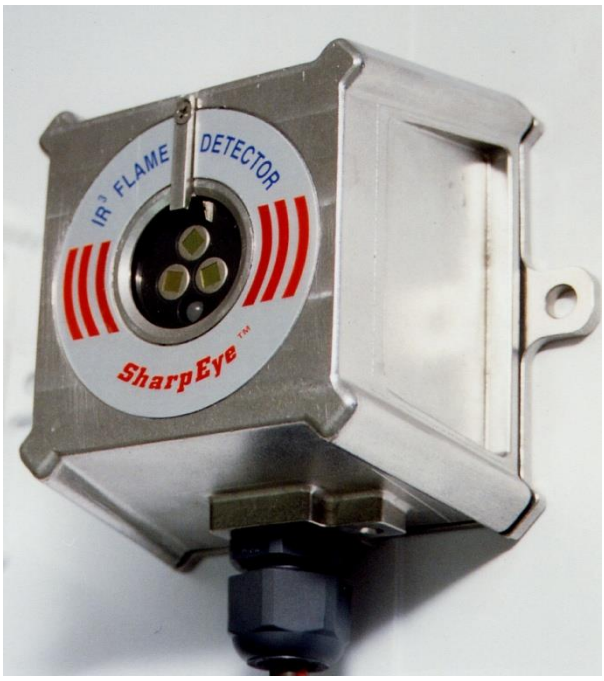
SharpEye™

Model 20/20MI
Mini Triple IR (IR3) Flame Detector

User Guide



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Legal Notice

Warning: This manual should be carefully read by all individuals who have or will have responsibility for using, maintaining or servicing the product.

The detector is not field-repairable due to the meticulous alignment and calibration of the sensors 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.

Release History

Rev	Date	Revision History	Prepared by	Approved by
5	May 2017	Sixth Release	Jay Cooley	Shaul Serero

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About this Guide

This guide describes the SharpEye Model 20/20MI Mini Triple IR (IR3) Flame detector and its features, and provides instructions on how to install, operate, and maintain the detector.

This guide includes the following chapters and appendices:

- **Chapter 1**, **Introduction**, provides a general introduction and overview of the product.
- **Chapter 2**, **Technical Description**, describes the detector's features and principles of operation.
- **Chapter 3**, **Performance**, describes the detector's detection sensitivity and capabilities.
- **Chapter 4**, **Operation**, describes the detector's operation modes, user interface, and indications.
- **Chapter 5**, **Technical Specifications**, lists the detector's electrical, mechanical, and environmental specifications.
- **Chapter 6**, **Installation Instructions**, describes preparations for installation, wiring, and mode settings.
- **Chapter 7, Operating Instructions,** shows how to power up and test the detector.
- **Chapter 8**, **Maintenance and troubleshooting**, describes basic maintenance and support procedures.
- **Appendix A**, **Typical Wiring Configurations**, lists the wiring instructions for connecting the detector, and provides examples of typical wiring configurations.
- **Appendix B, Long Range IR3 Flame Simulator**, describes the flame simulator that can be specifically used with SharpEye IR3 flame detectors.
- **Appendix C, FM Report for 20/20MI-3**, describes the tests that were performed on 4 sample products.

Abbreviations and Acronyms

Abbreviation	Meaning
AWG	American Wire Gauge
BIT	Built-In-Test
EMC	Electromagnetic Compatibility
EOL	End of Line
FOV	Field of View
IAD	Immune at Any Distance
IPA	Isopropyl Alcohol
IR	Infrared
JP5	Jet Fuel
Latched	Refers to relays remaining in the On state even after the On condition has been removed
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
mA	Milliamps (0.001 amps)
MODBUS	Master-slave messaging structure
N.C.	Normally Closed
N.O.	Normally Open
N/A	Not Applicable
NFPA	National Fire Protection Association
NPT	National Pipe Thread
VAC	Volts Alternating Current

1 Scope

1.1 Product Overview

The SPECTREX Model 20/20MI is a new version of the triple IR spectrum flame detector designed to provide maximum fire protection. It uses innovative technology of advanced digital signal processing to analyze the dynamic characteristics of fire. Three sensitive IR channels process the signals. Detection performance is controlled by a microprocessor and easily adapted to all environments, applications, and requirements. The result is a unique and superior flame detector, which provides excellent detection sensitivity together with extreme immunity to false alarm.

This version of IR3 is S.M.T. Technology. The programmable functions are available through an RS-485 port used with a standard PC and software supplied by SPECTREX, or by a handheld computer.

To use the HOST software and to change the required functions, refer to *Manual TM784050* for instructions.

2 Technical Description

2.1 Features

The SharpEye Model 20/20MI Mini Triple IR (IR3) Flame Detector includes the following features:

- **Detection Range**: up to 132ft/40m for a $1ft^2/0.1m^2$ fire
- **Ultra High Immunity to False Alarms** (see *False Alarms Detection*, page 24)
- **Advanced Digital Processing of the Dynamic Characteristics of Fire**: Flickering, Threshold correlation, and Ratio
- **3 Separate IR Channels**: Between 3–5 microns
- **Field Programmable Sensitivity**: 4 ranges
- **2 Response Levels**: Warning and Detection
- **Solar Blind**
- **Microprocessor Based**: Digital signal processing
- **Built In Test (BIT)**: Manual and Automatic
- **Electrical Interface**:
- Dry contact relays
- **Communications network RS-485**
- 4–20mA output
- **Certification**: EN54-10 approved per VdS

  FM approved per FM3260

2.2 Principles of Operation

2.2.1 Hydrocarbon Fire Detection

The triple IR flame detector detects all conceivable types of hydrocarbon fires, i.e. any fire which emits CO_2.

2.2.2 Identifying the CO2 Peak

The hydrocarbon fire is characterized by a typical radiation emission. The CO_2 peak emits intense radiation in the spectral band between 4.2µ–4.5µ and weaker radiation intensity outside this spectral band.

2.2.3 Limitations of IR-IR Flame Detectors

CO_2 in the atmosphere attenuates the radiation in this spectral band. (Absorption and emission of radiation always occur in the same band.) As a result, the greater the distance between the detector and the fire, the weaker the intensity of the radiation reaching the detector is (i.e. the CO_2 attenuation increases). This phenomenon explains the limitations of the existing IR-IR flame detectors in the market:

- Detection distance is restricted to 33ft/10m only.
- Their immunity to false alarm sources is limited.

2.2.4 Advantages of IR3 Technology

To overcome these limitations, SPECTREX devised an innovative concept of utilizing an additional detection channel. Three channels collect more data from the environment, providing a more accurate analysis and better performance.

After careful investigation, 3 channels were selected which, when operating jointly, provide optimal fire detection characteristics:

- **Channel 1**: 4.2–4.6μ

  Fire - the CO_2 peak
- **Channel 2**: 4.0–4.2μ

  Eliminates false alarms from high temperature sources
- **Channel 3**: 4.8–5.2μ

  Eliminates false alarms from flickering of background radiation

Most IR sources which create misleading IR alarm stimuli, including the sun, incandescent, and halogen lamps, electric arc discharges, electrical heaters, etc., do not possess this unique spectral signature of fire.

The IR sensors of the detector respond only to flickering of radiation signals. The signals are compared to a predetermined threshold. Processing of the results from the 3 IR channels is performed by the board microprocessor. The result is a much greater detection distance and a highly increased ability to distinguish between fire and false alarms.

This sophisticated technology surpasses all other existing flame detection techniques on the market today.

Note: This unique flame analysis capability (patent pending) has been incorporated into the Triple-IR fire detector manufactured by SPECTREX. The result is a unique flame detector which does not produce false alarms, and at the same time, provides detection over greatly increased distances.

2.2.5 Modbus RS-485

For more advanced communication, the 20/20MI has an RS-485 Modbus-compatible output that provides data communications from a network (up to

247 detectors) to a host computer on universal controller, for central monitoring. This feature enables easy maintenance, and local or remote diagnostic tools.

2.2.6 Types and Models

The 20/20MI has 2 models:

- Standard - up to 40m
- Short range - up to 10m

Optional:
The output is via either a connector or a cable tail (up to 2m long).

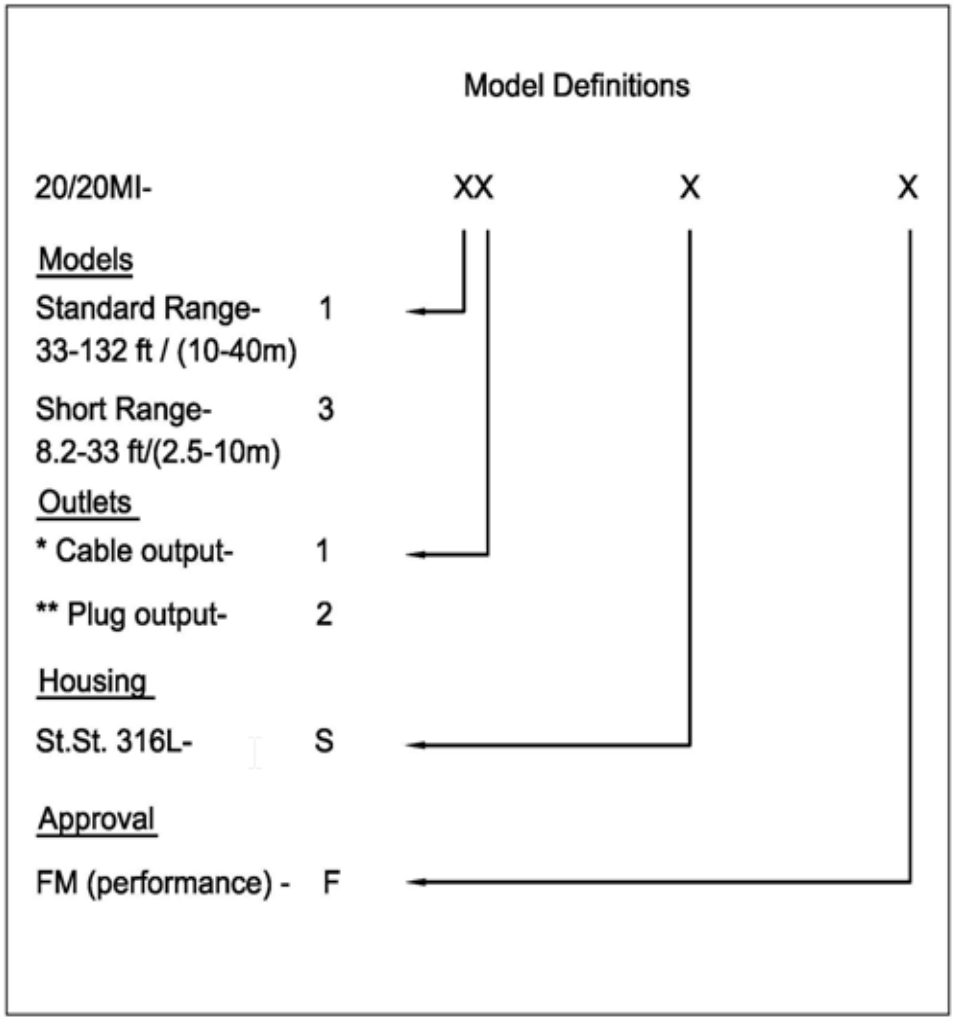


Figure 1: Types and Models

F- FM and EN54-10 – only 20/20MI-1 is approved per EN54-10

* Cable for connection to junction box

** Mating connector supplied with detector

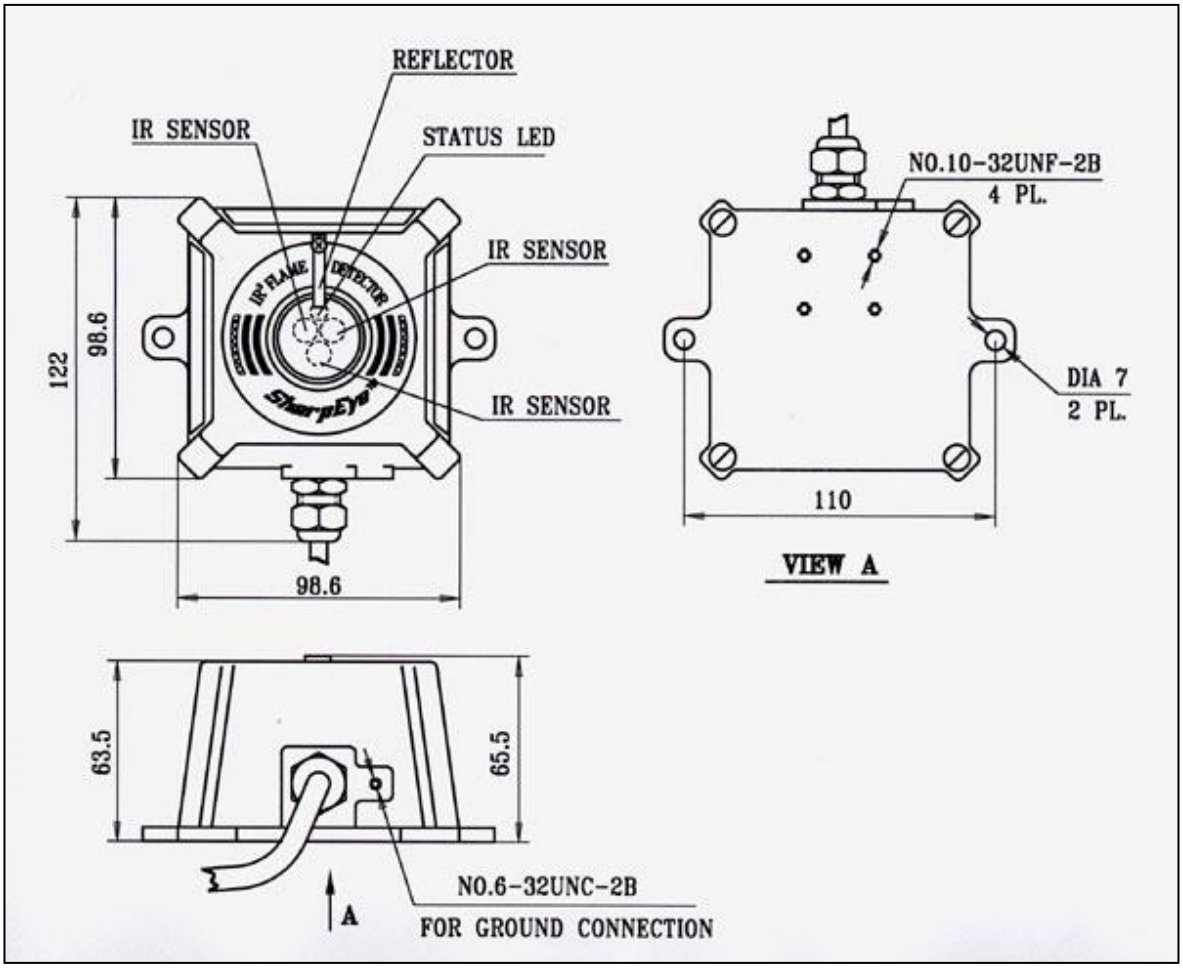


Figure 2: Flame Detector Assembly - Outline Drawing (Cable Output Option)

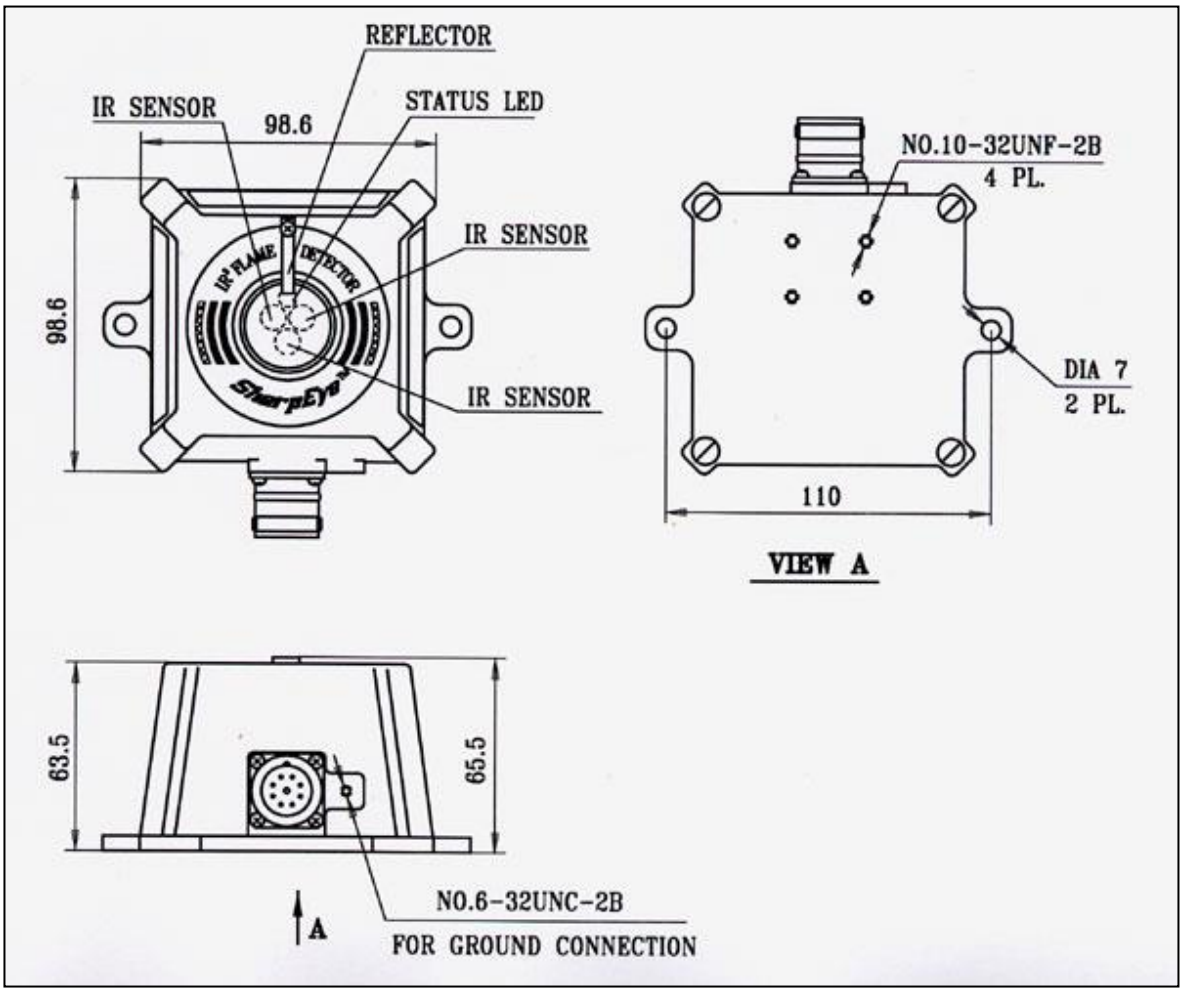


Figure 3: Flame Detector Assembly - Outline Drawing (Connector Output Option)

3 Performance

3.1 Detection Sensitivity

Detection sensitivity is the maximum distance at which the detector will reliably detect a specific size of fire and typical type of fuel (standard fire).

3.1.1 Standard Fire

A standard fire is defined as a $1ft^2/0.1m^2$ gasoline pan fire with maximum wind speed of 6.5ft/sec / 2m/sec.

3.1.2 Sensitivity Ranges

The detector has 4 user-selectable sensitivity ranges. For each range there are 2 response levels.

- Warning (pre-alarm)
- Alarm

The detection distance, for the warning level, is approximately 10% higher than the alarm distance. Alarm response times for a standard fire at a specified range are shown in Table 1.

Table 1: Alarm Response Time versus Range – 20/20MI-1

	10	**20**	**30**	**40**
Sensitivity Range (ft/m)	33/10	65/20	100/30	132/40
Response Time (sec)	5	8	10	10

Table 2: Alarm Response Time versus Range – 20/20MI-3

	2.5	**5**	**7.5**	**10**
Sensitivity Range (ft/m)	8.2/2.5	16.5/5	24.7/7.5	33/10
Response Time (sec)	1	1	2	3

For some typical ambient conditions the Zeta parameter, as defined in NFPA 72 for the detector, is 0.005 (1/meter).

Note: Zeta parameters may vary significantly with changes in temperature, air pressure, humidity, visibility conditions, etc.

3.1.3 Other Fuels

The detector reacts to other types of fires as shown in Table 3:

Table 3: Response Sensitivity Ranges

Type of Fuel	% of Max. Distance at Each Sensitivity Range
Gasoline	100%
N-Heptane	100%
Alcohol 95%	75%
JP4	75%
Kerosene	75%
Diesel Fuel	70%
Methane*	30%
Propane*	30%

* 0.5m plume fire

Pan Fire Size: $1ft^2/0.1m^2$

Maximum Wind Speed: 6.5ft/sec / 2m/sec

Maximum Response Time: 10sec

Table 4: Sensitivity to Other Fire Sizes

Fuel	Fire Size	Detection Sensitivity	Distance (ft/m)	Maximum Detection Time 20/20MI-1
Jet Fuel	2 x 2ft	40	132/40	10sec
Jet Fuel	2 x 2ft	20	65/20	8sec

3.2 Cone of Vision

- Horizontal: 100°
- Vertical: 100°

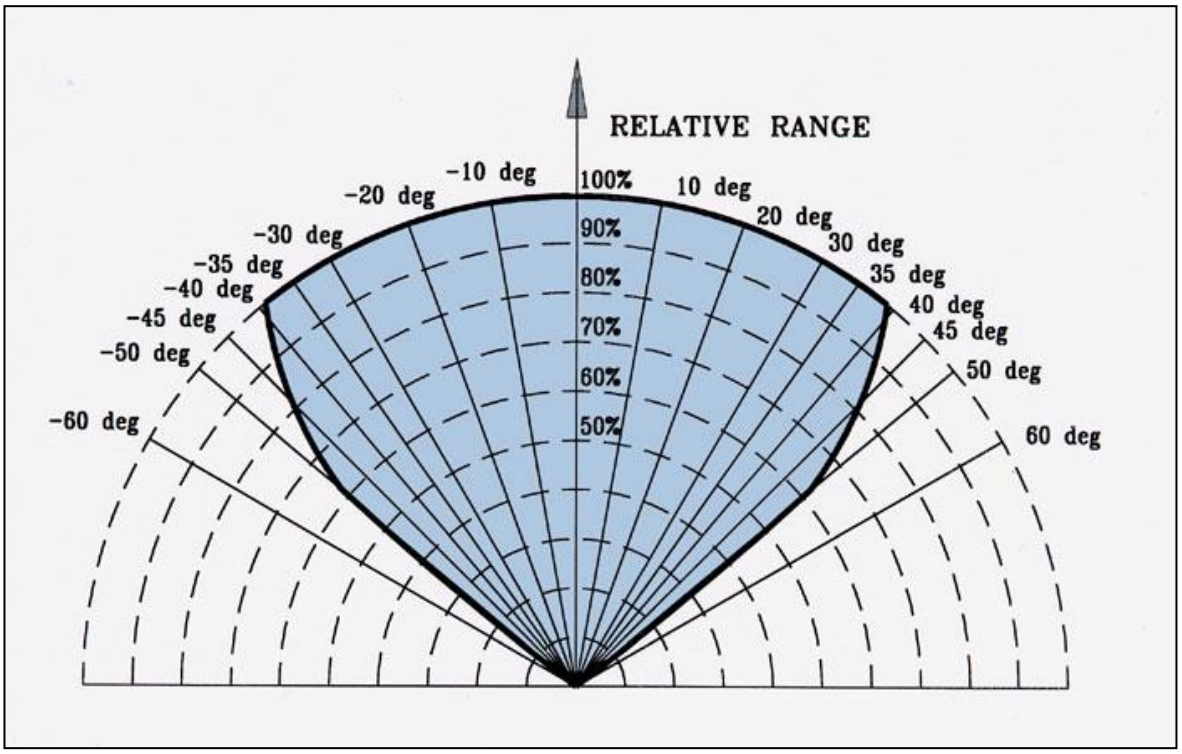


Figure 4: Horizontal and Vertical Fields of View

3.3 False Alarms Detection

The detector does not provide an alarm or a warning signal as a reaction to the radiation sources specified in Table 5.

Table 5: Immunity to False Alarm Sources

Radiation Source	Immunity Distance ft/m
Sunlight	IAD
Indirect or reflected sunlight	IAD
Incandescent frosted glass light, 100 W	IAD
Incandescent clear glass light, rough service, 100W	IAD
Fluorescent light with white enamel reflector, standard office or shop, 40W (or 2 20W)	IAD
Electric arc [12mm / 15/32” gap at 4000V alternating current, 60Hz]	IAD
Arc welding [4mm / 5/32” rod; 240A]	See Table 6 and Table 7
Ambient light extremes (darkness to bright light with snow, water, rain, desert glare, and fog)	IAD
Bright colored clothing, including red and safety orange.	IAD
Electronic flash (180 watt-seconds minimum output)	IAD
Movie light, 625W quartz DWY lamp (Sylvania S.G.-55 or equivalent)	6.5/2
Flashlight (MX 991/U)	IAD
Radiation heater, 1500W	IAD
Radiation heater, 1000W with fan	IAD
Quartz lamp (1000W)	10/3
Mercury vapor lamp	IAD
Grinding metal	IAD
Lit cigar	1/0.3
Lit cigarette	1/0.3
Match, wood, stick including flare up	10/3

Notes:

- IAD = Immune at Any Distance
- All sources are chopped from 0–20Hz

Table 6: Welding Immunity Distance – 20/20MI-1

Sensitivity	Detection Range (ft/m)	Immunity Distance (ft/m)
10	33/10	>10/3
20	65/20	>15/5
30	100/30	>20/7
40	132/40	>33/10

Table 7: Welding Immunity Distance – 20/20MI-3

Sensitivity	Detection Range (ft/m)	Immunity Distance (ft/m)
2.5	8.2/2.5	>2.5/0.75
5	16.5/5	>5/1.5
7.5	24.7/7.5	>7.5/2.25
10	33/10	>10/3

4 Operation

4.1 Visual Indications

One 3-color LED-indication is located in the detector front window:

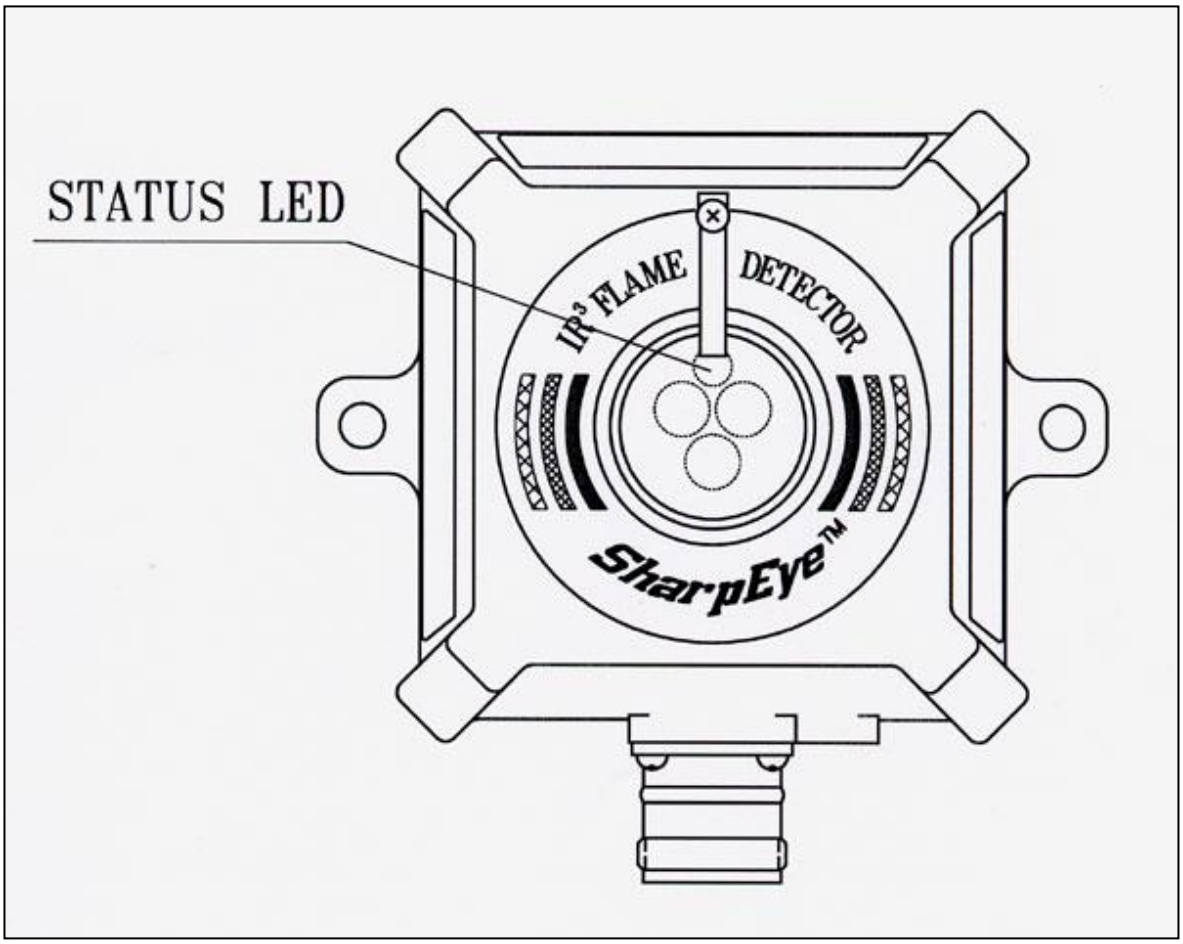


Figure 5: Indication LEDs

The LEDs are described in Table 8.

Table 8: 20/20MI Status

Detector Status	LED color	LED mode
Fault, BIT Fault	Yellow	4 Hz flashing
Normal	Green	1 Hz flashing
Warning	Red	2 Hz flashing
Alarm	Red	Steady

4.2 Output Signals

The detector controls the following outputs:

- Alarm relay
- Fault relay
- 4–20mA current output
- RS-485 communications

The detector can be in one of the following states:

Table 9: 20/20MPI Output Signals

Normal:	The detector is functioning normally.
BIT:	The detector performs a Built In Test.
Warning:	Fire detected – warming alarm (pre-alarm) state
Alarm:	Fire detected – fire alarm state
Latched Alarm (Optional)	The alarm outputs are latched due to the detection of a fire that has already been extinguished.
BIT Fault:	A fault is detected during BIT sequence. The detector will continue to detect fire if the alarm conditions occur.
Fault:	A fault is detected when the power supply is too low or during a software fault.

In each state, the detector activates different outputs as specified in Table 10.

Table 10: Detector State with Output Signals

Detector State	Color LED	Flashing LED	Alarm Relay	Fault Relay	4–20mA Output
Normal	Green	1Hz	Off	On	5mA
Warning	Red	2Hz	Off	On	10mA
Alarm (1)	Red	Steady	On	On	15mA
Latch(2)	Red	Steady	On	On	15mA
BIT Fault(3)	Yellow	4Hz	Off	Off	2mA
Warning at BIT Fault	Red	2Hz	Off	Off	10mA
Alarm at BIT Fault	Red	Steady	On	Off	15mA
Fault	Yellow	4Hz	Off	Off	0mA

Notes:

(1) The alarm outputs are activated as long as the alarm conditions are present.

(2) The alarm state can be latched (optional) according to programmable function.

(3) The detector is in its BIT fault state until it has passed a successful BIT and stops approximately 3 seconds after the fire is no longer detected.

4.2.1 Optional Latching

The detector has an optional latched alarm output capability, which operates according to the programmable function. If selected, upon detection of a fire, the detection signal is latched until manually reset by disconnecting the power supply, latching or performing a manual BIT. Latching affects the alarm relay, 4–20mA output, and the alarm LED.

4.2.2 Built-In-Test

When the programmable function alarm BIT at YES is successful, the manual BIT activates the alarm relay for 3sec and the 4–20mA output provides 15mA for 3 sec.

4.3 Detector Mode Setup

4.3.1 Detector Setting

Refer to *Detector Default Setup* on page 31 for default factory settings.

The detector incorporates several functions that can be set by the customer using SPECTREX host software, which is supplied with each detector shipment. Please refer to *Manual TM768050* for programming instructions.

The host software enables you to change functions as described in *Detector Default Setup* on page 31.

4.3.2 Sensitivity Ranges

The detector offers 4 sensitivity settings. The settings refer to the gasoline fire of $1ft^2$ from 33ft/10m to 132ft/40m for Model 20/20MI-1 and 8.2ft/2.5m to 33ft/10m for Model 20/20MI-3.

For other types of fuel sensitivity, refer to Table 11.

Table 11: Sensitivity ranges

Sensitivity	20/20MI-1 Detection Range		Sensitivity	20/20MI-3 Detection Range	
	ft	m		ft	m
10	30	10	2.5	8.2	2.5
20	66	20	5	16.5	5
30	100	30	7.5	24.7	7.5
40	132	40	10	33	10

4.3.3 Alarm Delay

The detector is equipped with an alarm delay option, which provides programmable time delays of 0–30 seconds with 8 fixed settings:

- 0 seconds
- Anti-flare
- 3 seconds
- 5 seconds
- 10 seconds
- 15 seconds
- 20 seconds
- 30 seconds

When an alarm (detection) level condition is encountered, the detector delays the execution of the alarm output's relay by the specified period of time. The detector will then evaluate the condition for 3 seconds. If the alarm level is still present, the alarm outputs are activated. If this condition no longer exists, the detector returns to its standby state. The alarm delay option affects the alarm relay and the 4–20mA output. The LED indicates warning level during the delay time only if the fire condition exists.

Anti-Flare
Anti-flare mode is selected to prevent false alarms in locations where fast flares may be present. The time delay for a fire alarm in this mode is from 2.5–15 seconds, and is usually less than 10 seconds.

Table 12: Time Delay

Delay (seconds)
0
A (anti-flare)
3 (default)
5
10
15
20
30

Note: The FM approval does not allow use of 20 and 30 second setting delay.

4.3.4 Function Setup

You can select the desired mode of operation by means of the host.

Table 13: Function Setup

Name	Yes	No
Alarm Latch	Alarm latching enable	Alarm latching disabled (default)
Automatic BIT	Automatic & manual BIT (default)	Manual BIT only
Alarm BIT	Successful Manual BIT activates the alarm relay for approximately 3 seconds; the 4–20mA will provide 15mA for 3sec	Successful manual BIT does not activate the alarm relay (default)

4.3.5 Addresses Setup

Refer to *TM 784050* for instructions for defining the addresses of the detectors.

The detector provides up to 247 addresses (from 1 to 247) that can be used with the RS-485 communications link.

4.3.6 Detector Default Setup

The detector has 5 functions that can be programmed according to the customer requirement at the factory or at the customer facility using the software host. Table 14 lists the standard setup (default) that the detector is programmed with if there are no specific requirements.

Table 14: Default Function Setup

Detector Default Setup:	20/20MI-1	20/20MI-3
Sensitivity	20	5
Delay	A	0
Alarm Latch	No	No
Automatic BIT	Yes	Yes
Alarm BIT	No	No

4.4 Built-In-Test

4.4.1 General

The detector's Built In Test (BIT) checks the following:

- Electronics circuitry
- Sensors
- Window cleanliness

The detector can be set to perform the BIT as:

- Automatically and manually

  Or

- Manually only

4.4.2 Principles

If the result of a BIT is the same as the current status of the detector (normal or BIT fault), the detector's status is left unchanged. If the result of a BIT differs from the current status of the detector, the detector's status is changed (from normal to BIT fault or from BIT fault to normal).

Note: In BIT fault status, the detector can continue to detect a fire.

4.4.3 Automatic & Manual BIT

4.4.3.1 Manual Bit

This functions in the same way as an automatic BIT except that a successful BIT will cause the detector to resume its normal operation.

An unsuccessful BIT sequence activates the following:

- The fault relay is opened.
- 4–20mA output indicates BIT FAULT (2mA).
- The LED flashes (4Hz) at yellow.
- BIT procedure is performed every 1 minute.

4.4.3.2 Automatic BIT

The detector automatically performs a BIT every 15 minutes.

A successful BIT does not activate any indicator.

- The fault relay remains closed (normal).
- The LED continues to flash (1Hz) at green.
- The 4–20mA output continues to indicate 5mA.

An unsuccessful BIT sequence activates the following:

- The fault relay is opened.
- 4–20mA output indicates BIT FAULT (2mA).
- The LED flashes (4Hz) at yellow.
- BIT procedure will be performed every 1 minute.

4.4.4 Manual BIT only

The BIT is initiated manually by momentarily connecting PIN No. 3 (or yellow wire) with PIN No. 2 (or black wire). A successful manual BIT activates the following:

- Fault relay remains closed
- Alarm relay is activated for 3sec (only when Function Alarm BIT at YES)
- 4–20mA output current will be 15mA (only when Function Alarm BIT at YES).
- The LED will illuminate at red for 3sec

Unsuccessful BIT activates the following:

- Fault relay is opened
- 4–20mA output indicates BIT fault condition (2mA)
- The LED flashes (4Hz) at yellow.

During a manual BIT, if function alarm BIT is in YES position, the alarm relay will be activated and the 4–20mA outputs will initiate 15mA. Therefore, automatic extinguishing systems or any external devices that would be activated under actual alarm conditions should be disconnected during a BIT.

5 Technical Specifications

5.1 Electrical Specifications

- **Operating Voltage**: 18–32VDC
  - **Power Consumption**:

    Max. 25mA in standby

    Max. 50mA in alarm
  - **Electric Input Protection**:
  - The input circuit is protected against voltage-reversed polarity, voltage transients, surges, and spikes according to MIL-STD-1275A.
    Electrical Outputs
- Dry Contact Relays:

Table 15: Contact Ratings

Relay Name	Type	Normal position	Maximum Ratings
Alarm	SPST	N.O.	2A at 30VDC
Fault *	SPST	N.C.	2A at 30VDC

* The fault relay is normally energized and the contact is closed during normal operation of the detector. The contact is open at fault condition or low voltage.

- 4–20mA current output:

  The 4–20mA is an isolated sink option.

  The maximum permitted load resistor is 600 Ohm.

Table 16: 0–20mA Current Output

STATE	Output
Fault	0 + 0.5mA
Bit Fault	2mA±10%
Normal	5mA±10%
Warning	10mA±5%
Alarm	15mA±5%

- **Communications Network:**

  The detector is equipped with an RS-485 communications link that can be used in installations with computerized controllers. The communications protocol is Modbus compatible.

  - This protocol is a standard and widely used.
  - It enables continuous communication between a single-standard Modbus controller (master device) and a serial network of up to 247 detectors.
  - It enables connection between different types of SPECTREX detectors or other Modbus devices to the same network.

5.2 Mechanical Specifications

- **Enclosure:** St.St 316L electro chemical and passivation coating.
- **Functional Test:**

  FM functional test per 3260 for 20/20MI-3 & 20/20MI-1

  VdS approval for 20/20MI-1 only
- **Water and dust tight**
- **NEMA 250** type 6p
- IP 66 and IP 67 per EN 60529
- **Electronic Modules**
- **Conformal coated**
  Electrical connection (2 options)

  Connector Interface (mating connector supplied with detector)

  Cable Interface
- **Dimensions**
  Base: 4.3”/110mm x 3.9”/100mm
  Height: 2.6”/65.5mm

Weight

St. St. 316L Housing

20/20MI-11 With Cable Output	3.3lb/1.5kg
20/20MI-12 With Plug Output	4.2lb/1.9kg
20/20MI-31 With Cable Output	3.3lb/1.5kg
20/20MI-32 with Plug Output	4.2lb/1.9kg
Tilt Mount	0.8 lb/0.37 kg

5.3 Environmental Specifications

- **High Temperature**

  Designed to meet MIL-STD-810C, method 501.1 procedure II

  - Operating temperature: +160°F / +70°C
  - Storage temperature: +185°F / +85°C

- **Low Temperature**

  Designed to meet MIL-STD-810C, method 502.1, procedure I

  - Operating temperature: –40°F / –40°C
  - Storage temperature: –65°F / –55°C

- **Humidity**

  Designed to meet MIL-STD-810C, method 507.1, procedure IV.

  Relative humidity of up to 95% for the operational temperature range.

- **Salt Fog**

  Designed to meet MIL-STD-810C, method 509.1, procedure I

  Exposure to a 5% Salt Solution Fog for 48 hours.

- **Dust**

  Designed to meet MIL-STD-810C, method 510.1, procedure I
  Exposure to a dust concentration of 0.3 frames/cubic ft at a velocity of 1750fpm, for 12 hours.

- **Vibration**
  Designed to meet MIL-STD-810C, method 514.2, procedure VIII
  Vibration at an acceleration of 1.1g within the frequency range of 5–30Hz, and an acceleration of 3g within the frequency range of 30–500Hz.

- **Mechanical Shock**

  Designed to meet MIL-STD-810C, method 516.2, procedure I

  Mechanical Shock of 30g half-sin wave, for 11 msec

Electromagnetic Compatibility (EMC)

This product is in conformance with EMC directive 89/336/EC.

- Radiated Emission EN61000-6-3
- Conducted Emission EN61000-6-3
- Radiated Immunity EN61000-4-3
- Conducted Immunity EN61000-4-6
- ESD EN61000-4-2
- Burst EN61000-4-4
- Surge EN61000-4-5

6 Installation Instructions

6.1 Scope

The SharpEye Model 20/20MI is a self-contained optical flame detector designed to operate as a stand-alone unit directly connected to alarm systems or automatic fire extinguishing systems. The detector can be a part of a more complex system where many detectors and other devices are integrated through a common control unit. This chapter does not attempt to cover all the standard practices and codes of installation. Rather, it emphasizes specific points of consideration and provides some general rules for qualified personnel. Wherever applicable, special safety precautions are stressed.

6.2 General Considerations

Important: The detector should be aimed toward the center of the detection zone and have a completely unobstructed view of the protected area. Whenever possible, the detector face should be tilted down at a slight angle to prevent the accumulation of dust and dirt. Do not start an installation unless all conceivable considerations regarding detector location have been taken into account.

To ensure optimal performance and an efficient installation, the following guidelines should be considered:

- Sensitivity

  To determine the level of sensitivity, the following issues should be considered:

  - Size of fire at determined distance to be detected
  - Type of flammable materials
- Spacing and Location

  The number of detectors and their locations in the protected area are affected by:

  - Size of the protected area
  - Sensitivity of the detectors
  - Obstructed lines of sight
  - Cone of view of the detectors

- Environment
  - Dust, snow, or rain can reduce the detectors sensitivity and require more maintenance activities.
  - The presence of high intensity flickering of IR sources may affect sensitivity.

6.3 Preparations for Installation

Installation should comply with NFPA 72E or local regulations, as applicable to flame detectors. The detectors can be installed with the use of general-purpose common tools and equipment.

1. Verify the appropriate purchase order. Record the Part Number (P/N and the Serial Number) of the detectors and the installation date in the appropriate logbook.
2. Open the container package prior to detector installation and visually inspect the detector.
3. Verify that all components required for the detector installation are readily available before commencing the installation. If the installation is not completed in a single session, secure, and seal detectors and conduits.
4. For wiring, use color-coded conductors or suitable wire markings or labels.
5. 12–20AWG / 0.5mm²–3.5mm² wires may be used for site wiring. The selection of wire gauge should be based on the number of detectors used on the same line and the distance from the control unit, in compliance with specifications.

6.4 Conduit Installation

The detector can be mounted directly on the wall through 7mm hole (Figure 6, Item 7) or preferably with the optional tilt mount, Model 787640 (Figure 6, Item 1).

The tilt mount enables the detector to be rotated up to 60 degrees in all directions.

6.4.1 Tilt Kit

Table 17: Tilt Kit P/N 787639

Item	Qty	Type/Model	Location
Tilt Mount	1	787640	
Screw	4	10-32 UNF x 7/16”	Detector - Holding plate
Spring Washer	4	No. 10	Detector - Holding plate

6.4.2 Tilt installation

Refer to Figure 6 and Figure 7.

1 Place the tilt mount (Item 1) in its designated location and secure it with 3 fasteners through 3 holes 5.2mm in diameter (Figure 7).

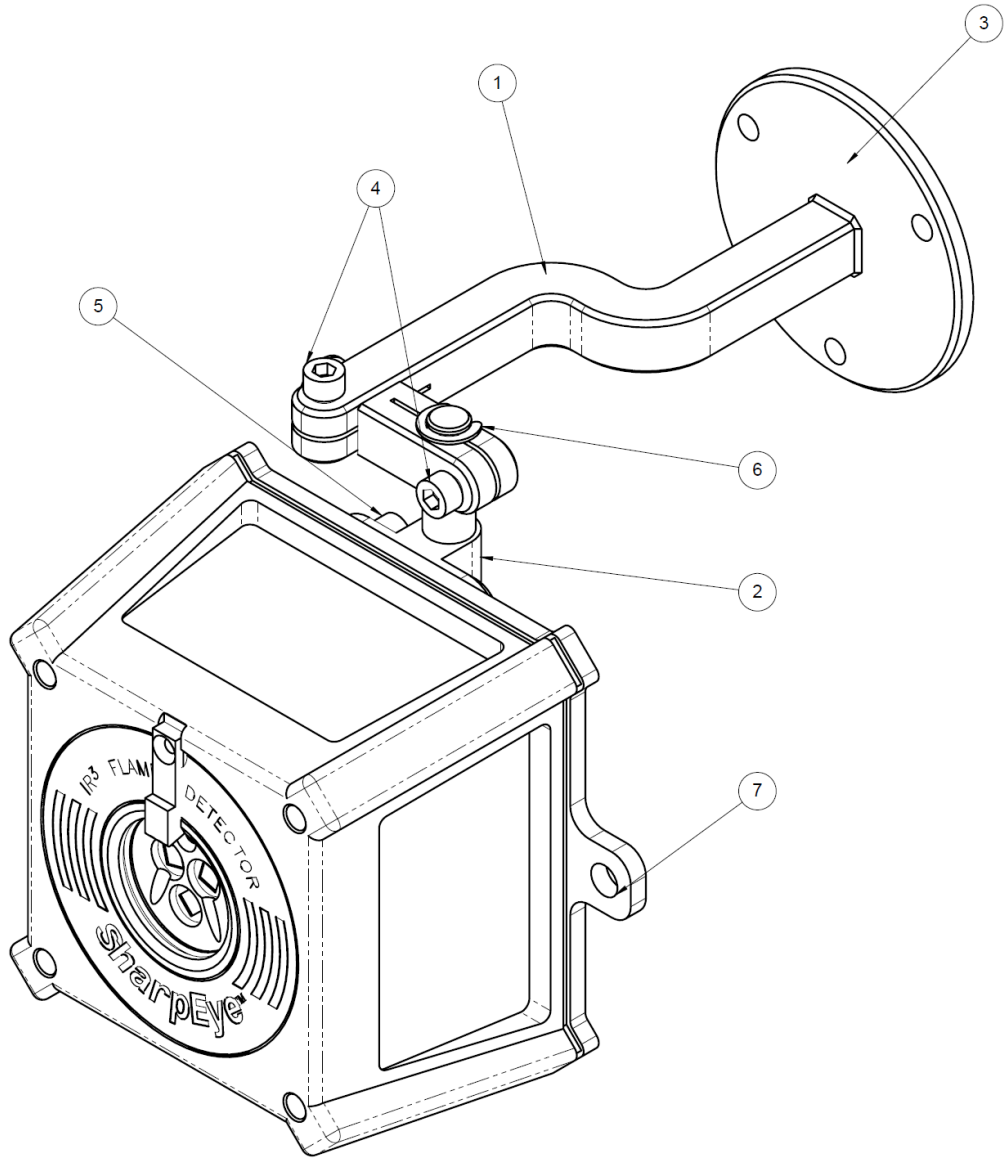
Note: Skip this step if the tilt mount is already installed. Also, detector removal for maintenance purposes does not require tilt mount removal.

2 Unpack the detector.

3 Place the detector, with its connector or cable pointing down, on the holding plate of the tilt mount (Item 2). Secure the detector by 4 10-32 UNF x 7/16" screws with No. 10 spring washers to the tilt mount. Use 5/32 Hex Key for 10-32 screw (Item 5).

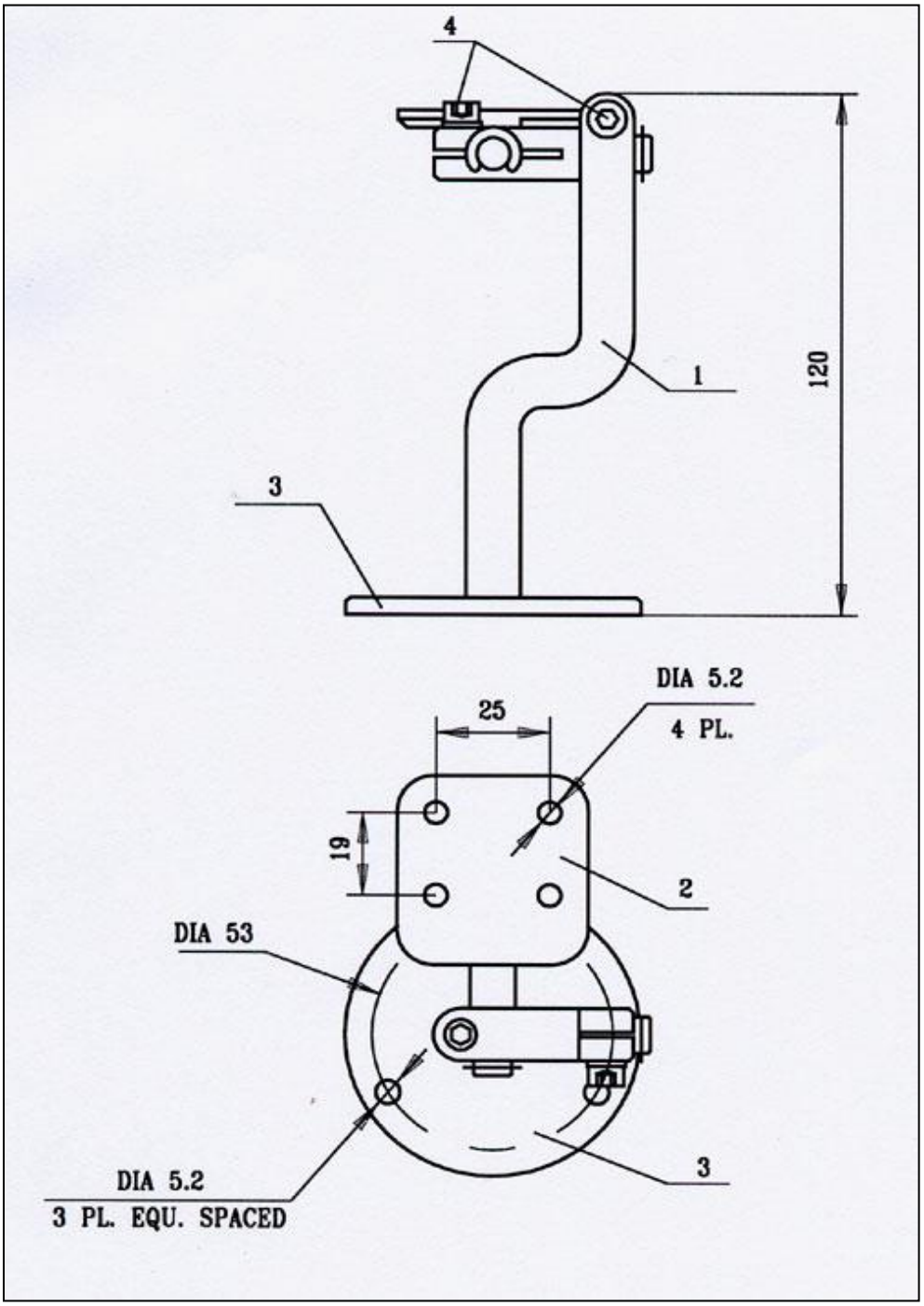
4 Release the locking screws (Items 5 and 6 in Figure 7) in such a way that allows for rotation of the detector. Point the detector towards the protected area and make certain that the view of the area is unobstructed. Secure the detector in that position by tightening the locking screws (Items 5 and 6) on the tilt mount. (Make sure the detector is in the right position.)

The detector is now correctly located, aligned, and ready to be connected to the system.



Description			
1	Tilt Mount	5	Holding Screws
2	Detector Holding Plate	6	Washers
3	Mounting Plate	7	IR3 Detector Direct Mounting Holes
4	Locking Screw		

Figure 6: IR3 Detector and Tilt Mount Assembly



	Description		
1	Tilt Mount	3	Mounting Plate
2	Detector Holding Plate	4	Locking Screw

Figure 7: Tilt Mount Assembly - Outline Drawing

6.5 Detector Installation

In order to comply with intrinsically safe requirements when the detector is used in hazardous areas, barriers must be incorporated. There will also be restrictions on cable types and lengths, depending on the type of barriers used.

1. Choose the wiring configuration according to *Typical Wiring Configurations* on page 53.
2. Connect the wire to the required PIN on the connector or choose the required color on the cable, according to your wiring.
3. Connect the grounding wire to general screw outside the detector (Figure 2 and Figure 3). The detector must be well grounded to earth ground for proper operation.

6.6 Wiring Function

Refer to Figure 8 and Figure 9.

The following describes the function of each electrical wire of the detector:

- Power Supply
  - PIN No. 1 or red wire - used for input power
  - PIN No. 2 or black wire - used for return
- Manual Bit Activation
  - PIN No. 11 or yellow wire - used for the Manual BIT activation.
  - The manual BIT is initiated by a momentary connection of the 11 (yellow wire) to the power supply return line.
- Fault Relay

  The fault output is a N.C. SPST contact relay:
  - PIN No. 5 or brown wire
  - PIN No. 6 or light blue wire

  The contact is normally energized closed when the detector is in its normal operational condition.
- Alarm Relay
  The alarm output is a N.O. SPST contact relay.
  - PIN No. 7 or orange wire
  - PIN No. 8 or violet wire
- 4–20mA Output
  - This output is used for analog, 4–20mA current output:
  - PIN No. 11 or pink wire is used as output (+)
  - PIN No. 12 or blue wire is used as input (-)

  - See *Typical Wiring Configurations* on page 53 for more details.
- RS-485
  - This output is used for a communications network as specified in *Typical Wiring Configurations* on page 53.
  - PIN No. 10 or white wire is the positive (+) lead
  - PIN No. 9 or gray wire is the negative (-) lead
- Ground
  - Pin No. 12 or green wire is used for ground connection.

6.7 Operation Mode

The detector is supplied with a default function setup as follows:

Table 18: Detector Default Setup

Function	20/20MI-1	20/20MI-3
Sensitivity	20	5
Delay	A	0
Alarm Latch	No	No
Automatic BIT	Yes	Yes
Alarm BIT	No	No

You can reprogram the function setup through RS-485 using a PC with a SPECTREX host, or using a handheld unit. Refer to *Manual TM 768050* for instructions.

6.7.1 Programmable Function

Modes of operation are programmable with a PC or handheld unit according to the selection table in *Sensitivity Ranges* on page 30. Refer to TM 784050 for further instructions.

6.7.2 Address

The detector has the capability of acting as an addressable device.

The detector provides 247 (1-247) addresses, which can be used by the RS-485 communications link as described above. Refer to *TM 784050* for further instructions.

6.7.3 Alarm Delay

An alarm delay may be required for certain applications. The detector has an alarm delay that permits time delays from 0, anti-flare, 3, 5, 10, 15, 20, and 30 seconds respectively. The delay can be defined by the RS-485.

Refer to *Manual TM 768050* for further instructions.

7 Operating Instructions

This chapter describes how to power up and test the detector. It also includes some very important safety checks that you should make before operating the detector.

7.1 Scope

The following instructions are designed to obtain optimal performance from the detector over its life cycle.

7.2 Power Up

To power up the detector:

1. Apply power and wait approximately 60 seconds for the automatic self-test of the detector.

   Note: Applying power initiates the following sequence:

   - 4Hz LED flashes yellow and the BIT is executed
   - If successful, the 1Hz LED flashes green, and the fault relay contacts close.

2. **Wiring Inspection**: If a short-circuit or line discontinuity exists, fault indications appear on the control unit display panel. Check your wiring.

   The detector is in fault state when the supply voltage drops under 16.5V. The detector status returns to normal when the supply voltage is above 17.5V.

3. **Detector Inspection**: Visually inspect the viewing window of the detector. It should be clean and clear. Verify the following:

   - 1Hz LED flashes green
   - Alarm relay is N.O.
   - Fault relay is N.C.
   - 4–20mA output is 5mA

4. If any of the outputs or indications is different from the description in step 3, see *Troubleshooting* on page 52.

The flame detector is now ready for functional testing.

7.3 Reset

Note: This is available only when the optional latched alarm has been selected.

To reset a detector when in it is in alarm state, disconnect the power.

7.4 Functional Testing

The detector can be tested for proper functioning using the Manual Built-in-Test or the SPECTREX IR3 Flame Simulator - FS-1100.

7.4.1 Manual BIT Test

Momentarily connecting PIN number 11 (yellow wire) with PIN 2 (black wire) causes a manual BIT to be performed.

Important: If the function setup "Alarm BIT" is on YES, then the alarm and 4–20mA output will be activated during a manual BIT. Automatic extinguishing systems or any external devices that may be activated during BIT must be disconnected.

- Verify that the detector is properly connected.
- Initiate a manual BIT. After a few seconds the following occurs:
  - Alarm relay is activated.
  - The 4–20mA output turns to 15mA for 3 seconds (only if "Alarm BIT" is set to YES).
  - The LED stays red for 3 seconds.
  - Fault Relay stays N.O. during the test.

7.4.2 Testing with Flame Simulator Model FS-1100

Refer to instructions in *IR3 Flame Simulator FS-1100* on page 57.

This test simulates an exposure of the detector to a real fire condition. The detector is exposed to radiation at the required detection level. As a result, the detector will generate a fire alarm signal.

Important: If the detector is exposed to a flame simulator, the alarm relay and 0–20mA will be activated during the simulation. Therefore, automatic extinguishing systems or any external devices, which may be activated during this process, must be disconnected.

To test with Flame Simulator Model FS-1100:

1. (If the detector is on, skip this step.)

   Apply power to the system and wait up to 60 seconds for the detector to return to the normal state.

   The 1Hz LED flashes green.

2. Aim the SPECTREX Flame Simulator Model FS-1100 at the target point of the detector (see Figure 14: Flame Simulator), in such a way that the radiation emitted by it is facing directly towards the detector. (See *IR3 Flame Simulator FS-1100* on page 57)

3. Press the operation button once. After few seconds, the following occurs:

   - The LED lights up red constantly for a few seconds.
   - The 4–20mA output turns to 15mA for a few seconds, and then returns to 4mA.
   - The alarm relay also turns on.

This completes the installation procedure. The detector and system are now ready for operation.

7.5 Safety Precautions

After power-up, the detector requires almost no attention in order to function properly, but the following should be noted:

- Follow the instructions in the manual and refer to the drawings and specifications issued by the manufacturer.
- Do not expose the detector to radiation of any kind unless required for testing purposes.
- Do not open the detector housing while the power is on.
- Do not touch internal parts other than the 3 functional switches. Interference with internal circuits may impair detector performance and will invalidate the SPECTREX warranty.
- Disconnect external devices, such as automatic extinguishing systems, before carrying out any maintenance.

8 Maintenance Instructions

This section deals with preventive maintenance, describes possible faults in detector operation and indicates corrective measures. Ignoring these instructions may cause problems with the detector and may invalidate the warranty. Whenever a unit requires service, please contact the manufacturer or its authorized distributor for assistance.

8.1 Maintenance Instrumentation and Personnel

The detector's maintenance requires ordinary tools and suitably qualified personnel, who should be familiar with local codes and practices.

8.2 Preventive Maintenance Procedures

The detector must be kept as clean as possible. The viewing window and the reflector flame detector must be cleaned on a periodic basis. The frequency of cleaning operations depends upon the environmental conditions and specific applications. The fire detection system designer will give his recommendations.

To clean the detector:

1. Disconnect power to the detector before beginning any maintenance including lens cleaning.
2. To clean the detector viewing window and reflector, use water and detergent, and rinse with clean water.
3. Where dust, dirt, or moisture accumulate on the window, first clean with a soft optical cloth and detergent, and then rinse with clean water.

8.3 Periodic Maintenance Procedures

In addition to preventive cleaning and maintenance, the detector should be functionally tested every 6 months. This test should also be carried out if for any reason the detector has been opened for any reason.

8.3.1 Power-Up Procedure

Perform the power-up procedure every time power is restored to the system. Follow the instructions in *Power Up* on page 47.

8.3.2 Functional Test Procedure

Perform a functional test of the detector as described in *Functional Testing* on page 48.

8.4 Maintenance Records

It is recommended that maintenance operations performed on a detector are recorded in a logbook. The record should include the following:

- Installation date
- Contractor
- Serial and tag number
- Entries for every maintenance operation performed, including the description of the operation, date, and personnel ID.

If a unit is sent to SPECTREX or a distributor for service, a copy of the maintenance records should accompany it.

8.5 Troubleshooting

8.5.1 Fault Indication

To identify the fault indication:

1. Check power supply for correct voltage, polarity, and wiring.
2. Check detector window and reflector for cleanliness. If necessary, clean the window as indicated in *Periodic Maintenance Procedures* on page 51, and then repeat the test.
3. Disconnect the power supply to the system and check the detector's internal wiring.

Reconnect the power supply and wait approximately 60 seconds. Repeat the test. If the 4Hz LED still flashes yellow, the unit requires service.

8.5.2 False Alarm or Warning Indication

To identify the false alarm or warning indication:

1. Disconnect the power supply from the system and check the internal wiring.
2. Reconnect the power supply and wait approximately 60 seconds. If the indication remains, the unit requires service.

8.5.3 RS-485 Communications Network

Using the RS-485 network capability of the IR3 detector and control software, you can connect up to 32 detectors in an addressable system with only 4 wires (2 for power and 2 for communication). Using repeaters, the number of detectors can be much larger (32 detectors for each repeater) up to 247 on the same 4 wires. When using the RS-485 network, you can read each detector status (FAULT, WARNING, ALARM) and initiate a BIT for each detector individually.

Appendix A Typical Wiring Configurations

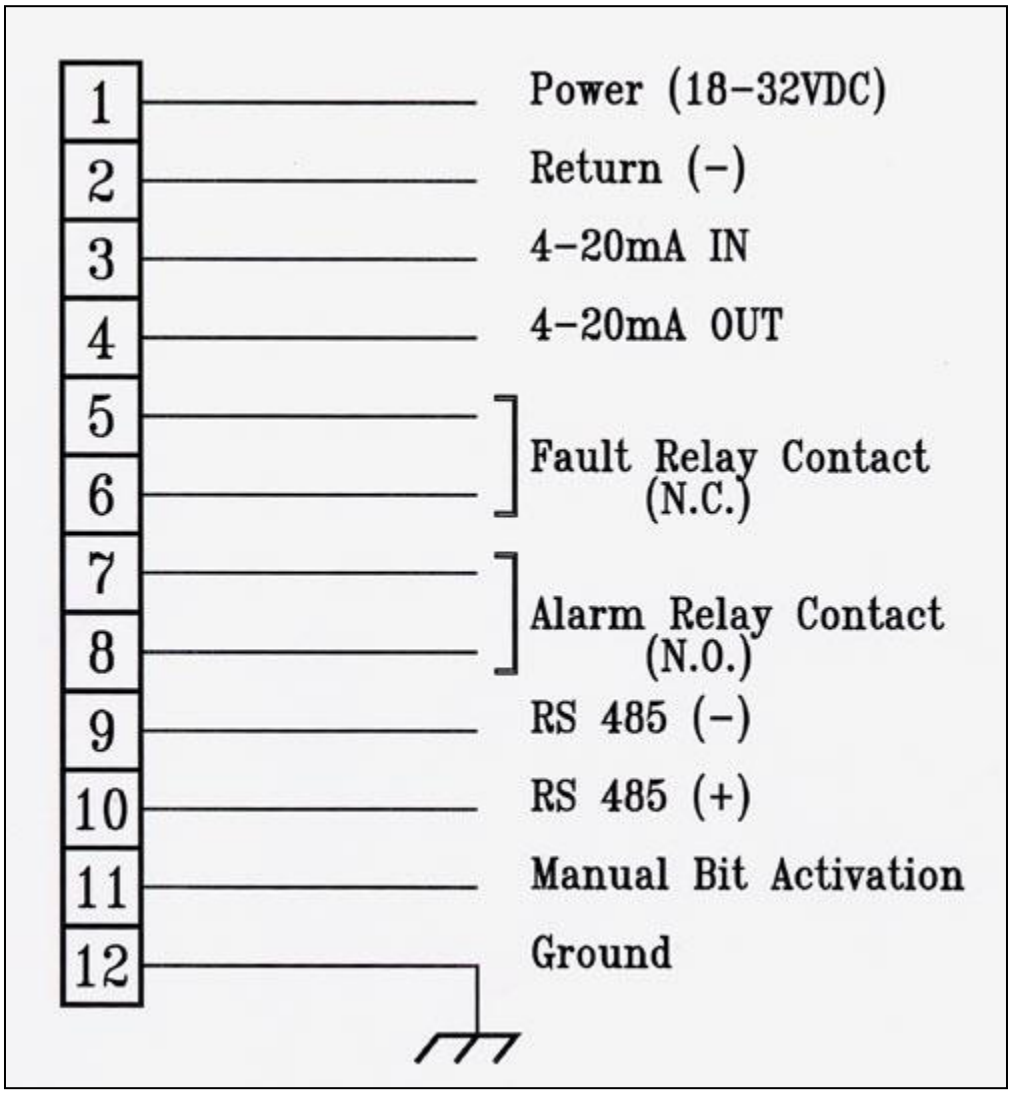


Figure 8: Connector Interface Option

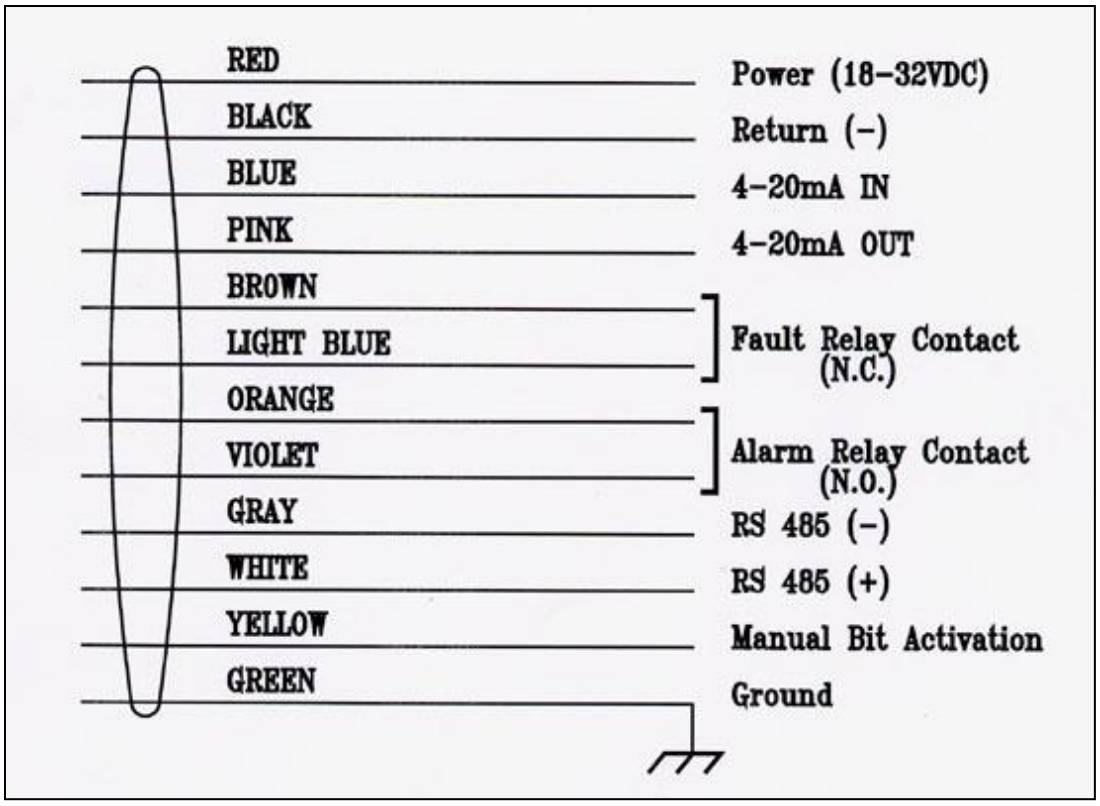


Figure 9: Cable Interface Option

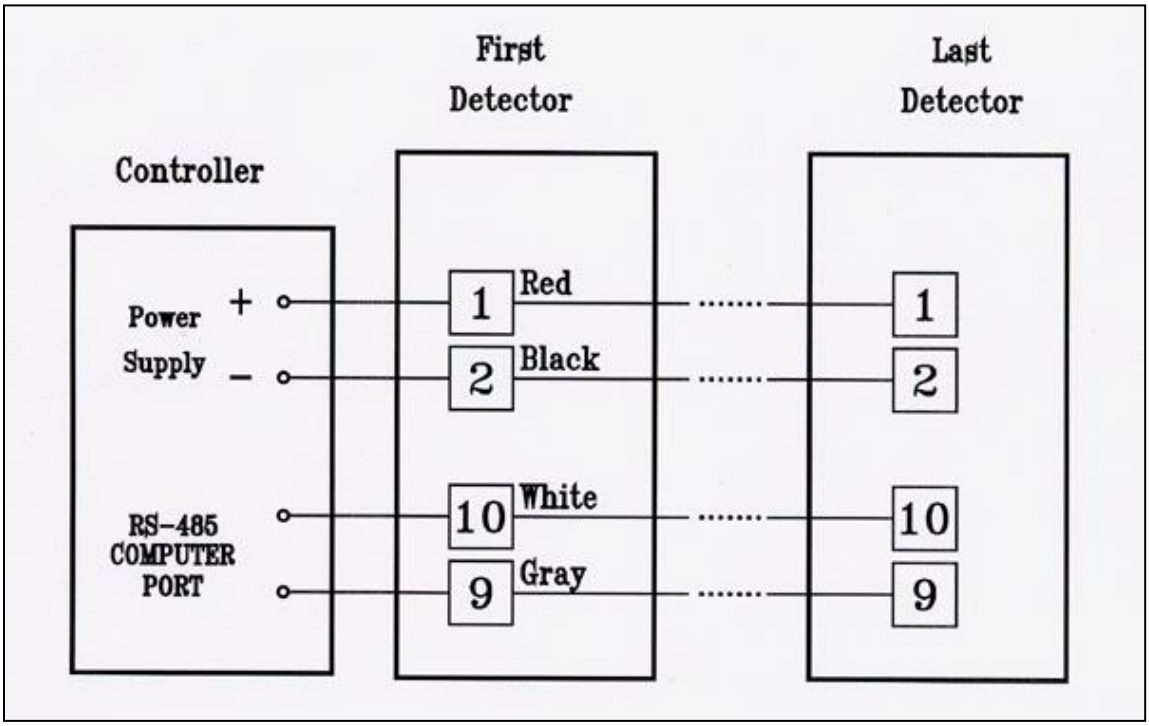


Figure 10: RS-485 Networking

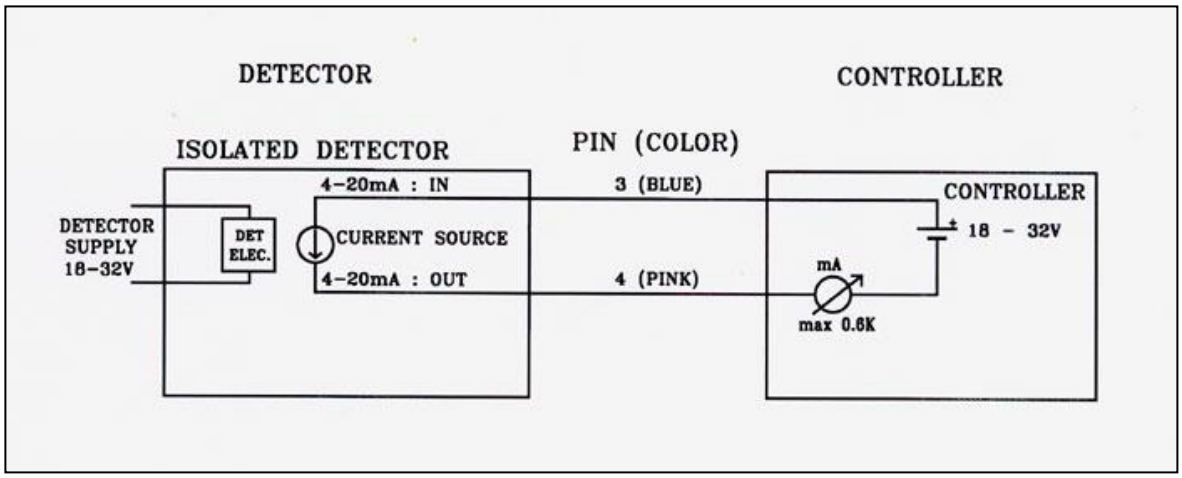


Figure 11: 4–20mA Wiring (Sink Option)

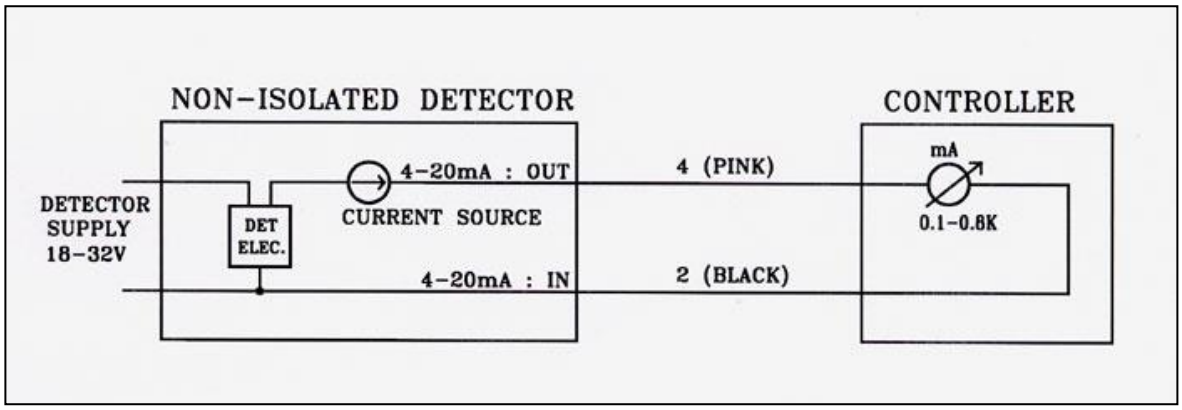


Figure 12: 4–20mA Wiring (Source Option)

Notes: The detectors are factory set to isolated 4–20mA-sink versions. To work at a non-isolated 4–20mA source version, connect PIN 3 or the blue wire to PIN 1 or the red wire. This can be done on the mating connector or in the junction box in the cable option. The 4–20mA will be measured between PIN 4 or the pink wire and PIN 2 or the black wire.

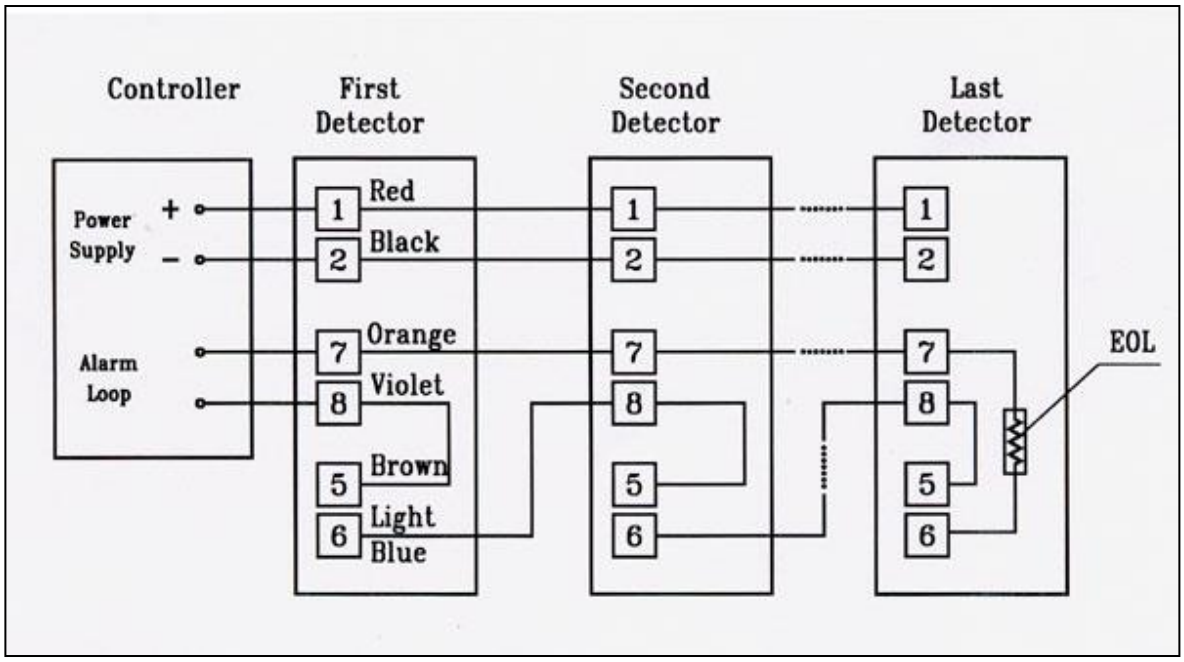


Figure 13: Typical Wiring for 4 Wire Controllers

Notes:

- For EOL resistor value see the Controller Manual.
- The color wire refers to the color of the cable output option. The PIN No. refers to the connector option.

Appendix B IR3 Flame Simulator FS-1100

B.1 Description

The Flame Simulator FS-1100 is designed specifically for use with SharpEye Flame Detectors. The flame simulator emits IR radiation in a unique sequential pattern corresponding to and recognizable by the detector as fire, which allows the detectors to be tested under simulated fire conditions without the associated risks of an open flame.

Figure 14: Flame Simulator

B.2 Operation

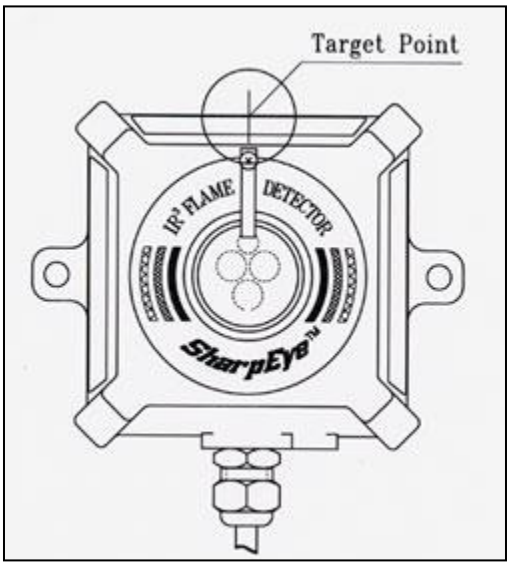


Figure 15: Mini IR3 Detector Target Point

Warning: Do not open the flame simulator to charge the batteries or for any other reason in a hazardous area.

Caution:	**The following test will simulate a real fire condition and may activate the extinguishing system or other alarms. If this is not desired, disconnect/inhibit them before the test and reconnect after the simulation.**

To simulate a fire:

1. Stay at a distance of at least 50cm/20” from the detector.
2. Using the mechanical sight, aim the flame simulator toward the target point of the detector.
3. Press the operation button once. The flame simulation will last for 20 seconds. The detector will send an alarm signal (solid red LED).
4. Wait 20 seconds before repeating the test.
5. Make sure the optical window is clean and keep the Flame Simulator in a safe place when not in use.

B.3 Charging the Battery

The flame simulator uses NiCad batteries as a rechargeable power source. When the batteries are fully charged, the simulator operates at least 60 times without recharging. An internal buzzer is sounded when the voltage from the batteries is lower than the required operational level.

To charge the battery:

1. Place the flame simulator on a table in a safe area, not exceeding 104°F/40°C.
2. Turn the sealed plug (next to the operation button) counter-clockwise with a suitable wrench.
3. Connect the battery charger.
4. Charge for a maximum of 14 hours.
5. Disconnect the charger.
6. Tighten the sealed plug clockwise.

Appendix C FM Report for 20/20MI-3

Examination and Test

Four samples of Model 20/20MI-3 Flame Detector, representative of production units, were examined and tested at FM Approvals in Norwood, Massachusetts.

One sample was examined, tested, and compared to the manufacturer's drawings.

All documentation applicable to this program is on file at FM Approvals.

Stability Test

One Model 20/20MI-3 flame detector was energized and tested to verify proper operation under normal, standby conditions. Continued operation of this sample was monitored for 30 days in clean-air (working office type): there was no evidence of instability or false signals during that period.

Baseline Sensitivity Test

All 4 samples of the 20/20MI-3 Flame Detectors were subjected to a small-scale sensitivity test consisting of a 1.75"/4.5cm diameter fire of n-Heptane at a distance of 3ft/1m from the detector. The average results for all 4 samples were as follows:

Model 20/20MI-3 at 3 ft/1m: 1.5 seconds.

Flame Response Sensitivity Test

All 4 samples of the Model 20/20MI-3 were exposed to the standard test consisting of a 12 x 12" / 0.3 x 0.3m pan fire with fuels noted below. The tests were conducted at FM Approvals in Norwood, MA, and the average results for all 4 samples are as follows:

Detector Model	Fuel	Distance to Fire (ft/m)	Sensitivity setting	Response (seconds – average)
20/20MI-3	n-heptane	33/10	10	3.0
20/20MI-3	n-heptane	24.7/7.5	7.5	4.2
20/20MI-3	n-heptane	16.5/5	5	4.1
20/20MI-3	n-heptane	8.2/2.5	2.5	8.2
20/20MI-3	Diesel	23.1/7	10	3.8
20/20MI-3	Diesel	17.3/5.3	7.5	5.5
20/20MI-3	Diesel	11.5/3.5	5	6.4
20/20MI-3	Diesel	5.7/1.7	2.5	9.2
20/20MI-3	Ethyl Alcohol	24.8/7.5	10	4.6
20/20MI-3	Ethyl Alcohol	18.5/5.6	7.5	3.2
20/20MI-3	Ethyl Alcohol	12.4/3.8	5	4.8
20/20MI-3	Ethyl Alcohol	6.1/1.8	2.5	3.6
20/20MI-3	Jet A	23.1/7	10	1.9
20/20MI-3	Jet A	17.3/5.3	7.5	4.3
20/20MI-3	Jet A	11.5/3.5	5	6.1
20/20MI-3	8”/20cm dia. Pan polypropylene pellets.	8/2.4	10	1.9

Field of View Test

One sample of the Model 20/20MI-1, which has an identical enclosure to the 20/20MI-3 and is considered representative of the series, was exposed to the 12 x 12" / 0.3 x 0.3m n-heptane pan fire during which time the viewing angle was varied +/–50º from the centerline along the horizontal and vertical axes. The following results were obtained:

Angle (Approximate)	Distance	Average Response Time
On centerline	33/10	3sec
+ 50º horizontal	16.5/3	8.7sec
– 50º horizontal	16.5/3	8.1sec
+ 50º vertical	16.5/3	8.8sec
– 50º vertical	16.5/3	12sec

False Stimuli Response Test

All 4 samples of the Model 20/20MI-1 with sensitivity setting 10, considered representative of the series, were tested in the presence of modulated and non-modulated artificial sources of light and other heated bodies. Then, in the presence of each of the false stimuli, the models were exposed to the standard test consisting of a 12 x 12"/ 0.3 x 0.3m n-heptane pan fire. The false stimuli sources were as follows:

Resistive Electric Heater (1350W) at 3ft/1m

Fluorescent light (40W) at 3ft/1m

Halogen light (500W with lens) at 3ft/1m

Incandescent Light (100W) at 3ft/1m

Arc welding with setting at 200A at 10ft/3m using 7011 rod and steel plate.

The detectors produced no trouble or false alarm signals in the presence of these false stimuli at the distance specified, and they continued to respond satisfactorily to the test fire in the presence of these sources.

Technical Support

For technical assistance and support, contact:

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