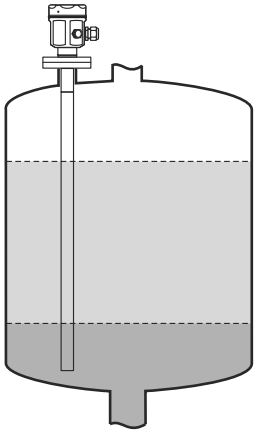
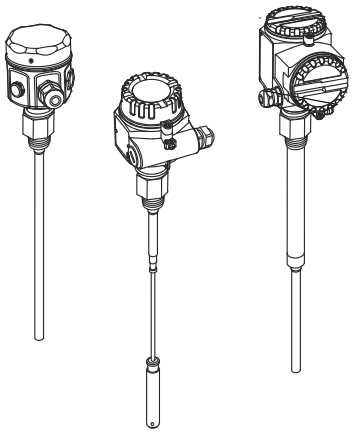
SD00198F/00/EN/16.21
71525018
2021-05-03

Special Documentation
Liquicap M FMI51, FMI52

Functional Safety Manual





Capacitance level measurement for liquids with a 4-20 mA output signal

Endress+Hauser
People for Process Automation

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Declaration of Conformity

The SIL Declaration of Conformity is specific to the device serial number. Therefore only a sample declaration is illustrated in this document!

SIL-06003b/00

Endress+Hauser
People for Process Automation

SIL Declaration of Conformity

Functional Safety according to IEC 61508 / 61511
Supplement 1 / NE130 Form B.1 and IGR 49-02-15 Datasheet 1

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

being the manufacturer, declares that the product stated below

Liquicap M FMI51, FMI52
+ Electronic insert FEI50H
(Serial number XXXXXXXXXX)

is suitable for the use in safety-instrumented systems according to IEC61508, if the safety instructions and following parameters are observed.

This declaration of conformity is only valid for the customer listed in the cover letter of the responsible Endress+Hauser sales center and for the listed products in delivery status.

Maulburg, 22.04.2015
Endress+Hauser GmbH+Co. KG

i. V.
Dr. Arno Götz
Dept. Manager Product Safety
Research & Development

i. V.
Dr.Dietmar Frühauf
Dept. Manager Level Switches
Research & Development

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SIL-06003b/00

Endress+Hauser
People for Process Automation

General			
Device designation and permissible types	**Liquicap M**, with electronic insert FEI50H		
	FMI51 / FMI52		
Safety-related output signal	4....20 mA		
Fault current	≤ 3.6 mA (Fail Low) and ≥21.0 mA (Fail High)		
Process variable/function	Capacitance level measurement for liquids		
Safety function(s)	Overfill protection or operating maximum/minimum detection		
Device type acc. to IEC 61508-2	☐ Typ A	☒ Typ B	
Operating mode	☒ Low Demand Mode	☒ High Demand or Continuous Mode	
Valid Hardware-Version	As of 02.00		
Valid Software-Version	As of 01.03.00		
Safety manual	SD00198F		
Type of evalutation (check only one box)	☒	Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of "Proven-in-use" performance for HW/SW incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of HW/SW field data to verify „prior use" acc. to IEC 61511	
	☐	Evaluation by FMEDA acc. to IEC61508-2 for devices w/o software	
Evaluation through – report no.	Exida Certification SA - E+H 1009074 P0012 C01		
Test documents	Development documents	Test reports	Data sheets

SIL - Integrity			
Systematic safety integrity		☒ SIL 2 capable	☐ SIL 3 capable
Hardware safety integrity	Single channel use (HFT = 0)	☒ SIL 2 capable	☐ SIL 3 capable
	Multi channel use (HFT ≥ 1)	☒ SIL 2 capable	☐ SIL 3 capable

FMEDA	
Safety function	MIN and MAX*4) Level
λ_{DU} *1)	75 FIT
λ_{DD} *1)	695 FIT
λ_{SU} *1)	118 FIT
λ_{SD} *1)	0 FIT
SFF - Safe Failure Fraction	91 %
PTC *2)	45 %
λ_{total} *1)	888 FIT
Diagnostic test interval	30 sec
Fault reaction time *3)	<5/30 sec /40 min RAM and ROM-check

Comments

*3) Voltage and current control / SW and other errors
*4) The functional safety assessment of the devices includes the basic unit with the main electronics, sensor electronics and sensor up to the sensor membrane and the process connection mounted directly. Process adapter and diaphragm seal are not taken into account in the rating.

Declaration

☒	Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future

*1) FIT = Failure In Time, Number of failures per 10^9 h
*2) PTC = Proof Test Coverage (Diagnostic coverage for proof test)

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Other safety-related characteristic values

Specific functional safety parameters:

Characteristic as per IEC 61508	Value
Safety function	MIN, MAX
SIL hardware	SIL 2
SIL software	SIL 2
HFT	0
Device type	B
Operation mode	Low demand mode/high demand mode
SFF	91 %
MTTR	8 h
Recommended time interval for proof-testing T_1	1 year
λ_{sd}	0 FIT
λ_{su}	118 FIT
λ_{dd}	695 FIT
λ_{du}	75 FIT
λ_{tot} [1)]	888 FIT
PFD_{avg} for T_1 = 1 year [2)]	3.29 x 10^{-4}
MTBF	114 years
Diagnostic test interval [3)]	30 s
Fault reaction time [4)]	< 5/30 s / 40 min RAM and ROM check
System reaction time [5)]	≤5 s
PTC test sequence	45 %

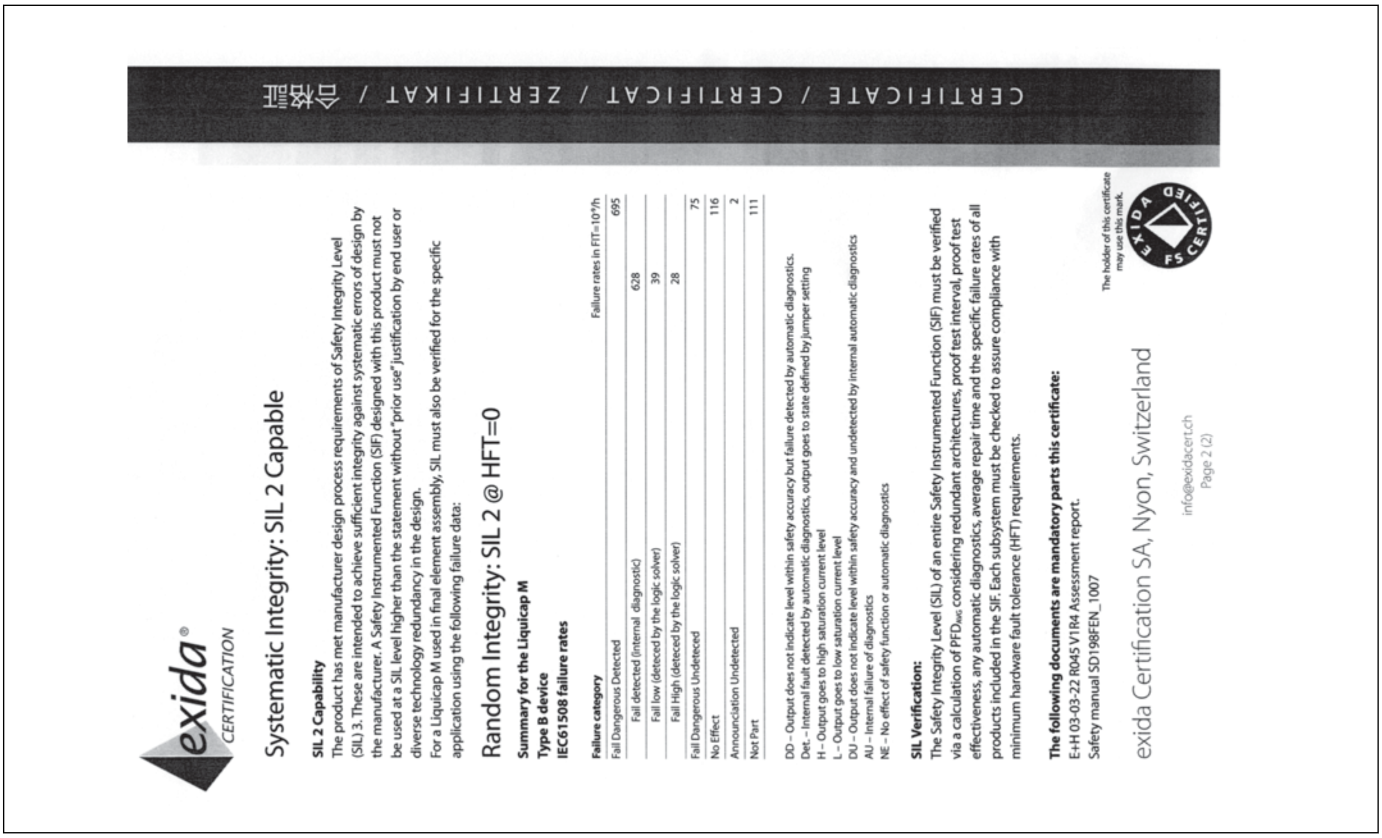
1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.
2) A factor of 1.3 should be taken into account where the average continuous service temperature is in the region of +50 °C (+122 °F).
3) During this time, all diagnostic functions are executed at least once.
4) Time between error detection and error response.
5) Step response time as per DIN EN 61298-2.

Useful lifetime of electrical components

The established failure rates of electrical components apply within the useful lifetime as per IEC 61508-2:2010 section 7.4.9.5 note 3.

According to DIN EN 61508-2:2011 section 7.4.9.5 national footnote N3, appropriate measures taken by the manufacturer and operator can extend the useful lifetime.

Certificate



exida® CERTIFICATION

CERTIFICATE / CERTIFICAT / ZERTIFIKAT / 合格証

Systematic Integrity: SIL 2 Capable

SIL 2 Capability
The product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer. A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than the statement without "prior use" justification by end user or diverse technology redundancy in the design.
For a Liquicap M used in final element assembly, SIL must also be verified for the specific application using the following failure data:

Random Integrity: SIL 2 @ HFT=0

Summary for the Liquicap M
Type B device
IEC61508 failure rates

Failure category		Failure rates in FIT=10^{-9}/h
Fail Dangerous Detected		695
Fail detected (internal diagnostic)	628	
Fail low (deteced by the logic solver)	39	
Fail High (deteced by the logic solver)	28	
Fail Dangerous Undeteced		75
No Effect		116
Announciation Undetected		2
Not Part		111

DD – Output does not indicate level within safety accuracy but failure detected by automatic diagnostics.
Det. – Internal fault detected by automatic diagnostics, output goes to state defined by jumper setting
H – Output goes to high saturation current level
L – Output goes to low saturation current level
DU – Output does not indicate level within safety accuracy and undetected by internal automatic diagnostics
AU – Internal failure of diagnostics
NE – No effect of safety function or automatic diagnostics

SIL Verification:
The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFD_{AVG} considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all products included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

The following documents are mandatory parts this certificate:
E+H 03-03-22 R045 V1R4 Assessment report.
Safety manual SD198FEN_1007

The holder of this certificate may use this mark.

exida Certification SA, Nyon, Switzerland

info@exidacert.ch
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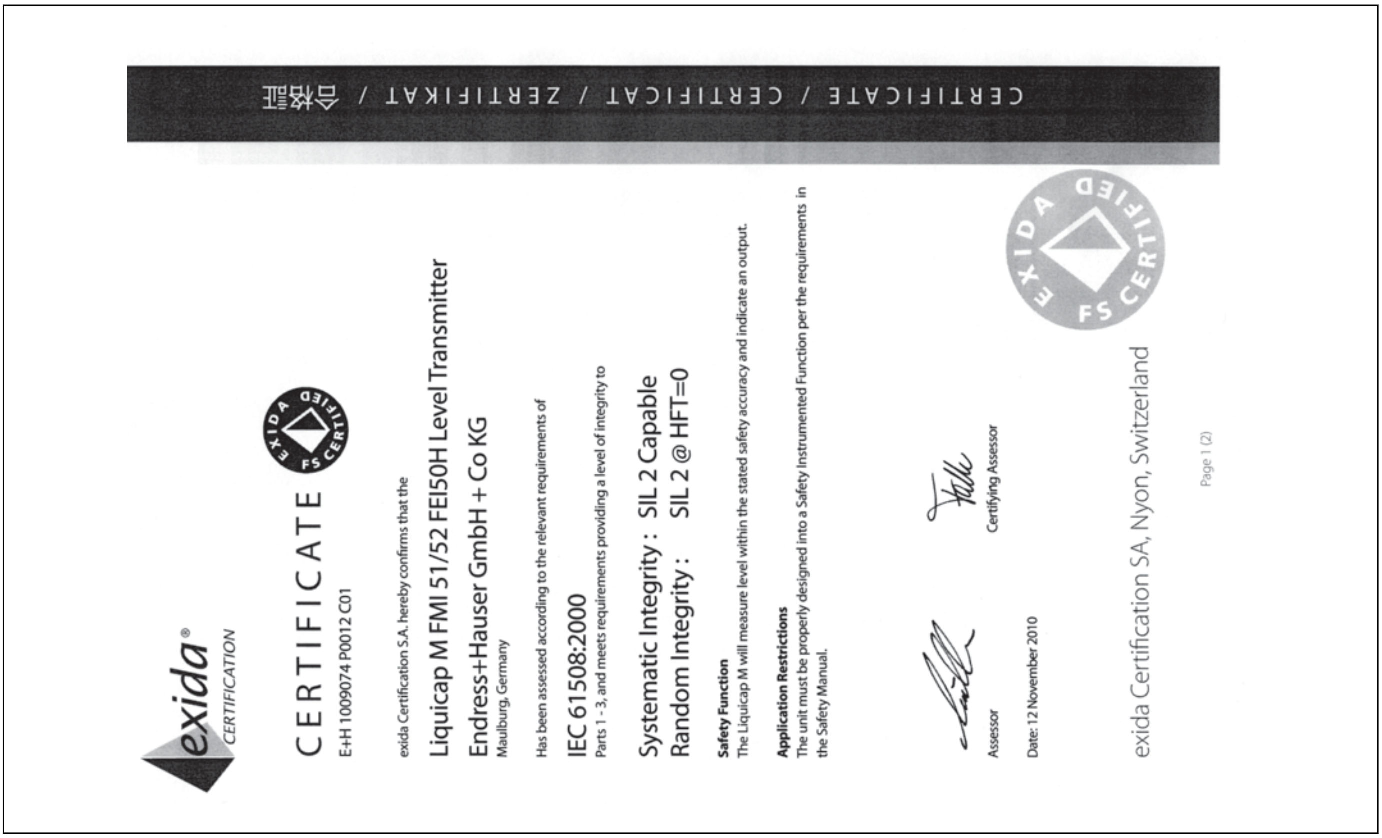

exida® CERTIFICATION

CERTIFICATE / CERTIFICAT / ZERTIFIKAT / 合格証

CERTIFICATE

E+H 1009074 P0012 C01

exida Certification S.A. hereby confirms that the

Liquicap M FMI 51/52 FEI50H Level Transmitter

Endress+Hauser GmbH + Co KG
Maulburg, Germany

Has been assessed according to the relevant requirements of

IEC 61508:2000
Parts 1 - 3, and meets requirements providing a level of integrity to

Systematic Integrity : SIL 2 Capable
Random Integrity : SIL 2 @ HFT=0

Safety Function
The Liquicap M will measure level within the stated safety accuracy and indicate an output.

Application Restrictions
The unit must be properly designed into a Safety Instrumented Function per the requirements in the Safety Manual.

Assessor

Certifying Assessor

Date: 12 November 2010

exida Certification SA, Nyon, Switzerland

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Results of the IEC 61508 Functional Safety Assessment

Project:

Liquicap M FMI 51/52 with 4..20 mA output FEI50H
Transmitter for continuous capacitance level measurement
Applications with level limit detection (MIN / MAX detection)

Customer:

Endress+Hauser GmbH+Co. KG
Maulburg
Germany

Contract No.: E+H 03/03-22
Report No.: E+H 03/03-22 R045
Version V1, Revision R4, November 2010

Peter Müller

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Management summary

The Functional Safety Assessment of the Endress+Hauser GmbH+Co. KG - Liquicap M FMI 51/52 with 4..20mA output FEI50H development project, performed by *exida* consisted of the following activities:

- *exida* assessed the development process used by Endress+Hauser for this development project against the objectives of IEC 61508 parts 1 to 3.
  All objectives have been successfully considered in the Endress+Hauser development process for the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H.
- *exida* audited the development process by a detailed development audit which investigated the compliance with IEC 61508 of the processes, procedures and techniques as implemented for the Endress+Hauser level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H development. The investigation was executed using subsets of the IEC 61508 requirements tailored to the work scope of the development team.
  The objectives of the standard are fulfilled by Endress+Hauser, for the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H development project.
- *exida* assessed the safety case prepared by Endress+Hauser against the technical requirements of IEC 61508 for a type B subsystem.
  The safety case demonstrated the fulfillment of the technical requirements of IEC 61508 for the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H.

Some areas for improvement were identified which are generally required to formally show the compliance to IEC 61508. However, because of the size of the project (limited number of people) and the low complexity / limited size of the product, Endress+Hauser was able to demonstrate that the *objectives of the related areas have been successfully met*.

The result of the Functional Safety Assessment can be summarized by the following statements:

The audited Endress+Hauser development process tailored and implemented by the Liquicap M FMI 51/52 with 4..20mA output FEI50H project complies with the relevant safety management requirements of IEC 61508 SIL2 related to the Hardware and Software development.The assessment of the FMEDA, which is performed according to IEC 61508, has shown that the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H has a PFD_{AVG} within the allowed range for SIL 2 (HFT = 0) according to table 2 of IEC 61508-1 and a Safe Failure Fraction (SFF) of more than 90%.

The assessment has shown that the SW developed for the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H, complies with the relevant safety requirements for design, implementation and verification.

This means that the level transmitter Liquicap M FMI 51/52 with 4..20mA output FEI50H with HW version V02.01 and SW version V01.03.02 is capable for use in SIL 2 applications in a single configuration.

Dipl.-Ing. (FH) Peter Müller, Senior Project Manager	Audun Opem, Senior Project Manager

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Document information

Document function

The document is part of the Operating Instructions and serves as a reference for application-specific parameters and notes.

Symbols used

Safety symbols

Symbol	Meaning
DANGER	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
WARNING	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for certain types of information

Symbol	Meaning
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.
 A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
1. , 2. , 3. ...	**Series of steps**

Symbols in graphics

Symbol	Meaning
1, 2, 3,...	Item numbers
1. , 2. , 3. ...	Series of steps
A, B, C, ...	Views

Supplementary device documentation

Liquicap M FMI51, FMI52

Documentation	Comment
Technical Information: TI00401F/00	The documentation is available on the internet: → www.de.endress.com
Operating Instructions: BA00298F/00	▪ The document is provided with the device. ▪ The documentation is available on the internet: → www.de.endress.com
Safety instructions depending on the selected option "Approval".	Additional safety instructions (XA, ZE) are supplied with certified device version. Please refer to the nameplate for the relevant safety instructions.

This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and Safety Instructions. The supplementary device documentation must be observed during installation, commissioning and operation. The requirements specific for the protection function are described in this Safety Manual.

Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware and hardware version. Unless otherwise specified, all the following versions can also be used for protective systems. A modification process according to IEC 61805 is applied for device changes.

Valid device versions for safety-related use: Liquicap M FMI51, FMI52

Ordering feature	Designation	Option
010	Approval	All
020	Inactive length L3	All
030	Active length L1; insulation	All
050	Process connection	All
060	Electronics; output	▪ A FEI50H; 4-20mA HART + display ▪ B FEI50H; 4-20mA HART
070	Housing	All
080	Cable entry	All
090	Type of probe	1 Compact
100	Additional option	F SIL Declaration of Conformity
995	Marking	All

- Valid firmware version: 01.03.00 and higher
- Valid hardware version (electronics): 02.00 and higher

SIL label on the nameplate

SIL certified devices are marked with the following symbol on the nameplate: SIL

Safety function

Definition of the safety function

The device's safety functions are:
- Minimum level measurement (e.g.: dry running protection)
- Maximum level measurement (e.g.: overfill prevention)

Safety-related signal

The safety-related signal is the analog output signal: 4 to 20 mA. All safety measures refer to this signal exclusively.

In addition, the device communicates via HART and contains HART commands with additional diagnostic information.

Restrictions for use in safety-related applications

The measuring system must be used correctly for the specific application, taking into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions. The specifications may not be exceeded, see the relevant Operating Instructions (→ 9).

The following restrictions also apply to safety-related use:
- The accuracy of the safety-related output signal 4 to 20 mA is ±2 % of the span (=0.32 mA).
- For operation in accordance with IEC 61508, the actual span (difference between full and empty calibration) must be between 25 and 4 000 pF:
  - If the span exceeds this range, the device cannot be calibrated correctly
  - If the span is below this range, unstable measured values can result
- The absolute permitted accuracy is max. 5 pF. If the span is below 250 pF, the accuracy of the 4 to 20 mA safety-related output signal of ±2 % can be exceeded, corresponding to the ratio of 5 pF to the actual span.

Rule out the following sources of error in a safety-related application:
- A minimum input voltage (terminal voltage) of 13.5 V must be ensured when the devices are used in a safety function
- Solid and/or heavy deposit buildup on the probe rod
- Corrosion or diffusion in the context of the compatibility of the medium in relation to the rod/rope material and the coating

Dangerous undetected failures in this scenario

A dangerous undetected failure is defined as an output signal that deviates by more than 2 % (0.32 mA) from the real measured value although the output signal is still in the M measurement information range according to NAMUR NE43 (3.8 to 20.5 mA). Deviations under 0.32 mA are considered safe undetected failures.

Use in protective systems

Device behavior during operation

Device behavior during power-up

The behavior of the device during power-up is described in the relevant Operating Instructions (→ 🖹 9).

Device behavior in safety function demand mode

The behavior of the device in safety function demand mode is described in the relevant Operating Instructions (→ 🖹 9).

Parameter configuration for safety-related applications

Calibration of the measuring point

The calibration of the measuring point is described in the relevant Operating Instructions (→ 🖹 9).

Dry calibration

If dry calibration has been performed, check whether the level matches the value displayed.

Recommendation:
Go to two different levels and compare the levels against the values displayed to ensure that dry calibration has been performed correctly.

Medium subfunction: no buildup/buildup

Only use the "Buildup" option if the conductivity of the medium is at least 1 000 µs/cm.

Linearization

Only use the "None" or "Linear" option for linearization. All other kinds of linearization are not permitted for operation according to ISO 61508.

Output, adv. calibration

The 4 000 pF measuring range may only be used if the actual span exceeds the standard setting of 2 000 pF.

Output, current turn down

If the current turn down function is used, the operator must ensure that the areas of the probe which this function hides are not safety-related.

Configuration methods

When using the devices in process control safety systems, the device configuration must comply with two requirements:
- Confirmation concept:
  Proven, independent testing of safety-related parameters entered.
- Locking concept:
  The device is locked after configuration.

- The method "Device configuration with increased safety (SIL/WHG mode)" is available.
- The device must be switched off and then on again following a reset.
- Due to the increased configuration safety when the device is used in process control safety systems, the use of the "Device configuration with increased safety" method is explained in the following section "Device configuration with increased safety via the display" (→ 🖹 12).

Device configuration with increased safety via display

When the display is connected, the keys on the electronic insert are disabled.

Locking must be activated if the device has been configured as explained in the Operating Instructions. For this purpose, select the "Safety settings" menu item in the main menu (CX001).

Locking a SIL device

The device must be locked in a defined locking order:

1. First control menu (SAX02): Check the output damping setting and the behavior of the current output in the event of a failure and confirm.

2. Second control menu (SAX03): Check the calibration of the device against the user's calibration data (previously noted down).
3. Third control menu (SAX04): The device only switches to the SIL/WHG mode if positive confirmation has been given in the first and second control menu.

- The device remains in SIL/WHG mode following a power failure!
- A key symbol on the display visually indicates that the device is locked.
- Following electronics replacement, the entire locking procedure must be performed again by the user.

Unlocking a SIL device

Enter the "7452" access code directly in the "SIL operating mode" menu (SAX04).

Configuration information concerning the evaluation unit

If the level sensor is used as continuous measuring system, the limit value determined must be entered at the subsequent limit switch (logic unit). Always proceed as explained in the relevant Operating Instructions when performing any calibration and configuration work (→ 9).

Proof-testing

NOTICE

The safety function is disabled during the proof test.
A potentially dangerous output signal is output temporarily.
▶ Take measures to guarantee the safety function during this period.

Recommendation: Check the probe rod for bending and other signs of substantial application of force!

Check the operativeness and safety of safety functions at appropriate intervals! The operator must determine the time intervals.

The values and graphics in the "Additional safety-related characteristics" section can be used for this purpose (→ 🖹 5). The test must be carried out in such a way that it verifies the correct operation of the protective system in interaction with all of the components.

Procedure of the proof-test

The proof test can and may only be performed if the device does not indicate an error.

The status of the individual output signal is indicated by a measuring device or a downstream component of the safety path (e.g. safety-related PLC, actuator). For more information, → 🖹 17.

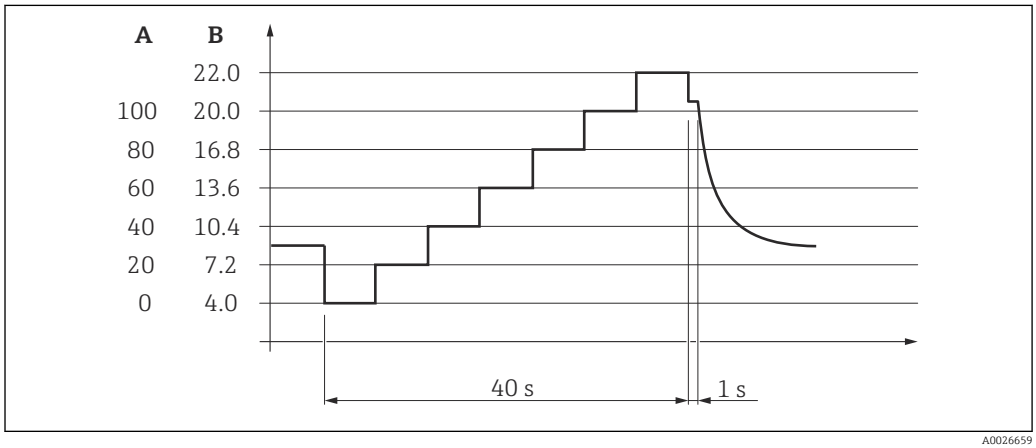
It is advisable to document the steps of the proof test (→ 🖹 19).

Test sequence

Procedure

1. Check whether the level value displayed matches the actual level.
2. Make sure that the level does not change throughout the proof test.
3. Unlock (→ 🖹 13).
4. Activate the proof test (via display or operating tool).
5. Monitor the current output using an ammeter (see the diagram below).
6. The proof test takes approx. 30 s. It cannot be interrupted. The current output returns to the current level value.
7. Lock (→ 🖹 12).
8. Document and store the results.

The proof-test has not been passed if the current value at a certain probe state deviates from the anticipated value (→ 🖹 19. For troubleshooting, refer to the Operating Instructions (→ 🖹 9). The test reveals 45 % of the dangerous undetected failures.



A Level [%]
B Current rating [mA]

Life cycle

Requirements for personnel

The personnel for installation, commissioning, diagnostics, repair and maintenance must meet the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood the instructions in the manuals and supplementary documentation as well as in the certificates (depending on the application)
- Follow instructions and comply with basic conditions

The operating personnel must meet the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator
- Follow the instructions in this manual

Installation

The installation of the device is described in the relevant Operating Instructions (→ 🖹 8).

Commissioning

The commissioning of the device is described in the relevant Operating Instructions (→ 🖹 8).

Operation

The operation of the device is described in the relevant Operating Instructions (→ 🖹 8).

Maintenance

Please refer to the relevant Operating Instructions for maintenance information (→ 🖹 9).

Alternative monitoring measures must be taken to ensure process safety during configuration, proof-testing and maintenance work on the device.

Repair

Repair means restoring functional integrity by replacing defective components. Components of the same type must be used for this purpose.

We recommend documenting the repair. This includes specifying the device serial number, the repair date, the type of repair and the individual who performed the repair.

The following components may be replaced by the customer's technical staff if genuine spare parts are used and the appropriate installation instructions are followed:

Component	Installation Instructions	Checking the device after repair
Electronic insert	EA01077F/00	Proof-testing, see the "Proof-testing" section (→ 🖹 14) [1]
Electronic insert FEI50H	KA00665F/00	
Terminal module	KA00666F/00	
Housing cover T13	▪ EA01049F/00 (inspection glass) ▪ EA01050F/00 (connection)	
Housing cover F13	EA01046F/00	
Housing cover F15	EA01034F/00	
Housing cover F17	EA01036F/00	
Cover seal [2]	KA00620F/00	

1) Additional country-specific regulations and tests must be observed.
2) The Brief Operating Instructions (KA) only apply for the stainless steel housing F15. No manual is provided for the other seals.

Installation Instructions, see the Download Area at www.endress.com

The replaced component must be sent to Endress+Hauser for the purpose of fault analysis if the device has been operated in a protective system and a device error cannot be ruled out. In this case, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in protective system" when returning the defective device. Please refer to the "Return" section of the relevant Operating Instructions (→ 🖹 9).

Decommissioning

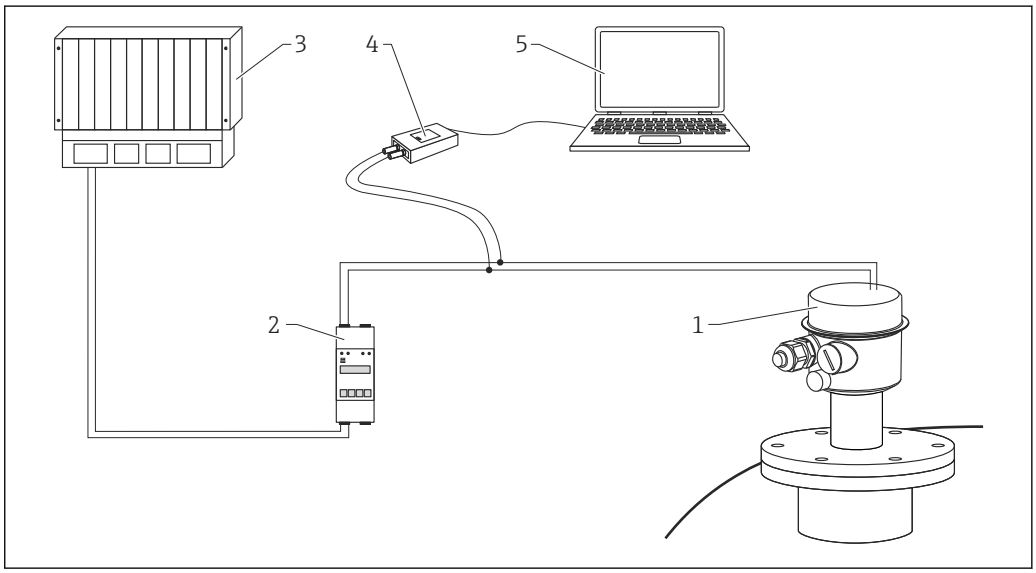
The procedure for decommissioning the device is described in the relevant Operating Instructions (→ 🖹 8).

Appendix

Structure of the measuring system

System components

The measuring system's devices are displayed in the following diagram (example):



1 *Liquicap M with electronic insert FEI50H*
2 *Active barrier*
3 *PLC*
4 *Commubox FXA195*
5 *Computer with operating tool, e.g. FieldCare*

The Commubox FXA195 may not be used during SIL operation!

An analog signal (4 to 20 mA) in proportion to the level is generated in the transmitter. This is sent to a downstream logic unit (e.g. PLC, limit signal transmitter, etc.) where it is monitored to determine whether:

- A specified level value or level range is exceeded or undershot
- A fault has occurred (e.g. sensor error, sensor line interruption or short-circuit, supply voltage failure)

For fault monitoring, the logic unit must recognize both HI alarms (≥21.0 mA) and LO alarms (≤3.6 mA) in accordance with NE43.

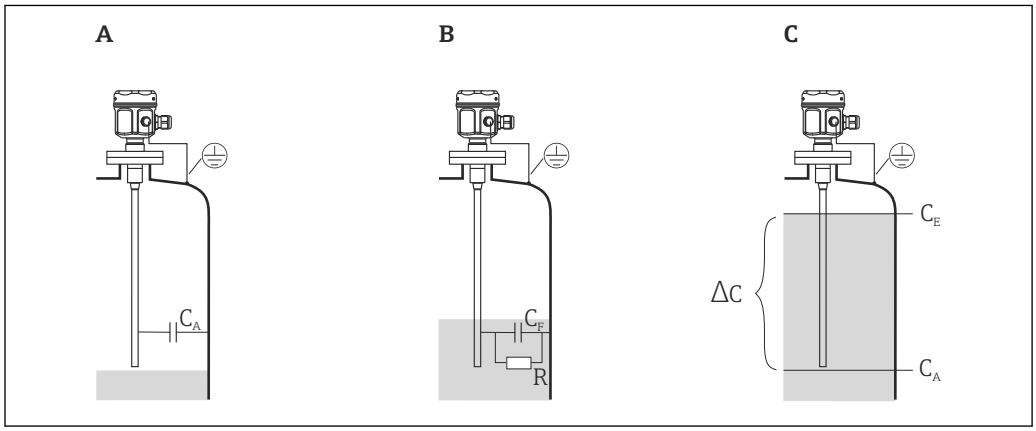
Description of use of protective system

The principle of capacitance level measurement is based on the change in capacitance of a capacitor which is caused by a change in the level. The probe and vessel wall (conductive material) form an electric capacitor. When the probe is in air (A), a certain low initial capacitance is measured. When the vessel is filled, the capacitance of the capacitor increases as more of the probe is covered (B, C).

As of a conductivity value of 100 µS/cm, the measurement is independent of the dielectric constant value (DK) of the liquid. This means that variations in the DK value have no effect on the measured value display. In addition, the effects of medium buildup or condensate near the process connection are avoided in the case of probes with an inactive length.

- A ground tube is used as a counterelectrode in the case of vessels made from non-conductive materials.
- Correct installation is a prerequisite for safe operation.

The following graphics show typical measuring arrangements when the devices are used in protective systems:



A *Free*
B *Covered (switch point not yet reached)*
C *Covered (switch point reached)*
R *Conductivity of the liquid*
C_F *Capacitance of the liquid*
C_A *Initial capacitance (probe free)*
C_E *Switching capacitance (probe covered)*
ΔC *Change in capacitance*

System-specific data			
Company			
Measuring point/TAG no.			
Facility			
Device type/Order code			
Serial number of Liquicap			
Name			
Date			
Signature			
Commissioning or proof test report			
Locking	Unlock beforehand		❑
	Current [1]		
Test step	**Nominal**	**Set point**	**Actual value**
Step 1 (0 %)	4.0 mA	3.68 to 4.32 mA	
Step 2 (20 %)	7.2 mA	6.99 to 7.52 mA	
Step 3 (40 %)	10.4 mA	10.08 to 10.72 mA	
Step 4 (60 %)	13.6 mA	13.28 to 13.92 mA	
Step 5 (80 %)	16.8 mA	16.48 to 17.12 mA	
Step 6 (100 %)	20.0 mA	19.68 to 20.32 mA	
Step 7 (short-circuit)	22.0 mA	21.68 to 22.32 mA	
Locking	Lock afterwards		❑
Conclusion	Passed ❑		Failed ❑

1) The terminal assignment depends on the cable entry or connector, see BA00298F.

Further information

General information on functional safety (SIL) is available at:

www.de.endress.com/SIL (Germany) or www.endress.com/SIL (English) and in the Competence Brochure CP01008Z/11 "Functional Safety in the Process Industry- Risk Reduction with Safety Instrumented Systems".

Version history

Version	changes	Valid from software version
SD00278F/00/EN/10.08	First version	01.03.zz
SD00278F/00/EN/13.15	"Proof testing" section	01.03.zz

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