSI B16.5
				AQK	1½" 300 lbs, PTFE >316/316L Flange ANSI B16.5
				AFK	2" 150 lbs, PTFE >316/316L Flange ANSI B16.5
				ARK	2" 300 lbs, PTFE >316/316L Flange ANSI B16.5
				AGK	3" 150 lbs, PTFE >316/316L Flange ANSI B16.5
				AHK	4" 150 lbs, PTFE >316/316L Flange ANSI B16.5
					JIS flanges
				KCJ	10K 25 RF, 316L Flange JIS B2220
				KEJ	10K 40 RF, 316L Flange JIS B2220
				KFJ	10K 50 RF, 316L Flange JIS B2220
				KGJ	10K 80 RF, 316L Flange JIS B2220
				KHJ	10K 100 RF, 316L Flange JIS B2220
				KRJ	20K 50 RF, 316L Flange JIS B2220
					PTFE clad
				KCK	10K 25 RF, PTFE >316L Flange JIS B2220
				KEK	10K 40 RF, PTFE >316L Flange JIS B2220
				KFK	10K 50 RF, PTFE >316L Flange JIS B2220
				KGK	10K 80 RF, PTFE >316L Flange JIS B2220
				KHK	10K 100 RF, PTFE >316L Flange JIS B2220
				YY9	Special version, to be specified
60					Electronics; Output:
				A	FEI50H; 4 to 20 mA HART + display
				B	FEI50H; 4 to 20 mA HART
				C	FEI57C; PFM

60										Electronics; Output:	
										V	None; Prepared for FEI5x + display, cover high, transparent
										W	None; Prepared for FEI5x, cover flat
										Y	Special version, to be specified
70										Housing:	
										1	F15 316L IP66, NEMA4X
										2	F16 polyester IP66, NEMA4X
										3	F17 aluminum IP66, NEMA4X
										4	F13 aluminum + gas-tight process seal IP66, NEMA4X
										5	T13 aluminum + gas-tight process seal + separate connection compartment IP66, NEMA4X
										9	Special version, to be specified
80										Cable Entry:	
										A	Gland M20 (EEx d > thread M20)
										B	Thread G ½
										C	Thread NPT ½
										D	Thread NPT ¾
										E	Plug M12
										F	Plug 7/8"
										Y	Special version, to be specified
90										Type of Probe:	
										L4: 100 to 6000 mm/12 to 240 inch	
										1	Compact
										2	2000 mm L4 cable > separate housing
										3	mm L4 cable > separate housing
										4	80 inch L4 cable > separate housing
										5	inch L4 cable > separate housing
										9	Special version, to be specified
100										Additional Option:	
										A	Basic version
										D	EN10204-3.1 (316L wetted parts), Inspection certificate
										E	EN10204-3.1 (316L wetted parts), Inspection certificate NACE MR0175
										F	SIL declaration of conformity
										S	GL marine certificate
										Y	Special version, to be specified
FMI52										Product designation	

2.2 Scope of delivery



Caution!

Please pay particular attention to the instructions on unpacking, transporting and storing the measuring devices outlined in the "Incoming acceptance, transport, storage" section on Page 16.

The scope of delivery comprises:

- The installed device
- ToF Tool (operating program)
- Accessories, where applicable (see Page 89)

Documentation supplied:

- Operating Instructions
- Approval documentation; if not listed in the Operating Instructions.

2.3 Certificates and approvals

CE mark, declaration of conformity

The device has been constructed and tested to state-of-the-art operational safety standards and left the factory in perfect condition as regards technical safety. The device complies with the applicable standards and regulations that are listed in the EC declaration of conformity and thus meets the legal requirements of the EC Directives. Endress+Hauser confirms that the device has been tested successfully by affixing the CE mark.

2.4 Registered trademarks

KALREZ®, VITON®, TEFLON®

Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

Tri-Clamp®

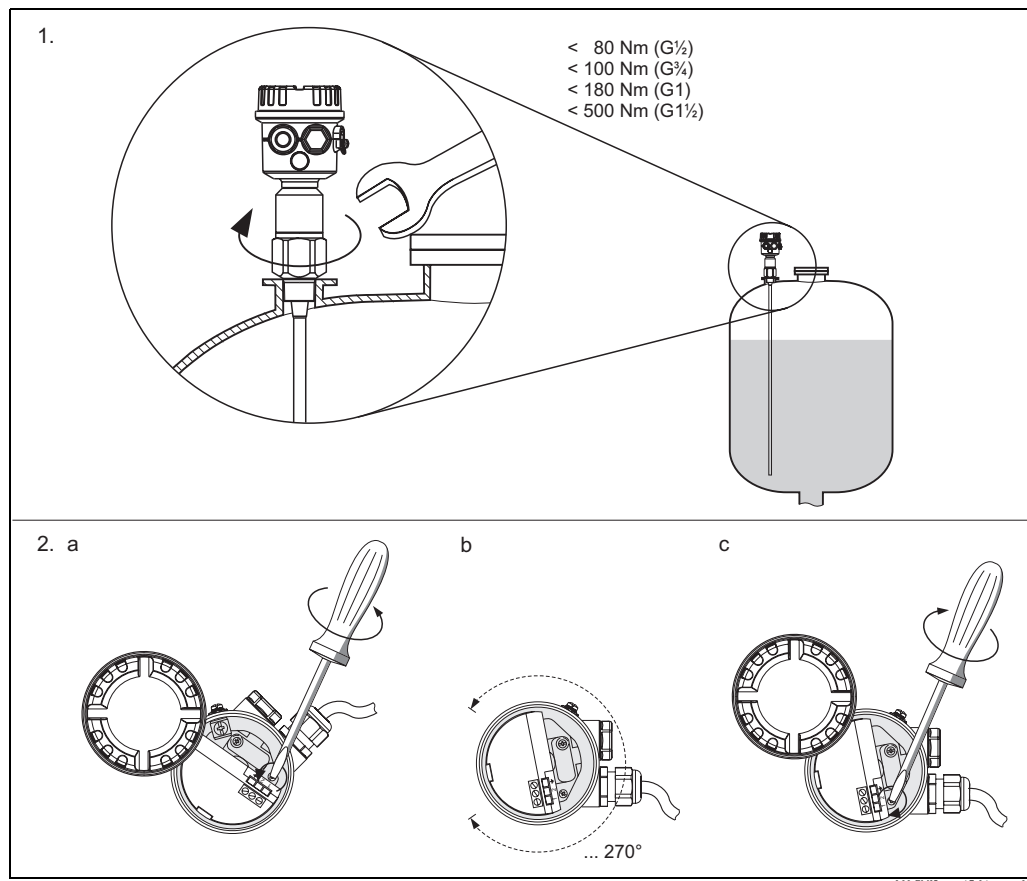
Registered trademark of Ladish & Co., Inc., Kenosha, USA

ToF®

Registered trademark of Endress+Hauser GmbH+Co. KG, Maulburg, Germany

3 Installation

3.1 Quick installation guide



- 1.) Screw in the device
2. a) Loosen clamping screw until the housing can be turned slightly.
2. b) Align the housing.
2. c) Tighten clamping screw (< 1 Nm) until the housing can no longer be rotated.

3.2 Incoming acceptance, transport, storage

3.2.1 Incoming acceptance

Check whether the packaging or content is damaged.
Check that the goods delivered are complete and compare the scope of delivery against the information on your order.

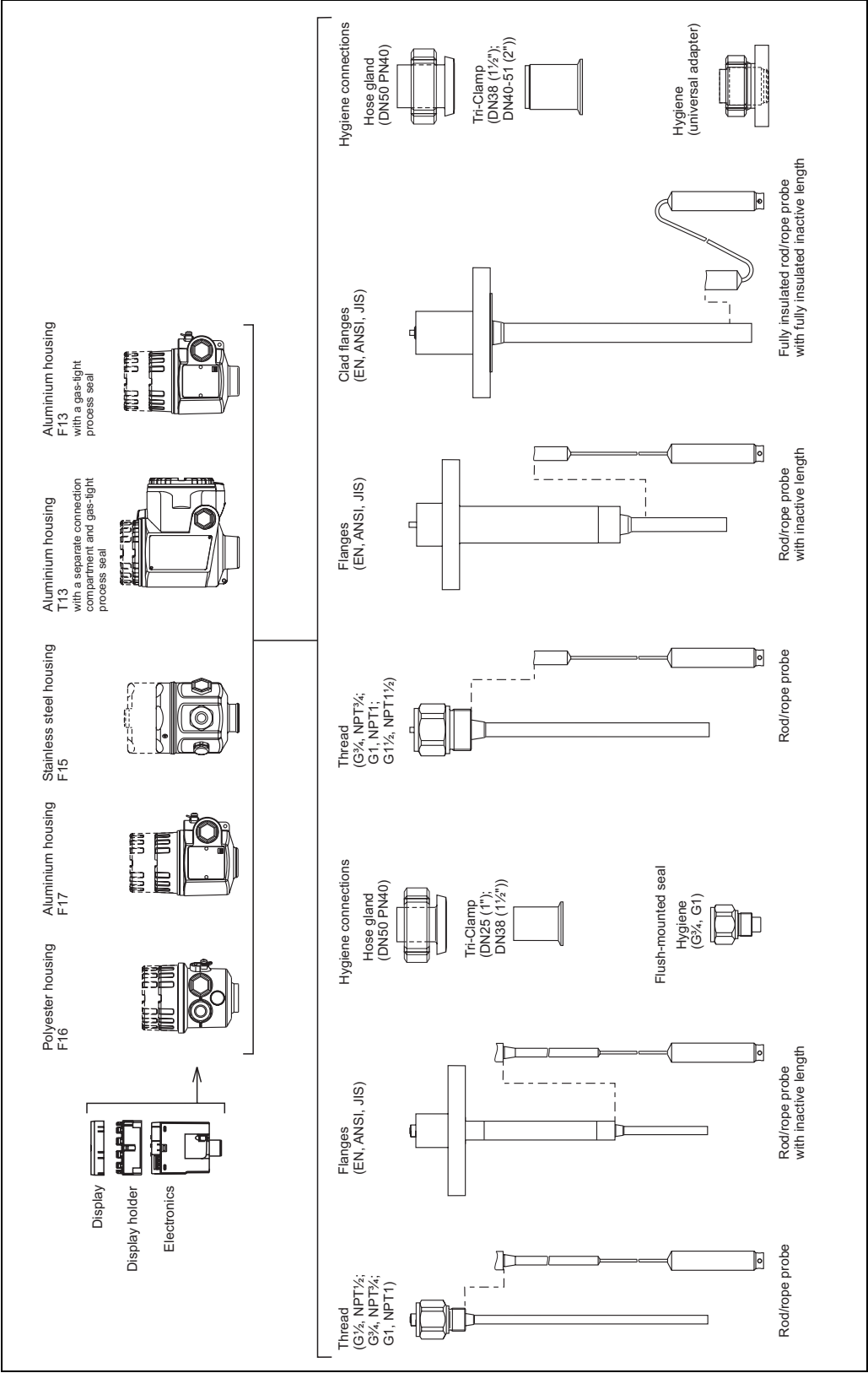
3.2.2 Storage

For storage and transportation, pack the device in such a way as to protect it reliably against impact.
The original packaging offers the best protection for this.
The permitted storage temperature is -50 °C...+85 °C.

3.3 Installation conditions



Hinweis!
All dimensions in mm!



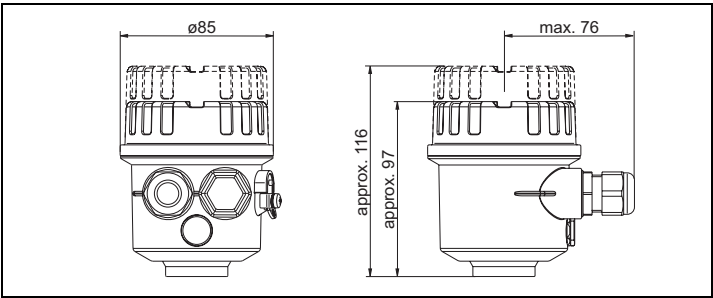
100-FMI5xxxx-03-05-xx-en-001

3.3.1 Housing



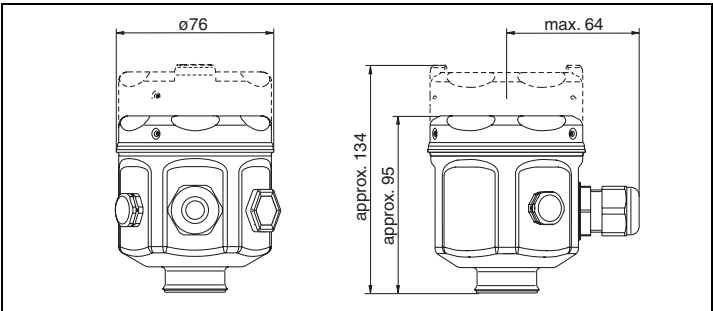
Note!
High cover for housing with display.

Polyester housing F16



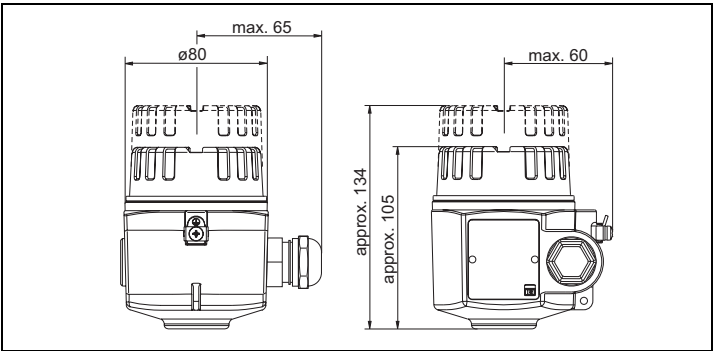
L00-FMI5xxxx-06-05-xx-en-001

Stainless steel housing F15



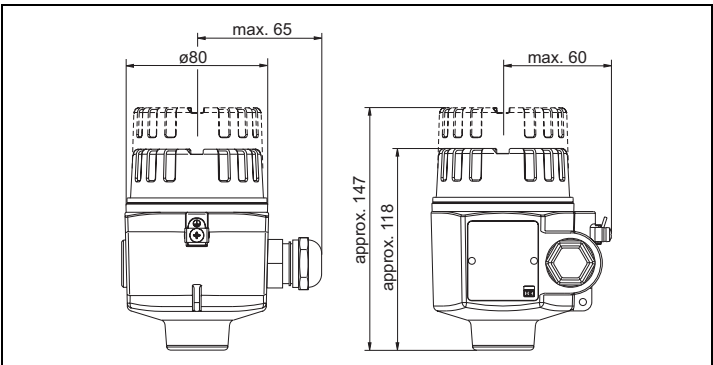
L00-FMI5xxxx-06-05-xx-en-003

Aluminum housing F17



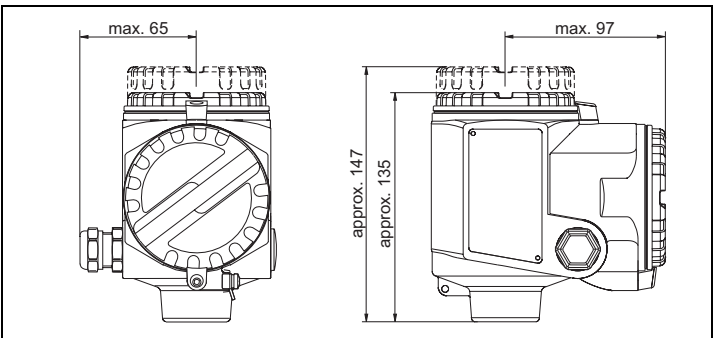
L00-FMI5xxxx-06-05-xx-en-002

Aluminum housing F13
With gas-tight process seal



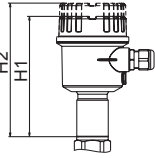
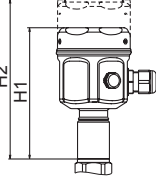
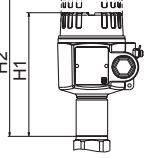
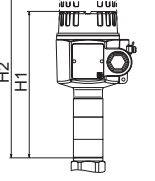
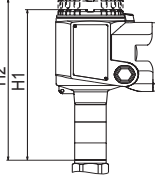
L00-FMI5xxxx-06-05-xx-en-000

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



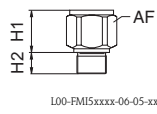
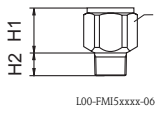
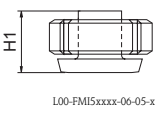
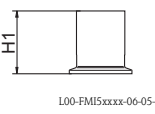
L00-FMI5xxxx-06-05-xx-en-004

3.3.2 Housing extension heights with adapter

	Polyester housing F16	Stainless steel housing F15	Aluminum housing F17	Aluminum housing F13*	Aluminum housing with separate connection compartment T13*
					
Order code	2	1	3	4	5
FMI51, FMI52					
H1 (for electronic inserts without display)	144	142	152	194	202
H2 (for electronic inserts with display)	163	181	181	223	214

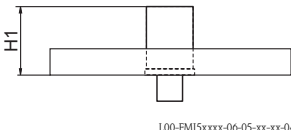
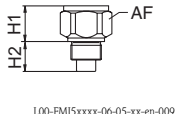
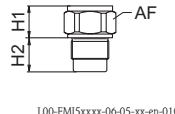
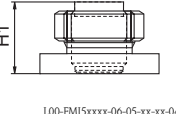
* Housing with gas-tight process seal

3.3.3 Process connections

	Thread G		Thread NPT		Threaded pipe joint	Tri-Clamp		
	 (DIN EN ISO 228-1)		 (ANSI B 1.20.1)		 (DIN11851)	 (ISO2852)		
Rod probes Ø10, rope probes								
For pressures up to	25 bar		25 bar		25 bar	16 bar		
Version / order code	G½ / GCJ G¾ / GDJ G1 / GEJ		NPT½ / RCJ NPT¾ / RDJ NPT1 / REJ		DN50 PN40 / MRJ	DN25 (1") / TCJ DN38 (1½") / TJJ		
Dimensions	H1 = 38 H2 = 19 AF = 41		H1 = 38 H2 = 19 AF = 41		H1 = 57	H1 = 57		
Surface roughness	–		–		≤ 0.8 µm	≤ 0.8 µm		
Additional information	With elastomer flat seal		–		–	EHEDG*		
Rod probes Ø16, rope probes								
For pressures up to	25 bar	100 bar	25 bar	100 bar	40 bar	16 bar	16 bar	
Version / order code	G¾ / GDJ G1 / GEJ	G1½ / GGJ	NPT¾ / RDJ NPT1 / REJ	NPT1½ / RGJ	DN50 PN40 / MRJ	DN38 / TNJ (1½")	DN40-51 / TDJ (2")	
Dimensions	H1 = 38 H2 = 19 AF = 41	H1 = 41 H2 = 25 AF = 55	H1 = 38 H2 = 19 AF = 41	H1 = 41 H2 = 25 AF = 55	H1 = 66	H1 = 47	H1 = 66	
Surface roughness	–		–		≤ 0.8 µm	≤ 0.8 µm	≤ 0.8 µm	
Additional information	With elastomer flat seal		–		–	–		

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

	Thread G	Thread NPT	Threaded pipe joint	Tri-Clamp
Rod probes Ø22, rope probes				
For pressures up to	50 bar	50 bar	—	—
Version / order code	G1½ / GGJ	NPT1½ / RGJ	—	—
Dimensions	H1 = 85 H2 = 25 AF = 55	H1 = 85 H2 = 25 AF = 55	—	—
Surface roughness	—	—	≤ 0.8 µm	≤ 0.8 µm
Additional information	With elastomer flat seal	—	—	—

	Flanges	Hygiene connection	Hygiene connection	Hygiene connection
	 (EN1092-1) (ANSI B 16.5) (JIS B2220)	 With flush-mounted seal	 With flush-mounted seal	 Adapter 44 mm with flush-mounted seal
Rod probes Ø10, 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	H1 = 57	H1 = 31 H2 = 26 AF = 41	H1 = 30 H2 = 27 AF = 41	—
Additional information	Also clad (PTFE)	Weld-in adapter see "Accessories"Page 89 EHEDG*	Weld-in adapter see "Accessories"Page 89 EHEDG*	—
Rod probes Ø16, 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
Dimensions	H1 = 66	—	—	H1 = 57
Additional information	Also clad (PTFE)	—	—	Universal adapter see "Accessories"Page 90
Rod probes Ø22, rope probes				
For pressures up to	Max. 50 bar (depends on flange)	—	—	—
Version / order code	EN / B** ANSI / A** JIS / K**	—	—	—
Dimensions	H1 = 110	—	—	—
Additional information	Only clad (PTFE)	—	—	—

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

** Wildcard for nominal diameter and permitted process pressure

 **Note!**
Only use clad flanges for aggressive liquids!

3.3.4 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 $\varnothing$ 10 mm = 1 mm; 16 mm = 2 mm; 22 mm = 2 mm
- For conductive liquids ($>100 \mu\text{S}/\text{cm}$), the probe is calibrated at the factory to the probe length ordered (0 % to 100 %). For nonconductive liquids ($<1 \mu\text{S}/\text{cm}$), 0% calibration is performed at the factory. Only the 100% calibration has to be carried out on site.
- The isolation is at the probe rod point approx. 10 mm welded. This range is not part of the active measuring range.

	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-061.eps					L00-FMI5xxxx-06-05-xx-xx-051
Total length (L)	100 to 4000	100 to 4000	100 to 6000	100 to 6000	300 to 4000
Active rod length (L1)	100 to 4000	100 to 4000	100 to 4000	100 to 4000	150 to 3000
Inactive rod length (L3)	-	-	100 to 2000	100 to 2000	150 to 1000
Probe rod diameter	10 / 16	10 / 16	10 / 16	10 / 16	22*
Diameter of 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 $> 100 \mu\text{S}/\text{cm}$	X	-	X	-	X
For nonconductive liquids $< 100 \mu\text{S}/\text{cm}$	-	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

X = recommended
* probe shaft

Length tolerance L1, L3

up to 1 m: 0 ... -5 mm

1 ... 3 m: 0 ... -10 mm

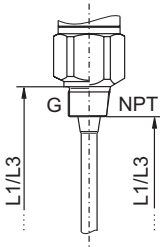
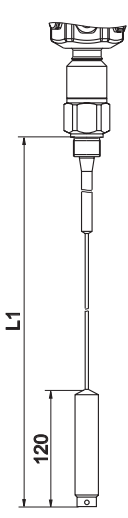
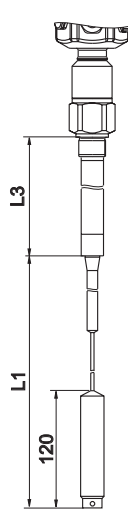
3 ... 6 m: 0 ... -20 mm

3.3.5 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 with anchor hole)
- For conductive liquids ($>100 \mu\text{S}/\text{cm}$), the probe is calibrated at the factory to the probe length ordered
(0 % to 100 %). For nonconductive liquids ($<1 \mu\text{S}/\text{cm}$), 0% calibration is performed at the factory.
Only the 100% calibration has to 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.

	Rope probe	Rope probe with inactive length	Rope probe with fully insulated inactive length
			
	L00-FMI5xxxx-06-05-xx-xx-061.eps		L00-FMI5xxxx-06-05-xx-xx-036
Total length (L)	420 to 10000	420 to 12000	420 to 11000
Active rope length (L1)	420 to 10000	420 to 10000	420 to 10000
Inactive length (L3)	-	150 to 2000	150 to 1000
Probe rope diameter	4	4	4
Anchor weight diameter	22	22	22
Anchor hole diameter	5	5	5
Tensile loading capacity (N) of probe rope at 20 °C	200	200	200
For conductive liquids > 100 $\mu\text{S}/\text{cm}$	X	X	X
For nonconductive liquids < 100 $\mu\text{S}/\text{cm}$	X	X	X
For aggressive liquids	X	-	X
For use in mounting nozzles	-	X	X
In the event of condensate on tank ceiling	-	X	X

X = recommended

Length tolerance L1, L3

to 1 m: 0 ... -10 mm

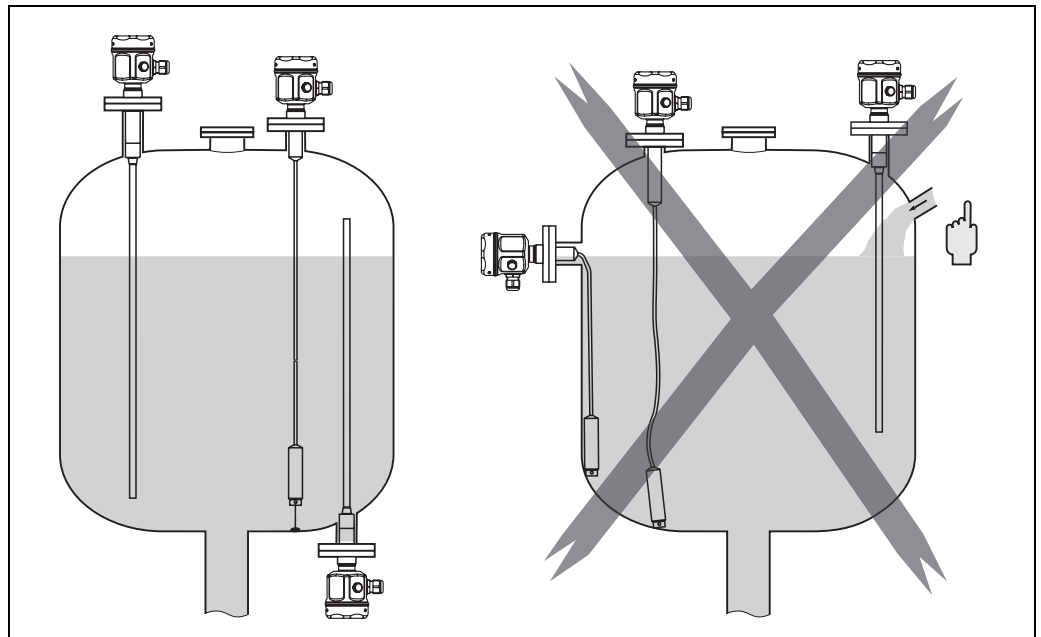
1 ... 3 m: 0 ... -20 mm

3 ... 6 m: 0 ... -30 mm

6 ... 12 m: 0 ... -40 mm

3.3.6 Planning instructions

Orientation



L00-FMI5xxxx-11-06-xx-xx-003

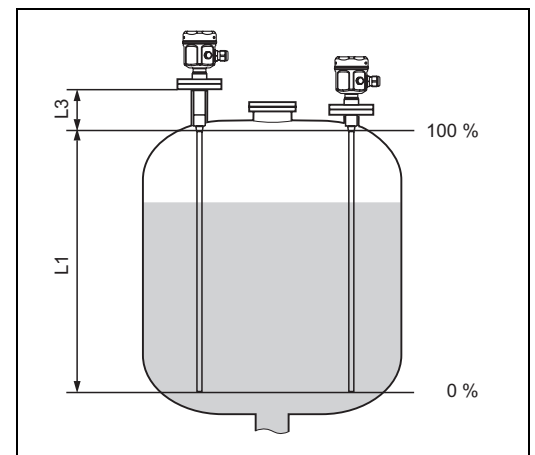
Measuring condition

- 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 % calibration can be inverted.



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

Measuring range with FEI50H (HART)

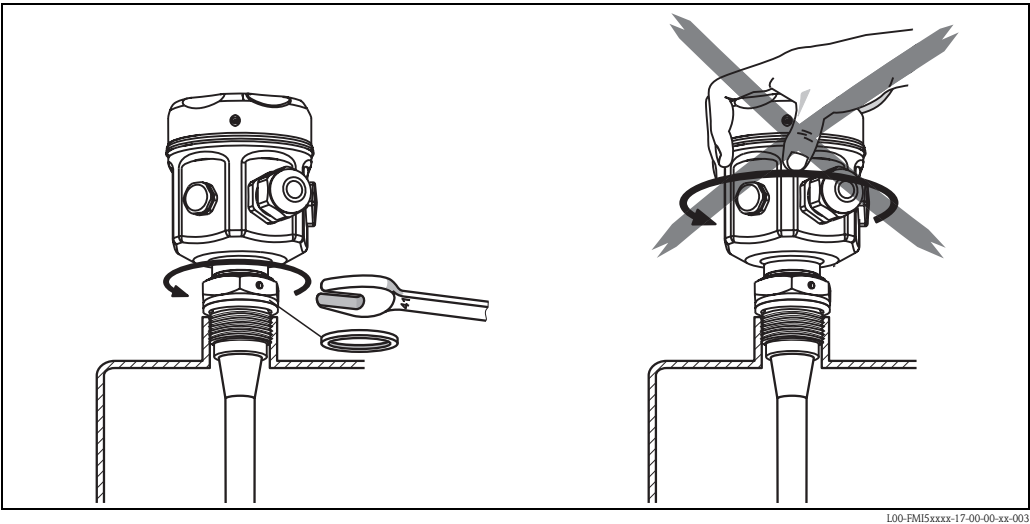
- Measuring frequency:
 - 500 kHz
- Span:
 - $\Delta C = 25$ to 4000 pF recommended (2 to 4000 pF possible)
- Final capacitance:
 - $C_E = \text{max. } 4000 \text{ pF}$
- Adjustable initial capacitance:
 - $C_A = 0$ to 2000 pF (< 6 m probe length)
 - $C_A = 0$ to 4000 pF (> 6 m probe length)

3.4 Installation instructions

- 

Caution!
Do not damage the probe insulation when installing!
- 

Caution!
When screwing in the probe, do not turn at the housing as this could damage the housing mounting.



Probe with thread

- G ½, G ¾, G 1 or G 1½ (cylindrical):
 - To be used with the elastomer fiber seal supplied (temperature-resistant up to 300 °C) or another chemically resistant seal.



Note!
The following applies for probes with a parallel thread and supplied seal:

Thread	For pressures up to 25 bar	For pressures up to 100 bar	Maximum torque
G ½	25 Nm	–	80 Nm
G ¾	30 Nm	–	100 Nm
G 1	50 Nm	–	180 Nm
G 1½	–	300 Nm	500 Nm

- ½ NPT , ¾ NPT, 1 NPT and 1½ NPT (conical):
 - Wrap the thread by a suitable sealing material (Use conductive sealing material only).

Probe with Tri-Clamp, sanitary connection or flange

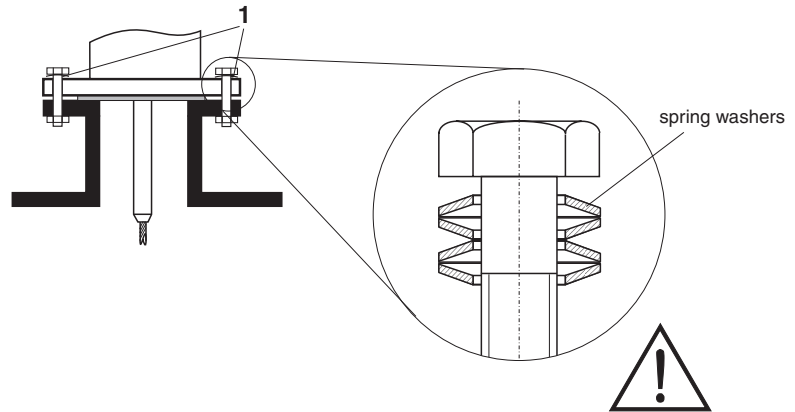
- The process seal must meet the specifications of the application (resistant to temperature and medium).
If the flange is PTFE-clad, this generally suffices as the seal up to the permitted operating pressure.

Probe with PTFE-clad flange

Note!

Use spring washers (1)

It is recommended to retighten the flange bolts periodically, depending on process temperature and pressure. Recommended torque: 60 ... 100 Nm.



L00-FMI5xxxx-17-00-00-en-005

3.4.1 Mounting tools

You need the following tool for mounting:

- Tool for flange mounting or
- A wrench AF 41 or AF 55 for the threaded connection and
- A Phillips screwdriver for aligning the cable entry.

3.5 Installation examples

3.5.1 Rod probes

Conductive tanks (metal tanks)

If the process connection of the probe is insulated from the metal tank (e.g. through seal material), the ground connection at the probe housing must be connected to the tank by means of a short cable.

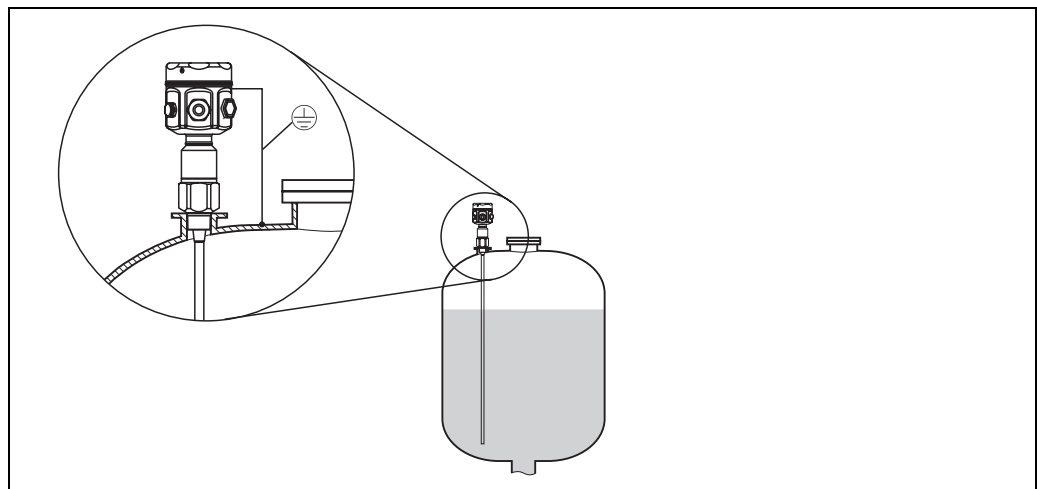


Note!

A fully insulated rod probe may neither be shortened nor extended.

If the insulation of the probe rod is damaged, this results in an incorrect measurement result.

FMI51 rod probe

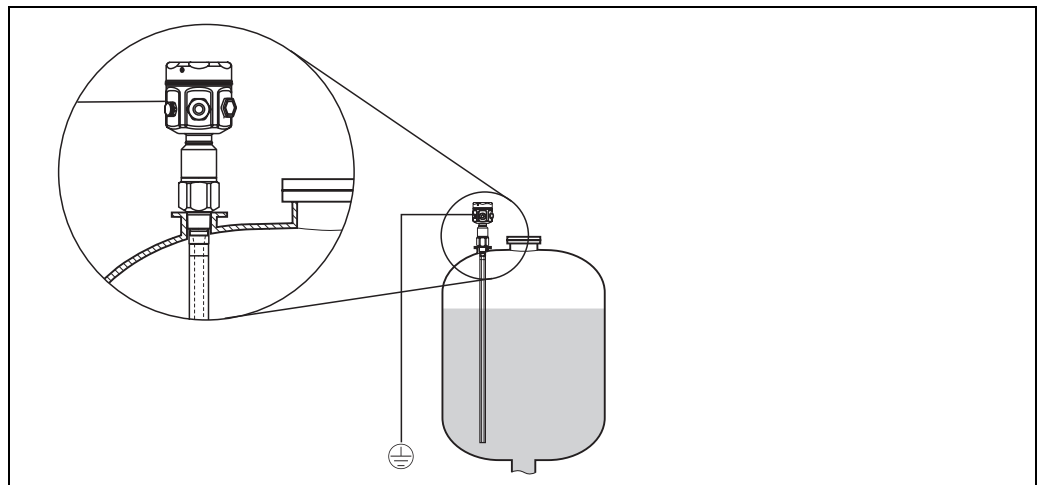


L00-FMI5xxxx-11-06-xx-xx-004

FMI51 rod probe with ground tube

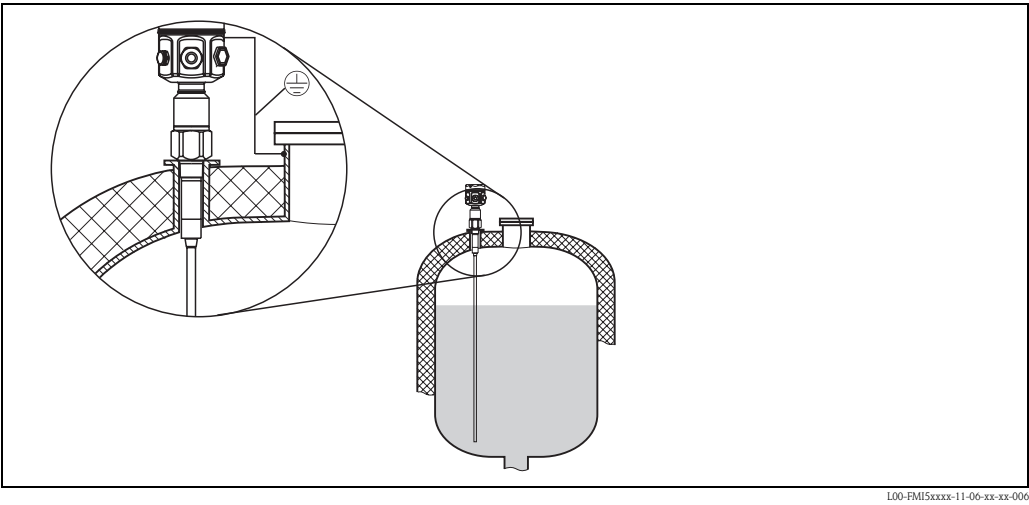
Nonconductive tanks (plastic tanks)

When installing in a plastic tank, a probe with a ground tube must be used.

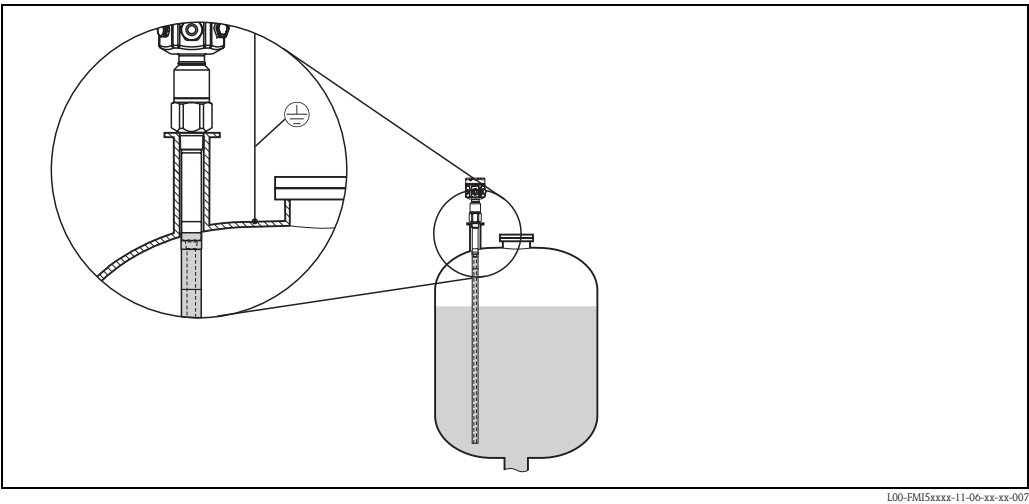


L00-FMI5xxxx-11-06-xx-xx-005

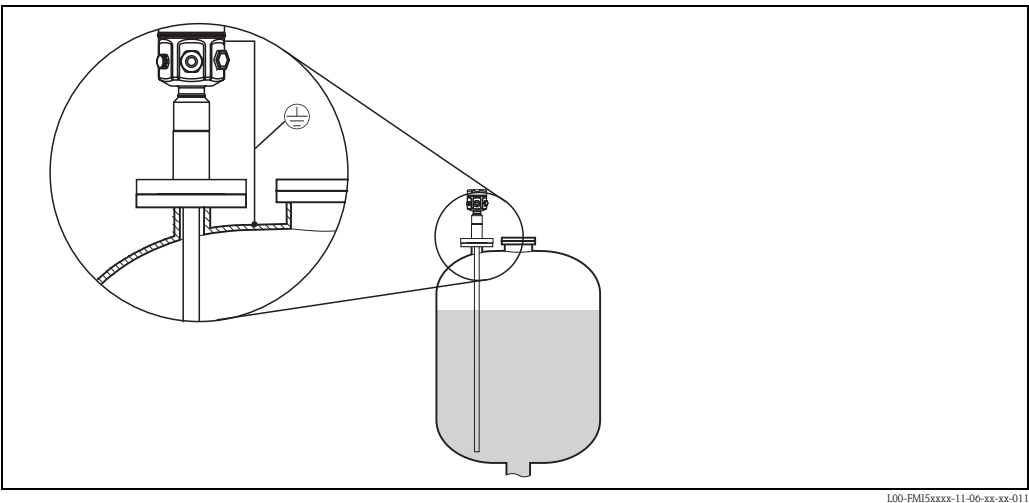
FMI51 rod probe with inactive length (e.g. for insulated tanks)



FMI51 rod probe with ground tube and inactive length (for mounting nozzles)

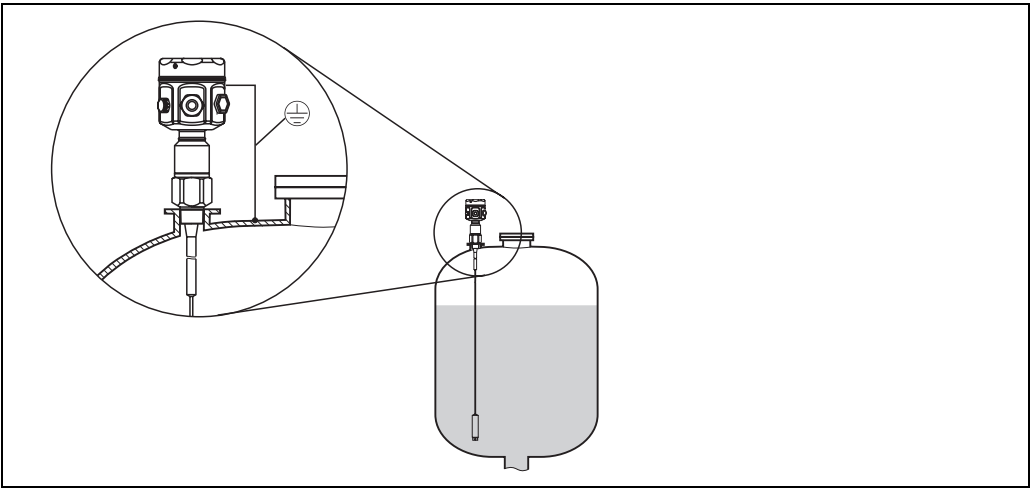


FMI51 fully insulated probe with clad flange for aggressive media



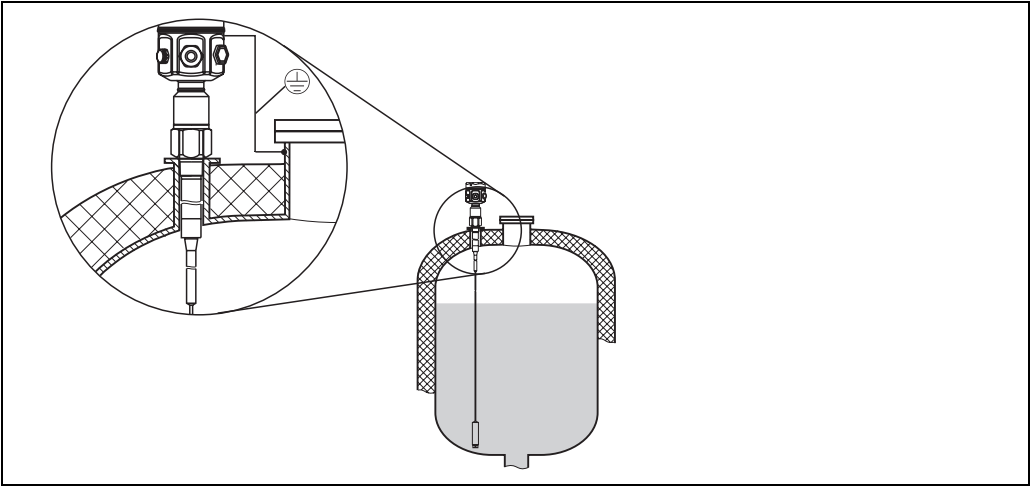
3.5.2 Rope probes

FMI52 rope probe



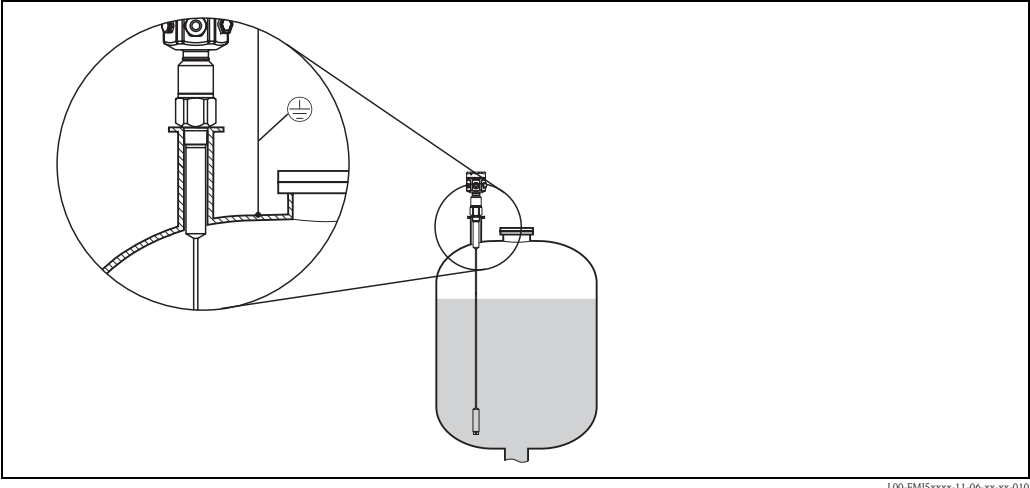
L00-FMI5xxxx-11-06-xx-xx-008

FMI52 rope probe with inactive length (e.g. for insulated tanks)



L00-FMI5xxxx-11-06-xx-xx-009

FMI52 rope probe with fully insulated inactive length (for mounting nozzles)



L00-FMI5xxxx-11-06-xx-xx-010

3.5.3 Shortening the rope



Note!

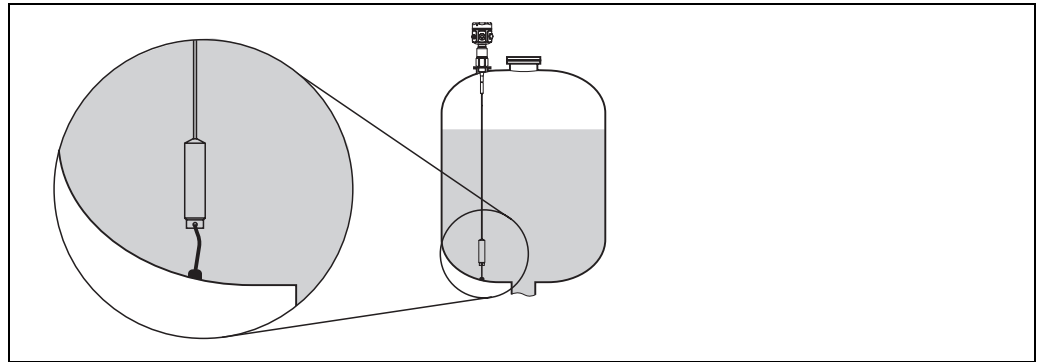
See Operating Instructions, rope shortening kit KA061F/00.

3.5.4 Tensioning weight with tension

The end of the probe needs to be secured if the probe would otherwise touch the silo wall or another part in the tank. This is what the internal thread in the probe weight is intended for.

The bracing can be conductive or insulating to the tank wall.

To avoid a too high tensile load the rope should be loose or guyed with a feather. The maximum tensile load may not exceed 200 Nm.



L00-FMI5xxxx-11-06-xx-xx-012

3.5.5 Aligning the housing

The housing can be rotated 270° to align the cable entry.

For an even better way of preventing moisture penetration, we recommend you route the connecting cable downwards before the cable gland and secure it with a cable tie. This is particularly recommended when mounting outdoors.

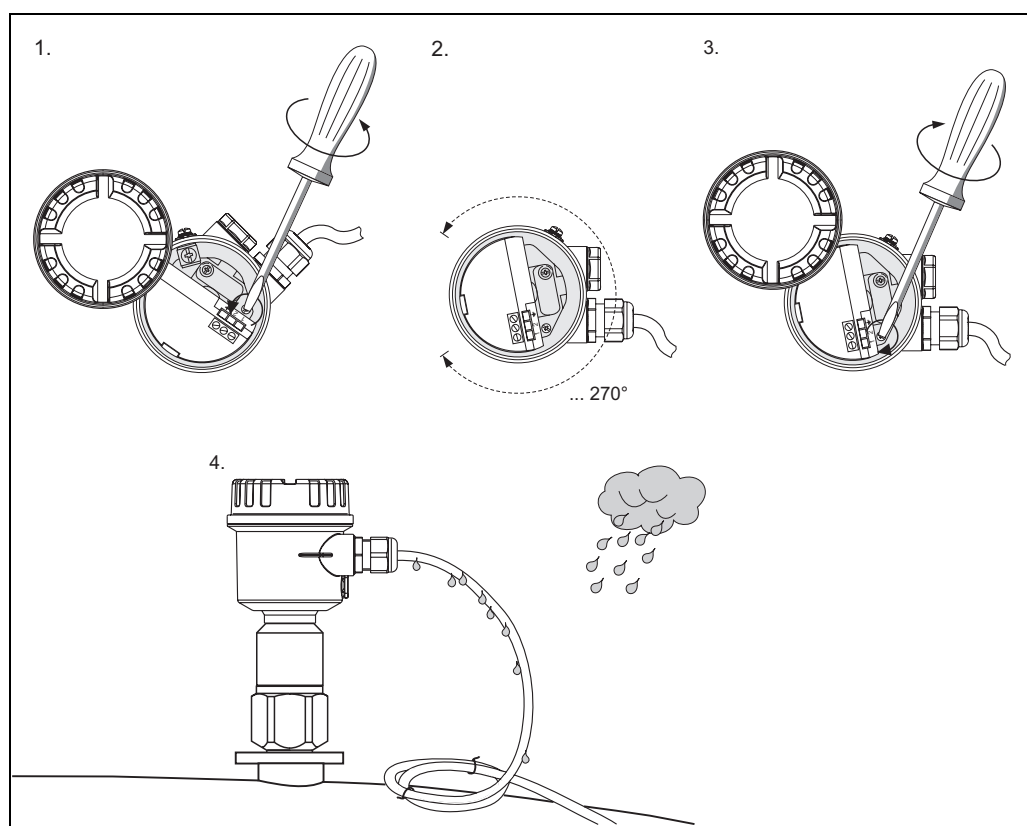
Housing (type F16, F15, F17, F13, T13)

- Unscrew cover
- Loosen Phillips screw at bottom of housing by turning the screw 3 to 4 times
- Turn the housing to the desired position (max. 270°, from one stop to the next)
- Tighten Phillips screw at bottom of housing.



Note!

For housing type T13 with a separate connection compartment, the Phillips screw for aligning the housing is also located in the electronics compartment.



L00-FMI5xxxx-04-00-00-xx-002

1. Loosen clamping screw until the housing can be turned slightly.
2. Align the housing.
3. Tighten clamping screw (< 1 Nm) until the housing can no longer be rotated.
4. Additional protection against moisture penetration for electronics compartment.

3.5.6 Sealing the probe housing

When mounting the probe, connecting the electronic insert and later during operation, it is important that moisture does not penetrate the probe housing. For this reason, the housing cover and the cable entries must always be closed tight.

The O-ring seal on the housing cover is provided with a lubricant when delivered.

In this way, the cover can be sealed tight and the aluminum thread does not bite when screwing down.

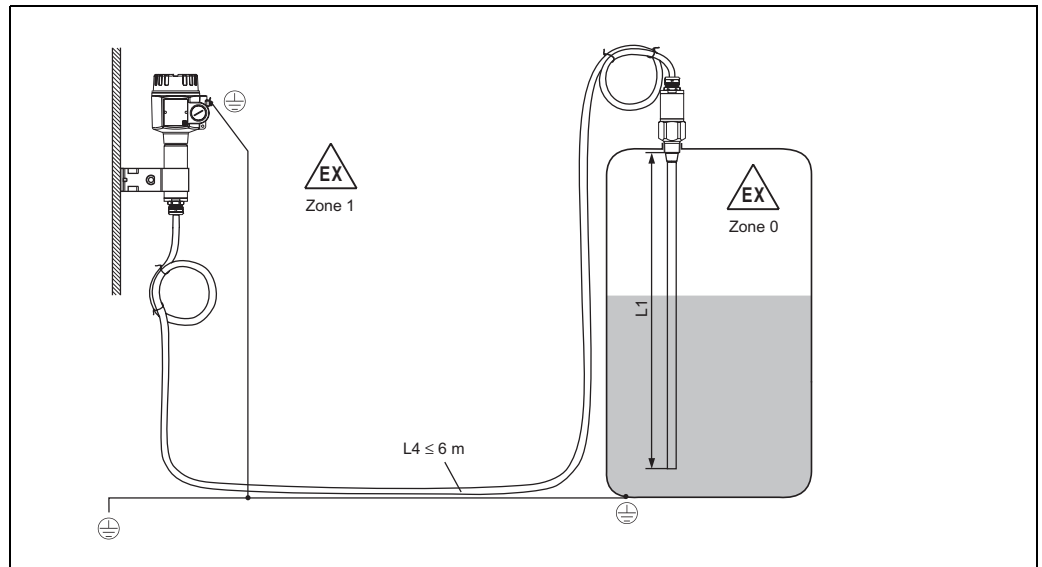
Never use a lubricant on a mineral-oil base! This would destroy the O-ring.

3.6 With separate housing



Note!

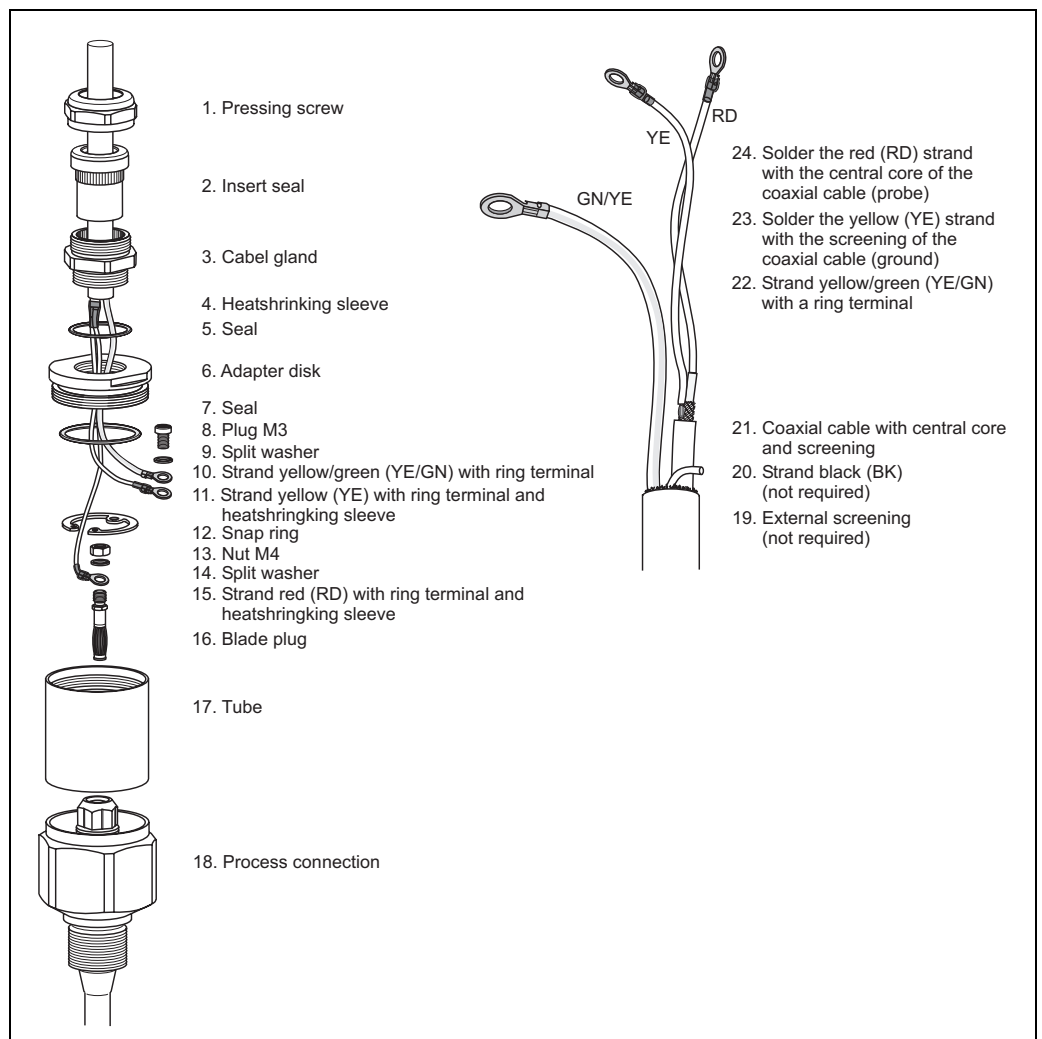
The overall length $L = L1 + L4$ may not exceed 10 m.



L00-FMI5xxxx-14-00-06-xx-002

Rod length $L1$ max. 4 m

Rope length $L1$ max. 10 m.



L00-FMI5xxxx-03-05-xx-en-005

3.6.1 Shortening the connecting cable



Note!

The maximum connection length between the probe and the separate housing is 6 m and is shown by the dimension L4. When ordering a Liquicap M with separate housing you must indicate the required connection length.

If the connecting cable must be shortened or be led through a wall, you must disconnect the cable from the process connection. Please proceed as follows:

- Loosen the pressing screw (1) with an open-end wrench (size 22). If necessary, hold the process connection. Please make sure that neither the connecting cable nor the probe is turning with the pressing screw.
- Pull the insert seal (2) out of the cable gland (3).
- Loosen the cable gland (3) with an open-end wrench (size 22). If necessary, hold the adapter disk (6) with an open-end wrench (size 34).
- Loosen the adapter disk (6) from the tube (17).
- Remove the snap ring with a pair of snap ring pliers.
- Clutch the nut (M4) of the blade plug with a pair of pliers and pull this out.



Note!

If you are shortening the connecting cable, we recommend to reuse all strands with ring terminals. After the strands were soldered on again the soldering points must be isolated.



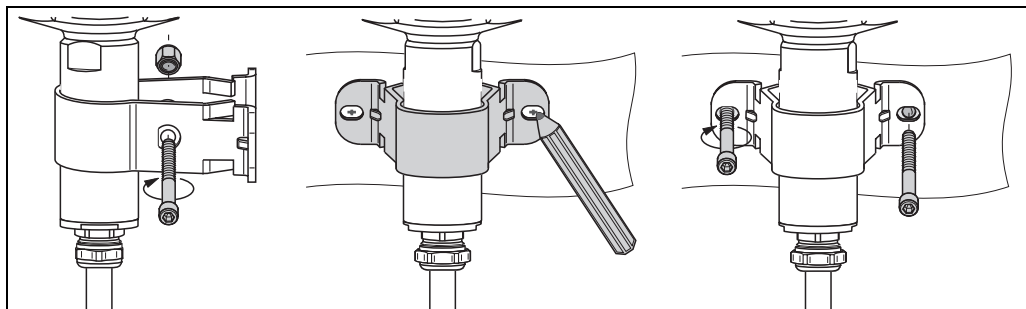
Note!

If the strands are not reused, the ring terminals of the yellow and the red strand must be isolated at the crimp connection e.g. with a heat shrinking sleeve.

Mounting a wall bracket or pipe bracket

Wall mounting

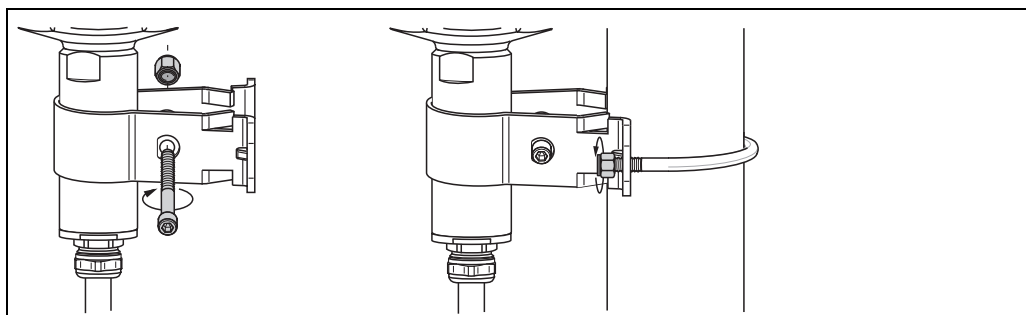
- Push the wall bracket onto the tube and screw it together.
- Mark the distance between the holes on the wall and drill the 2 holes.
- Screw the separate housing on the wall.



L00-FMI5xxxx-03-05-xx-xx-011

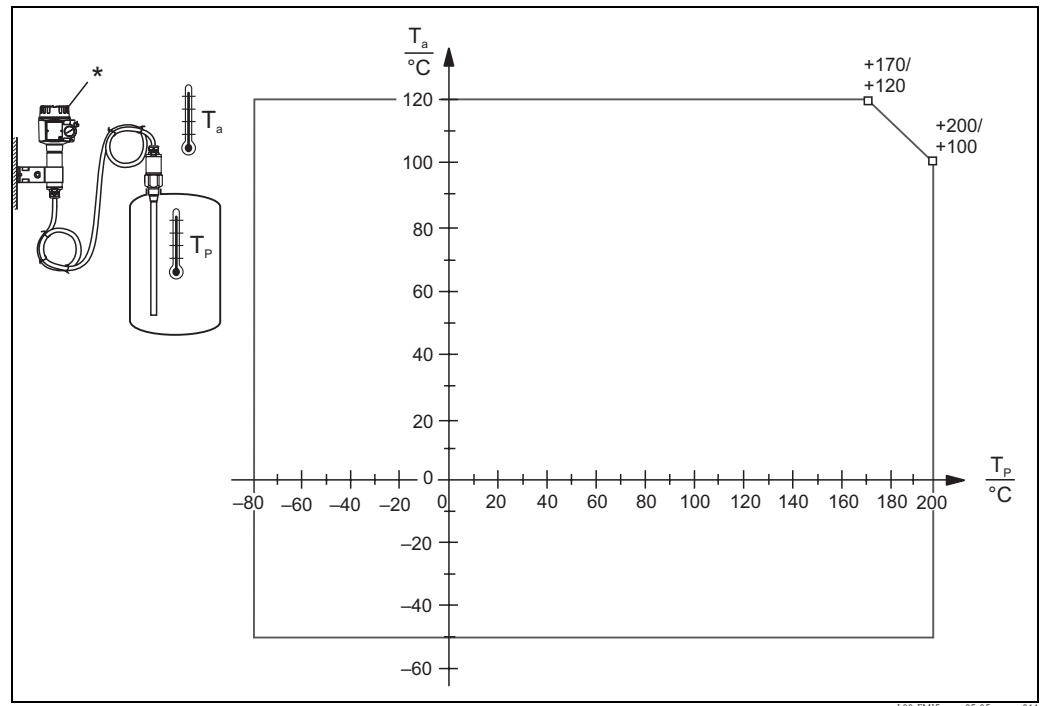
Pipe mounting

- Push the wall bracket onto the tube and screw it together.
- Screw the separate housing on a pipe of max. 2".



L00-FMI5xxxx-03-05-xx-xx-011

3.6.2 Process data



L00-FMI5xxxx-05-xx-xx-011

T_a = Ambient temperature

T_p = Process temperature



Note!

The maximum cable length between probe and separate housing is 6 m (L4). The required cable length must be indicated in the ordering process of a Liquicap M with separate housing. If the cable connection has to be shortened or led through a wall, it must be separated from the process connection. See in addition chapters Section 3.6.1.

3.7 Post-installation check

After installing the measuring device, carry out the following checks:

- Is the device damaged (visual inspection)?
- Does the device meet the specifications at the measuring point with regard to process temperature/pressure, ambient temperature, measuring range etc.?
- Has the process connection been tightened with the appropriate tightening torque?
- Are the measuring point number and labeling correct (visual inspection)?
- Is the device adequately protected against precipitation and direct sunshine?

4 Wiring

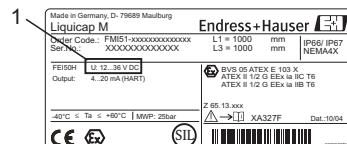
4.1 Quick wiring guide

Wiring in F16, F15, F17, F13 housings



Before connecting, please note the following:

- The supply voltage must match that on the nameplate (1).
- Switch off the supply voltage before connecting the device.
- Connect the potential matching line to the earth terminal of the sensor before connecting the device to the power supply.



When using the probe in hazardous areas, applicable national standards and the information in the Safety Instructions (XA) must be observed. The specified cable gland must be used.

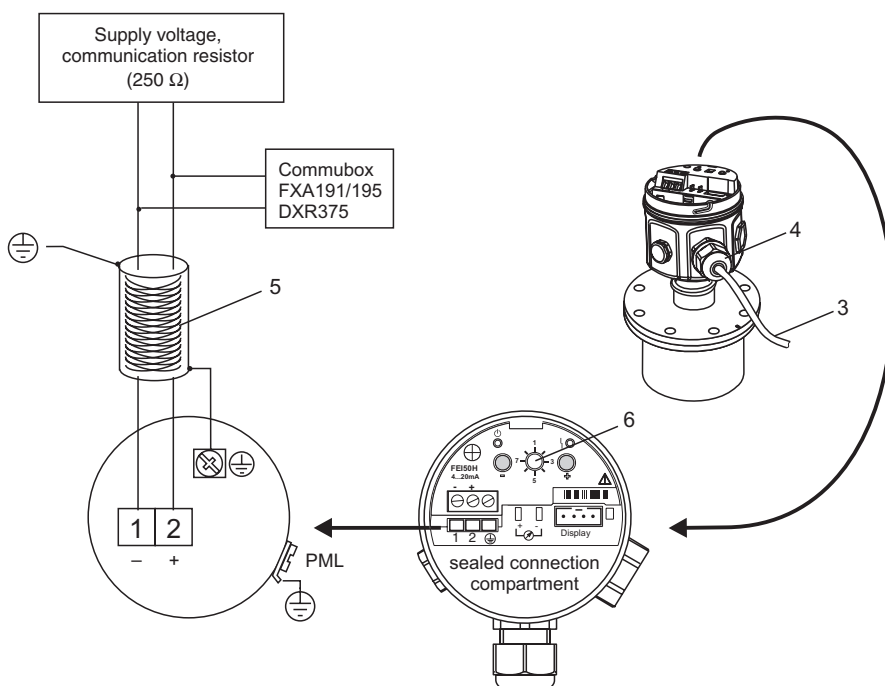


The explosion protection is as follows for devices with a certificate:

- Housing F15, F16 – EEx ia:
The power supply must be intrinsically safe.

Liquicap M is connected as follows:

- Remove the housing cover (2).
- Guide the connecting cable (3) through the gland (4).
- Ground the screening (5) on both sides!
- Establish the connection (see terminal assignment).
- Tighten the cable gland (4).
- At the electronic insert, set the function switch (6) to position 1 (operation).
- Screw down the housing.
- Switch on the power supply.



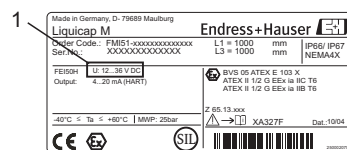
L00-FMI5xxxx-04-00-00-en-020

Wiring in T13 housing

**Caution!**

Before connecting, please note the following:

- The supply voltage must match that on the nameplate (1)
- Switch off the supply voltage before connecting the device
- Connect the potential matching line to the earth terminal of the sensor before connecting the device to the power supply.



When using the probe in hazardous areas, applicable national standards and the information in the Safety Instructions (XA) must be observed. The specified cable gland must be used.

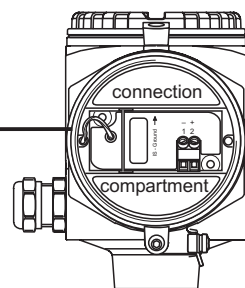
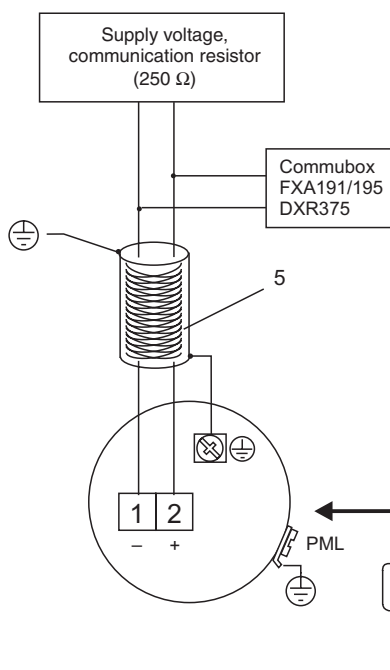
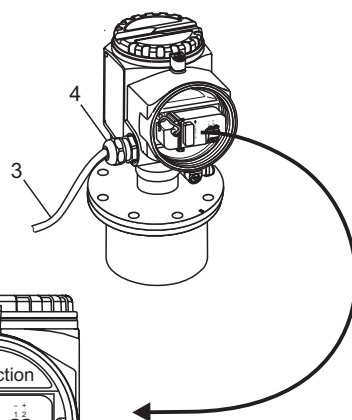
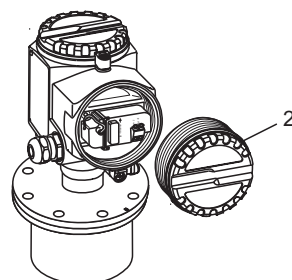


Liquicap M is connected as follows:

- Switch off the power supply before the housing cover (2) is unscrewed at the separate connection compartment!
- Pull cable (3) through the gland (4).
- Ground the screening on both sides!
- Establish the connection (see terminal assignment).



- Tighten the cable gland (4).
- Screw down the housing cover (2).
- Switch on the power supply.

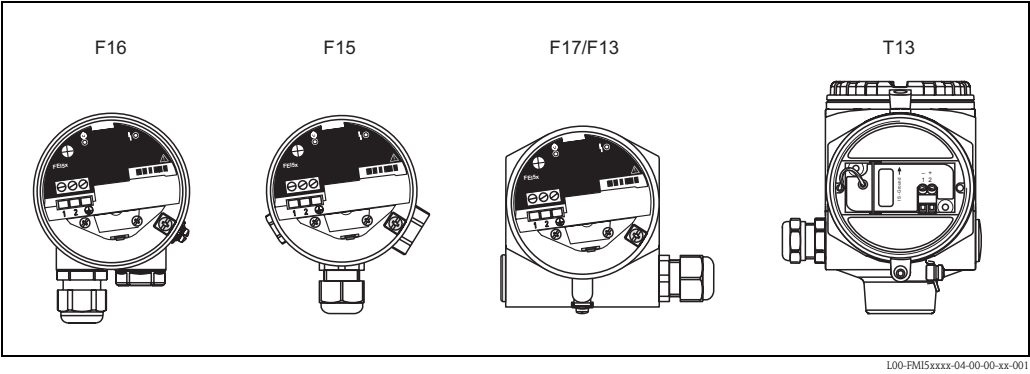


4.2 Connecting the measuring unit

Connection compartment

Five housings are available:

	Standard	EEx ia	EEx d	Gas-tight process seal
Plastic housing F16	X	X	–	–
Stainless steel housing F15	X	X	–	–
Aluminum housing F17	X	X	–	–
Aluminum housing F13	X	X	–	X
Aluminum housing T13 (with separate connection compartment)	X	X	X	X



The device data are located on the nameplate and contain important information regarding the analog output and power supply.

Cable entry

Cable gland: M20x1.5 (for EEx d only cable entry)
Cable entry: G ½ or NPT ½ , NPT ¾

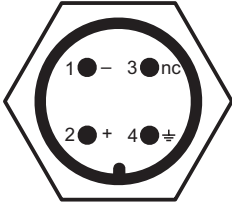
Connector

For the versions with a connector (M12 or 7/8"), the housing does not have to be opened for connecting the signal line.

PIN assignment for M12 connector (PROFIBUS PA standard, HART)

	PIN	Meaning
	1	Earth
	2	Signal +
	3	Signal –
	4	Not assigned

PIN assignment for 7/8" connector (Fieldbus FOUNDATION standard, HART)

	PIN	Meaning
	1	Signal -
	2	Signal +
	3	Not assigned
	4	Earth

L00-FMxxxxxx-04-00-00-yy-017

Supply voltage

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



Note!
With integrated reverse polarity protection.

Power consumption

Min. 40 mW, max. 800 mW

Current consumption

- Current consumption: 3.8 to 22 mA
- HART multidrop operation: 4 mA

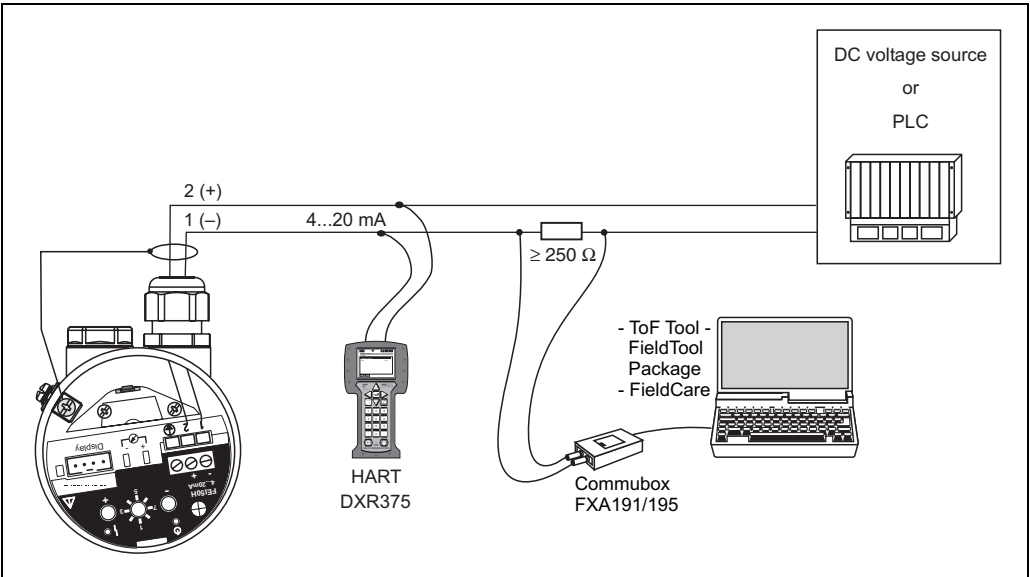
Residual ripple

47 to 125 Hz: $U_{ss} = 200 \text{ mV}$ (with 500Ω)

Noise

500 Hz to 10 kHz: $U_{eff} < 2.2 \text{ mV}$ (with 500Ω)

4.2.1 Connecting HART with other supply units



**Caution!**

If the HART communication resistor is not integrated in the supply unit, a 250 Ω communication resistor must be included in the 2-wire line.

4.3 Recommendations for connection

4.3.1 Potential equalization

Connect the potential equalization to the outer earth terminal of the sensor housing (T13, F13, F16, F17).

The earth terminal of the stainless steel housing F15 is situated inside the housing.

4.3.2 Wiring a screened cable

**Caution!**

In Ex-applications, the screen may only be grounded on the sensor side. For further safety instructions, please refer to the separate documentation for applications in hazardous areas.

4.4 Degree of protection

	IP66*	IP67*	IP68*	NEMA 4X**
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
Aluminum housing T13 with gas-tight process seal and separate connection compartment (EEx d)	X	–	X	X
Separate housing	X		X	X

* As per EN 60529

** As per NEMA 250

4.5 Post-connection check

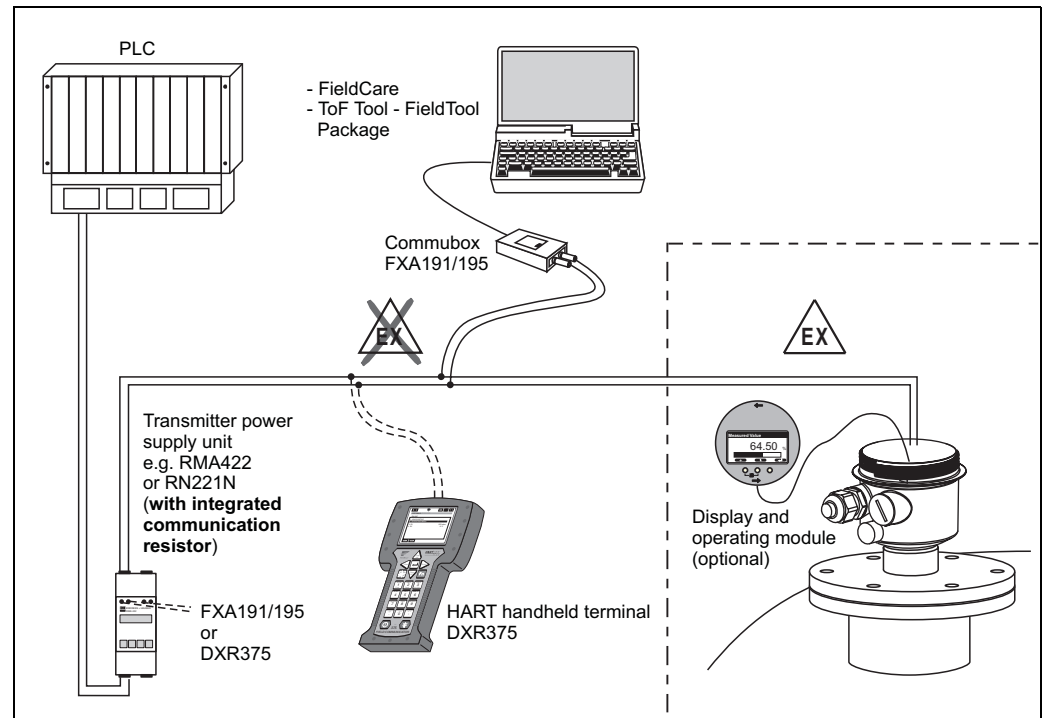
After wiring the measuring device, carry out the following checks:

- Is the terminal assignment correct (see Page 34 and Page 35)?
- Is the cable gland sealed tight?
- Is the housing cover screwed down until the stop?
- If power supply is present:
Is the device operational and is the green LED flashing?

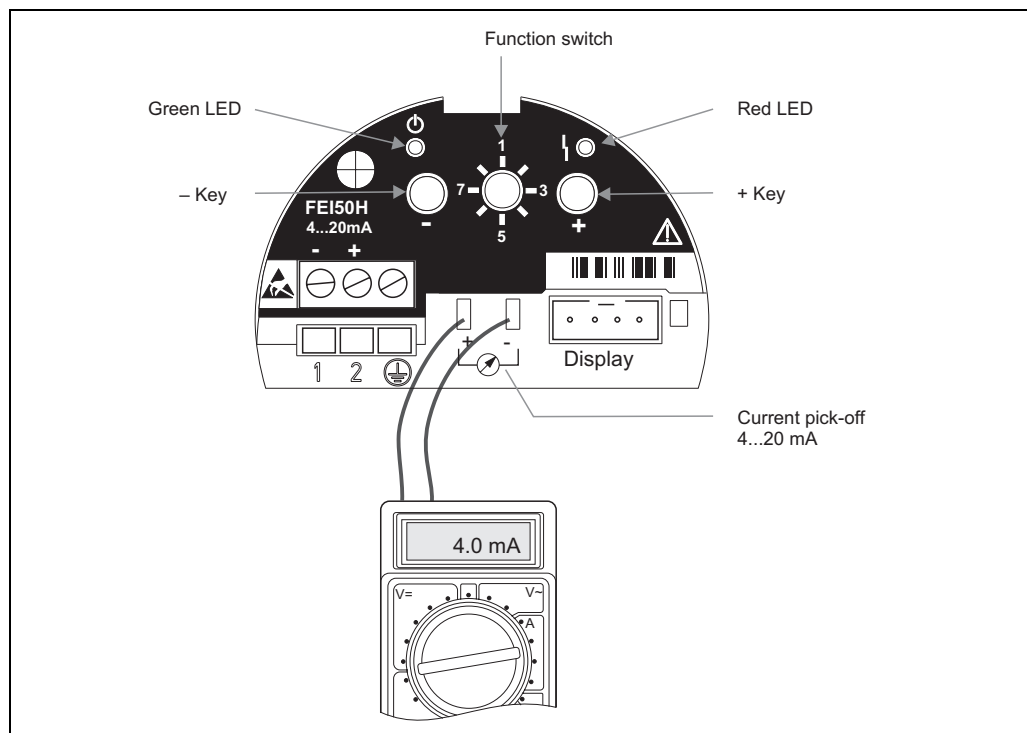
5 Operation

5.1 Operating options

- Via the operating elements at the FEI50H electronic insert
- Via the display and operating module
- Via the HART protocol with Commubox FXA191, FXA195 and the ToF Tool - FieldTool Package or FieldCare operating programs
- With the HART handheld terminal DXR375



5.1.1 Display and operating elements at the FEI50H electronic insert



L00-FMI5xxxx-07-05-xx-en-100

Green LED (ⓘ indicates operation):

- Flashes every 5 s:
 - Indicates whether the device is operational.
- Flashes once every s:
 - The device is in the calibration mode

Red LED (⚡ indicates a fault or malfunction):

- Flashes five times a s:
 - Capacitance at probe is too large, short-circuit at the probe or FEI50H is defective
- Flashes once every s:
 - The temperature in the electronic insert is outside the permitted temperature range.

Key (–)

- To execute the functions set via the function switch

Key (+)

- To execute the functions set via the function switch

Function switch

- 1 : Operation
 - Switch position for normal operation
- 2 : Empty calibration
 - Empty calibration is carried out in this operating mode.
- 3 : Full calibration
 - Full calibration is carried out in this operating mode.
- 4 : Measuring modes
 - In this operating mode, chose between operation for media that form buildup (e.g. yoghurt) or for media without buildup (e.g. water).
- 5 : Measuring range
 - In this operating mode, select the measuring range in pF for:
 - => Measuring range probe length < 6 m (corresponds to 2000 pF)
 - => Measuring range probe length > 6 m (corresponds to 4000 pF)
- 6 : Self-test
 - In this operating mode, you can activate the self-test.

- 7 : Reset (factory settings)
 - In this operating mode, you can restore the data of the factory settings.
- 8 : Upload sensor EEPROM
 - In this operating mode, you can:
 - => Transfer the calibration values in the electronic insert to the probe DAT module if replacing the probe
 - => Transfer the calibration values of the probe DAT module to the electronics if replacing the electronic insert

Display connection

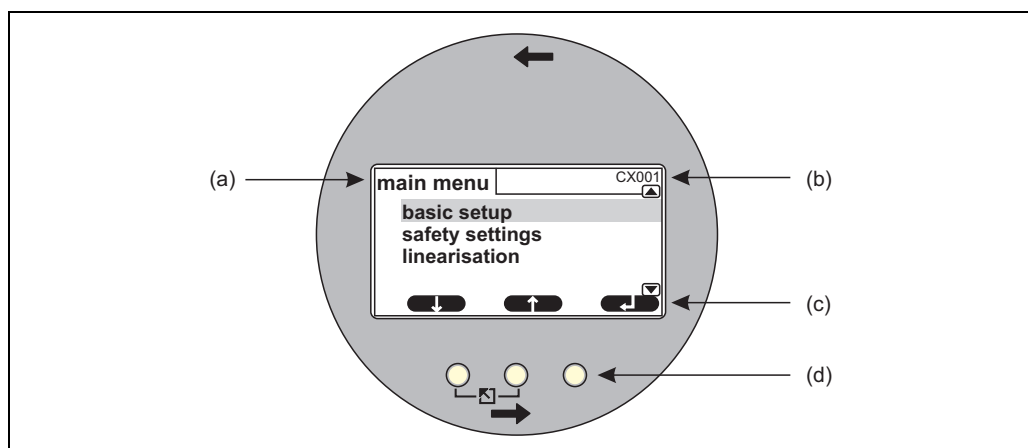
- For onsite display and operation (optional)
 - Display and operating module

4 to 20 mA current pick-off

- E.g. for full/empty calibration with multimeter . (No need to disconnect circuit!)

5.1.2 Operation via the display and operating module

Display and operating elements



(a): Name of what is being displayed, e.g. Main menu view; (b): Item code of function displayed; (c): Softkey symbols; (d): Keys

Display symbols

Symbol	Meaning
Operating mode of the instrument	
	User User parameters can be edited.
	Locked All parameters are locked.
 	Scrollbar This symbol tells you whether you can scroll up or down to get to more functions other than those shown on the display.
Locking state of the currently displayed parameter	
	Display parameter The parameter cannot be edited in the current operating mode of the instrument.
	Write parameter The parameter can be edited.

Keys (softkey operation)

The keys work as softkeys. This means that their function and meaning depends on the current position in the operating menu. The key functions are indicated by softkey symbols in the bottom line of the display.

Symbol	Meaning
	Down Moves the bar downwards in a picklist.
	Up Moves the bar upwards in a picklist.
	Enter - Enter the selected submenu or selected function. - Confirm the edited function value.
	Previous function Go to the previous function within the function group.
	Next function Go to the next function within the function group.
	Confirm selection From the picklist, select the option the bar is currently on.
	Increase value Increases the selected position of an alphanumeric function.
	Decrease value Decreases the selected position of an alphanumeric function.
	Error list Opens the list of the errors currently present. The symbol is inverted and flashes if a warning is present. The symbol appears constantly if an alarm is present.

General key combinations

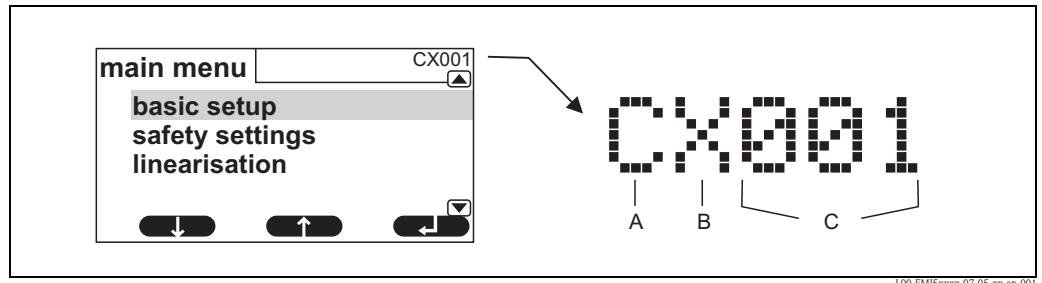
The following key combinations apply regardless of the menu item in question:

Key combinations	Meaning
	Escape - When editing a function: exits the editing mode for the current function. - When navigating: returns to the next-highest menu level.
	Increase contrast Increases the contrast of the display module.
	Decrease contrast Decreases the contrast of the display module.
	Locking Locks the device against parameter changes. Locking can only be reversed by entering a release code.

5.1.3 The operating menu

Function codes

The functions of Liquicap M are arranged in an operating menu. A 5-digit item code is shown on the display for every function to aid orientation within the menu.

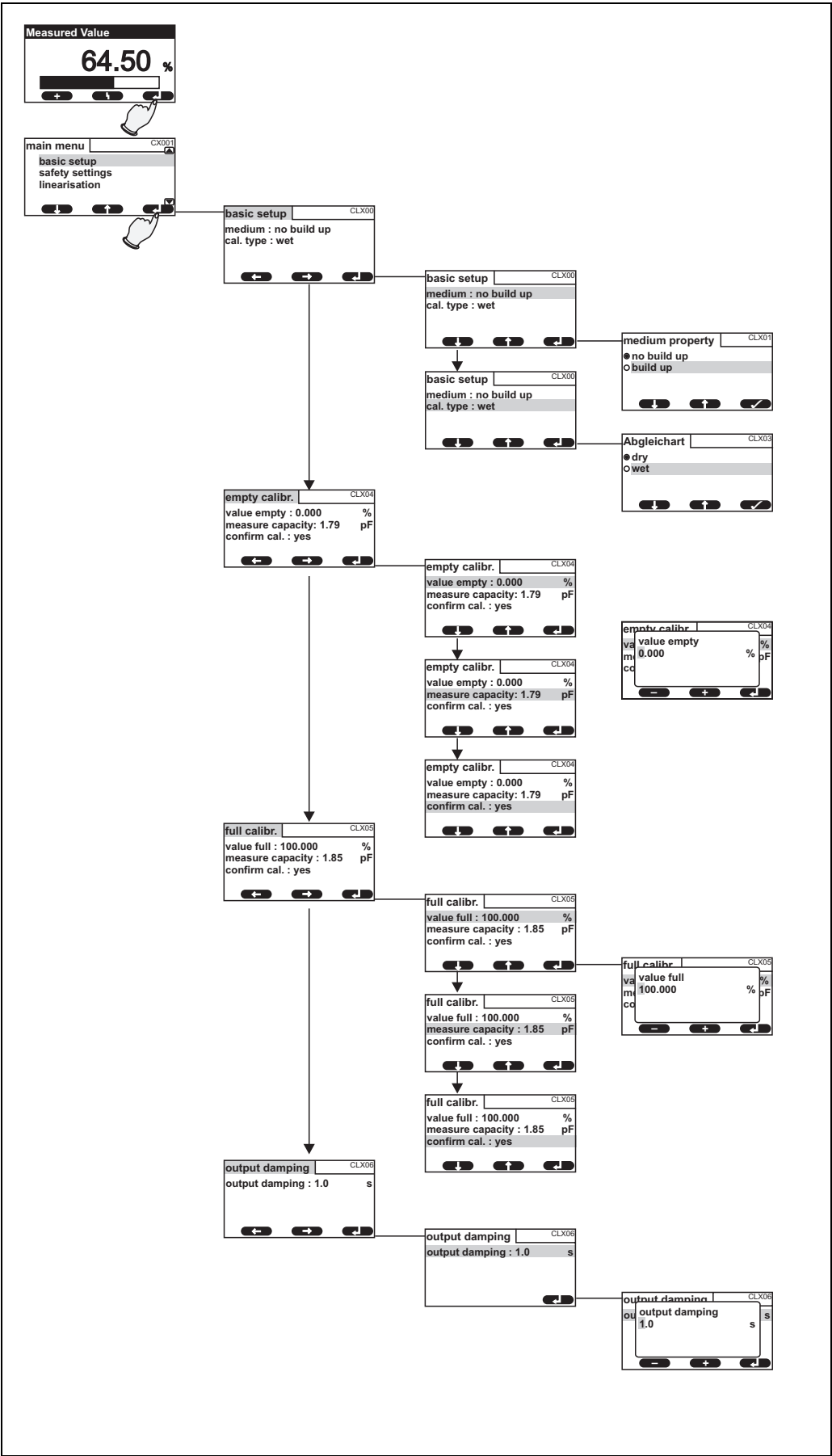


A: Function group; **B:** Channel; **C:** Number of the function within the group

- The first position (A) refers to the function group¹⁾:
 - **C:** Basic setup
 - **S:** Safety setting
 - **L:** Linearization
 - **O:** Output
 - **D:** Device properties
- The second position (B) is without function.
- The last three positions (C) refer to the individual functions within the function group.

1) The function groups available depend on the device version, the installation environment and the operating mode selected.

Navigating in the menu - Basic calibration example



L00-FMI5xxxx-05-06-xx-en-002

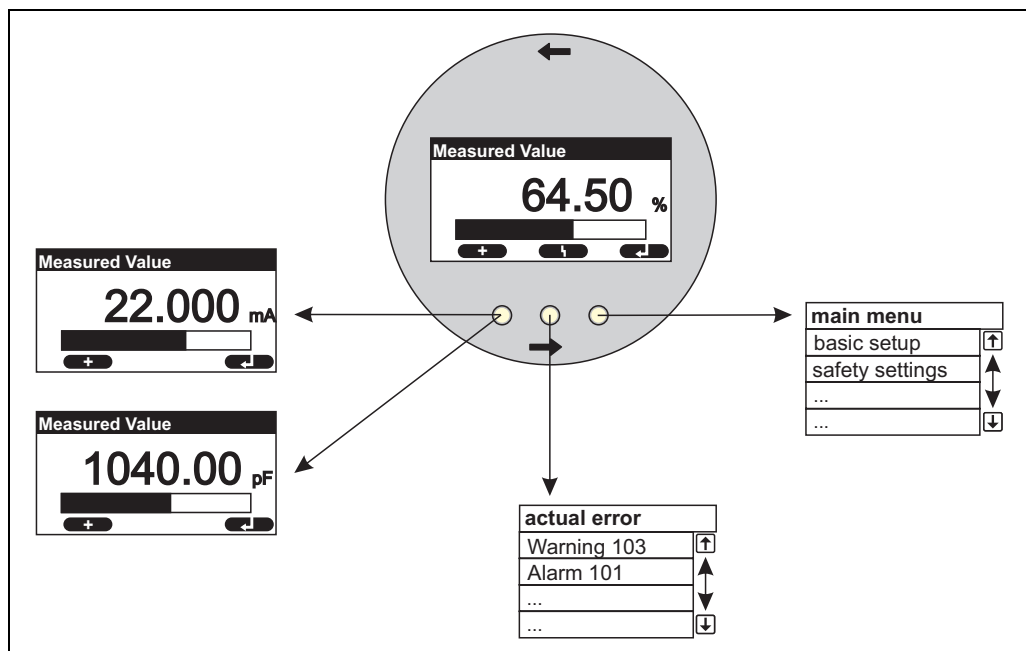
Launching menus



Note!

If you are within a submenu and do not press a key for 15 minutes, the display automatically switches to the main screen (measured value).

Navigation always starts with the main screen (measured value display). From here, you can go to the following menus with the aid of the keys:



L00-FMI5xxxx-19-05-xx-en-011

■ Measured value

Displays the measured value in %, mA or pF.

■ Main menu

The main menu contains all the parameters of Liquicap M. It is split into submenus. Some of the submenus themselves have additional submenus.

An overview of the submenus and the functions they contain is provided in the "Commissioning" section.

■ Actual errors

If the automatic monitoring function of Liquicap M detects an error, the related softkey symbol appears over the center key.

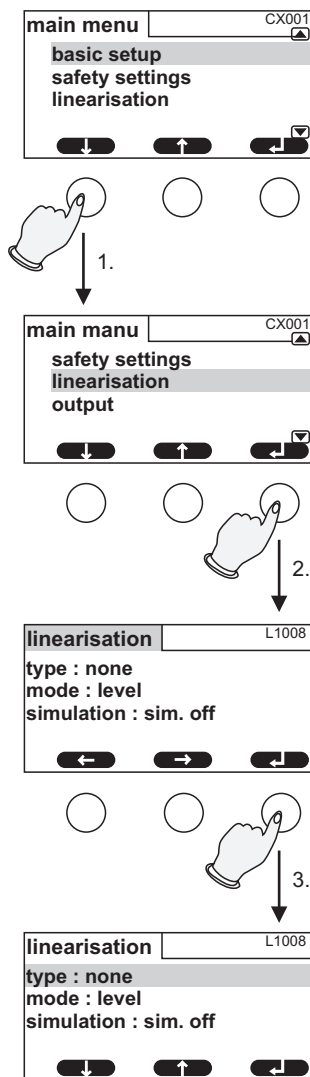
If the softkey symbol is flashing, only "Warning"-type errors are present.²⁾

If the symbol is displayed continuously, at least one "Alarm"-type error is present²⁾.

Once you press the key, a list appears with all the errors currently pending.

2) See Section 9.2, "System error messages" for information on the difference between a "Warning" and an "Alarm".

Selecting a submenu



L00-FMI5xxxx-19-05-xx-en-001

1. Press or until the desired submenu is selected.
2. Press to enter the selected submenu.
3. If the submenu contains additional submenus, continue in the same manner until you reach the function level. The softkey symbols and then appear.

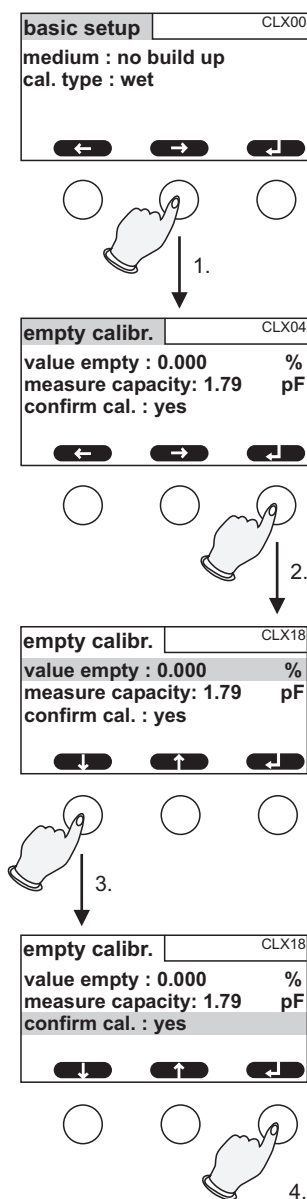


Note!

You can return to the next-highest menu level any time by pressing .

Selecting a function and subfunction

Once you have reached the function level, you can navigate through the functions with $\leftarrow$ and $\rightarrow$. The current values of all the related subfunctions are displayed. Proceed as follows to change a value:



1. Press $\leftarrow$ or $\rightarrow$ until you reach the desired function.

2. Press $\rightarrow$ to enter the selected function.

3. Use $\downarrow$ and $\uparrow$ to select the desired subfunction. (This step is not necessary if the function only has one subfunction.)

4. Press $\rightarrow$ to enter the subfunction. The editing process that follows depends on the type of subfunction selected (picklist, numeric function or alphanumeric function). Details are explained in the following sections.

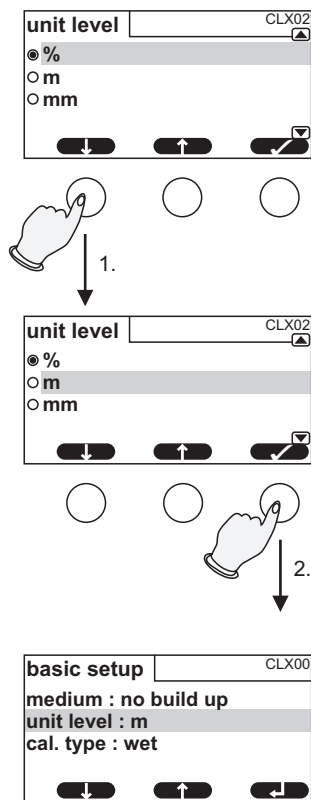


Note!

You can leave the function at any time and return to the next-highest menu level by pressing .

L00-FMI5xxxx-19-05-xx-en-002

Editing functions with the picklist



1. Press or until the bar is on the desired option (here: "m").
2. Press to select this option.
The new value is now transferred to the device.
If required, you can edit another subfunction in the same way.

L00-FMI5xxxx-19-05-xx-en-003

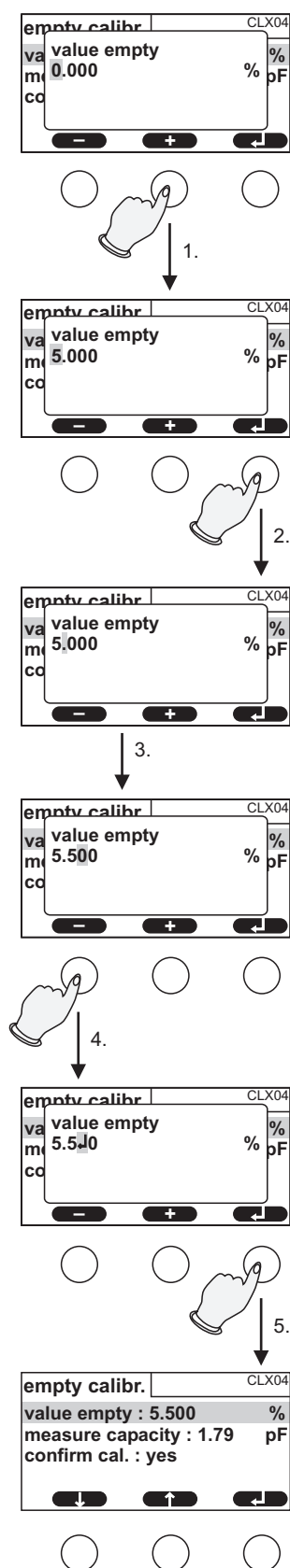


Note!

You can leave the function at any time and return to the next-highest menu level by pressing .



Editing numeric and alphanumeric functions



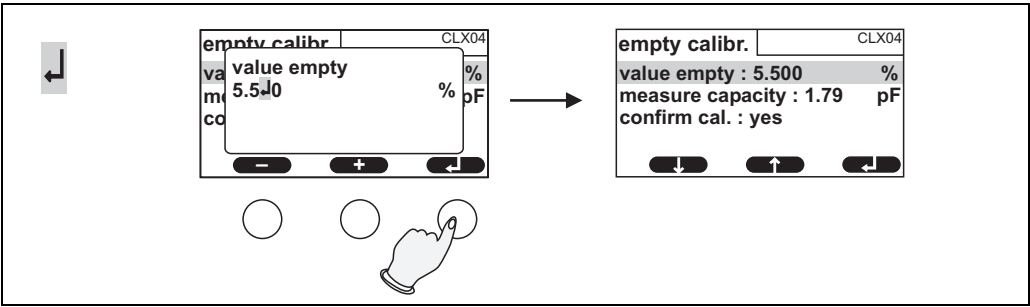
If you select a numeric function ("Empty calibration", "Full calibration" etc.) or an alphanumeric function ("Device marking" etc.), the editor for numbers/ alphanumeric characters opens.

Enter the desired value as follows:

1. The marker is on the first position. Press $\square$ or $\boxplus$ until this position shows the desired value.
2. Press $\downarrow$ to enter the value and go to the next position.
3. Follow the same procedure for the positions that follow.
4. Once all the necessary positions have been entered, press $\square$ or $\boxplus$ until $\downarrow$ appears at the marker.
5. Press $\downarrow$ to transfer the entire value to the device.

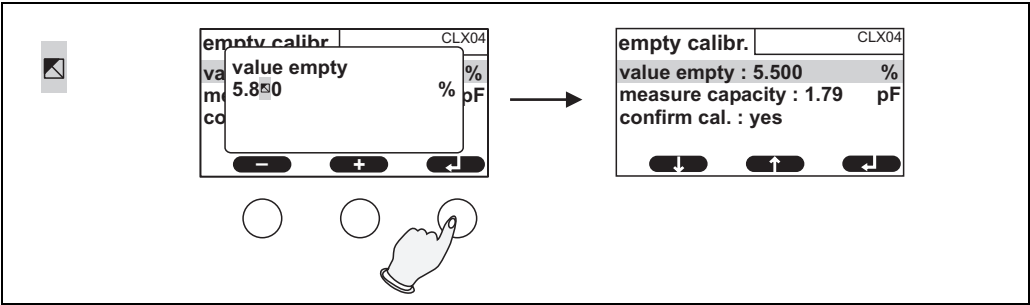
Special functions when making entries

In the editor for numbers and alphanumeric characters, the  and  keys not only call up numbers and letters but also call up the following symbols for special editing tasks which make inputting information easier and make it possible to make corrections quickly.



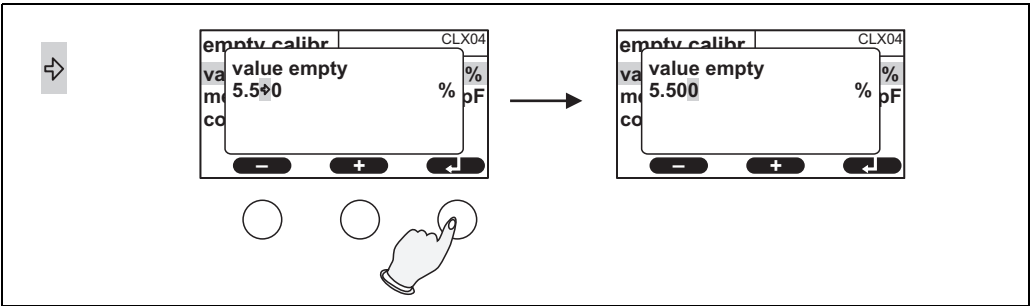
L00-FMI5xxxx-19-05-xx-en-005

Enter: The number to the left of the marker is transferred to the device.



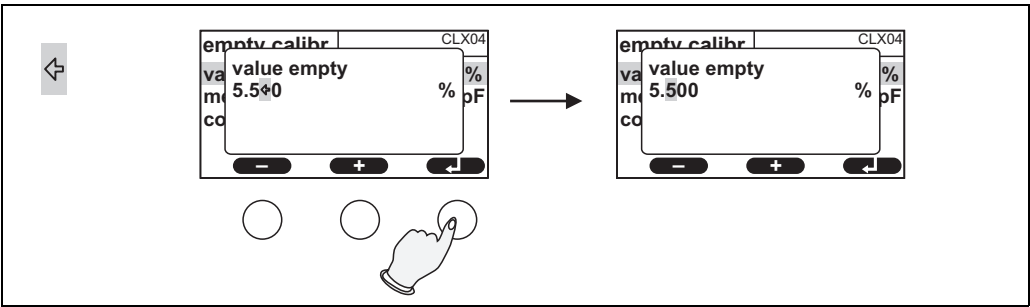
L00-FMI5xxxx-19-05-xx-en-006

Escape: You exit the editor. The old function value remains.



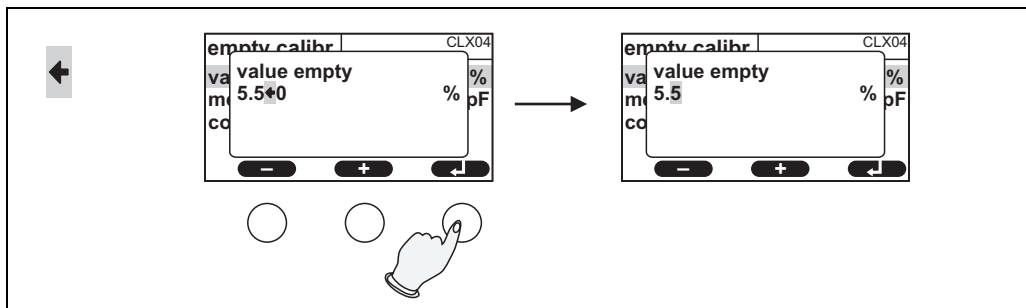
L00-FMI5xxxx-19-05-xx-en-007

Next position: The marker jumps to the next position.



L00-FMI5xxxx-19-05-xx-en-008

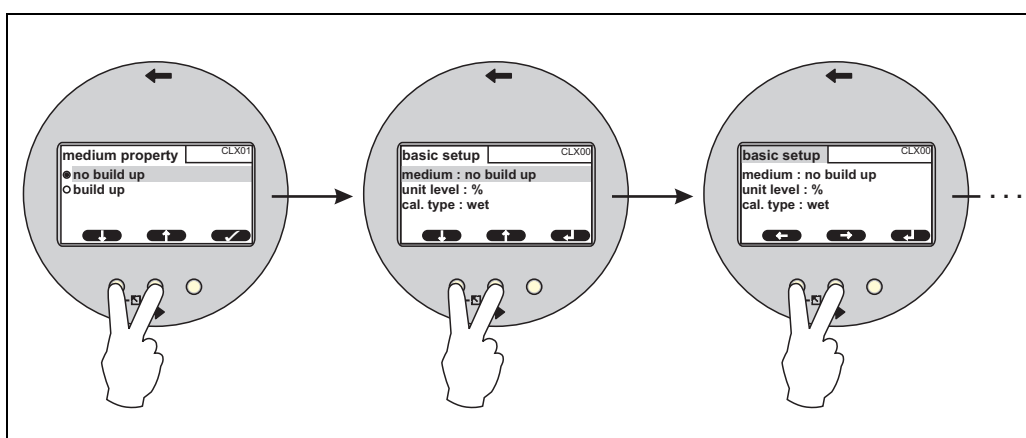
Previous position: The marker jumps back to the previous position.



100-FMI5xxxx-19-05-xx-en-009

Delete: The current position and all positions to the right of this position are deleted.

Return to the measured value display



100-FMI5xxxx-19-05-xx-en-010

Pressing the left and center key simultaneously has the following effect:

- Takes you from the editing mode to the display mode of the functions
- Takes you from the display mode of the functions to the submenu
- Takes you from the submenu to the main menu
- Takes you from the main menu to the measured value display.

5.2 Error messages

If the automatic monitoring function of Liquicap M detects an error, the related softkey symbol $\downarrow$ appears over the center key.

If the softkey symbol $\downarrow$ is flashing, only "Warning"-type errors are present³⁾

If the symbol is displayed continuously, at least one "Alarm"-type error is present³⁾ vor.

Once you press the key, a list appears with all the errors currently pending.

3) See Section 9.2, "System error messages" for information on the difference between a "Warning" and an "Alarm".

5.3 Locking/unlocking configuration

5.3.1 Key locking

Press all three keys simultaneously. The device is then locked against entries.

5.3.2 Key unlocking

Press all three keys simultaneously. The device is then unlocked.

5.3.3 Software locking

Locking

Go to the "Safety settings" function.

In the menu, the current locking status of the device is displayed in the "Status" subfunction under "Safety settings" (SAX01). The following values can appear:

- **Unlocked**

All parameters can be modified.

- **Locked**

The device has been locked by means of the operating menu. It can only be enabled again by entering "100" in the "Safety settings" function.

If an attempt is made to change a parameter, the device goes to the "Safety settings" function. "Key locking" is displayed in the "Status" subfunction. Press all the keys simultaneously. The device then goes back to the original function and all the parameters can be changed again.

- **Key locked**

The device has been locked by means of the operating keys. It can only be enabled again by pressing all three keys simultaneously.



Note!

A key symbol is shown on the display when locked.

5.4 Resetting to factory setting (reset)



Caution!

The reset can affect the measurement as the current values are overwritten by those of the factory calibration 0 % (4 mA) and 100 % (20 mA).

Using the reset

A reset is always recommended if a device with an unknown history is to be used.

Effects of a reset

- All parameters are reset to the factory setting.
- The linearization is reset to "linear". However, any linearization table available is retained and can be activated again where necessary.



Note!

The factory setting of the parameters is marked in bold in the menu overview (see the "Basic setup" menu ff.).

Performing a reset

To carry out a reset, enter the value "333" in the "Device properties/Diagnosis/Password reset/Reset" function.

5.5 Operation via the ToF Tool - FieldTool Package

5.5.1 ToF Tool operating program

The ToF Tool is a graphic operating program for Endress+Hauser measuring devices based on the time-of-flight principle. It is used to support commissioning, data back-up, signal analysis and documentation of the devices. The following operating systems are supported: WinNT4.0, Win2000 and WinXP.

The ToF Tool supports the following functions:

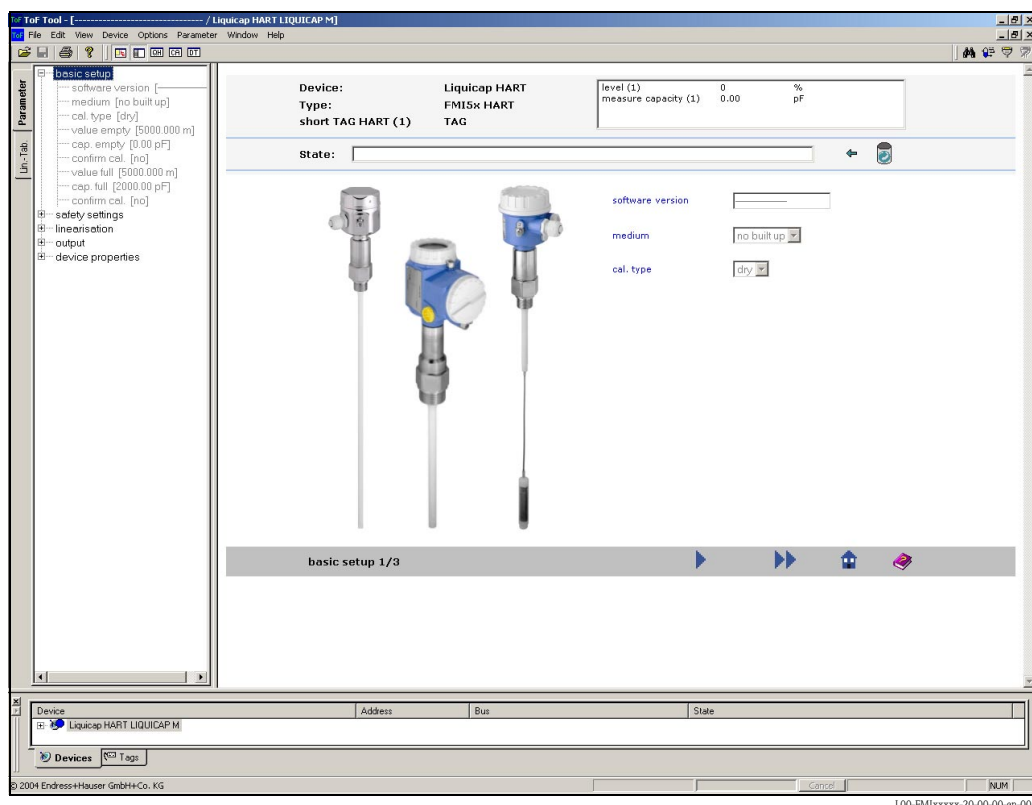
- Configuration of transmitters in online operation
- Tank linearization
- Loading and saving device data (upload/download)
- Documentation of the measuring point



Note!

Further information on the ToF Tool is provided on the CD-ROM which is supplied with the device.

Menu-guided commissioning

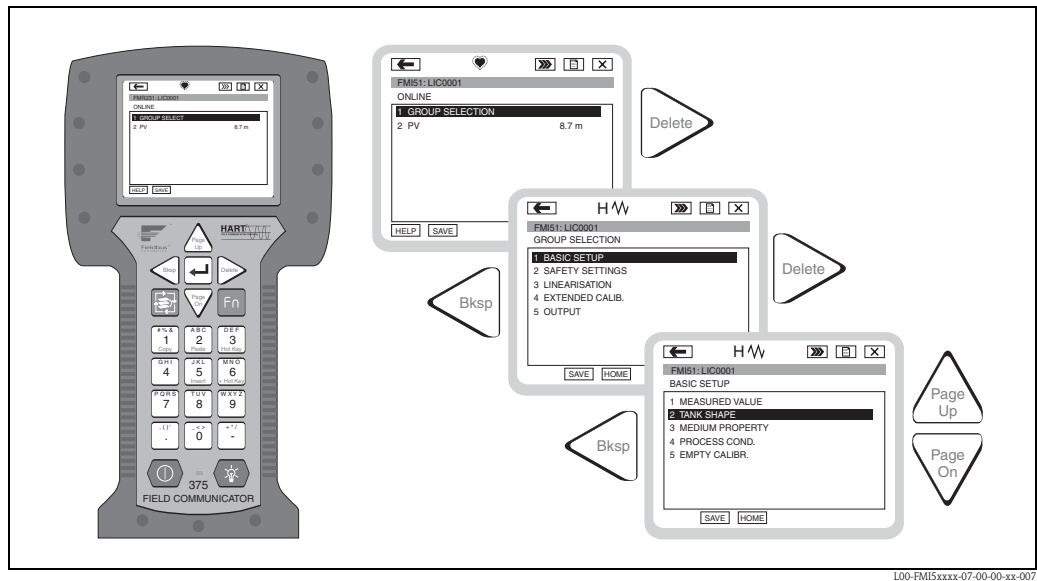


Connection options:

- HART with Commubox FXA191/195

5.6 Operation via HART handheld terminal DXR375

The handheld terminal DXR375 (Field Communicator) can be used to set all device functions via menu operation.



Menu operation with the DXR375 handheld terminal



Note!

- Further information on the HART handheld terminal can be found in the associated Operating Instructions which can be found in the carrying case for the device.

6 Commissioning



Note!

The device is operated by means of the electronic insert, the display or with the ToF Tool - Fieldtool Package. If a display is connected to the electronic insert, the function keys (- key/ + key) and the Mode switch at the electronic insert are deactivated. All other settings can be made using the function keys on the display or with the ToF Tool - Fieldtool Package.

6.1 Installation and function check

Make sure that all post-installation and post-connection checks have been carried out before you commission your measuring point:

- See "Post-installation check" checklist → Page 33
- See "Post-connection check" checklist → Page 38

6.2 Basic setup Commissioning without the display/operating module

This section describes commissioning the Liquicap M with the function switch and the operating keys (-/+) on the FEI50H electronic insert.



Note!

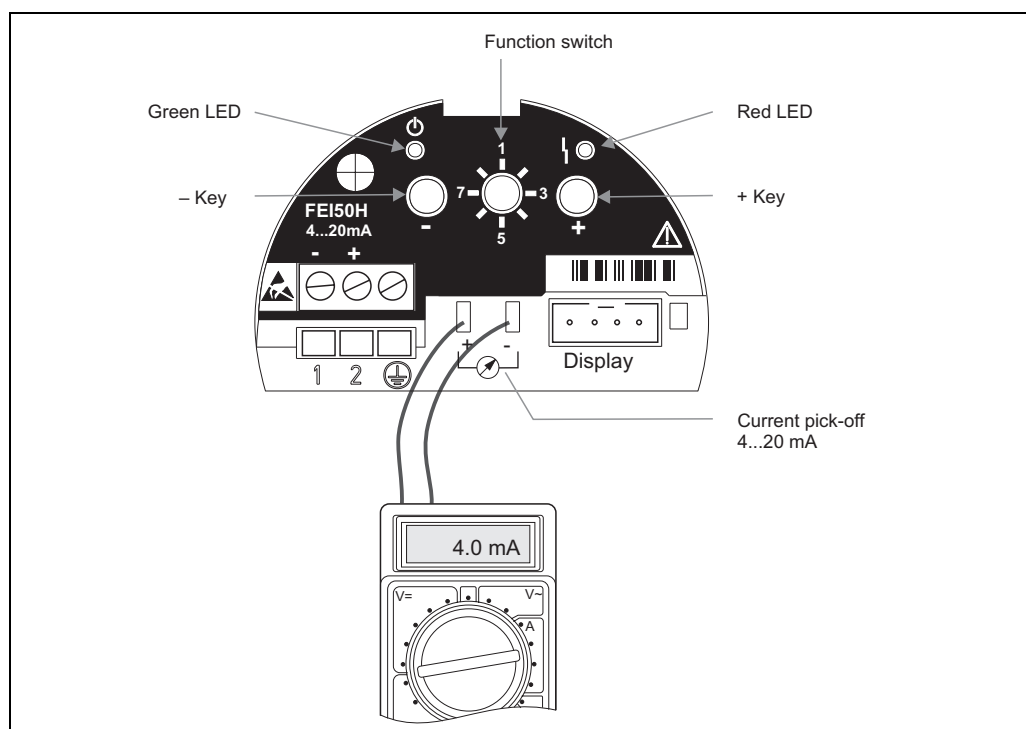
On leaving the factory, Liquicap M devices are calibrated for media with a conductivity of $\geq 100 \mu\text{S}/\text{cm}$ (e.g. for all water-based liquids, acids, alkalis ...). A recalibration is only necessary if the 0 %-value or the 100 %-value should be adjusted to suit customer-specific requirements, the distance to the tank wall is $< 250 \text{ mm}$ or if the liquid is not conductive.



Note!

Only the "Wet" type of calibration can be carried out without the display and operating module.

During wet calibration ("Wet" operating mode), the 0 %-value and/or the 100 %-value is adjusted to customer-specific requirements. This calibration can be carried out if the tank is empty, full or partially full. During full calibration, the probe must be covered by liquid in the installed state. An empty and full calibration must be performed.



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6.2.1 Function switch – position 1 Operation

In normal operation, the function switch must be set to **position 1**.

6.2.2 Function switch – position 4 Measuring modes



Note!

Before carrying out empty and full calibration, the medium properties must be configured. If the medium is conductive and tends to form buildup, the "Buildup" operating mode must be selected. In this operating mode, the buildup on the probe rod is compensated. The "No buildup" operating mode is set at the factory.

"Medium property" subfunction

The **"No buildup"** operating mode should be set for media that do not tend to form buildup on the probe rod (e.g. water, beverages ...). As of a conductivity of 100 $\mu\text{S}/\text{cm}$ (i.e. all water-based liquids, acids, alkalis ...), the measured value is independent of the conductivity of the liquid (independent of concentration fluctuations).

In the **"Buildup"** operating mode, the buildup compensation function integrated in the software is activated. In this operating mode, the measured value is independent of the conductivity of the liquid as of a conductivity of 1000 $\mu\text{S}/\text{cm}$ (independent of concentration fluctuations). This compensates measuring errors caused by conductive media sticking to the probe rod (e.g. yoghurt). This corresponds to buildup compensation.

Proceed as follows to choose between media forming buildup (e.g. yoghurt) and media not forming buildup (e.g. water):

- Turn the function switch to **position 4**
- "Buildup" operating mode
 - => Press the + key for media that tend to form buildup.
 - => The green LED confirms your entry by flashing four times.
- "No buildup" operating mode
 - => Press the – key for media that do not form buildup.
 - => The green LED confirms your entry by flashing four times.

6.2.3 Function switch – position 2 Carry out empty calibration (for empty tanks)

If the tank is empty (0 %), the empty calibration sets the signal current to the lower value of 4 mA. When empty calibration is completed, the current value of 4 mA is displayed at the ammeter.

Proceed as follows to perform empty calibration:

- Turn the function switch to **position 2**
- Press the – and + keys together for approx. 2 s until the green LED flashes
 - => Release the two keys again.
 - => The flashing stops after approx. 5 s.
 - => Empty calibration is saved.

6.2.4 Function switch – position 2 Carry out empty calibration (for almost empty tanks)

If possible, the exact level of the tank should be known and should not be too large (< 30 %). Too high a level reduces the accuracy of the zero point (corresponds to the empty tank). An ammeter must be connected to the current pick-off at the electronic insert.

Let us presume that the level was determined for 15 %. Now the current value that corresponds to the level of 15 % must be determined. The lower current value can be adjusted with the +/– keys. The + key increases the value, the – key reduces the value. The following must also be considered:

1. The lower current value (= empty tank, 0 %) is 4 mA.
2. The upper current value (= full tank, 100 %) is 20 mA.
3. This results in a measuring range of 16 mA for a change from 0 % to 100 %, i.e. 0.16 mA increase in the current for every 1 % increase in the level.
4. For a 15 % level, this is 15 % x 0.16 mA/% which equals 2.4 mA. This must be added to the 4 mA to achieve the current value to be set: 2.4 mA + 4 mA = 6.4 mA.

Proceed as follows to perform empty calibration on a partially filled tank:

- Turn the function switch to **position 2**
- The current value can be adjusted with the +/– keys. For this purpose, press the + or – key for at least 2 seconds. You can set the desired current value (> 4 mA) using the multimeter connected.
- The empty calibration is saved when you release the key.

6.2.5 Function switch - position 3 Carry out full calibration (for full tanks)

If the tank is full (100 %), the full calibration sets the signal current to the upper value of 20 mA. When empty calibration is completed, the current value of 20 mA is displayed at the ammeter.

Proceed as follows to perform full calibration:

- Turn the function switch to **position 3**
- Press the – and + keys together for approx. 2 s until the red LED flashes
 - => Release the two keys again.
 - => The flashing stops after approx. 10 s.
 - => Full calibration is saved.

6.2.6 Function switch - position 3 Carry out full calibration (for almost full tanks)

If possible, the exact level of the tank should be known and should be as large as possible (> 70 %). Too low a level reduces the accuracy of the upper point (corresponds to the full tank). An ammeter must be connected to the current pick-off at the electronic insert.

Let us presume that the level was determined for 90 %. Now the current value that corresponds to the level of 90 % must be determined. The upper current value can be adjusted with the +/– keys. The + key increases the value, the – key reduces the value.

The following must also be considered:

1. The lower current value (= empty tank, 0 %) is 4 mA.
2. The upper current value (= full tank, 100 %) is 20 mA.
3. This results in a measuring range of 16 mA for a change from 0 % to 100 %, i.e. 0.16 mA increase in the current for every 1 % increase in the level.
4. For a 90 % level, this is 90 % x 0.16 mA/% which equals 14.4 mA. This must be added to the 4 mA to achieve the current value to be set: 14.4 mA + 4 mA = 18.4 mA. (You can also take the upper current value and then subtract 10 % x 0.16 mA/% = 1.6 mA from 20 mA.)

Proceed as follows to perform full calibration on a partially filled tank:

- Turn the function switch to **position 3**

- The current value can be adjusted with the +/- keys. For this purpose, press the + or – key for at least 2 seconds. You can set the desired current value (< 20 mA) using the multimeter connected.
- The full calibration is saved when you release the key.

6.2.7 Function switch – position 5 Measuring range

At the factory, the measuring range is always calibrated to the probe length ordered. If the electronic insert is used in another probe, the measuring range must be configured in accordance with the probe length.

Proceed as follows to configure the measuring range 2000 pF (probe length < 6 m) or 4000 pF (probe length > 6 m):

- Turn the function switch to **position 5**
- Press the – key to set 2000 pF
=> The red LED confirms your entry by flashing briefly.
- Press the + key to set 4000 pF
=> The red LED confirms your entry by flashing briefly.

6.2.8 Function switch – position 6 Proof test (self-test)



Note!

- From version FW: V 01.03.00
- Before the automatic Proof test is started, it must be examined whether the indicated level value corresponds also to the actual level value.

When the self-test is activated, the current output is set to 4 mA and follows a ramp function up to 22 mA. This test is completed after approx. 35 s.

Proceed as follows to activate the device self-test:

- Turn the function switch to **position 6**
- Press the + and – keys together to start the function test
=> The green LED confirms your entry by flashing twice.



Note!

After the self-test, the device automatically returns to the operating mode.

6.2.9 Function switch – position 7 Reset – restore factory settings



Caution!

The reset can affect the measurement as the current values are overwritten by those of the factory calibration (0 % (4 mA) and 100 % (20 mA)).

Proceed as follows to restore the factory settings:

- Turn the function switch to **position 7**
- Press the – and + keys together until the red LED starts flashing.
=> You can release the keys again.
=> The device reset is performed and completed when the red LED stops flashing rapidly.

6.2.10 Function switch – position 8 Download/Upload sensor DAT

Calibration values can be transmitted with this function. A distinction is made between two types:

- The sensor has been replaced and the electronic insert should continue to be used.
- The electronic insert has been replaced but the sensor should continue to be used.

For instances of this nature, the calibration values already set can be transferred from the sensor to the electronic insert or from the electronic insert to the sensor.

Proceed as follows to transfer the calibration values from the electronic insert to the sensor:

Download

- Turn the function switch to **position 8**
- Press the – key to start downloading from the electronic insert to the sensor
 - => The green LED flashes for approx. 2 s, thereby confirming your entry.
 - => The device now restarts.

Proceed as follows to transfer the calibration values from the sensor to the electronic insert:

Upload

- Turn the function switch to **position 8**
- Press the + key to start uploading from the sensor to the electronic insert
 - => The green LED flashes for approx. 2 s, thereby confirming your entry.
 - => The device now restarts.

6.3 "Basic setup" menu

Commissioning with the display/operating module



Note!

This section describes how to commission the Liquicap M by means of the display and operating module. The procedure for commissioning by means of the ToF Tool – FieldTool Package or the DXR375 handheld terminal is the same. More detailed information can be found in the Operating Instructions for ToF Tool – FieldTool Package (BA 224F/00) or for DXR375 (is supplied together with the handheld terminal).

6.3.1 Initial commissioning

On first power-up, you are requested to select the language for the display texts. After this selection the measured value is displayed.



Note!

If a reset is performed at the instrument and if the power supply is switched off and on again, the language of the display texts has to be selected again.

Menu structures: Main menu

The main menu is activated by means of the right Enter key ↵.

The following menu headings appear. These are explained in more detail over the following pages:

- **"Basic setup"**
- **"Safety setting"** (see Page 66 ff.)
- **"Linearization"** (see Page 70 ff.)
- **"Output"** (see Page 76 ff.)
- **"Device properties"** (see Page 80 ff.)



Note!

Liquicap M devices are calibrated on leaving the factory for media with a conductivity of $\geq 100 \mu\text{S}/\text{cm}$ (e.g. for all water-based liquids, acids, alkalis ...). A recalibration is only necessary if the 0 %-value or the 100 %-value should be adjusted to suit customer-specific requirements, the distance to the tank wall is $< 250 \text{ mm}$ or if the liquid is not conductive.

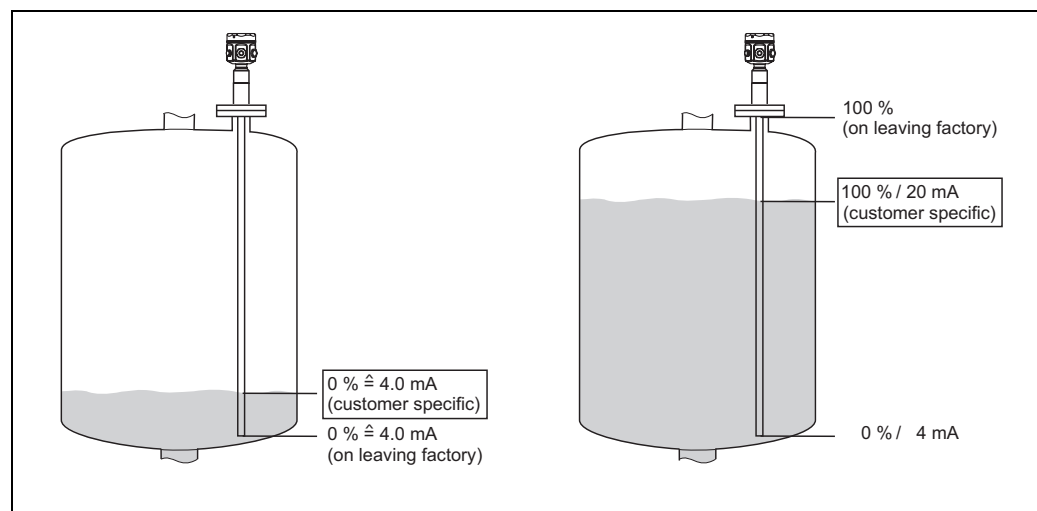


Note!

A distinction is generally made between two types of calibration:

■ Wet calibration:

During wet calibration ("Wet" operating mode), the probe must be covered by liquid in the installed state. This calibration can be carried out if the tank is empty, full or partially full. Empty and full calibration must be performed.



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■ Dry calibration

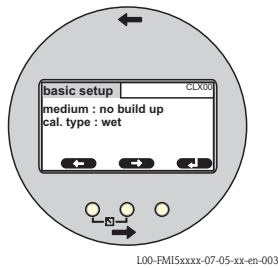
During dry calibration, empty and full calibration can be carried out without the probe being in contact with the liquid. The calibration values can be entered directly in units of length (e.g. m, mm ...) for example.

You can make the following settings in the "Basic setup" menu.

Menu	Function	Subfunction	Function value
	 	 	
Basic setup	Basic setup	Medium property	no buildup ¹⁾ buildup
		Cal. type	Dry Wet
	Medium property ²⁾	Medium property	Conductive Nonconductive interface unknown
		DC value ³⁾	Value
		Unit level ⁴⁾	% (percentage)
			m mm ft inch
	Empty calibr.	Value empty	0 %
		Measure capacity	xxxx pF
		Confirm cal.:	Yes
	Full calibr.	Value full	100 %
		Measure capacity	xxxx pF
		Confirm cal.:	Yes
	Output damping	Output damping	1 s

- 1) The values marked in bold are the factory settings.
- 2) This function is only displayed if the function value "Dry" was selected under the subfunction "Cal. type".
- 3) This subfunction is only displayed if the function value "Nonconductive" was selected under the subfunction "Medium property".
- 4) This subfunction is only displayed if the function value "Nonconductive" or "Conductive" was selected under the subfunction "Medium property".

6.3.2 "Basic setup" function



Basic setup CLX00
Medium : no buildup
Cal. type: Wet

"Medium property" subfunction

The **"No buildup"** operating mode should be set for media that do not tend to form buildup on the probe rod (e.g. water, beverages ...). As of a conductivity of 100 $\mu\text{S}/\text{cm}$ (i.e. all water-based liquids, acids, alkalis ...), the measured value is independent of the conductivity of the liquid (independent of concentration fluctuations).

In the **"Buildup"** operating mode, the buildup compensation function integrated in the software is activated. In this operating mode, the measured value is independent of the conductivity of the liquid as of a conductivity of 1000 $\mu\text{S}/\text{cm}$ (independent of concentration fluctuations).

This compensates measuring errors caused by conductive media sticking to the probe rod (e.g. yoghurt). This corresponds to buildup compensation.

"Cal. type" subfunction

In the **"Dry"** "Cal. type", empty and full calibration can be carried out without the probe being in contact with the liquid. The calibration values can be entered directly in units of length (e.g. m, mm, ...) for example.

In the **"Wet"** "Cal. type", the probe must be covered by liquid in the installed state for full calibration. This calibration can also be carried out if the tank is partially full. Both the empty calibration and full calibration must be performed.

6.3.3 "Medium property" function



Note!

This function is only displayed if the "Dry" option was selected under the "Cal. type" subfunction.

"Medium property" subfunction

The properties of the medium are entered here.

- **"Nonconductive"**: the conductivity of the medium is $\leq 1 \mu\text{S}/\text{cm}$
- **"Conductive"**: the conductivity of the medium is $\geq 100 \mu\text{S}/\text{cm}$
- **"Interface"**: the properties of the two media can be entered in the operating program of ToF Tool. The associated calibration values are then calculated.
- **"Unknown"**: the medium properties are not known. The capacitance values of the "Empty calibr." and "Full calibr." functions can be entered directly.

"DC value" subfunction



Note!

This subfunction is only displayed if the "Nonconductive" option was selected under the "Medium property" subfunction.

The dielectric constant for the liquid to be measured is entered here (e.g. 3.4)

"Unit level" subfunction

Note!

This subfunction is only displayed if the function value "Conductive" or "Nonconductive" was selected under "Medium property".

The desired level unit for Basic setup is entered here.

6.3.4 "Empty calibr." function ("Wet" operating mode)

Note!

The calibration data can be calculated with **CapCalc.xls**. See → Page 84.

With "Empty calibration", the 0 % value or the 4 mA value is assigned to the level value.



Note!

The procedure applies to the "Wet" type of calibration. Information on "Dry" calibration is provided further below.

"Value empty" subfunction

The current level value is entered here,
e.g. 5 % partial filling => "Value empty" 5 % or
e.g. 0 % partial filling => "Value empty" 0 %



Note!

To keep the calibration error to a minimum, the level should be between 0 % and 30 %.

"Measure capacity" subfunction

The capacitance value currently measured is displayed here.

"Confirm cal." subfunction

In this function, empty calibration is confirmed and the "Measure capacity" currently measured is assigned to the percentage level value entered above ("Value empty").

6.3.5 "Full calibr." function ("Wet" operating mode)

With "Full calibration", the 100 % value or the 20 mA value is assigned to the level value.



Note!

The procedure applies to the "Wet" type of calibration. Information on "Dry" calibration is provided further below.

"Value full" subfunction

The current level value is entered here,
e.g. 90 % partial filling => "Value full" 90 % or
e.g. 100 % filling => "Value full" 100 %



Note!

To keep the calibration error to a minimum, the level should be between 70 % and 100 %.

"Measure capacity" subfunction

The capacitance value currently measured is displayed here.

"Confirm cal." subfunction

Full calibration must be confirmed with this function.

6.3.6 "Empty calibr." function ("Dry" operating mode)

The "Empty" value can be entered directly in units of length if the medium property has been set to conductive or nonconductive.

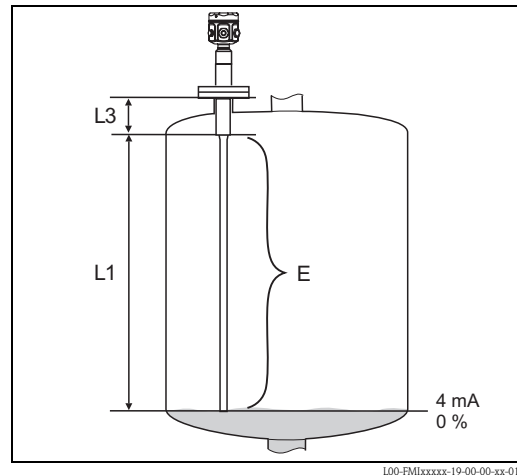
"Value empty" subfunction, medium property (conductive, nonconductive)

In this function, specify the distance E, i.e. the distance between the minimum and maximum level.

Value E:
 Empty calibration $\leq$ active probe length
 $E \leq L1 - (\text{thread length } H2 + \text{plug})$

Thread length:
 $H2$ for $G1\frac{1}{2} = 25$ mm
 $H2$ for $G < 1\frac{1}{2} = 19$ mm

Plug:
 10 mm rod = 10 mm
 16 mm rod = 15 mm
 22 mm rod = 15 mm



"Cap. empty" subfunction

The calculated capacitance value is displayed here. This field cannot be edited.

"Confirm cal." subfunction

Empty calibration is confirmed with this subfunction.

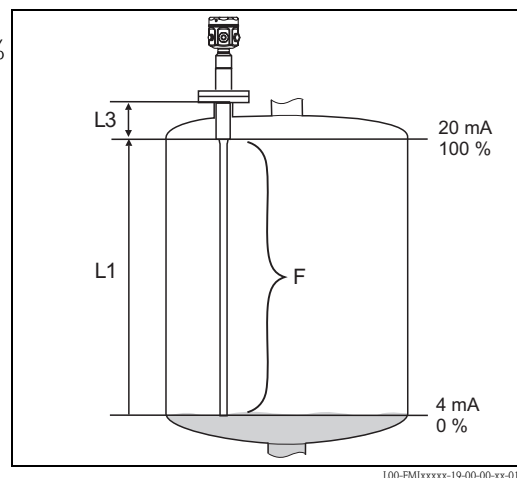
6.3.7 "Full calibration" function ("Dry" operating mode) for conductive and nonconductive media

The "Full" value can be entered directly in units of length.

"Value full" subfunction, medium property (conductive, nonconductive)

In this function, specify the span F, i.e. the distance from the zero point to the desired 100 % point.

"Value full"
 $F \leq E$ "Value empty" → Page 64



"Cap. full" subfunction

The calculated capacitance value is displayed here. This field cannot be edited.

"Confirm cal." subfunction

Full calibration is confirmed with this subfunction.

6.3.8 "Empty calibration" function ("Dry" operating mode for "Interface" or "Unknown" medium properties)**"Value empty" subfunction**

This field displays 0 % and cannot be edited.

"Cap. empty" subfunction

The capacitance value calculated with CapCalc.xls, for example, (capacitance calculation program in ToF Tool) is entered here.

"Confirm cal." subfunction

Empty calibration must be confirmed with this subfunction.

6.3.9 "Full calibration" function ("Dry" operating mode for "Interface" or "Unknown" medium properties)**"Value full" subfunction**

This field displays 100 % and cannot be edited.

"Cap. full" subfunction

The capacitance value calculated with CapCalc.xls, for example, (capacitance calculation program in ToF Tool) is entered here.

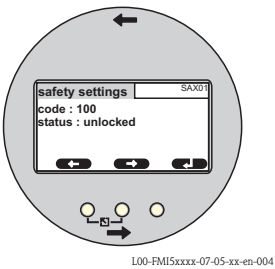
"Confirm cal." subfunction

Full calibration must be confirmed with this subfunction.

6.3.10 "Output damping" function

With this function, you can set the reaction time of your measuring device to changes in the level. If surfaces are turbulent, a higher output damping (e.g. 2 s) should be selected.

6.4 "Safety settings" menu



Safety settings SAX01
Code: 100
Status: unlocked

You can make the following settings in the "Safety settings" menu.

Menu	Function	Subfunction	Function value
	 	 	
Safety settings	Safety settings	Code	100 ¹⁾
		Status	Unlocked Locked
	Safety settings	Operating mode	Standard SIL/WHG
		Output damping	1 s
		Output 1	MAX
		Parameter okay	no yes
	Safety settings	Cap. empty	x,xx pF
		Value empty	x,xxx %
		Cap. full	2000.00 pF
		Value full	100,000 %
		Parameter okay	no yes
	Operating mode	Operating mode	Standard SIL/WHG
		SIL op. mode ²⁾	Unlocked Locked
		Status	Unlocked Locked
	Output on alarm	Output	Max Hold User-spec.
		Output value ³⁾	xx.xx mA
	Proof test	Proof test	Off On

- 1) The values marked in bold are the factory settings.
- 2) This subfunction is only displayed if the "SIL/WHG" option was selected under the "Operating mode" subfunction.
- 3) This subfunction is only displayed if the "User-specific" option was selected under the "Output" subfunction.

6.4.1 "Safety settings" function

"Code" subfunction

With this subfunction, you can lock the device against unpermitted or unintentional changes.

- Enter a number ≠ 100 to lock the device. Parameters can then no longer be modified.
- Enter "100" to unlock the device. Parameters can then be modified again.

"Status" subfunction

This subfunction displays the current locking status of the device. The following values can appear:

- **"Unlocked"**

All writeable parameters can be modified.

- **"Locked"**

The device has been locked via the operating menu ("Code" subfunction). It can only be unlocked by entering "100" in the "Code" subfunction.

6.4.2 "Safety settings" function**"Operating mode" subfunction**

This subfunction displays the set operating mode and cannot be edited.

Possible operating modes:

- Standard
- SIL/WHG

"Output damping" subfunction

This subfunction displays the output damping set. Output damping is the time at which the measuring system reacts to changes in level and is between 0 and 60 seconds.

"Output 1" subfunction

This subfunction displays the set value the output assumes in an alarm condition. Possible values are:

- MAX (22 mA)
- Hold (the last value is held)
- User-spec.

"Parameter okay" subfunction

With this subfunction, you confirm that the parameter values displayed under the "Safety settings II" function are correct.



Note!

The "Parameter okay" subfunction has to be confirmed with "Yes" so the device can be locked for the SIL/WHG operating mode. In addition, the SIL/WHG function value has to be selected for the "Operating mode" subfunction and "Locked" must be set for the "Status" subfunction. The device can be unlocked using the special release code. The release code is "7452".

6.4.3 "Safety settings" function**"Cap. empty" subfunction**

This subfunction displays the measured capacitance during empty calibration in pF.

"Value empty" subfunction

This subfunction displays the empty calibration value in %.

"Cap. full" subfunction

This subfunction displays the measured capacitance during full calibration in pF.

"Value full" subfunction

This subfunction displays the full calibration value in %.

"Parameter okay" subfunction

With this subfunction, you confirm that the parameter values displayed under the "Safety settings II" function are correct.



Note!

The "Parameter okay" subfunction has to be confirmed with "Yes" so the device can be locked for the SIL/WHG operating mode. In addition, the SIL/WHG function value has to be selected for the "Operating mode" subfunction and "Locked" must be set for the "Status" subfunction. The device can be unlocked using the special release code. The release code is "7452".

6.4.4 "Operating mode" function**"Operating mode" subfunction**

With this subfunction, you can switch from the Standard operating mode to the SIL/WHG operating mode:

- **"Standard"**
- **"SIL/WHG"**

The following parameters are set to defined values in the "SIL/WHG" operating mode:

- **Output damping:** Output damping is fixed at "1 s"
- **Output on alarm:** The "Output on alarm" function is fixed at "22 mA".

In the "SIL/WHG" operating mode, cyclic self-monitoring of the device takes place (e.g. memory test, processor test, current output ...).

"SIL operating mode" subfunction

You can lock or unlock the device in this subfunction. No parameters can be changed in the locked state.

"Status" subfunction

This subfunction displays the current locking status of the device. The following values can appear:

- **"Unlocked"**
All writeable parameters can be modified.
- **"Locked"**
The device has been locked via the operating menu ("Code" subfunction). It can only be unlocked by entering "100" in the "Code" subfunction.

6.4.5 "Safety settings" function**"Operating mode" subfunction**

The "Standard" or "SIL/WHG" operating mode entered is displayed here.

"Output damping" subfunction

The output damping entered is displayed here.

"Value empty" subfunction

The capacitance of the empty calibration is displayed here.

"Value full" subfunction

The capacitance of the full calibration is displayed here.

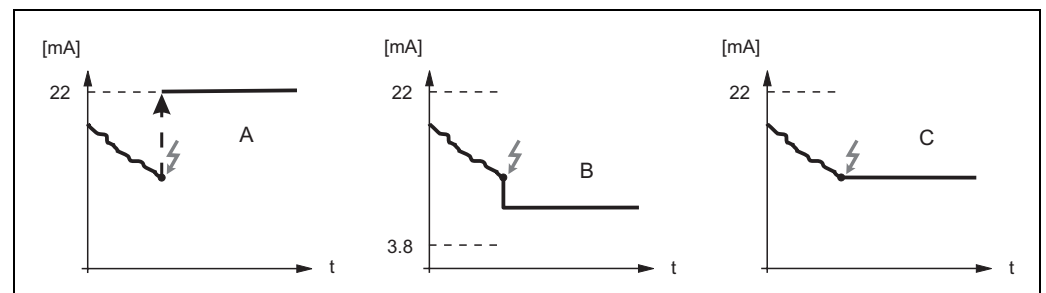
6.4.6 "Output on alarm" function

"Output" subfunction

This function determines the value the output in question assumes when an alarm condition occurs.

Options:

- **"Max"**
22 mA
- **"Hold"**
The last value is retained
- **"User-spec."**
As defined in the "Output value" subfunction



A: Max; B: User-specific (between 3.8 and 22 mA); C: Hold

"Output value" subfunction (only for "Output", "User-specific")

In this function, specify the user-specific value the current output should assume in an alarm condition.

- Value range: 3.8 to 22 mA

6.4.7 "Proof test" function (self-test)



Note!
From Version FW: 01.03.00



Note!
Before the automatic Proof test is started, it must be examined whether the indicated level value corresponds also to the actual level value.

"Proof test" subfunction

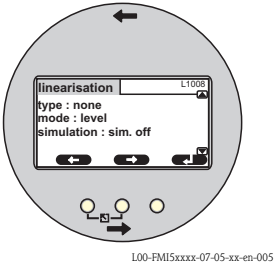
With this subfunction, you activate the device self-test. All electronic components relevant to the function are tested. In a ramp of approx. 10 s, the current output goes through the range of 3.8 to 20.5 mA.



Note!
After the self-test, the device automatically returns to the operating mode.

6.5 "Linearization" menu

"Linearization" is used for converting the level to any unit. You can determine the volume or the mass in a tank of any shape. Liquicap M makes various linearization modes available for situations that occur frequently. Furthermore, a linearization table can be entered for tanks and containers of any shape.



Linearisation L1008
Type: None
Mode: Level
Simulation: Sim. off

Note!
The number and type of subfunctions depend on the type of linearisation selected.
Only the "Type" and "Mode" subfunctions are always available.

You can do the following settings in the "Linearization" menu.

Menu	Function	Subfunction	Function value	Additional function values
Linearization	Linearization	Type	None Linear ¹⁾ Horizontal cyl ²⁾ Sphere ²⁾ Pyramid bottom ³⁾ Conical bottom ³⁾ Angled bottom ³⁾ Table	
		Mode	level Ullage	
		Simulation	Sim. off Sim. level Sim. volume	
		Sim. level value ⁴⁾ or Sim. vol. value ⁴⁾	xx.x % xx.x %	
	Linearization	Customer unit	% (percentage), l, hl, m3, dm3, cm3, ft3, usgal, igoal, kg, t, lb, ton, m3, ft3, mm, inch, user-spec.	
		Customized text ⁵⁾	...	
		Diameter ⁶⁾	xxxx m	
		Intermed. height ⁷⁾	xx m	
		Edit ⁸⁾	Read Manual Semi-automat. Delete	Table No.: 1 Input level: x m Input volume: % Table No.: 1 Input level: x m Input volume: % Table No.: 1 Input level: x m Input volume: %
		Status table ⁷⁾	Enabled Disabled	
		Max. scale ⁹⁾	100 %	

- 1) The values marked in bold are the factory settings.
- 2) If you enter a value for this function, you must also enter a value for the "Diameter" subfunction in another step.
- 3) If you enter a value for this function, you must also enter a value for the "Intermed. height" subfunction in another step.
- 4) This function is only displayed if the "Sim. off" option was not selected under the "Simulation" subfunction.
- 5) This function is only displayed if the "User-spec." option was selected under the "Customer unit" subfunction.

- 6) This function is only displayed if the "Horizontal cyl" or "Sphere" option was selected under the "Type" subfunction.
- 7) This function is only displayed if the "Pyramid bottom", "Conical bottom" or "Angled bottom" option was selected under the "Type" subfunction.
- 8) This function is only displayed if the "Table" option was selected under the "Type" subfunction.
- 9) This function is not displayed if the "Table" option was selected under the "Type" subfunction.

6.5.1 "Linearization" function

"Type" subfunction

Select the type of linearization in this subfunction.

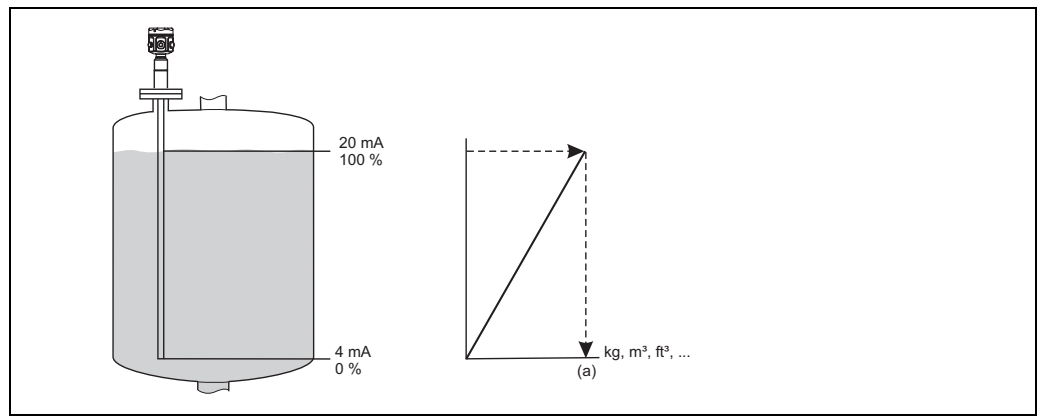
Options:

■ "None"

In this type of linearization, the measured level is not converted but instead is output linearly in the level unit selected (see "Unit level" function).

■ "Linear"

In this type of linearization, the measured value output is linear to the measured level.



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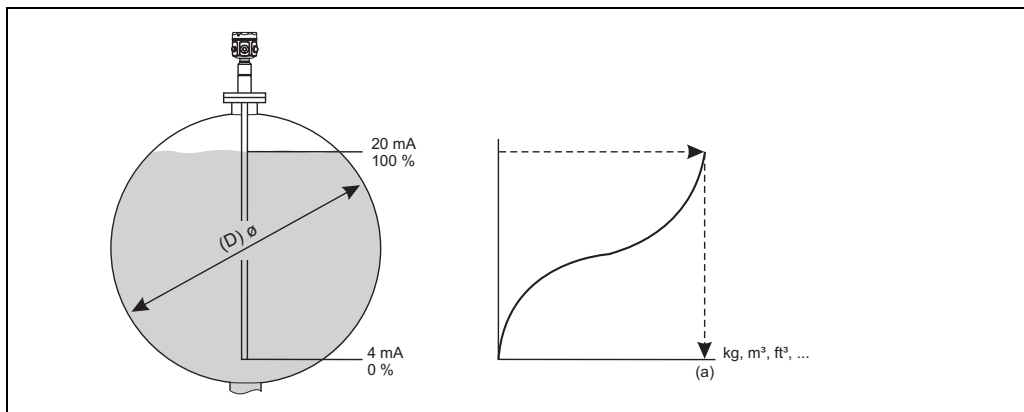
The following must be specified as additional parameters:

- The unit for the linearized value, e.g. kg, m³, ft³, ... ("Customer unit" subfunction)
- The maximum tank contents (a) measured in a customer unit ("Max. tank contents" subfunction).

Options:

- "Horizontal cyl."
- "Sphere"

In these types of linearization, the volume in a spherical tank or in a horizontal cylindrical tank is calculated from the level.



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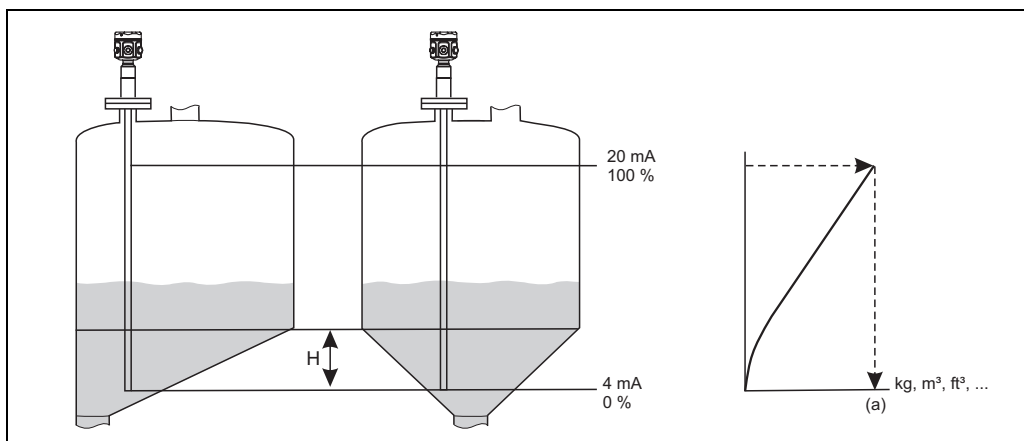
The following must be specified as additional parameters:

- The unit for the linearized value, e.g. kg, m³, ft³, ... ("**Customer unit**" subfunction)
- The diameter (D) of the cylindrical or spherical tank ("**Diameter**" subfunction)
- The maximum tank contents (a) measured in a customer unit ("**Max. tank contents**" subfunction)

Options:

- "Pyramid bottom"
- "Conical bottom"
- "Angled bottom"

In these types of linearization, the volume in the tank in question is calculated from the level measured.



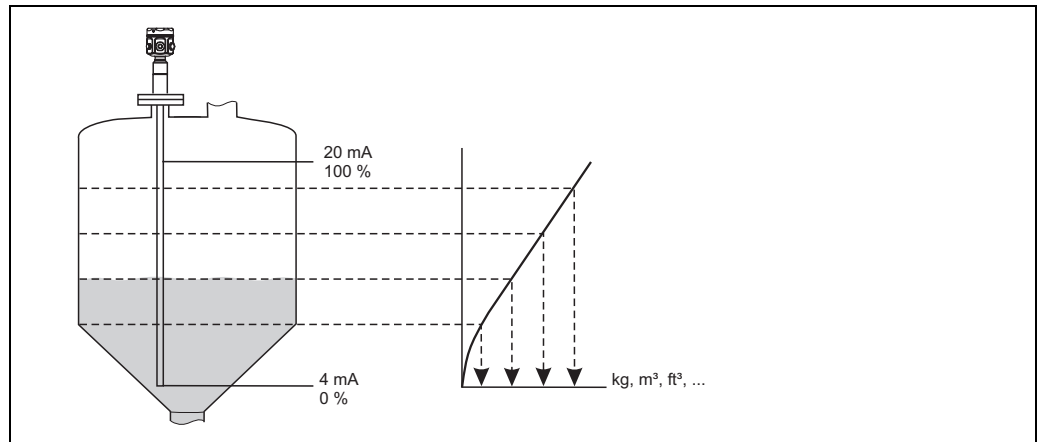
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The following must be specified as additional parameters:

- The unit for the linearized value, e.g. kg, m³, ft³, ... ("**Customer unit**" subfunction)
- The intermediate height H in accordance with the diagram above ("**Intermed. height**" subfunction)
- The maximum tank contents (a) measured in a customer unit ("**Max. tank contents**" subfunction)

Options:■ **"Table"**

In this type of linearization, the measured value is calculated using a linearization table. The table can comprise up to 32 "Level - Volume" value pairs. The table must be monotone.



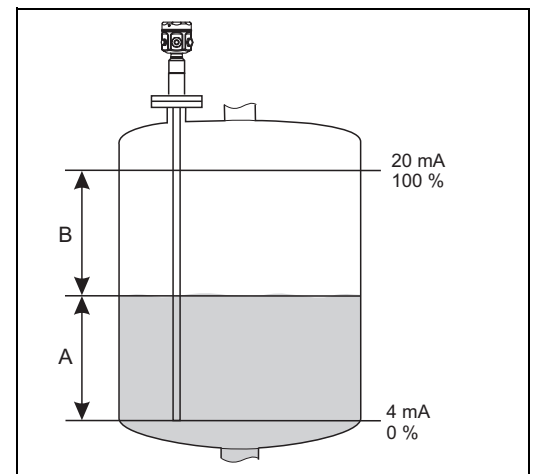
L00-FMI5xxxx-19-05-xx-xx-004

The following must be specified as additional parameters:

- The unit for the linearized value ("**Customer unit**" subfunction)
- The linearization table ("**Edit**" subfunction)

"Mode" subfunction

In this function, specify whether the measurement should refer to level A or to the empty area B.



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"Simulation" subfunction

In this subfunction, you can simulate the level or the volume by entering a level under "Sim. level value" or a volume under "Sim. vol. value".

"Sim. level value" or "Sim. vol. value" subfunction

In this subfunction, you can enter the level or volume value to be simulated.

6.5.2 "Linearization" function**"Customer unit" subfunction**

In this function, enter the desired unit for the linearized values (e.g. kg, m³, ft³, ...).

"Customized text" subfunction

In this function, enter your specific name for the unit. The measured value indicated in the main screen will then be displayed in this unit.

"Diameter" subfunction

In this subfunction, specify the diameter of the horizontal cylindrical tank or the spherical tank.

"Intermed. height" subfunction

In this function, specify the intermediate height H (see graphic -> options: "Pyramid bottom", "Conical bottom", "Angled bottom") of the container in question.

"Edit" subfunction

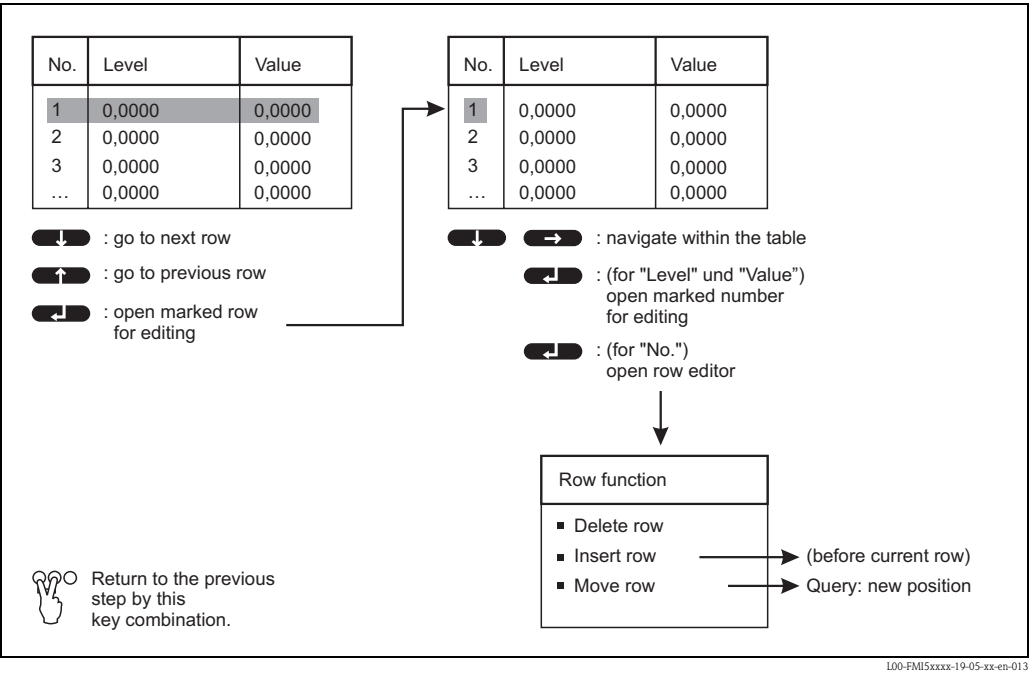
Use this function to enter, modify or read the linearization table.
The following options are available:

- "Read"
The table editor is opened. The existing table can be read but not edited.
- "Manual"
The table editor is opened. Table values can be entered or modified.
- "Semi-automat."
The table editor is opened. The level value is read in automatically.
The related measured value (volume, weight or flow) must be entered by the user.
- "Delete"
The linearization table is deleted.



Note!
The linearization table can only be edited if it is disabled ("Status" subfunction)

The table editor



"Status table" subfunction

In this function, you can specify whether the linearization table should be used or not.

- Options:
- "Enabled"

The table is used.

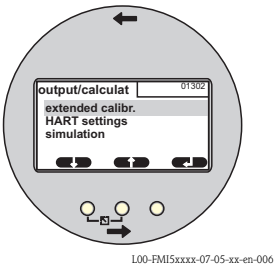
■ **"Disabled"**

The table is **not** used. The measured value is output linearly with regard to the level unit.

"Max. scale" subfunction

In this function, specify the maximum contents of the tank in question in the customer unit.

6.6 "Output" menu



- Output/Calculat O1302
- extended calibr.
- HART settings
- simulation

You can do the following settings in the "Output" menu.

Menu	Submenu	Function	Subfunction	Function value
	 	 		
Output	Extended calibr.	Extended calibr.	Measuring range	2000 pF¹⁾ 4000 pF
			Sensor DAT Stat.	OK
			Sensor DAT	Upload Download
		Output/Calculat	Curr. turn down	On Off
			Turn down 4 mA ²⁾	0 %
			Turn down 20 mA ²⁾	100 %
			4 mA threshold	On Off
	HART setting	HART setting	HART address	0
			No. of preambles	5
			Short TAG HART	TAG
		Output/Calculat	Current span	4 to 20 mA Fix. curr. HART
			mA value ³⁾	4 mA
	Simulation	Simulation		Off On
			Simulation value ⁴⁾	xx.xx mA

- 1) The values marked in bold are the factory settings.
- 2) This function is only displayed if the "On" option was selected under the "Curr. turn down" subfunction.
- 3) This function is only displayed if the function value "Fix. curr. HART" was selected under the "Current span" subfunction.
- 4) This function is only displayed if the "On" option was selected under the "Simulation" function.

6.6.1 "Extended calibr." submenu

"Extended calibr." function

In this function, you can specify the measuring range.

"Measuring range" subfunction

Specify the measuring range in this subfunction.

- C_A = 0 to 2000 pF (< 6 m probe length)
- C_A = 0 to 4000 pF (> 6 m probe length)



Note!
At the factory, the measuring range is always calibrated to the probe length ordered. If the electronic insert is used in another probe, the measuring range must be configured in accordance with the probe length.

"Output/Calculat." function**"Sensor DAT stat." subfunction**

This subfunction shows the status of the sensor DAT.

- OK (Sensor DAT is ready for use).
- Error (Sensor DAT is not ready for use ore or missing).

"Sensor DAT" subfunction

Calibration values can be transmitted with this function. A distinction is made between two types:

- The sensor has been replaced and the electronic insert should continue to be used.
- The electronic insert has been replaced but the sensor should continue to be used.

For instances of this nature, the calibration values already set can be transferred from the sensor to the electronic insert or from the electronic insert to the sensor.

Upload

To transfer the calibration values from the sensor to the electronic insert.

Download

To transfer the calibration values from the electronic insert to the sensor.

"Curr. turn down" subfunction

With this function, you can switch on the current turn down. The current output then only refers to a (freely definable) part of the measuring range. This is then magnified when displayed.

"Curr. turn down" subfunction (not available for "Current span", "Fix. curr. HART")

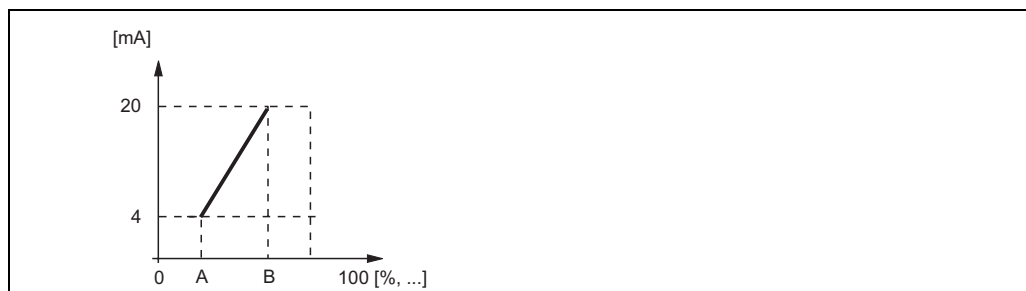
With this function, you can switch on the current turn down. The current output then only refers to a (freely definable) part of the measuring range. This is then magnified when displayed.

"Turn down 4 mA" subfunction (only for "Curr. turn down", "On")

In this function, enter the measured value at which the current should be 4 mA.

"Turn down 20 mA" subfunction (only for "Curr. turn down", "On")

In this function, enter the measured value at which the current should be 20 mA.



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A: Turn down 4 mA; **B:** turn down 20 mA

"4 mA threshold" subfunction (for "Current span" = "4 to 20 mA")

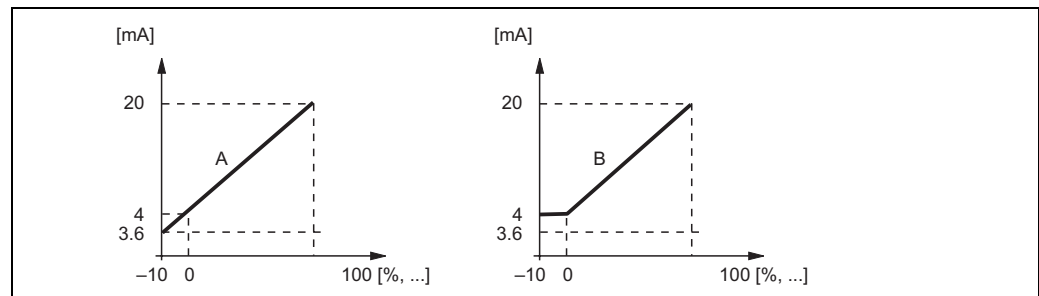
You can switch on the 4 mA threshold in this subfunction. The 4 mA threshold means that the current never undershoots 4 mA even if the measured value is negative.

Options:■ **"Off"**

The threshold is switched off. Currents under 4 mA can occur.

■ **"On"**

The threshold is switched on. The current never undershoots 4 mA.



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A: 4 mA threshold off; B: 4 mA threshold on

6.6.2 "HART setting" submenu**"HART settings" function****"HART address" subfunction**

In this subfunction, specify the HART communication address for the device.

Possible values:

- For standard operation: **0**
- For multidrop operation: **1 - 15**



Note!

In multidrop operation, the output current is 4 mA as standard. However, it can be changed in the "mA value" function.

"No. of preambles" subfunction

In this subfunction, specify the number of preambles for the HART protocol. It might make sense to increase the value if there are communication problems on the lines.

"Short TAG HART" subfunction

Here, you can enter the TAG name for HART communication in the device.

"Output/Calculat" function**"Current span" subfunction**

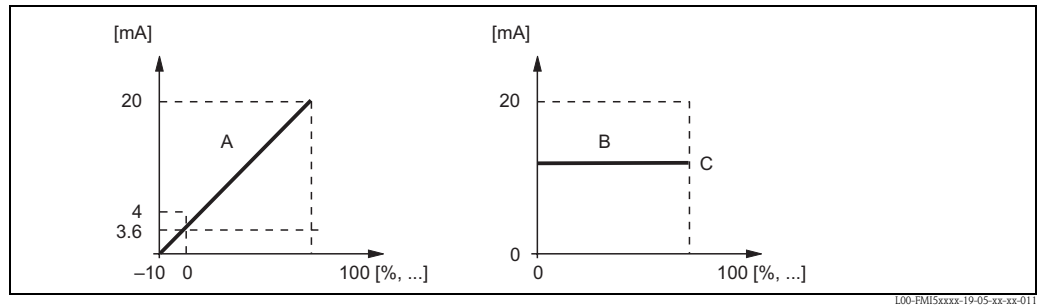
In this subfunction, select the current span to which the measuring range should be mapped.

Options:■ **"4 to 20 mA"**

The measuring range (0 % to 100 %) is mapped to the 4 to 20 mA current span.

■ **"Fix. curr. HART"**

A fixed current is output. Its value can be specified in the "mA value" subfunction. The measured value is only transmitted via the HART signal.



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A: Current span = 4 to 20 mA; **B:** current span = fix. curr. HART; **C:** mA value

6.6.3 "Simulation" submenu

"Simulation" function

"Simulation" subfunction

With this function, you can switch the simulation of an output current on and off.

Options:

■ "Off"

Simulation does not take place. Instead, the device is in the measuring mode.

■ "On"

The device is in the simulation mode. A measured value is not output. Instead, the current output assumes the value defined in the "Simulation value" subfunction.

"Simulation value" subfunction (only for "Simulation", "On")

Specify the current value to be simulated in this function.

6.7 "Device properties" menu

You can do the following settings in the "Device properties" menu.

Menu	Submenu	Function	Subfunction	Function value
	 	 		
Device properties	Display	Language		English Deutsch Francais Espanol Italiano Nederlands
			Display format	Format
				Decimal ft-in-1/16"
			No of decimals	x
				x.x
				x.xx
				x.xxx
			Sep. character	. (dot)
				,
			Back to home	900 s
	Diagnostics	Actual error	Actual error 1	
			Actual error 2	
			Actual error 3	
		Last error	reset errorlist	Keep Delete
			Last error 2	...
			Last error 3	...
		Password/reset	Reset	12345
			Status	Unlocked
		Electronic temp.	Electronic temp.	xx.x °C
			Max. temp.	xx.x °C
			Min. temp.	xx.x °C
			Temperature unit	°C
				°F
				K
			Min/Max temp.	Keep Delete Reset Min. Reset Max.
		Measure capacity	Measure capacity	xxxx.xx pF
			Max. capacity val	xxxx.xx pF
			Min. capacity val	xxxx.xx pF
			Min/Max capacity	Keep Delete Reset Min. Reset Max.
	System parameters	Device information	Device marking	Liquicap-FMI5x
			Serial No.	...
			EC Serial No.	xxxxxxxxxxx
			Device marking	FMI51-OrderCode
		Device information	Dev. rev	x
			Software version	V01.xx.xx.xxx
			DD version	xx
		Device information	Working hour	xxxxx h
			Current run time	000d00h00m
	Probe length	Probe length	Probe length	xxx mm
			Sensitivity	0.0

6.7.1 "Display" submenu

"Language" function

In this function, select the language for the display and operating module.

Options:

- "English"
- "Deutsch"
- "Français"
- "Español"
- "Italiano"
- "Nederlands"

"Display format" function

The "Display format" refers to how the measured value is displayed.

"Format" subfunction

In this subfunction, select the display format for displaying numbers.

Options:

- "Decimal"
- "ft-in-1/16"

"No. of decimals" subfunction

In this subfunction, select the number of places after the decimal point for displaying numbers.

Options:

- "x"
- "x.x"
- "x.xx"
- "x.xxx"

"Sep. character" subfunction

In this function, select the separator for displaying decimal numbers.

Options:

- "Dot (.)"
- "Comma (,)"

6.7.2 "Diagnosis" submenu

"Actual error" function

With this function, you can call up a list of the errors currently pending. The errors are arranged by priority. If you select an error, a text field appears with a brief description of the error (e.g. probe incorrectly calibrated, operating temperature too high, electronics error), (see also "Error code list" in Section 9, "Trouble-shooting").

"Last error" function

With this function, you can call up a list of the errors last rectified. You also have the option of resetting the error list (with "reset errorlist"). This overwrites the last three error codes with 0.

"Password/reset" function

With this function, you can restore the factory settings. All parameters are reset to their factory setting.

"Reset" subfunction

In this subfunction, enter the reset code ("333" or "7864") to reset all the parameters to their factory setting.

- The factory settings of the parameters are marked in bold in the menu overview.
- During a "333" reset, linearization is reset to "linear". However, any linearization table available is retained and can be activated again where necessary.
- During a "7864" reset, linearization is reset to "linear" and the linearization table deleted.

"Electronic temp." function

In this function, you can have temperatures displayed that were measured by the electronic insert during operation.

"Electronic temp." subfunction

This subfunction displays the electronics temperature currently measured.

"Max. meas. temp." subfunction

This subfunction displays the highest temperature value measured by the device.

"Min. temp." subfunction

This subfunction displays the lowest temperature value measured by the device.

"Temperature unit" subfunction

In this subfunction, you can determine the unit in which the temperature should be displayed. The following options are available:

- "°C"
- "°F"
- "K"

"Min/Max temp." subfunction

In this subfunction, you delete or individually reset the "Min. or Max. temp".

"Measure capacity" function

In this function, you can have measuring capacities displayed that were measured by the electronic insert during operation.

"Measure capacity" subfunction

This subfunction displays the measuring capacity currently measured.

"Max. capacity val." subfunction

This subfunction displays the highest capacitance value measured by the device.

"Min. capacity val." subfunction

This subfunction displays the lowest capacitance value measured by the device.

"Min/Max capacity" subfunction

In this subfunction, you delete or individually reset the "Min. or Max. capacity".

6.7.3 "System parameters" submenu



Note!

All functions listed below can be viewed only.

"Device information" (I) function

In this function, device information, with which the device can be identified, can be displayed.

"Device marking" subfunction

This subfunction displays the device name (e.g. Liquicap M-FMI51).

"Serial No." subfunction

This subfunction displays the serial number of the device that was assigned in the factory.

"EC Serial No." subfunction

This subfunction displays the serial number of the electronic insert.

"Device marking" subfunction

This subfunction displays the device marking and the order code.

"Dev. rev" subfunction

This subfunction displays the version of the electronic-hardware.

"Software version" subfunction

This subfunction displays the software version of the device that was assigned in the factory.

"DD version" subfunction

This function indicates the DD version with which this device can be operated using the ToF Tool.

"Working hour" subfunction

This subfunction displays the number of operating hours.

"Current run time" subfunction

This subfunction displays the "current run time" of the device. The first three digits display the number of days, followed by "d". The next two digits display the hours, followed by "h". The last two digits indicate the minutes.

"Probe length" function

In this function, more probe information can be displayed.

"Probe length" subfunction

You can read off the current probe length in this subfunction (probe length without thread and plug). $\text{Probe length} = L1 - (\text{thread length} - \text{plug})$

See also → Chap. 6.3.6.

"Sensitivity" subfunction

You can read off the current sensitivity in mm/pF in this subfunction.

6.8 Operation

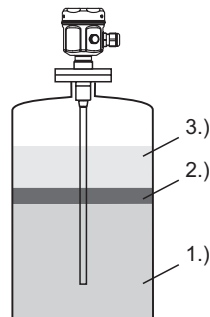
After Basic setup, Liquicap M outputs the measured value via

- the display and operating module
- the current output
(the entire measuring range (0 % to 100 %) is then mapped to the range (4 to 20 mA) of the current output.
- the digital HART signal.

6.9 Interface measurement

If there are different media in the container (e.g. water and oil), the capacitance values for "Empty calibration" and "Full calibration" can be calculated.

CapCalc.xls is a capacitance calculation program in the ToF Tool or FieldCare which can be used to calculate the calibration values for level measurement and interface measurement.



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- 1.) e.g. water (the medium must be conductive $\geq 100 \mu\text{S}/\text{cm}$)
 2.) emulsion
 3.) e.g. oil (nonconductive medium $< 1 \mu\text{S}/\text{cm}$ and $\text{DC} < 5$)

The program calculates the calibration values on the basis of the data entered (e.g. probe length, probe type, medium properties etc.). The secure functioning of interface measurement can already be determined at this time.

The calculated calibration values can be transmitted to the FEI50H electronic insert via the display, ToF Tool or Fieldcare.



Note!

Generally speaking, capacitance interface measurement is also suitable for very pronounced emulsion layers. The emulsion layer average is always measured.

6.9.1 Dry calibration for interface measurement

Prerequisites

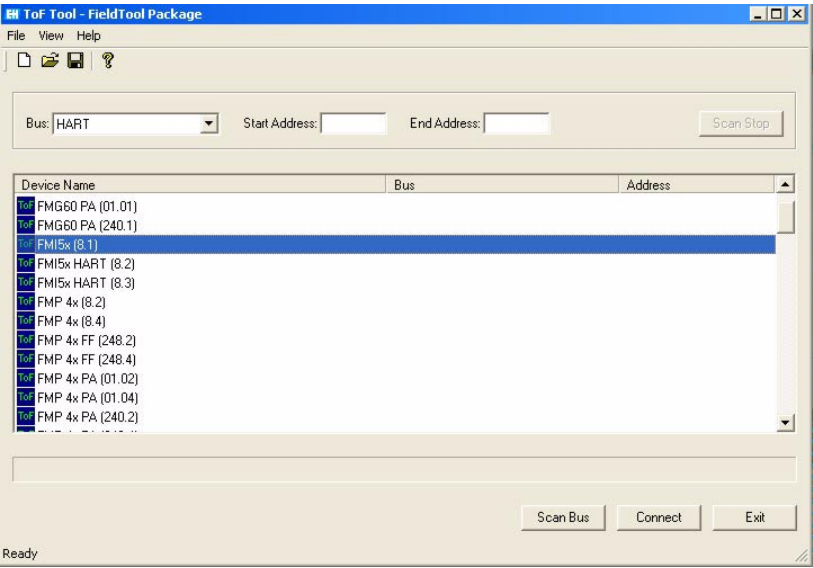
- The device is connected and operational.
- ToF Tool – FieldToolPackage is installed and operational.
- Microsoft Excel version 97 or higher is installed on your computer.

Starting the ToF Tool

Start the ToF Tool – FieldToolPackage with Start -> Programs -> Endress+Hauser -> ToF Tool – Field Tool Package -> ToF Tool Field Tool Package -> the connection wizard starts.

Select the communication mode and the device

Under "Bus", select the HART communication mode for your device.



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To find the device, click the "Scan bus" button. You get a list of all the devices connected to the bus. Select your device and confirm with the "Connect" button.

Device	Version
FEC 14	1.0
FMG60	8.1
FMG60 FF	248.1
FMG60 PA	240.1
FMG60 PA	01.01
FMI5x	8.1
FMI5x HART	8.3
FMI5x HART	8.2
FMP 4x	8.4
FMP 4x	8.2
FMP 4x FF	240.1

L00-FMIxxxxx-20-00-00-en-012

In the Navigation Window, select the "Basic calibration" menu.



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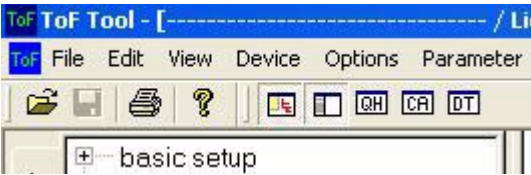
In the "Medium" submenu, select the "No buildup" function value and press Enter to confirm. The function value is now accepted. This can take a few seconds.



Once the function value has been accepted, use the "blue button" to switch to the dialog window with the calibration data.

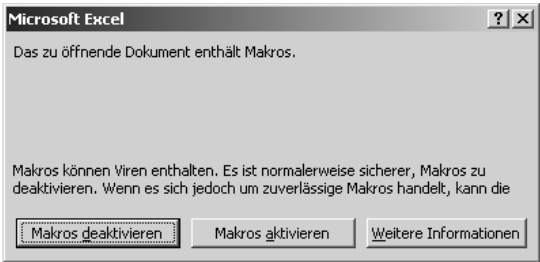
Calculating the calibration data with CapCalc

Click the CA button in the tool bar to start CapCalc.



L00-FMIxxxxx-20-00-00-en-017

In the dialog that follows, click the "Activate macros" button.



L00-FMIxxxxx-20-00-00-de-018

In the window that follows, click the [Next] button in the top right.



L00-FMIxxxxx-20-00-00-en-019

Editing the probe and application-specific data

Endress+Hauser GmbH+Co. KG
Hauptstraße 1
79689 Maulburg
Germany

Endress+Hauser
People for Process Automation

Sprache wählen
Select language

19.01.2007

Print

Customer	Muster GmbH+Co. KG	Attention	Hans Mustermann
Customer-No.	X0815	Phone	0815 - 12345
Street	Musterstraße 5	Fax	0815 - 0789
ZIP-Code/Town	12345	Reference	Trennschichtmessung
	Musterstadt	Tag	1122334455

Probe type

FMI51, rod 10mm, PTFE or PFA

Probe diameter

8 mm

Probe diameter with isolation

10 mm

DC-value of isolation

1,9

Base capacity

27,07 pF

Auxiliary capacities

0 pF

Probe length L1

1000 mm

inactive length L3

0 mm

Value Empty E

1000 mm

Value Full F

500 mm

Wall distance

250 mm

Medium top

Name

oil

Conductivity

0,01 µS/cm

Dielectric constant

2,1

Medium bottom

Name

water

Conductivity

180 µS/cm

Dielectric constant

80,4

Calibration data level

Calibration data interface measurement

Value Empty E

Value Full F

Probe length L1

100%

0%

Probe type

Auxiliary capacities

DC handbook

L00-FMIxxxxx-20-00-00-en-020

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Endress+Hauser

1. To select the probe type, click the "Probe type" button.
2. The probe data (L1 and L3) can be found on the nameplate of the probe. Enter these data accordingly.
3. Enter the application-specific data such as "Value empty" and "Value full" and "Wall distance" in accordance with the application.
4. In the "Medium top" and "Medium bottom" fields, enter the conductivity and the DC value of the medium.
5. To obtain the capacitance values for the calibration, click the "Calibration data interface measurement" button. The capacitance values for empty calibration and full calibration are calculated and displayed as a result.

If the medium properties are not known, you can use the "DC handbook" button to transfer the DC values and the conductivity of the corresponding media to the calculation program.

6.9.2 Wet calibration for interface measurement

This chapter describes the wet calibration procedure for "Empty calibration" and "Full calibration".

"Empty calibration"

1. Fill the container with the top medium and perform "Empty calibration" 0 % (see basic calibration → Chap. 6.3)
If it is not possible to fill with medium, "Empty calibration" can also be performed with the probe exposed (in the air). A calibration inaccuracy of approx. 2.5 % per meter should be expected here (oil and water are the reference media).

"Full calibration"

2. Fill the container with the bottom medium and perform "Full calibration" 100 % (see basic calibration → Chap. 6.3)

You have now performed basic calibration.

6.9.3 Empty and full calibration completed

You have now performed empty and full calibration and saved the values in the electronic insert and the sensor DAT.

7 Maintenance

No special maintenance work is required for the Liquicap M level transmitter.

External cleaning

When externally cleaning Liquicap M, make sure that the cleaning agent used does not attack or corrode the housing surface or seals.

Seals

The process seals of the sensor should be replaced periodically, especially when using molded seals (aseptic version)! The intervals between seal replacement depend on the frequency of the cleaning cycles and on the fluid and cleaning temperature.

Repair

The Endress+Hauser repair concept is devised in such a way that the devices have a modular design and repairs can be carried out by the customers.

Spare parts are grouped into handy kits with related replacement instructions. The "Spare parts" section lists all the spare part kits, including the order numbers, which you can order from Endress+Hauser for repairing Liquicap M. For further information on service and spare parts, please contact Endress+Hauser Service.

Repairing Ex-certified devices

The following information also has to be taken into account when repairing Ex-certified devices:

- Ex-certified devices may only be repaired by experienced, skilled staff or by Endress+Hauser Service.
- Applicable standards, national Ex-area regulations as well as the Safety Instructions (XA) and certificates must be observed.
- Only genuine spare parts from Endress+Hauser may be used.
- When ordering spare parts, please note the device designation on the nameplate. Parts can only be replaced by the same parts.
- Repairs must be carried out in accordance with the instructions. Following a repair, the individual testing specified for the device must be carried out.
- Certified devices can only be converted to other certified device versions by Endress+Hauser Service.
- Every repair and conversion made to the device must be documented.

Replacement

Once Liquicap M or the FEI50H electronic insert has been replaced, the calibration values must be transferred to the replacement device.

=> When the probe is replaced, the calibration values in the electronic insert are transferred to the probe DAT module

=> When the electronic insert is replaced, the calibration values of the probe DAT module are transferred to the electronics

Measuring can continue without having to carry out a new calibration.

8 Accessories

8.1 Protective cover

For F13 and F17 housing
Order number: TSP17090

8.2 Shortening set

For Liquicap M FMI52 (no hygienic approval, EHEDG, 3A)
Order number: 942901-0001

8.3 Commubox FXA191/195 HART

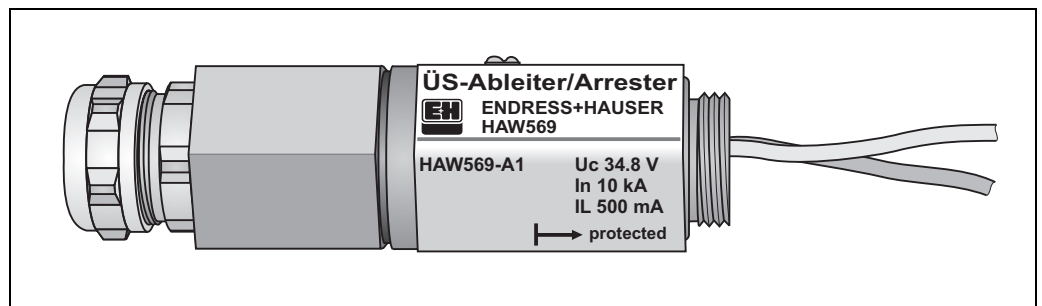
For intrinsically safe HART communication with ToF Tool /FieldCare via the RS232C interface or USB.

8.4 HAW569 surge arrester

Order number:

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

Surge arrester for limiting overvoltage in signal lines and components. The HAW562Z module can be used in hazardous areas.



100-FMI5xxxx-03-05-xx-xx-009

8.5 Weld-in adapter for universal adapter

- Order number: 52006262
Order number: 52010173 with 3.1 certificate
Diameter D: 85 mm
Height H: 12 mm

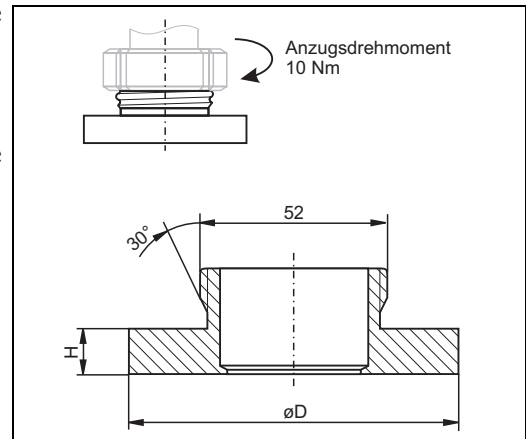
- Order number: 214880-0002
Order number: 52010174 with 3.1 certificate
Diameter D: 65 mm
Height H: 8 mm

For flush-mounted Liquicap M installation with process connection UPJ

Material: corrosion-resistant steel
1.4435 (AISI 316L)

Replacement seal:
Silicone O-ring (Set of 5 seals—FDA-listed)
Order number: 52023572

max. 16 psi / -20 to 150°C



L00-FMI5xxxx-06-05-xx-xx-012

8.6 Weld-in adapter for G 3/4

- Order number: 52018765 with 3.1 certificate max. 25 psi / -50 to 150°C

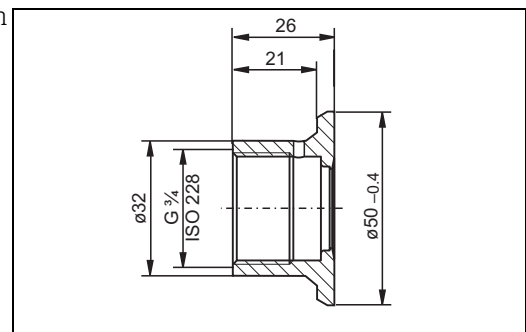
For flush-mounted Liquicap M installation with process connection GQJ

(seal included in scope of delivery)

Material: corrosion-resistant steel
1.4435 (AISI 316L)

Weight: 0.13 kg
Certificate: EHEDG

Replacement seal:
Silicone O-ring (5-piece set - FDA listed)
Order number: 52021717



L00-FTL5xxxx-06-05-xx-xx-020

8.7 Weld-in adapter for G 1

- Order number: 52001051
Order number: 52011896 with 3.1 certificate
For flush-mounted Liquicap M installation with process connection GWJ

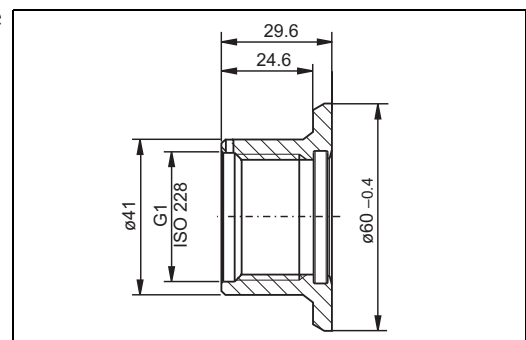
(seal included in scope of delivery)

Material: corrosion-resistant steel
1.4435 (AISI 316L)

Weight: 0.19 kg
Certificate: EHEDG

Replacement seal:
Silicone O-ring (5-piece set - FDA listed)
Order number: 52014472

max. 25 psi / -50 to 150°C



L00-FTL5xxxx-06-05-xx-xx-020

9 Troubleshooting

9.1 Error messages at electronic insert

9.1.1 Green LED flashing

Green LED (Φ indicates operation):

- Flashes every 5 s:
 - Indicates whether the device is operational
- Flashes once every s:
 - The device is in the calibration mode
- Flashes 4 times:
 - The device confirms a parameter change (Function-switch position 4, 5, 6)

9.1.2 Red LED flashing

Red LED (Ψ indicates a fault or malfunction):

- Flashes five times a s:
 - Capacitance at probe is too large
 - Probe insulation break detection
 - FEI50H is defective
- Flashes once every s:
 - The temperature in the electronic insert is outside the permitted temperature range.

9.2 System error messages

9.2.1 Error signal

Errors occurring during commissioning or during operation are displayed as follows:

- Error symbol, error code and error description on the display and operating module.
- Current output, can be configured ("Output on alarm" function)
 - MAX, 110 %, 22 mA
 - Hold (last value is retained)
 - User-spec. value

9.2.2 Last errors

With the "Last error" function ("System information" function group, "Error list" submenu), you can call up a list of the errors last rectified.

9.2.3 Types of error

Type of error	Display symbol	Meaning
Alarm (A)	 Permanent	The output signal assumes a value that can be specified with the "Output on alarm" function: ■ MAX: 110 %, 22 mA ■ Hold: Last value is retained ■ User-spec. value In addition, an error message is also shown on the display.
Warning (W)	 Flashing	The device continues measuring. An error message is shown on the display.

9.2.4 Error codes

4-digit error codes are displayed. They can be broken down as follows:

- Position 1: Type of error
 - A: Alarm
 - W: Warning
- Positions 2-5:
Refer to the error in accordance with the following table

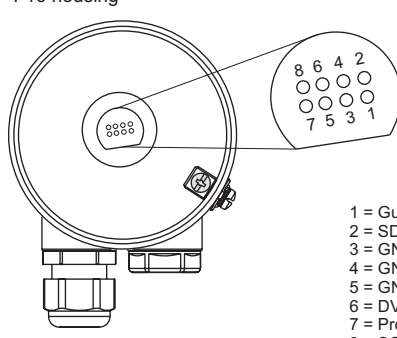
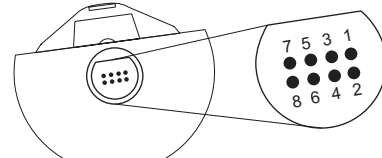
Example:

A 116	■ A: Alarm ■ 116: Download error
-------	---

Code	Error description	Remedial action
A 101, A 102, A 110, A 152	Checksum error	Total reset and recalibration necessary
W 103, W153	Initializing - please wait	Replace the electronics if the message does not disappear after a few seconds
A 106	Downloading - please wait	Wait until the downloading is complete
A 111, A 112, A 113, A 114, A 115, A 155, A 164, A 171, A 404, A 405, A 407, A 408, A 409, A 410, A 411, A 412, A 413, A 414, A 415, A 416, A 417, A 418, A 421, A 422, A 423, A 424,	Electronics defective	Switch device off/on; if the error persists, Contact Endress+Hauser-Service
A 116	Download error	Repeat download or perform a total reset
A 426	Data of Sensor-DAT not consistent	Repeat download from electronic insert or perform a total reset
A 427	Hardware not recognized after replacement	Repeat download or perform a total reset.
A 1121	Current output not calibrated	Contact Endress+Hauser-Service
W 153	Initializing	Replace the electronics if the message does not disappear after a few seconds
A 400	Measured capacitance too high	Change measuring range, verify probe
A 403	Measured capacitance too low	Verify probe
W 420	No Sensor-DAT available	Exchange sensor
A 428	Probe insulation break detection	Verify probe
W 425	Warning insulation defective	Check insulation
W 429	Proof test active	Wait until the proof test is completed
W 1601	Linearization curve not monotone for level	Re-enter linearization
A 1604	Calibration faulty	Correct calibration
W 1611	Level linearization points	Enter additional linearization points
W 1662	Temperature at electronic insert too high (max. temp. at sensor exceeded)	Lower ambient temperature by suitable measures
A 430	Data of probe and electronic insert not compatible	Check probe, perform a total reset

Code	Error description	Remedial action
W 1671	Linearization table entered incorrectly	Readjust table
W 1681	Current outside measuring range	Perform basic calibration; Check linearization
A 1682	Current calibration: Current turn down faulty	Correct current turn down
W 1683	Current turn down calibration faulty	Repeat calibration
W 1801	Level simulation switched on	Switch off level simulation
W 1802	Simulation switched on	Switch off simulation
W 1806	Current output is in simulation mode	Set current output to normal mode
W 511	Electronic insert has lost calibration data	Contact Endress+Hauser service

9.3 Possible measuring errors

Error	Remedial measures
Measured value is incorrect	1. Verify empty and full calibration. 2. Clean probe if necessary, verify probe 3. If necessary, alter better installation position of probe (do not mount in filling curtain) 4. Check ground from process connection to tank wall. Resistance measurement $< 1 \Omega$ 5. Check probe insulation (resistance measurement) $> 800 \text{ k}\Omega$ (only possible for conductive media) F16 housing  Electronic insert FEI50H  BA298Fen080
If the surface is turbulent, the measured value jumps sporadically to higher levels	Increase output damping

9.4 Spare parts



Note!

- You can order spare parts directly from your E+H service organization by quoting the order number (see below).
- The corresponding spare part number is on every spare part. Installation instructions can be found in the form supplied with the spare parts.
- Before ordering, please note, that all ordered spare parts must correspond with the indications on your nameplate. Otherwise, the indications on the nameplate do no longer correspond with the instrument version.

Electronic insert

- FEI50H electronic insert (HART)
52028260

Cover for housing without display

- Cover for aluminum housing F13: gray with sealing ring
52002698
- Cover for stainless steel housing F15: with sealing ring
52027000
- Cover for stainless steel housing F15: with safety claws and sealing ring
52028268
- Cover for polyester housing F16, flat: gray with sealing ring
52025606
- Cover for aluminum housing F17, flat: with sealing ring
52002699
- Cover for aluminum housing T13, flat: gray with sealing ring/electronics compartment
52006903
- Cover for aluminum housing T13, flat: gray with sealing ring/connection compartment
52007103

Cover for housing with display

- Cover for stainless steel housing F15: high, with sealing ring and viewing window
71005440
- Cover for stainless steel housing F15: high, with sealing ring, safety claw and viewing window
52028267
- Cover for aluminum housing F13/F17: high, with sealing ring and viewing window
52028270
- Cover for aluminum housing T13: high, with sealing ring and viewing window
electronics compartment for EEx d
52028271
- Cover for polyester housing F16: high, with sealing ring and transparent housing
52025605

Display with holder

- Display with holder for electronic insert FEI50H
52028266

Sealing kit for stainless steel housing

- Sealing kit for stainless steel housing F15: including 5 sealing rings
52028179

Terminal module

- Terminal module 2-pin EEx d, RFI filter for T13 housing 71020804

9.5 Return

The following measures must be taken before returning a device to Endress+Hauser for repair or calibration:

- Remove all traces of fluid. Pay particular attention to crevices and grooves for seals into which fluid can penetrate. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic etc.
- Always enclose a fully completed "Declaration of Contamination" with the device (a master copy of the "Declaration of Contamination" can be found at the end of these Operating Instructions). Only then can Endress+Hauser check or repair a returned device.
- If necessary, enclose special handling instructions when returning the device, e.g. a safety data sheet in accordance with EN 91/155/EEC.

In addition, specify the following:

- The chemical and physical properties of the fluid
- A description of the application
- A description of the error that occurred (give error code where applicable)
- Operating time of the device

9.6 Disposal

When disposing of the device, make sure the device components are separated based on the materials used and recycled where possible.

9.7 Software history

Software-Version / Date	Software updates	Documentation
FW: V 01.00.00 / 08.2005	Original-Software. Operable with: ■ ToF Tool - FieldTool Package, version 3.00 and higher ■ FieldCare, version 2.08.00 and higher	-
FW: V 01.03.00 / 02.2007	Expansion feature suitable for SIL 2 applications	
HW: V 02.00	-	-

9.8 Contact addresses at Endress+Hauser

On the back page of these Operating Instructions, you can find an internet address for Endress+Hauser. The addresses of people you can contact if you have any queries or questions are provided below this address.

10 Technical data

10.0.1 Input

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

Output signal	3.8 to 20.5 mA with HART protocol
---------------	-----------------------------------

Signal on alarm	Fault diagnosis can be called up via the following interfaces: ■ Local display: – Red LED ■ Local display showing: – Error symbol – Plain text display ■ Current output: 22 mA ■ Digital interface (HART status error message)
-----------------	---

Linearization	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.
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10.0.3 Power supply

Electrical connection	<i>Connection compartment</i> Five housings are available:
-----------------------	--

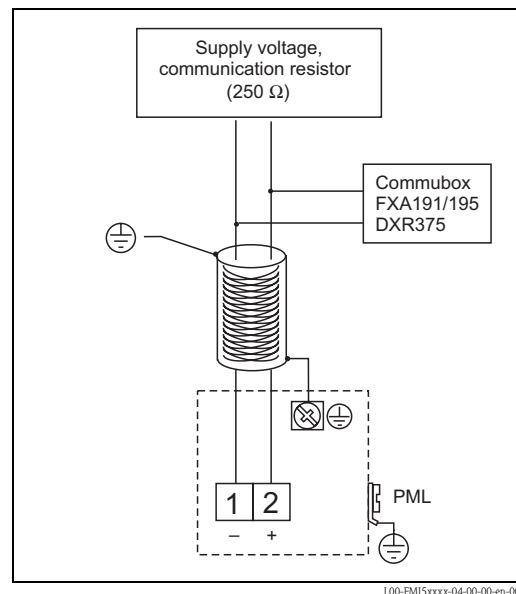
	Standard	EEx ia	EEx d	Gas-tight process seal
Plastic housing F16	X	X	–	–
Stainless steel housing F15	X	X	–	–
Aluminum housing F17	X	X	–	–
Aluminum housing F13	X	X	–	X
Aluminum housing T13 (with separate connection compartment)	X	X	X	X

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...2.5 mm) in the connection compartment at the electronic insert. If the superimposed communication signal (HART) is used, a screened cable must be used and the screening connected at the sensor and power supply.

Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated (see TI241F "EMC test procedures").



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Supply voltage

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

FEI50H:

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



Note!

The electronic insert has integrated reverse polarity protection.

Cable entry

- Cable gland: M20x1.5 (for EEx d only cable entry)
- Cable entry: G ½ or NPT ½, NPT ¾

Power consumption

Min. 40 mW, max. 800 mW

Current consumption

- Current consumption: 3.8 to 22 mA
- HART multidrop operation: 4 mA

Residual ripple

47 to 125 Hz: $U_{ss} = 200 \text{ mV}$ (with 500 Ω)

Noise

500 Hz to 10 kHz: $U_{eff} < 2.2 \text{ mV}$ (with 500 Ω)

10.0.4 Performance characteristics

Reference operating conditions

- Temperature = +20 °C ±5 °C
- Pressure = 1013 mbar abs. ±20 mbar
- Humidity = 65 % ±20%
- Medium = tap water (Conductivity ≥ 180 μS/cm)
- Rod probe = active probe length 1 m (PFA)

Maximum measured error

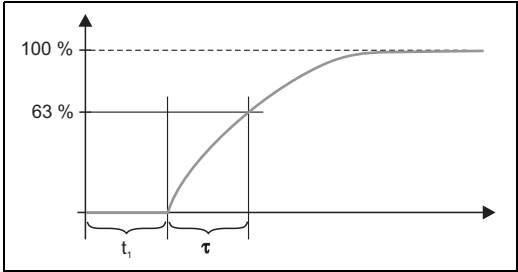
- Linearity: < 0.5 %
- Reproducibility: 0.1 %

Influence of ambient temperature < 0.06 %/10 K related to the full scale value

Start-up settling time 14 s (stable measured value after switch-on procedure)

Measured value reaction time $t_1 \leq 0.3 \text{ s}$

SIL operating mode $t_1 \leq 0.5 \text{ s}$



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τ = Output damping
 t_1 = Measured value reaction time

Output damping $\tau = 1 \text{ s}$ (factory setting) 0 to 60 s can be set.
The output damping affects the speed at which the display and the current output react to changes in the level.

Accuracy of factory calibration

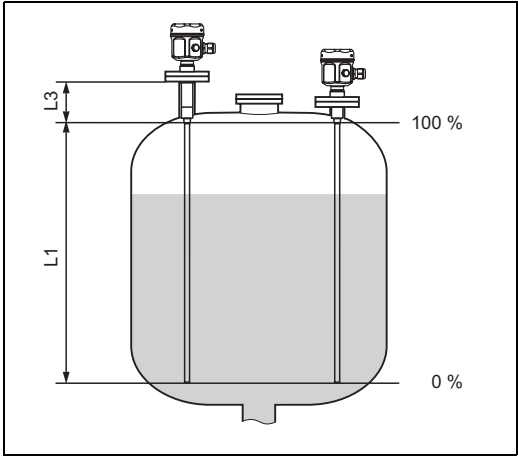
	Probe length < 2 m	Probe length > 2 m
Empty calibration (0 %), Full calibration (100 %)	typically $\leq 5 \text{ mm}$	typically $\leq 2 \%$

Reference conditions for the factory calibration:

- Medium conductivity $\geq 100 \text{ }\mu\text{S/cm}$
- Minimum distance to tank wall = 250 mm

 **Note!**
In an installed state, recalibration is only necessary if:

- The 0 % or the 100 % values have to be adjusted specifically for customer
- The liquid is not conductive.
- The probe distance to the tank wall is < 250 mm



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Resolution 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. For example, active probe rod 1000 mm.

Resolution = 1000 mm/2048 = 0.48 mm

10.0.5 Operating conditions: Environment

Ambient temperature range

- Ambient temperature of the transmitter: $-50 \text{ }^\circ\text{C}$ to $+70 \text{ }^\circ\text{C}$ (Restrictions → Page 100 ff. with WHG approval restriction on $-40 \text{ }^\circ\text{C}$)
- At $T_U < -20 \text{ }^\circ\text{C}$ and $T_U > +60 \text{ }^\circ\text{C}$, the functionality of the LCD display is limited.

- A weather protection cover should be used when operating outdoors in strong sunlight. For further information on the protective cover, see Page 89.

Storage temperature ■ -50 °C to +85 °C

Climate class ■ DIN EN 60068-2-38/IEC 68-2-38: Z/AD check

Degree of protection As per EN 60529

	IP66	IP67	IP68	NEMA 4X
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
Aluminum housing T13 with gas-tight process seal and separate connection compartment (EEx d)	X	-	X	X
Separate housing	X	X		X

Vibration resistance ■ DIN EN 60068-2-64/IEC 68-2-64: 20...2000 Hz, 1 (m/s²)/Hz

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. Buildup that crystallizes out can affect the measurement result. If the medium tends to create a high degree of buildup, regular cleaning is recommended. When hosing down or during mechanical 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!

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)
- If only the analog signal is to be used, a normal instrument cable is sufficient.
If the superimposed communication signal (HART 4 to 20 mA) is used, a screened cable must be used.

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

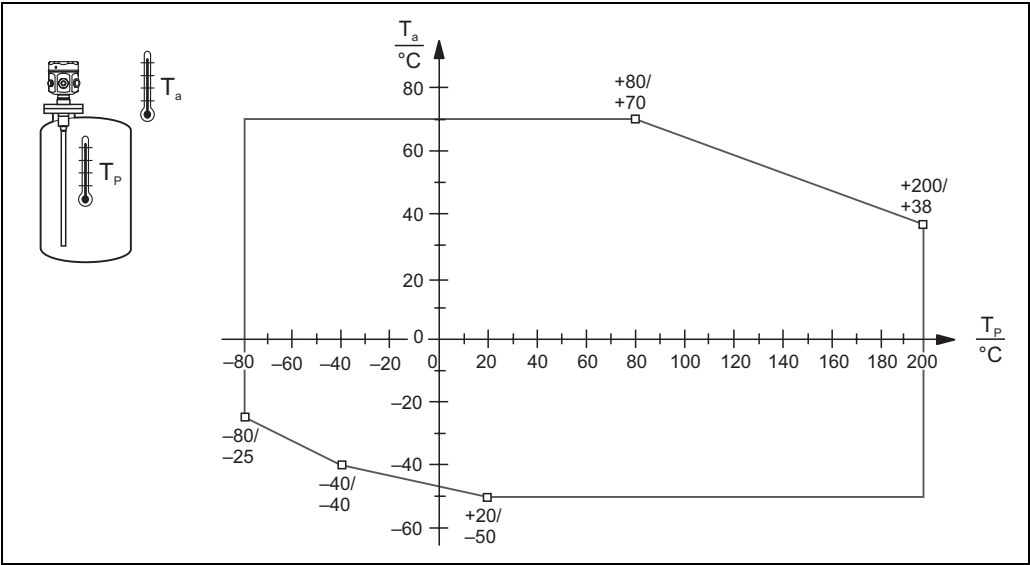
10.0.6 Operating conditions: Process

Process temperature range

With compact housing

The following diagram applies to:

- Rod and rope version
- Insulation: PTFE, PFA, FEP



Note!

- Restriction on $T_a - 40\text{ °C}$ for F16 polyester housing.
- Only relevant for FMI51!

If the additional option B (LABS free) was selected, the minimum ambient temperature T_a is -40 °C .

Pressure and temperature derating

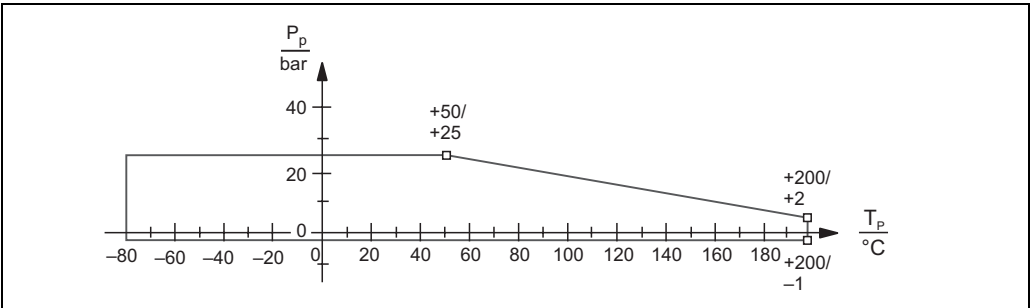
For process connections 1/2", 3/4", 1", flanges ≤ DN50, ≤ ANSI 2", ≤ JIS 10K

Rod insulation: PTFE
Rope insulation: FEP, PFA



Note!

See also "Process connections" on Page 19 ff.



For process connections 1½", flanges > DN50, > ANSI 2", > JIS 10K

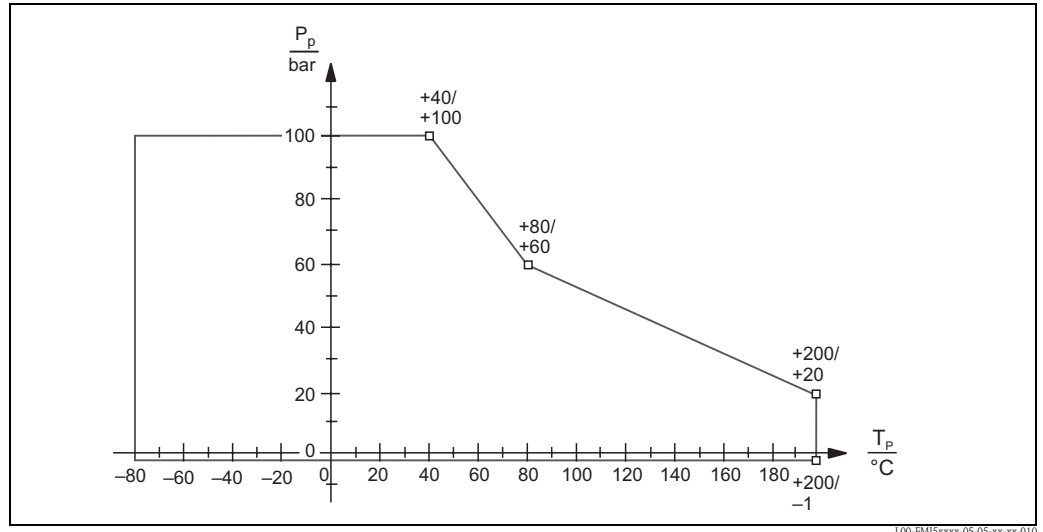
Rod insulation: PTFE, PFA

Rope insulation: FEP, PFA



Note!

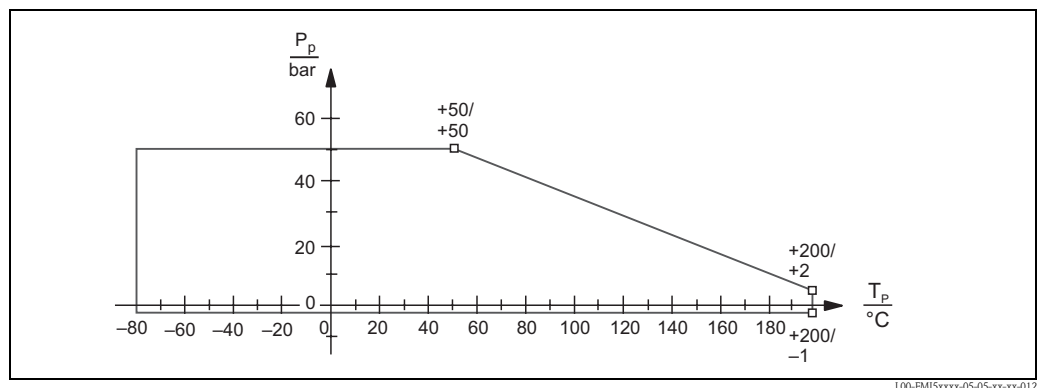
See also "Process connections" on Page 19 ff.



P_p : Process pressure

T_p : Process temperature

With fully insulated inactive length:



P_p : Process pressure

T_p : Process temperature



Note!

In flange process connections, the maximum pressure is limited by the nominal pressure of the flange.

Process pressure limits

The process pressure limits depend on the process connection. For further information refer to Chapter 3.3 ("Installation conditions", "Process connections")

The pressure values permitted at higher temperatures can be found in the following standards:

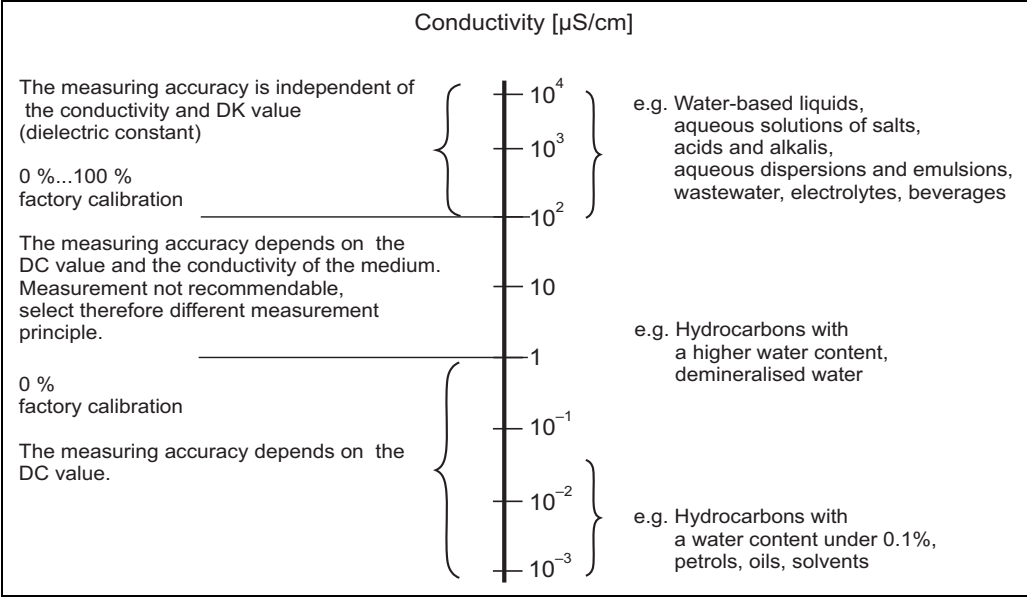
- pR EN 1092-1: 2005 Table, Appendix G2
With regard to its stability property, the material 1.4435 is identical to 1.4404 which is grouped under 13EO in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B2238/2210

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

State of aggregation Liquid

Liquicap M operational range

Typical DC values	
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



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10.0.7 Mechanical construction

See "Installation" section, "Installation instructions" on Page 17 ff.

10.0.8 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.

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

Ex approval See "Identification" section on Page 8 ff.

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

10.0.9 Documentation

Technical Information

- Liquicap M FMI51, FMI52
TI401F/00

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
XA327F/00/a3
- Liquicap M FMI51, FMI52
ATEX II 1/2 G (EEx d (ia) IIC/IIB T3 to T6)
XA328F/00/a3

Overfill protection DIBt (WHG)

- Liquicap M FMI51, FMI52
ZE265F/00/de

Functional safety (SIL2)

- Liquicap M FMI51, FMI52
SD198F/00/en

Control Drawings

- Liquicap M FMI51, FMI52
FM
ZD220F/00/en
- Liquicap M FMI51, FMI52
CSA
ZD221F/00/en

11 Operating menu

The main menu is activated by means of the right Enter key ↵.

The following menu headings appear. These are explained in more detail over the following pages:

- "Basic calibration"
- "Safety set."
- "Linearization"
- "Output"
- "Device properties"

11.1 "Basic calibration" menu Commissioning with display and operating module

You can make the following settings in the "Basic setup" menu.

Menu	Function	Subfunction	Function value
	 	 	
Basic setup	Basic setup	Medium property	no buildup ¹⁾ buildup
		Cal. type	Dry Wet
	Medium property ²⁾	Medium property	Conductive Nonconductive interface unknown
		DC value ³⁾	Value
		Unit level ⁴⁾	% (percentage) m mm ft inch
	Empty calibr.	Value empty	0 %
		Measure capacity	xxxx pF
		Confirm cal.:	Yes
	Full calibr.	Value full	100 %
		Measure capacity	xxxx pF
		Confirm cal.:	Yes
	Output damping	Output damping	1 s

- 1) The values marked in bold are the factory settings.
- 2) This function is only displayed if the function value "Dry" was selected under the subfunction "Cal. type".
- 3) This subfunction is only displayed if the function value "Nonconductive" was selected under the subfunction "Medium property".
- 4) This subfunction is only displayed if the function value "Nonconductive" or "Conductive" was selected under the subfunction "Medium property".

11.2 "Safety setting" menu

You can make the following settings in the "Safety settings" menu.

Menu	Function	Subfunction	Function value
	 	 	
Safety settings	Safety settings I	Code	100 ¹⁾
		Status	Unlocked Locked
	Safety settings II	Operating mode	Standard SIL/WHG
		Output damping	1 s
		Output 1	MAX
		Parameter okay	no yes
	Safety settings III	Cap. empty	x,xx pF
		Value empty	x,xxx %
		Cap. full	2000.00 pF
		Value full	100,000 %
		Parameter okay	no yes
	Operating mode	Operating mode	Standard SIL/WHG
		SIL op. mode ²⁾	Unlocked Locked
		Status	Unlocked Locked
	Output on alarm	Output	Max Hold User-spec.
		Output value ³⁾	xx.xx mA
	Proof test	Proof test	Off On

- 1) The values marked in bold are the factory settings.
- 2) This subfunction is only displayed if the "SIL/WHG" option was selected under the "Operating mode" subfunction.
- 3) This subfunction is only displayed if the "User-specific" option was selected under the "Output" subfunction.

11.3 "Linearization" menu

You can do the following settings in the "Linearization" menu.

Menu	Function	Subfunction	Function value	Additional function values
	 	 		
Linearization	Linearization	Type	None Linear ¹⁾ Horizontal cyl ²⁾ Sphere ²⁾ Pyramid bottom ³⁾ Conical bottom ³⁾ Angled bottom ³⁾ Table	
		Mode	level Ullage	
		Simulation	Sim. off Sim. level Sim. volume	
		Sim. level value ⁴⁾ or Sim. vol. value ⁴⁾	xx.x % xx.x %	
		Linearization	Customer unit	% (percentage), l, hl, m3, dm3, cm3, ft3, usgal, igal, kg, t, lb, ton, m3, ft3, mm, inch, user-spec.
			Customized text ⁵⁾	...
			Diameter ⁶⁾	xxxx m
			Intermed. height ⁷⁾	xx m
		Edit ⁸⁾	Read	Table No.: 1 Input level: x m Input volume: %
			Manual	Table No.: 1 Input level: x m Input volume: %
			Semi-automat.	Table No.: 1 Input level: x m Input volume: %
			Delete	
		Status table ⁷⁾	Enabled Disabled	
		Max. scale ⁹⁾	100 %	

- 1) The values marked in bold are the factory settings.
- 2) If you enter a value for this function, you must also enter a value for the "Diameter" subfunction in another step.
- 3) If you enter a value for this function, you must also enter a value for the "Intermed. height" subfunction in another step.
- 4) This function is only displayed if the "Sim. off" option was not selected under the "Simulation" subfunction.
- 5) This function is only displayed if the "User-spec." option was selected under the "Customer unit" subfunction.
- 6) This function is only displayed if the "Horizontal cyl" or "Sphere" option was selected under the "Type" subfunction.
- 7) This function is only displayed if the "Pyramid bottom", "Conical bottom" or "Angled bottom" option was selected under the "Type" subfunction.
- 8) This function is only displayed if the "Table" option was selected under the "Type" subfunction.
- 9) This function is not displayed if the "Table" option was selected under the "Type" subfunction.

11.4 "Output" menu

You can do the following settings in the "Output" menu.

Menu	Submenu	Function	Subfunction	Function value
	 	 		
Output	Extended calibr.	Extended calibr.	Measuring range	2000 pF¹⁾ 4000 pF
			Sensor DAT Stat.	OK
			Sensor DAT	Upload Download
		Output/Calculat	Curr. turn down	On Off
			Turn down 4 mA ²⁾	0 %
			Turn down 20 mA ²⁾	100 %
			4 mA threshold	On Off
	HART setting	HART setting	HART address	0
			No. of preambles	5
			Short TAG HART	TAG
	Simulation	Simulation	Current span	4 to 20 mA Fix. curr. HART
			mA value ³⁾	4 mA
				Off On
	Simulation	Simulation	Simulation value ⁴⁾	xx.xx mA

- 1) The values marked in bold are the factory settings.
- 2) This function is only displayed if the "On" option was selected under the "Curr. turn down" subfunction.
- 3) This function is only displayed if the function value "Fix. curr. HART" was selected under the "Current span" subfunction.
- 4) This function is only displayed if the "On" option was selected under the "Simulation" function.

11.5 "Device properties" menu

You can do the following settings in the "Device properties" menu.

Menu	Submenu	Function	Subfunction	Function value
	 	 		
Device properties	Display	Language		English Deutsch Francais Espanol Italiano Nederlands
			Display format	Format
				Decimal ft-in-1/16"
			No of decimals	x x.x x.xx x.xxx
			Sep. character	. (dot) ,
			Back to home	900 s
	Diagnostics	Actual error	Actual error 1	
			Actual error 2	
			Actual error 3	
		Last error	reset errorlist	Keep Delete
			Last error 2	...
			Last error 3	...
		Password/reset	Reset	12345
			Status	Unlocked
		Electronic temp.	Electronic temp.	xx.x °C
			Max. temp.	xx.x °C
			Min. temp.	xx.x °C
			Temperature unit	°C °F K
			Min/Max temp.	Keep Delete Reset Min. Reset Max.
		Measure capacity	Measure capacity	xxxx.xx pF
			Max. capacity val	xxxx.xx pF
			Min. capacity val	xxxx.xx pF
			Min/Max capacity	Keep Delete Reset Min. Reset Max.
	System parameters	Device information I	Device marking	Liquicap-FMI5x
			Serial No.	...
			EC Serial No.	xxxxxxxxxxx
		Device information	Device marking	FMI51-OrderCode
			Dev. rev	x
			Software version	V01.xx.xx.xxx
			DD version	xx
		Device information III	Working hour	xxxxx h
			Current run time	000d00h00m
	Probe length	Probe length	Probe length	xxx mm
			Sensitivity	0.0

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Declaration of Hazardous Material and De-Contamination *Erklärung zur Kontamination und Reinigung*

RA No.

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor

Geräte-/Sensortyp _____

Serial number

Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System / Einsatz als SIL Gerät in Schutzeinrichtungen**

Process data / Prozessdaten

Temperature / Temperatur _____ [°F] _____ [°C]

Pressure / Druck _____ [psi] _____ [Pa]

Conductivity / Leitfähigkeit _____ [µS/cm]

Viscosity / Viskosität _____ [cp] _____ [mm²/s]

Medium and warnings

Warnhinweise zum Medium



	Medium / concentration Medium / Konzentration	Identification CAS No.	flammable entzündlich	toxic giftig	corrosive ätzend	harmful/ irritant gesundheitsschädlich/ reizend	other * sonstiges*	harmless unbedenklich
Process medium Medium im Prozess								
Medium for process cleaning Medium zur Prozessreinigung								
Returned part cleaned with Medium zur Endreinigung								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive

* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.

Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / Fehlerbeschreibung

Company data / Angaben zum Absender

Company / Firma _____	Phone number of contact person / Telefon-Nr. Ansprechpartner: _____
Address / Adresse _____	Fax / E-Mail _____
_____	Your order No. / Ihre Auftragsnr. _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge. We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefährlicher Menge sind."

(place, date / Ort, Datum)

Name, dept./ Abt. (please print / bitte Druckschrift)

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