



GENERAL MONITORS

SAFETY MANUAL

FL31xxH and FL31xx Flame Detector Series



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Safety Manual

11-09

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Part No.
Revision

MANFL31SAFETY
B/11-09

This manual describes the safety related information for the installation, operation, configuration, and maintenance for following flame detectors:

- FL3100H – UV/IR Flame Detector with HART Communications
- FL3101H – UV Only Flame Detector with HART Communications
- FL3100 – UV/IR Flame Detector
- FL3101 – UV Only Flame Detector
- FL3102 – Digital Frequency Infrared Flame Detector
- FL3110 – UV/IR Flame Detector for European Applications
- FL3111 – UV Only Flame Detector for European Applications
- FL3112 – Digital Frequency Infrared Flame Detector for European Applications

For complete information regarding performance, installation, operation, maintenance and specifications of the above products, please refer to the associated product manual.

General Monitors' mission is to benefit society by providing solutions through industry-leading safety products, services and systems that save lives and protect capital resources from the dangers of hazardous flames, gases and vapors.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the associated product instruction manual. Remember, these products are for your safety.



WARNING: TOXIC, COMBUSTIBLE, AND FLAMMABLE GASES AND VAPORS ARE VERY DANGEROUS. USE EXTREME CAUTION WHEN THESE HAZARDS ARE PRESENT.

INTRODUCTION

General Description

The General Monitors FL3100H, FL3101H, FL3100, FL3101, and FL3102 series flame detectors and FL3110, FL3111, and FL3112 series flame detectors for European applications are ultraviolet and/or infrared flame detectors that detect unwanted fires and respond with a 4-20 mA analog output or optional relay output. All detectors are regarded as Type B field devices per IEC 61508. All flame detectors, including the non-HART versions of the FL3100H and FL3101H, can interface with the Safety Integrity Level (SIL) suitable TA402A Trip Amplifier module that monitors the presence of fire and provides status indication and alarm outputs.

The safety function of the flame detectors do not include:

- RS-485 Modbus communication
- HART communication

Modbus and HART communication are typically used for field device setup, diagnostics, and troubleshooting. Carefully observe requirements for interfacing in hazardous locations. Modbus and HART communication are non-interfering functions and do not interrupt the safety critical function of the detectors.

INSTALLATION

NOTE: Power should remain disconnected until all other wiring connections are made.

For complete installation information for the FL3100H, FL3101H, FL3100, FL3101, FL3102, FL3110, FL3111, and FL3112, refer to the specific instruction manual for each of these field devices.

Location Considerations

There is no one optimal manner to install a flame detector for all applications. Instead, several variables should be considered when selecting locations to install detectors, including the following:

- Detector field of view (FOV)
- Optical sensitivity range
- Environmental conditions

In addition, the flame detectors should be mounted in locations, which will inhibit people or objects from obscuring the detector's FOV. The unit should be mounted free from shock and vibration and convenient for visual inspection and cleaning. Furthermore, the detector(s) should be tilted downward so that dust or moisture does not accumulate on the window. Finally, though the detectors are Radio Frequency Interference (RFI) resistant, they should not be located near radio transmitters, high magnetic or electrical fields, or in areas with similar interference.

NOTE: Frequent inspection, cleaning, and sensitivity checking is suggested for detectors mounted in dirty environments.

No special or additional detector mounting, wiring, power, or tool requirements exist beyond the standard installation practices documented in the product instruction manuals for each flame detector.



WARNING: Under NO circumstances should equipment be connected or disconnected when under power. This is contrary to hazardous area regulations and may also lead to serious damage to the equipment. Equipment damaged in this manner is not covered under warranty.

OPERATION AND MAINTENANCE

For complete operation and maintenance information for the FL3100H, FL3101H, FL3100, FL3101, FL3102, FL3110, FL3111, and FL3112, refer to the specific instruction manual for each of these field devices.

Before connecting a unit, check to make sure power is turned off. Before power-up, check all wiring connections.

Once correctly installed, the unit requires very little maintenance other than regular sensitivity and alarm checks and cleaning of the window. General Monitors recommends that a schedule be established and followed.

The flame detectors perform internal diagnostics on critical faults every second and a Continuous Optical Path Monitor (COPM) check every 1 minute. The detector will respond with 0 mA and fault relay trip for an internal fault and 2 mA and fault relay trip for a COPM fault.

NOTE: The removal of particulate matter and any film buildup on the lenses and light rods is necessary to ensure proper sensitivity of the system. It is recommended that the window and light rods be cleaned at least every 30 days, or more often if the detector is located in a particularly dirty environment.



CAUTION: In case of a power cycle event confirm that sensitivity settings have not changed. Use the Modbus communication to verify sensitivity – Low, Medium, or High. The TL105 test lamp can also be used to check the operation of the FL310xH and FL310x. Observe requirements for interfacing in hazardous locations.

Refer to the Troubleshooting Section in the appropriate product instruction manual in the event of sensitivity check fault or operational fault. Spare parts should be on-hand as described in the Spare Parts Section of the product instruction manual.

SPECIFICATIONS

Table 1 and Table 2 list specifications for the FL310xH and FL31xx flame detector series. For a complete list of specifications, refer to the instruction manual of each respective model.

	FL3100H	FL3101H	FL3100 / FL3101	FL3102
Instruction Manual P/N	MANFL3100/3101H	MANFL3100/3101H	MANFL3100/3101	MANFL3102
Temp. Range				
Operating:	-40°F to 185°F (-40°C to 85°C)	-40°F to 185°F (-40°C to 85°C)	-40°F to 185°F (-40°C to 85°C)	-40°F to 176°F (-40°C to 80°C)
Storage:	-40°F to 185°F (-40°C to 85°C)	-40°F to 185°F (-40°C to 85°C)	-40°F to 185°F (-40°C to 85°C)	-40°F to 176°F (-40°C to 80°C)
Humidity Range:	0 to 100% RH, non-condensing	0 to 100% RH, non-condensing	0 to 100% RH, non-condensing	0 to 100% RH, non-condensing
Input Power:				
Absolute min:	20 VDC	20 VDC	20 VDC	20 VDC
Nominal:	24 VDC	24 VDC	24 VDC	24 VDC
Absolute max:	36 VDC	36 VDC	36 VDC	36 VDC

Table 1A – FL310xH and FL310x Environmental/Electrical Specifications

	FL3110	FL3111	FL3112
Instruction Manual P/N	MANFL3110/11-EU	MANFL3110/11-EU	MANFL3112-EU
Temp. Range			
Operating:	-40°F to 194°F (-40°C to 90°C)	-40°F to 194°F (-40°C to 90°C)	-40°F to 167°F (-40°C to 75°C)
Storage:	-40°F to 194°F (-40°C to 90°C)	-40°F to 194°F (-40°C to 90°C)	-40°F to 167°F (-40°C to 75°C)
Humidity Range:	0 to 100% RH, non-condensing	0 to 100% RH, non-condensing	0 to 100% RH, non-condensing
Input Power:			
Absolute min:	20 VDC	20 VDC	20 VDC
Nominal:	24 VDC	24 VDC	24 VDC
Absolute max:	36 VDC	36 VDC	36 VDC

Table 1B – FL311x Environmental/Electrical Specifications

Mode	FL310xH	FL310x	FL311x
Fault	0 mA	0 mA	0 mA
COPM Fault	2 mA	2 mA	2 mA
Ready	4 mA	4 mA	4 mA
IR only Signal (FL3100 and FL3110 only)	8 mA	8 mA	8 mA
UV only Signal (FL3100 and FL3110 only)	12 mA	12 mA	12 mA
WARN Signal	16 mA	16 mA	16 mA
ALARM Signal	20 mA	20 mA	20 mA

Table 2 – Analog Output Specifications (Max Load: 600 ohms)

CERTIFICATIONS AND FAILURE RATE DATA

The FL3100H, FL3101H, FL3100, FL3101, FL3102, FL3110, FL3111, and FL3112 have gone through rigorous reliability and functional safety assessments, which have resulted in these field devices being certified to IEC 61508 Parts 1, 2, and 3, by FM Approvals. The reliability assessment is a failure rate prediction that assumes an average temperature of 40°C and an environmental factor equivalent to Ground Fixed. It is assumed that the field devices will be installed in a Safety Instrumented System (SIS) operating in a Low Demand environment per IEC 61508. Tables 3A, 3B, and 3C list the SIL parameters for each field device.

Field Device Output Type	FL3100H		FL3101H	
	Relay Output	4-20 mA Output	Relay Output	4-20 mA Output
FM Certificate	3037588-FL3100H		3037588-FL3101H	
MTBF (Years)	20		21	
λ_{DD} (Fails per hour)	2.63E-6	2.61E-6	2.24E-6	2.22E-6
λ_{DU} (Fails per hour)	3.15E-7	2.65E-8	3.15E-7	2.64E-8
Safe Failure Fraction (SFF)	95%	99.6%	95%	99.6%
Safety Integrity Level (SIL)*	2	3	2	3
Diagnostic Test Interval	1 second (Critical Faults) 1 minute (COPM)		1 second (Critical Faults) 1 minute (COPM)	
Typical Response Time	< 3 seconds		< 3 seconds	
Average Probability of Failure on Demand $PFD_{avg1001}^{**}$	3.51E-04	3.91E-05	3.49E-04	3.74E-05

Table 3A – SIL Parameters for FL310xH

* Hardware Fault Tolerance (HFT) = 0

** $PFD_{avg1001}$ assumes a 4 hour repair time and 90 day proof test interval.

Field Device Output Type	FL3100		FL3101		FL3102	
	Relay Output	4-20 mA Output	Relay Output	4-20 mA Output	Relay Output	4-20 mA Output
FM Certificate	3034949-FL3100		3034949-FL3101		3034949-FL3102	
MTBF (Years)	31		34		22	
λ_{DD} (Fails per hour)	1.15E-6	1.28E-6	1.15E-6	0.89E-6	2E-6	1.75E-6
λ_{DU} (Fails per hour)	0.14E-6	1.55E-8	0.14E-6	1.55E-8	2E-7	7E-8
Safe Failure Fraction (SFF)	96%	>99%	96%	>99%	95%	98%
Safety Integrity Level (SIL)*	2	3	2	3	2	2
Diagnostic Test Interval	1 second (Critical Faults) 1 minute (COPM)		1 second (Critical Faults) 1 minute (COPM)		1 second (Critical Faults) 1 minute (COPM)	
Typical Response Time	< 3 seconds		< 3 seconds		< 3 seconds	
Average Probability of Failure on Demand $PFD_{avg1001}^{**}$	1.6E-4	2E-5	1.6E-4	2E-5	3E-4	2.3E-5

Table 3B – SIL Parameters for FL310x

* Hardware Fault Tolerance (HFT) = 0

** $PFD_{avg1001}$ assumes a 4 hour repair time and 90 day proof test interval.

Field Device Output Type	FL3110		FL3111		FL3112	
	Relay Output	4-20 mA Output	Relay Output	4-20 mA Output	Relay Output	4-20 mA Output
FM Certificate	3034949-FL3110		3034949-FL3111		3034949-FL3112	
MTBF (Years)	21		20		20	
λ_{DD} (Fails per hour)	2.5E-6	2.5E-6	2.07E-6	2.05E-6	7.85E-7	7.65E-7
λ_{DU} (Fails per hour)	1.2E-7	1.3E-7	2.3E-7	2.3E-7	7.77E-8	8E-8
Safe Failure Fraction (SFF)	98.2%	98%	95.8%	95.7%	96.8%	96.6%
Safety Integrity Level (SIL)*	2	2	2	2	2	2
Diagnostic Test Interval	1 second (Critical Faults) 1 minute (COPM)		1 second (Critical Faults) 1 minute (COPM)		1 second (Critical Faults) 1 minute (COPM)	
Typical Response Time	< 3 seconds		< 3 seconds		< 3 seconds	
Average Probability of Failure on Demand $PFD_{avg1001}^{**}$	1.4E-4	1.5E-4	2.6E-4	2.6E-4	8.8E-5	9E-5

Table 3C – SIL Parameters for FL311x

* Hardware Fault Tolerance (HFT) = 0

** $PFD_{avg1001}$ assumes a 4 hour repair time and 90 day proof test interval.

Agency Approvals

The FL3100H, FL3101H, FL3100, FL3101, FL3102, FL3110, FL3111, and FL3112 have the following approvals:

FL3100H	FL3101H	FL3100	FL3101	FL3102
CSA	CSA	CSA	CSA	CSA
FM Approvals*	FM Approvals	FM Approvals	FM Approvals	FM Approvals
ATEX	ATEX	ATEX	ATEX	ATEX
HART Registered	HART Registered	IEC 61508 per FM Approvals	IEC 61508 per FM Approvals	IEC 61508 per FM Approvals
IEC 61508 per FM Approvals	IEC 61508 per FM Approvals			

Table 4A – Agency Approvals FL310xH and FL310x

* The FL3100H-Hydrogen is not FM approved.

FL3110	FL3111	FL3112
ATEX	ATEX	ATEX
BV	Approved for Russia	BV
Approved for Russia	IEC 61508 per FM Approvals	Approved for Russia
IEC 61508 per FM Approvals		Approved for Kazakhstan
		IEC 61508 per FM Approvals

Table 4B – Agency Approvals FL311x