

SharpEye™

Model FS-1100

Triple IR3 Flame Simulator

User Guide



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Table of Contents

Table of Contents	v
List of Figures	vii
List of Tables.....	vii
1 About this Guide	8
1.1 Release History.....	8
1.2 Glossary and Abbreviations	11
2 Product Overview	13
2.1 Flame Simulator Compatibility with Flame Detector Models	13
2.2 Features and Benefits	14
2.3 Principles of Operation	14
2.4 Product Certification	15
2.4.1 ATEX, IECEx.....	15
2.4.2 cCSAus.....	15
2.4.3 TR CU/EAC.....	15
2.5 Simulator Structure.....	16
2.6 Certification Instructions	18
2.6.1 General Instructions.....	18
2.6.2 Specific Conditions of Use	18
3 Operation Instructions	20
3.1 Ordering Information.....	20
3.2 Unpacking.....	20
3.3 Operating Instructions	21
3.4 Simulator Status	21
3.4.1 Normal Status	22
3.4.2 Fault Status	22
3.5 Detection Ranges.....	23
3.6 Charging the Battery	24
3.7 Maintenance.....	25
3.8 Troubleshooting	26
3.9 Technical Specifications	26
3.9.1 General Specifications	26
3.9.2 Electrical Specifications.....	26
3.9.3 Physical Specifications	26

3.9.4	RoHS Directive	27
3.9.5	EMI Compatibility	27
Technical Support		32

List of Figures

Figure 1: Flame Simulator Side View	16
Figure 2: Flame Simulator Rear View	17
Figure 3: Flame Simulator Front View	17
Figure 4: FS-1100 reflector	21
Figure 6: Flame Simulator Battery Replacement	25

List of Tables

Table 1: Detection Ranges per Detector/Flame Simulator	23
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1 About this Guide

This guide describes the SharpEye Flame Simulator and its features, and provides instructions on how to operate and maintain the simulator.

1.1 Release History

Rev	Date	Revision History	Prepared by	Approved by
0	January 2014	First Release	Ian Buchanan	Eric Zinn
1	May 2014	Second Release	Ian Buchanan	Eric Zinn
2	October 2014	Third Release	Ian Buchanan	Eric Zinn
3	December 2014	Fourth Release	Ian Buchanan	Eric Zinn
4	January 2015	Fifth Release	Ian Buchanan	Eric Zinn
5	February 2015	Sixth Release	Ian Buchanan	Eric Zinn
6	March 2015	Seventh Release	Ian Buchanan	Eric Zinn
7	July 2015	Eighth Release	Ian Buchanan	Eric Zinn
8	December 2015	Ninth Release	Ian Buchanan	Eric Zinn
9	March 2016	Tenth Release	Ian Buchanan	Eric Zinn
10	May 2016	Eleventh Release	Ian Buchanan	Eric Zinn
11	July 2016	Twelfth Release	Ian Buchanan	Eric Zinn
12	January 2017	Thirteenth Release	Jay Cooley	Ian Buchanan
13	February 2017	Fourteenth Release	Jay Cooley	Ian Buchanan
14	February 2017	Fifteenth Release	Jay Cooley	Ian Buchanan
15	April 2017	Sixteenth Release	Jay Cooley	Shaul Serero
Aa	August 2017	Seventeenth Release	Jay Cooley	Shaul Serero

Ab	March 2018	Eighteenth Release	Michal Heller	Udi Tzuri
Ac	December 2019	Nineteenth Release	Michal Heller	Udi Tzuri
Ad	September 2020	Twentieth Release	Michal Heller	Udi Tzuri

1.2 Glossary and Abbreviations

Abbreviation/Term	Meaning
Analog Video	Video values are represented by a scaled signal
ATEX	Atmosphere Explosives
AWG	American Wire Gauge
BIT	Built-In-Test
CMOS	Complementary Metal-Oxide Semiconductor image sensor
Digital Video	Each component is represented by a number representing a discrete quantization
DSP	Digital Signal Processing
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EOL	End of Line
FOV	Field of View
HART	Highway Addressable Remote Transducer – communications protocol
IAD	Immune at Any Distance
IECE _x	International Electro-Technical Commission Explosion
IP	Internet Protocol
IPA	Isopropyl Alcohol
IR	Infrared
IR3	Refers to the 3 IR sensors
JP5	Jet Fuel
LED	Light Emitting Diode
MODBUS	Serial communications protocol using Master-Slave messaging
N/A	Not Applicable
N.C.	Normally Closed
NFPA	National Fire Protection Association
N.O.	Normally Open
NPT	National Pipe Thread
P/N	Part Number
RFI	Radio Frequency Interference
RTSP	Real Time Streaming Protocol

Abbreviation/Term	Meaning
SIL	Safety Integrity Level
UNC	Unified Coarse Thread
VAC	Volts Alternating Current

2 Product Overview

To comply with local standards and jurisdictional authorities, "end-to-end" loop testing of fire protection alarm systems, including detectors, should be performed periodically. Many safety authorities and plant managers of high-value/high-risk assets and facilities insist on quarterly "end-to-end" testing of their entire fire protection systems using an external flame simulator.

SPECTREX flame simulators emit electromagnetic radiation in a unique sequential pattern corresponding to and recognizable as fire by specific SharpEye Flame Detector models. This allows for testing under real fire conditions without the associated risks of an open flame. SPECTREX flame simulators are ATEX certified EExd for use in hazardous zones 1, 2, 21, and 22, and are powered by rechargeable lithium-ion batteries. When fully charged, the flame simulator operates for at least 1,000 tests without recharging.

The SPECTREX flame simulator is the only non-hazardous and safe method to test the flame detector's sensors, internal electronics, alarm activation software, cleanliness of the viewing window/lens, wiring integrity, actual relay activation, and proper functionality of any other outputs used (mA, RS-485, HART).



Warning:

The Simulator is not field-repairable due to the meticulous alignment and calibration of the emitter and the respective circuits. Do not attempt to modify or repair the internal circuits or change their settings, as this will impair the system's performance and void the SPECTREX product warranty.

2.1 Flame Simulator Compatibility with Flame Detector Models

The FS-1100 Flame Simulator is compatible with several detector types:

Simulator	P/N	Compatible with:
Triple IR3 Flame Simulator	FS-1100	40/40C-I, 40/40D-I, 40/40I, 40/40UFI, 20/20MI-1, 20/20MPI

Note: See *Operating Instructions* for activation and testing instructions for 20/20MI-3 models.

2.2 Features and Benefits

- Used for maintenance and testing of flame detectors
- Ability to activate the flame detector from a distance of up to 12m
- Rechargeable battery included
- Operates at least 1,000 tests before battery recharge is necessary

2.3 Principles of Operation

The **FS-1100** emits IR energy, which is filtered to emit electromagnetic radiation in a unique sequential pattern, corresponding to and recognizable as a fire by the SharpEye IR3 Flame Detector.

The simulator includes a reflector that accumulates the IR energy and directs it towards the detector.

The **FS-1100** includes a laser diode and a sight for guiding the simulator to the center of the flame detector.

2.4 Product Certification

The Flame Simulator has the following certifications:

- ATEX, IECEx, page 15
- cCSAus, page 15
- TR CU/EAC, page 15

2.4.1 ATEX, IECEx

Ex II 2 G D

Ex db ib op is IIB + H₂ T4 Gb

Ex ib op is tb IIIC T135°C Db

-4°F to +122°F / -20°C to +50°C

2.4.2 cCSAus

Class I, Zone 1, AEx db ib op is IIB+H₂ T4 Gb

Zone 21, AEx ib op is tb IIIC T135°C Db

-20°C ≤ Ta ≤ +50°C

2.4.3 TR CU/EAC

1Ex db ib op is IIB+H₂ T5 Gb X

Ex ib op is tb IIIC T135°C Db X

-20°C ≤ Ta ≤ +50°C

This product is suitable for use in hazardous zones 1, 2, 21, and 22 with IIB + H₂ gas group vapor present.

2.5 Simulator Structure

The flame simulator has a black-coated aluminum ex-proof enclosure. It includes the following components:

- Reflector
- Electronic compartment
- Battery compartment
- Handgrip

The electronic compartment includes the internal optical and electronic parts of the device.

The battery compartment includes a battery pack containing 4 lithium-ion batteries, measuring a total of 14.8VDC and 2.6Ah.

To charge or replace the battery pack, follow the instructions in section 3.6 on page 24.



Figure 1: Flame Simulator Side View

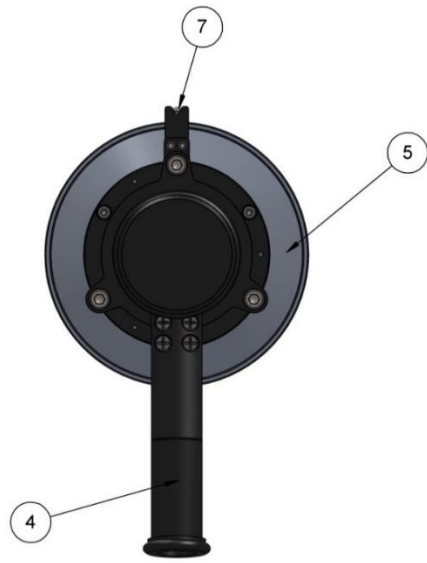


Figure 2: Flame Simulator Rear View

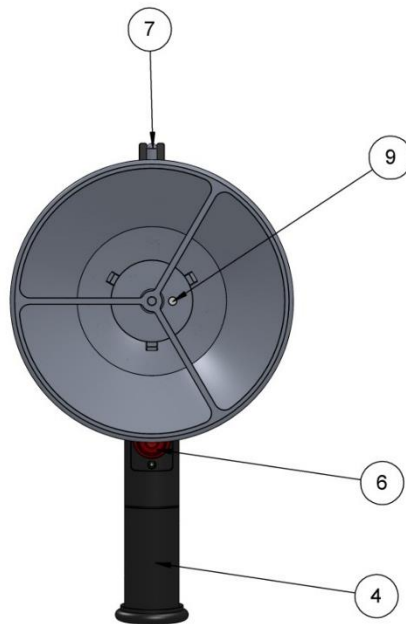


Figure 3: Flame Simulator Front View

1	Electronic Compartment	6	Push Button
2	Battery Compartment	7	Sight
3	Battery Back Cover	8	Back Cover Locking Screw
4	Handgrip	9	Laser Diode
5	Reflector		

2.6 Certification Instructions

2.6.1 General Instructions

The equipment marking is defined as follows:

Ex II 2 G D

Ex db ib op is IIB + H₂ T4 Gb

Ex ib op is tb IIIC T135°C Db

-20°C to +50°C / -4°F to +122°F

The equipment may be used with flammable gasses and vapors with apparatus groups IIA and IIB+H₂ T4 in the ambient temperature range of -4°F to +122°F / -20°C to +50°C.

- Inspection and maintenance of this equipment should be performed by suitable trained personnel, in accordance with the applicable code of practice, e.g. EN 60079-17.
- Repair of this equipment should be performed by suitable trained personnel, in accordance with the applicable code of practice, e.g. EN 60079-19.
- Certification of this equipment relies upon use of the following materials in its construction:
 - Enclosure: Aluminum 6061T6
 - Window: Sapphire glass
 - Seals: EPDM
- If the equipment is likely to come into contact with aggressive substances (described below), then it is the responsibility of the user to take suitable precautions (described below) to prevent the equipment from being adversely affected. This ensures that the type of protection provided by the equipment is not compromised.
- Examples of aggressive substances: acidic liquids or gases that may attack metals or solvents, or may affect polymeric materials.
- Examples of suitable precautions: routine inspections, establishing resistance to specific chemicals from the material's data sheets.

2.6.2 Specific Conditions of Use

The dimensions of the flameproof joints are other than the relevant minimum or maximum values required by Table 3 of IEC/EN 60079-1:2014 for IIB + H₂, as detailed below:

Flamepath Description	Type of Joint	Minimum Width "L" (mm)	Maximum Gap "ic" (mm)
Joint formed by window against the enclosure	Flanged	10.75	0.02
Enclosure end-cap spigot	Cylindrical	15	0.08

Gaps should not be machined to be any larger than the values of "ic," and width should not be modified to be any smaller than the values of "L," as shown in the table above.

The equipment should only be charged in a safe area. Batteries must be removed from the flameproof enclosure. The charge conditions are as follows:

- Maximum charge voltage: 16.8V
- Maximum charge current: 4A

The charge voltage and current should not exceed these values.

3 Operation Instructions

3.1 Ordering Information

The P/N of the Flame Simulator Kit is 380114-1.

The kit is supplied in a carry case that includes:

- Flame Simulator FS-1100
- Battery pack 380004
- Charger
- Tool Kit
- Technical Manual TM380002

3.2 Unpacking

Verify that you received the following components:

- Delivery form
- Flame simulator with integral battery
- Battery charger
- Tool keys
- User manual
- FAT forms
- EC declaration
- Storage case

**Note:**

The FS shall be stored in a suitable suitcase to prevent possible damage during handling

**Warning:**

Do not open when an explosive atmosphere is present. Use only replaceable battery pack P.N. 380015

3.3 Operating Instructions

- 1 Verify you are using the correct simulator that fits the tested detector, per section 2.1: s on page 13
- 2 Verify you are at the correct distance from the detector according to the type of detector and the detector sensitivity (see *Detection Ranges* on page 23).
- 3 Using the mechanical sight, aim the flame simulator toward the center of the detector.
Push the activate button; direct the laser spot toward the center of the detector.
- 4 Once the trigger is pressed, with an initial 2 seconds delay, the equipment will operate for a maximum period of 60 seconds, following which the equipment cannot be operated for a minimum period of 30 seconds.

Note: The FS-1100 is ex proof and is specially designed to active ex proof flame detector models. However, it is also able to activate some non-ex proof detector models listed in the compatibility table in section 2.1. When using the FS-1100 to activate the 20/20MI-3x flame detector models the reflector will need to be disconnected prior to operation (**Figure 5**, item 5) by unscrewing the three fixing screw using an Allen wrench (3mm) and point the simulator towards the detector from a close distance, as shown in image 1.

Please note that the detector should be set on highest sensitivity of 10m prior to the test.

Figure 4: FS-1100 reflector

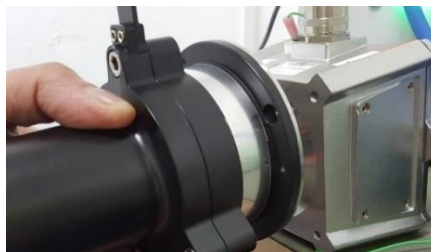
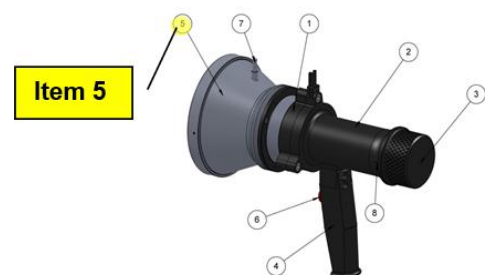


Figure 5: FS-1100 reflector diagram



3.4 Simulator Status

During the first 5 seconds of operation, the laser defines the simulator's status.

3.4.1 Normal Status

When switching to normal status, the laser beams for 5 seconds before IR radiation is activated. These 5 seconds are used to aim the simulator to the center of the detector before activating IR radiation. Once the trigger is pressed, with an initial 2 second delay, the equipment will operate for a maximum period of 60 seconds, following which the equipment cannot be operated for a minimum period of 30 seconds.

3.4.2 Fault Status

- **Low Battery** – The laser flashes 3 times in 3 consecutive cycles. IR radiation will be activated.
- **IR Fault** – The laser flashes 3 times in 5 consecutive cycles. IR radiation will not be activated.
- **Total Failure** – The laser does not turn on. IR radiation will not be activated.

3.5 Detection Ranges

Table 1: Detection Ranges per Detector/Flame Simulator

Model	Detector Types	Detector Sensitivity Setting (ft/m)	Testing Distance (ft/m)
FS-1100	40/40C-I	10/3	3/1
		50/15	6.6/2
		100/30	19.6/6
		150/45	29.5/9
		215/65	39.3/12
	40/40D-I	10/3	3/1
		50/15	6.6/2
100/30		19.6/6	
150/45		29.5/9	
215/65		39.3/12	
300/90	39.3/12		
40/40I	50/15	6.6/2	
	100/30	19.6/6	
	150/45	29.5/9	
	215/65	39.3/12	
40/40UFI	66/20	13/4	
	133/40	26/8	
	200/60	40/12	
	300/90	50/15	
20/20MPI	33/10	6.6/2	
	65/20	8.2/2.5	
	100/30	19.6/6	
	132/40	26.2/8	
20/20MI-1	33/10	N/A	
	65/20	8.2/2.5	
	100/30	19.6/6	
	132/40	26.2/8	



Notes:

- The minimum distance from the detector is 30"/75cm.
- At extreme temperatures there is a 15% reduction in the testing range.

**Warning:**

Keep the flame simulator in a safe place when not in use.

3.6 Charging the Battery

The flame simulator uses lithium-ion batteries as a rechargeable power source. When the batteries are fully charged, under normal conditions (room temperature) the simulator can be activated 1,000 times without recharging. When the voltage from the batteries is lower than the required operational level, the simulator will not operate.

■ **To charge the battery:**

- 1 Place the flame simulator on a table in a safe area, not exceeding 104°F/40°C.
 - 2 Release the locking screw (Figure 1, Item 8).
 - 3 Unscrew the battery compartment cover counterclockwise (Figure 1 and Figure 6, Item 3).
 - 4 Unscrew the locking disc clockwise using 1.5mm hex key (Figure 6, Item 4).
 - 5 Pull the battery out of the flame simulator (Figure 6, Item 2).
-

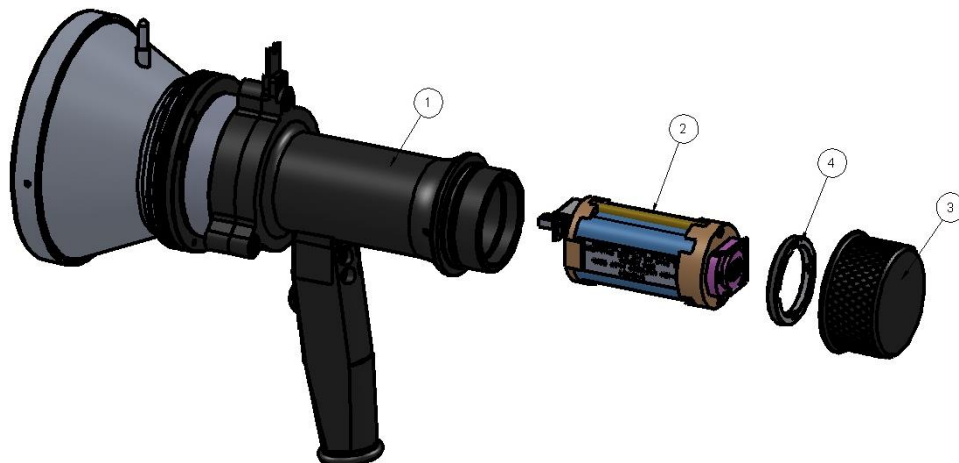
**Warning:**

The battery must be charged only after being removed from the flame simulator.

- 6 Connect the battery to the charger. Verify that the charger is supplied with the flame simulator model.
- 7 Charge for a maximum of 2–3 hours.
- 8 Disconnect the charger.
- 9 Insert the battery into the flame simulator (Figure 6, Item 2). The LED will flash twice to indicate that the battery is fully charged.
- 10 Screw on the locking disc using 1.5mm hex key (Figure 6, Item 4).
- 11 Screw on the battery compartment cover (Figure 1 and Figure 6, Item 3).
- 12 Lock the back cover with the locking screw (Figure 1, Item 8).

■ **To replace the battery:**

- 1 To remove the battery, follow steps 1-4 in "**To Charge the Battery**" section.
- 2 Insert the new battery pack in the simulator housing. Use only a SPECTREX battery pack, P/N 380004.
- 3 Follow steps 9-11 in "**To Charge the Battery**" section.



1	Simulator
2	Battery Pack
3	Battery Compartment Cover
4	Locking Disc

Figure 6: Flame Simulator Battery Replacement

3.7 Maintenance

- Ensure the flame simulator is charged before operation. The LED will flash twice to indicate that the battery is fully charged.
- Ensure the reflector and window are clean.
- Before replacing the battery, check that you have a SPECTREX Battery Pack, P/N 380004.
- When the simulator is not in use, remove the battery pack and recharge every 6 months.
- The typical Li-on battery lifetime is 2-3 years under normal conditions.

3.8 Troubleshooting

Model	Problem	Solution
FS-1100	LED flashes 3 times in 3 consecutive cycles	Recharge the battery.
	LED flashes 3 times in 5 consecutive cycles	Disconnect and reconnect the battery. Operate the flame simulator again.
	LED does not turn on	<ol style="list-style-type: none"> 1. Recharge the battery. 2. Replace the battery.
	Flame simulator seems to work properly but does not activate the detector	<ol style="list-style-type: none"> 3. Verify that you are aiming the flame simulator beam to the center of the flame detector 4. Verify that you are at the correct distance. 5. Verify that the flame detector is at the correct sensitivity. 6. Verify that the flame detector is operating. 7. Verify that the flame detector window is clean.

3.9 Technical Specifications

3.9.1 General Specifications

- Temperature range: -4°F to +122°F / -20°C to +50°C
- Vibration protection: 1g (10–50Hz)

3.9.2 Electrical Specifications

- Rechargeable four cell lithium-ion battery:
 - Power: 14.8V (4 x 3.7V), max current 0.2A
 - Charging: 16.8V (4 x 4.2V), max current 4A
- Battery capacity: 2.6Ah
- Charging time: 2hr at 2A

3.9.3 Physical Specifications

- Dimensions: 9" x 7.3" x 5.35" / 230 x 185 x 136 mm
- Weight: 5.5lb/2.5kg
- Enclosure: aluminum, heavy duty copper free, black zinc coating.

- Explosion proof enclosure:
 ATEX and IECEx
 Ex II 2 G D
 Ex db ib op is IIB + H2 T4 Gb
 Ex ib op is tb IIIC T135°C Db
 -20°C to +50°C / -4°F to +122°F
 cCSAus
 Class I, Zone 1, AEx db ib op is IIB+H2 T4 Gb
 Zone 21, AEx ib op is tb IIIC T135°C Db
 -20°C ≤ Ta ≤ +50°C
 TR CU/EAC
 1Ex db ib op is IIB+H2 T5 Gb X
 Ex ib op is tb IIIC T135°C Db X
 -20°C ≤ Ta ≤ +50°C
- Water and dust tight: IP65

3.9.4 RoHS Directive

The Flame Simulator is compliant with RoHS directive 2011/65/EU, 2015/863

3.9.5 EMI Compatibility

Immunity Tests		
Title	Basic Standard	Level to be tested
Electrostatic Discharge (ESD)	IEC 61000-4-2	6kV/8kV contact/air
Radiated Electromagnetic Field	IEC 61000-4-3	20V/m (80MHz-1GHz) 10V/m (1.4-2GHz) 3V/m (2.0-2.7GHz)
Conducted Disturbances	IEC 61000-4-6	10 Vrms (150kHz-80MHz)
Immunity to Main Supply Voltage Variations	MIL-STD-1275B	

Emission Tests			
Title	Basic Standard	Level to be Tested	Class
Radiated Emission	IEC 61000-6-3	40dbuv/m (30-230MHz), 47dbuv/m (230MHz-1GHz)	Like Class B of EN 55022

Technical Support

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