ABB MEASUREMENT & ANALYTICS | SIL-SAFETY MANUAL | SM/FEX630/SIL-EN REV. E

ProcessMaster FEP630, HygienicMaster FEH630

Electromagnetic flowmeter

Information about functional safety

Firmware Version: 00.07.03

Measurement made easy

ProcessMaster FEP630
HygienicMaster FEH630

Introduction

Electromagnetic Flowmeter for flow measurement of liquid, pulpy or pasty measurement media with electrical conductivity.

Additional Information

Additional documentation on ProcessMaster FEP630, HygienicMaster FEH630 is available for download free of charge at www.abb.com/flow.

Alternatively simply scan this code:

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1 Overview – Devices with SIL certification

	Process Master series 630		**HygienicMaster Series 630**	
Non-Ex	 FEP631		 FEH631	
Zone 2 Div 2	 FEP631		 FEH631	
Zone 1	 FEP631	 FEP632+FET632	 FEH631	 FEH632+FET632

Table 1: Process Master / HygienicMaxter FEX630 - Devices with SIL certification

… 1 Overview – Devices with SIL certification

Product identification

The Device-Nameplate indicates the modelcoding.
A SIL Device is coded ‘CS’ in the modelcode

Process Master

FEPxxx xxxxxxxxxxxxxxxxxxxxxxxx-xxx-xxx-xx-CS-xxx

HygienicMaster

FEHxxx xxxxxxxxxxxxxxxxxxxxxxxx-xxx-xxx-xx-CS-xxx

Service address

To find your local ABB contact visit:
www.abb.com/contacts

For more information visit:
www.abb.com/measurement

Manufacturer’s address

ABB Limited
Measurement & Analytics
Oldends Lane, Stonehouse
Gloucestershire, GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671
Email: instrumentation@gb.abb.com

ABB Engineering (Shanghai) Ltd.
Measurement & Analytics
No. 4528, Kangxin Highway, Pudong New District
Shanghai, 201319,
P.R. China
Tel: +86(0) 21 6105 6666
Fax: +86(0) 21 6105 6677
Email: china.instrumentation@cn.abb.com

ABB Limited
Measurement & Analytics
Peenya Industrial Area
Bangalore-560058
India
Tel: 1800 420 0707 – Toll free
Tel: +91 80 67143000 – International
Email: contact.center@in.abb.com

2 Acronyms and abbreviations

Abbreviation	Designation	Description
HFT	Hardware Fault Tolerance	Hardware fault tolerance of the unit. Ability of a functional unit (hardware) to continue to perform a required function when faults or errors are prevailing.
MTBF	Mean Time Between Failures	Mean time between failures.
MTTR	Mean Time To Restoration	Mean time between the occurrence of an error in a unit or in a system and its repair.
PFD	Probability of Dangerous Failure on Demand	Probability of hazardous failures for a safety function on demand.
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of hazardous failures for a safety function on demand.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for the failure of a safety function. The higher the Safety Integrity Level of the safety-related systems, the lower the probability that they will not perform the required safety function.
Low Demand Mode	Low Demand Mode of operation	Measurement type with low request rate. Measurement type for which the request rate for the safety-related system is not more than once a year and not greater than twice the frequency of the retest.
DCS	Distributed Control System	Control system used in industrial applications to monitor and control decentralized units.
HMI	Human Machine Interface	In this case, the HMI is a combined module consisting of an LCD display with or without a local keyboard.
DTM	Device Type Manager	A DTM is a software module that supports specific functions for accessing device parameters, the setup and the operation of devices, and diagnostics. The DTM is not executable software. It requires an FDT container program in order to be activated.
LRV	Device Configuration	Lower Range Value of the measurement range
URV	Device Configuration	Upper Range Value of the measurement range
DC	Diagnostic Coverage	Fraction of dangerous failures covered by cyclical diagnosis functions on runtime.
Multidrop	Multidrop Mode	In Multidrop Mode, up to 15 field devices are connected in parallel to a single wire pair. The analog current signal simply serves to supply power to the devices in two-wire technology with a fixed current of ≤ 4 mA.

3 Standards and definitions of terms

Standard IEC 61508 (2010), Part 1 and 2

- English
  Functional safety of electrical / electronic / programmable electronic safety-related systems (Target group: Manufacturers and Suppliers of Devices).
- German
  Funktionale Sicherheit sicherheitsbezogener elektrischer / elektronischer / programmierbarer elektronischer Systeme (Zielgruppe: Hersteller und Lieferanten von Geräten).

Dangerous failure

A failure that has the potential to place the safety-related system in a dangerous state or render the system inoperative.

Safety-related system

A safety-related system performs the safety functions that are required to achieve or maintain a safe condition, e.g., in a plant. Example: pressure meter, logics unit (e.g., alarm signalling unit) and valve form a safety-related system.

Safety function

A specified function that is performed by a safety-related system with the goal, under consideration of a defined hazardous incident, of achieving or maintaining a safe condition for the plant.
Example: limit pressure monitoring

4 Other applicable documents and papers

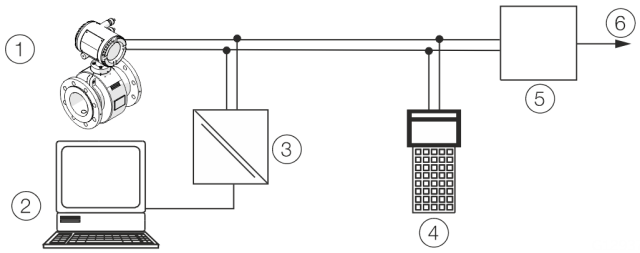
The following documentation must be available for the flowmeter. These documents include details about functional specifications of the analog output and how to operate and configure the device.

Document name	Document type
CI/FEX630	Commissioning Instruction
OI/FEX630	Operating Instruction

For devices in explosion-proof design, the Safetey Instructions must also be observed.

Document name	Document type
SI/FEP630/FEH630/ATEX/IECEX	Ex Safety Instructions ATEX / IEC
SI/FEP630/FEH630/FM/CSA	Ex Safety Instructions cFMus

5 The Flowmeter as part of the safety function system



1. ProcessMaster or HygienicMaster
2. Notebook with configuration Tool such as Field Information Manager (FIM)
3. FSK modem
4. Handheld-Terminal
5. Automation System, Logic-Unit, PLC, limit signal generator, etc.
6. Actuator

Figure 1: Safety function (e.g. min / max flowrate monitoring) with flowmeter as a sub-system

The Flowmeter transmitter generates an analog signal (4 to 20 mA) proportional to the flowrate. The analog signal is fed to a downstream logics unit such as a PLC or a limit signal generator, and is monitored for exceeding a specified maximum or minimum value.

SAFETY NOTE

The safety-related signal is the 4 to 20 mA analog output signal of the flowmeter transmitter.
All safety functions refer exclusively to this analog output (terminals UCO/31 or 31/32).

Device specific data related to functional safety

Term	Value
DeviceType	ProcessMaster FEP630 HygienicMaster FEH630
Firmware Level:	Firmware version Fex Frontend: 00.07.02 (Part No. 3KXF000405U0300), CRC 0xCD10
	Firmware version Fex Motherboard:00.07.02 (Part No. 3KXF000406U0300), CRC 0x2D8A
	Firmware version Current Out (MB + Module): 00.09.01 (Part No. KXF000436U0100), CRC 0x0547
Hardware Level:	Motherboard Type 3 • Board U_{low} 3KQZ402013U0100 • Board Uhigh 3KQZ402013U0200 • Circuit Diagram 3KQZ402012U0111, Rev. 02 • PCB 3KOZ402012U0100, Rev. 01
	Frontendboard Mag • Board 3KXF004011U0100 • Board 3KXF004011U0200 • Board 3KXF004011U0300 • Board 3KXF004011U0600 • Circuit Diagram 3KXF004210U0111, Rev. 01 • PCB 3KXF004210U0100, Rev. 01
	Terminalboard Remote • Board 3KXF002953U0100 • Circuit Diagram 3KXF002952U0111, Rev. 01 • PCB 3KXF002952U0100, Rev. 01
	EMC-Board Type 3 • Board 3KQZ402003U0300 • Board 3KQZ402003U0400 • Circuit Diagram 3KQZ402002U0111, Rev. 07 • PCB 3KQZ402002U0100, Rev. 05
Hardware component	HMI Type C 3KQZ406011U0100
Type of Assessment	Assessment according IEC 61508-2, Route 1S/1H
SIL capability	SIL 2 (Low Demand Mode)
HFT	0
Component Type	B

… 5 The Flowmeter as part of the safety function system

Failure rates

	integral mount design	remote mount design
SFF	91,20 %	91,26 %
PFD_{AVG} after 1 Year (MTTR 48 h)	$5{,}54E^{-04}$	$5{,}91E^{-04}$
PFD_{AVG} after 2 Years (MTTR 48 h)	$1{,}07E^{-03}$	$1{,}14E^{-03}$
PFD_{AVG} after 4 Years (MTTR 48 h)	$2{,}10E^{-03}$	$2{,}23E^{-03}$
λS	412 FIT	412 FIT
λDd	807 FIT	894 FIT
λDu	117 FIT	125 FIT

SAFETY NOTE

The listed failure rates λS, λDd, λDu, and PFDAVG refer to the failure rates according to the Siemens standard SN29500 at an average component temperature of 40 °C (104 °F). This corresponds to an average ambient temperature of 30 °C (86 °F).

The listed failure rates λSD, λSU, λDD, and λDU depend on the device version (standard version or high-temperature version).

The listed failure rates λSD, λSU, λDD, and λDU apply to ambient temperatures up to 40 °C (104 °F).

For higher ambient temperatures up to 60 °C (140 °F), the failure rates and the PFDAVG value must be multiplied by a factor of 2.5.

Prerequisites operating the device functional safety compliant

- The analog signal of the transmitter can be considered to be safe after 30 minutes (warm up time).
- A dangerous error is an error during which the output analog output of the transmitter no longer responds to the input signal or deviates by more than 2 % from the maximum flow range $Q_{max}DN$.
- For $Q_{max}DN$ see device nameplate or refer to instruction manual.
- The maximum reaction time of the device on error is less than 10 Minutes.
- The response time of the current output depends on the parameterization (Noise Filter settings and Damping).

Response time of the current output

Damping (1 Tau)	Max. Response Time
0.04 Seconds	0.65 Seconds
60 s Seconds	300 Seconds

- Use of the device in a safety-related system is only permitted within the first 20 years after production of the device. This is a basis for the calculated failure rates.
- The ambient temperature for use in a safety-related system must be above −40 °C (−40 °F). The information according to the operating instructions applies to the upper limit of the ambient temperature.
- When using the device for the measurement of corrosive media, keep in mind the limitations referred to in the commissioning instructions or operating instructions.
- Selection of the wetted part materials (liner and electrodes) is the Operators responsibility.

6 Configuration

Analog output

The status of this analog output (4 to 20 mA output) during alarm conditions, can be configured either to go to a 'high alarm' level or to a 'low alarm' level. (See instruction manual). For 'high alarm' level, a range from 21 to 23 mA can be assigned to the analog output.

For 'low alarm' level, a range from 3.5 to 3.6 mA can be assigned to the analog output.

SAFETY NOTE

The safety function of the automation system must be able to detect errors that result in 'high alarm' level as well as those that result in 'low alarm' level.

The analog output signal of the transmitter can be configured as 'active mode' or as 'passive mode'. With the analog output configured “passive mode”, the external supply power of the 20mA loop must be capable to provide the required voltage level even in case of a 'high alarm' level.

SAFETY NOTE

After completion of the parameter configuration, the safety function has to be checked.

The transmitter software menu allows for simulation of the analog output. See Instruction manual.

Behavior during operation and failure is described in the operating instructions.

Write protection

⚠ WARNING

Unauthorized changes of the parameter settings may affect the safety function.
This device can be configured through the local Keypad or using HART communication.
During configuration and in case of simulation and driving the device in HART Multidrop Mode, the device is not safety compliant.

- Once configuration is completed, the device must be protected against unauthorized access. Refer to Instruction manual – set hardware write switch to ensure the keypad is locked and write protection through HART is enabled too.
- With the hardware write protection switched to ON, try to alter a parameter to make sure the write protection mechanism is enabled properly.

To lock the device access menu ‘Device Setup / ...Access Control’ and set the password of the corresponding log in level.

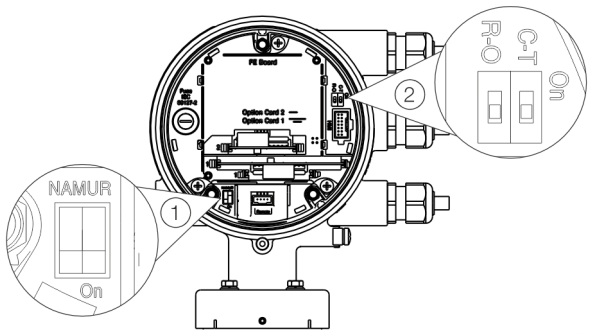
Menu / parameter	Value range	Description
Device Setup / ...Access Control		
Standard Password	Alphanumeric	Enter the password for the 'Standard' access level

Reset Password

In case the Operator forgot the Password, there is an Option to reset it. Please refer to ABB to have your Passwort reset.

Hardware write protection

In addition to the software password protection, it is possible to enable a hardware write protection.



① DIP switch NAMUR ② DIP switch write protection (R-O)

Figure 2: Position of DIP switches

DIP switches are located behind the front housing cover. The DIP switches are used to configure specific hardware functions. The power supply to the transmitter must be briefly interrupted in order for the modified setting to take effect.

Write protection switch

When write protection is activated, device parameterization cannot be changed via the LCD indicator. Activating and sealing the write protection switch protects the device against tampering.

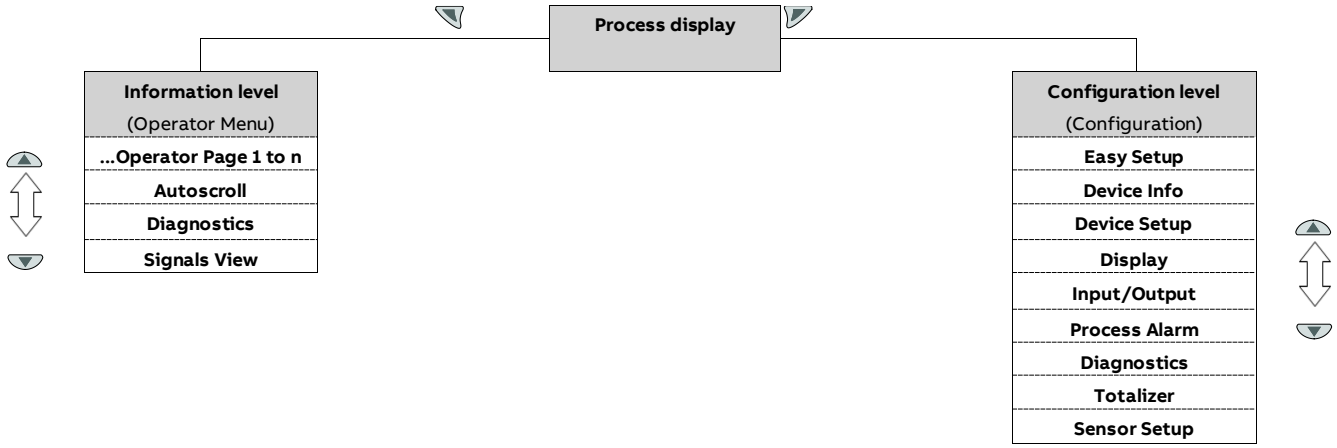
1. Switch off power supply.
2. Open housing cover.
3. Set DIP-switches on Backplane in accordance with the following table.

Position	Function
On	Write protection active
Off	Write protection deactivated

4. Close housing cover

… 6 Configuration

Menu levels



Process display
The process display shows the current process values.
There are two menu levels under the process display.

Information level (Operator Menu)
The information level contains the parameters and information that are relevant for the operator.
The device configuration cannot be changed on this level.

Configuration level (Configuration)
The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level.
For additional information on the parameters see ,

SAFETY INSTRUCTIONS

The following parameters may affect the safety function.
The following parameters are factory set so that an application as part of a safety function is possible.

To exclude interim changes and to ensure the suitability for the intended use, the following parameters (see table) need to be checked after activation of the write protection and before taking the safety function into operation.

The instructions for settings and installation can be found in the Commissioning Instructions (CI/FEP630/FEH630-EN) or Operating Instructions (OI/FEP630/FEH630-EN).

Parameter descriptions

Menu / Parameter	Description	Additional notes / restrictions
Device Setup / ...Access Control		
Standard Password	Entry / change of the password for the 'Standard' access level.	The password or the DIP switch write protection must be activated before the security-relevant parameter settings of the device are checked. This check must be performed before commissioning the safety function.
Easy Setup		
Volume Flow [unit]	Select the engineering unit for flowrate indication in the display.	
Qv Max 1	Select the flow range for forward and reverse flow. Default setting: 1 x Q_{maxDN}. (~ 10m/s flow velocity). 2 x Q_{maxDN} is the max. range the Flowmeter can be configured to with the specific Sensor size (DN).	This setting affects the scaling of the 20 mA output and must be adjusted in accordance with the requirements of the safety function.
Damping	Select the damping. The setting relates to 1 T (Tau). The value refers to the response time for a stepwise density change. This setting affects the response time of the 20mA Signal. Default setting: 1 second.	This setting affects the scaling of the 20 mA output and must be adjusted in accordance with the requirements of the safety function.
Curr.Out at Alarm	Status of the analog output during error conditions can be configured either to go to a 'high alarm' level or to a 'low alarm' level – see instruction manual. Default setting: 'High'	
Low Alarm	Analog output 'Low alarm' level. A range from 3.5 to 3.6 mA can be assigned to the analog output. Default setting: 3.5 mA.	
High Alarm	Analog output 'High alarm' level. A range from 21 to 23 mA can be assigned to the analog output. Default setting: 21.8 mA.	
System Zero	The zero point must be adjusted correctly.	The zero point must be adjusted correctly.
Device Setup / ...Sensor		
Qv Max 2	See Q_{max1}	
Qm Range Mode	Manual switchover between flow range Q_{max} and $Q_{max}2$.	This setting affects the scaling of the 20 mA output and must be adjusted in accordance with the requirements of the safety function.

… 6 Configuration

… Parameter descriptions

Menu / Parameter	Description	Additional notes / restrictions
Device Setup / …Transmitter / …Units		
Unit Massflow Qm Unit Volumeflow Qv	Select whether the user-defined flow unit is displayed as a mass flow (with density) or volume flow (without density).	
Cust Qv Unit F.	Enter the factor for a user-defined flow unit. The factor relates to the flow per liter.	
Device Setup / …Transmitter		
Density Fixed Value	To show the flowrate in mass flow units a fixed density must be configured to convert the volume flowrate into mass flowrate.	
Device Setup / …Transmitter / …Cut Off		
Threshold	Threshold for low flowrate monitoring. If the flowrate is below threshold, the flow is not measured. The current output is set to zero.	
Low Flow Hysteresis	Set the hysteresis for the low flow cut off	
Device Setup / …Transmitter / …Operating Mode		
Flow Direction	Measuring direction for the flowmeter. • Forward only: The device measures only forward flow direction. • Forward & Reverse: The device measures both directions.	
Flow Indication	Inverts the flow direction displayed.	
Device Setup / …Transmitter /		
Output Value	Selection of process variable issued at the corresponding current output. • Qm [%]: The current output provides the mass flow in percent. • Qv [%]: The current output provides the volume flow in percent. • Conductivity[µS/cm]: The current output provides the conductivity in µS/cm.	Qv [%] must be selected as the current output value here.
Curr.Out Mode	Select the operating mode for the current output. • 4 to 20 mA – 4 mA = No flow – 20 mA = Maximum flow • 4 to 12 to 20 mA – 4 mA = Maximum reverse flow – 12 mA = No flow – 20 mA = Maximum forward flow	This setting affects the scaling of the 20 mA output and must be adjusted in accordance with the requirements of the safety function.

Menu / Parameter	Description	Additional notes / restrictions
Device Setup / ...Transmitter /		
Curr.Out > 20.5mA	Behavior of current output if 20.5 mA is exceeded. • Hold Last Value: The last measured value is retained and issued. • High Alarm: The high alarm current is issued. • Low Alarm: The low alarm current is issued. Default setting: Hold Last Value.	
Curr. at TFE Alarm	Status of the analog output during empty pipe condition. • Off: Error is not output at the current output. • Q = 0 %: The current output assumes the value for 'No flow'. • High Alarm: The current output assumes the value for 'High Alarm'. • Low Alarm: The current output assumes the value for 'Low Alarm'. • Default setting: Off.	Sensor must be completely filled for an accurate flow measurement.
Process Alarm / ...Group Masking		
Maintenance Required	Alarm messages are divided into 3 groups. Maintenance, Function Check and Out of Spec. Masking of a group results in no error message any longer for errors belonging to this group.	Masking is not allowed for parameter setting for a Functional Safety application. Parameter has to be switched to OFF
Function Check		
Out Of Specification		
Process Alarm / ...Alarm Simulation		
...Simulation Mode	Manual simulation of measured values. The output values correspond to the simulated flowrate entered. The 'Configuration' information is displayed in the lower line of the display. Restore the Simulation mode to 'Off' once completed.	When running the safety function only setting 'Off' is permitted
Diagnostics / ...Diagnosis Control / ...Diagnosis Tfe		
Tfe On/Off	Activate the Partial Filling Detection function. Default Setting: OFF. **Note** This feature is available if the sensor is equipped with a Partial Filling Electrode (optional). This function is available for sensors from size DN 50 without explosion protection or with explosion protection for Zone 2 / Div 2. The flow sensor must be installed horizontally with the terminal box pointing upwards. The conductivity of the measured medium must be in the range of 20 to 20.000 µS/cm.	When running the safety function only setting 'Off' is permitted

… 6 Configuration

… Parameter descriptions

Menu / Parameter	Description	Additional notes / restrictions
Diagnostics / …Diagnosis Control / …Empty Pipe Detector		
Empty Pipe Detector	Activate the 'Empty Pipe Detector' function (only for sizes ≥ DN 10). The 'Empty Tube Detection' function detects an empty meter tube. In case of an alarm, the current output records the determined status in the menu 'Input/Output / …Curr.Out 31/32 / Curr. at EPD Alarm' and the pulse output is stopped.	When running the safety function only setting 'Off' is permitted
Diagnostics / …Diagnosis Control / …Diagnosis Coil		
Coil Diag On/Off	Activate the coil diagnosis function. Default: OFF. Display indicates Coil Resistance, Coil Current, Coil Inductance, min/max. Alarm limit setting for Coil-temperature, Coil temperature adjustment.	
Diagnostics / …Diagnosis Control / …Diagnosis Gas Bub.		
Gas Bubble On/Off	Activate the 'Gas Bubble Detection' function. Default: OFF	
Diagnostics / …Diagnosis Control / …Diagnosis Conductiv		
Conductivity On/Off	Activate the 'Conductivity Measurement'. Default: OFF	
Diagnostics / …Diagnosis Control / …Diagnosis SIL		
SIL On/Off	For Information only. Devices are shipped as SIL Devices from the factory. There is no specific SIL Mode to be enabled.	
Diagnostics / …Diagnosis Control /		
Start Noise Check	Start 'Noise Check' Once completed the result is displayed	When running the safety function starting 'Noise Check' is not permitted
Diagnostics / …Diagnosis Control / …Fingerprints		
Start. FP verification	Performing a Verification. The fingerprint database allows for a comparison of device integrity at the time of factory calibration with the current status. Errors in the integrity of the device are detected. Corrective actions can be taken	When running the safety function starting 'Fingerprint Verification' is not permitted

7 Recurring tests

In accordance with IEC61508, the safety function of the measuring device must be checked at appropriate time intervals. The operator must determine the checking interval and take this into account when determining the probability of failure PFDavg of the flowmeter.

The test must be carried out in such a way that it verifies correct operation of the device.

Testing the device can be performed in the following steps:

Calibration

Calibrating the device in a certified calibration rig checking the analog output safety function results in a > 98 % diagnostic coverage detecting undetected failures.

On-site test, performed by ABB service personnel

An on-site test, performed by ABB service personnel results in a > 90 % diagnostic coverage detecting undetected failures.

An on-site inspection includes:

- Visual inspection
- Simulation and electrical inspection of the current output
- Switching off and on

On-site test with verification tool SRV500)

An on-site test, performed using SRV500 results in a >80 % diagnostic coverage detecting undetected failures.

An on-site inspection includes:

- Visual inspection
- Simulation and electrical inspection of the current output
- Switching off and on
- Performing a Fingerprint Verification

8 Repair

To ensure the safety related function, repairs have to be performed by ABB.

Replacing modular components by original ABB spare parts is permitted if personnel was trained by ABB for this purpose.

The "Declaration of contamination and cleaning" must be enclosed when returning the defective device.
Refer to instruction manual for further details.

Adress:
Please contact Customer Center Service acc. to page 4 for nearest service location.

9 Appendix

SIL 2 certificate

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z10 095854 0002 Rev. 02

Holder of Certificate: **ABB AG**
Anna-Vandenhoeck-Ring 5
37081 Göttingen
GERMANY

Certification Mark:

Product: **Sensors**
Measuring System

Model(s): **ProcessMaster FEP630 series**
HygienicMaster FEH630 series

Parameters:

Safety Integrity Level (SIL):	SIL2
Rated Output Current:	4 ... 20mA
Protection Degree:	IP65 / IP67

Tested according to:
IEC 61508-1:2010
IEC 61508-2:2010
IEC 61508-3:2010

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. This certificate is valid until the listed date, unless it is cancelled earlier. All applicable requirements of the Testing, Certification, Validation and Verification Regulations of TÜV SÜD Group have to be complied. For details see: www.tuvsud.com/ps-cert

Test report no.: AG95303C

Valid until: 2030-08-25

Date, 2025-08-27

(Gert Effenberger)

Page 1 of 1
TÜV SÜD Product Service GmbH • Certification Body • Ridlerstraße 65 • 80339 Munich • Germany

Return form

Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.
Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	Email:

Device details:

Type:	Serial no.:
Reason for the return/description of the defect:	

Was this device used in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

If yes, which type of contamination (please place an X next to the applicable items):

☐ biological	☐ corrosive / irritating	☐ combustible (highly / extremely combustible)
☐ toxic	☐ explosive	☐ other toxic substances
☐ radioactive		

Which substances have come into contact with the device?

1.
2.
3.

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date	Signature and company stamp

Notes

Notes

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ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/flow

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