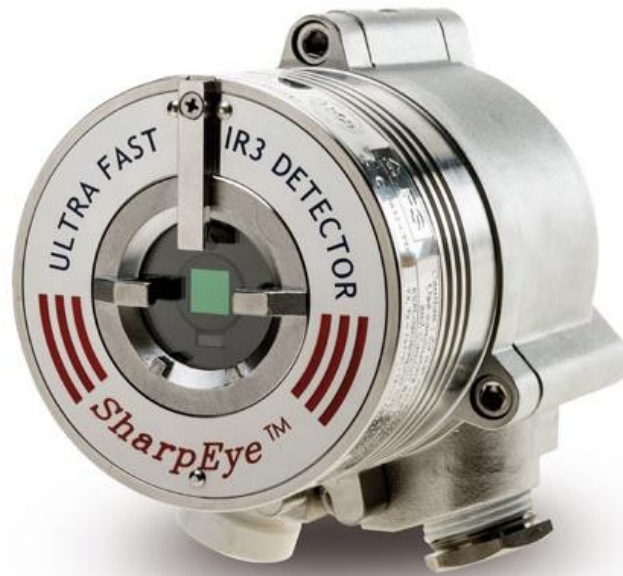


SharpEye™

Model 40/40UFI Ultra-Fast IR3 Flame Detector User Guide



FM, CSA Approved

Class I Div. 1 Groups B, C, D
Class II/III Div. 1 Groups E, F, G

ATEX, IECEx Approved

Ex II 2G D
Ex db eb op is IIC T4 G b
Ex tb op is IIIC T96°C Db

Document ref: TM 40/40UFI, Rev (7) February 2017



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Warning: This manual should be read carefully 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.

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About this Guide

This guide describes the SharpEye Model 40/40UFI Ultra-Fast 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 overview of the product, principles of operation, and performance considerations.
- **Chapter 2, Installing the Detector**, describes how to install the detector including preparations before installation, wiring and mode settings.
- **Chapter 3, Operating the Detector**, describes how to power-up and test the detector. The chapter also lists safety precautions you should take when operating the detector.
- **Chapter 4, Maintenance and Troubleshooting**, describes basic maintenance, troubleshooting, and support procedures.
- **Appendix A, Technical Specifications**, lists the detectors' technical and other specifications.
- **Appendix B, Wiring Instructions**, lists the wiring instructions for connecting the detector and also provides examples of typical wiring configurations.
- **Appendix C, RS-485 Communication Network**, provides an overview of the RS-485 communications network.
- **Appendix D, Accessories**, describes the accessories available for the detector.
- **Appendix E, SIL-2 Features**, describes the special conditions for compliance with EN 61508 for SIL 2 requirements according to TÜV.

Abbreviations and Acronyms

Abbreviation	Meaning
ATEX	Atmosphere Explosives
AWG	American Wire Gauge
BIT	Built In Test
EMC	Electromagnetic Compatibility
EOL	End of Line
FOV	Field of View
HART	Highway Addressable Remote Transducer-communication protocol
IAD	Immune at Any Distance
IECEX	International Electrotechnical Commission Explosion
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
SIL	Safety Integrity Level
UNC	Unified Coarse Thread
VAC	Volts Alternating Current

1 Introduction

➤ In this chapter...

<i>Overview</i>	<i>page 13</i>
<i>Model and Types</i>	<i>page 14</i>
<i>Features and Benefits</i>	<i>page 15</i>
<i>Principles of Operation</i>	<i>page 16</i>
<i>Performance Considerations</i>	<i>page 20</i>
<i>Internal Detector Tests</i>	<i>page 27</i>

1.1 Overview

The SharpEye 40/40UFI is a flame detector that utilizes improved IR3 technology to provide state-of-the-art fire protection. The 40/40UFI uses patented digital signal processing to analyze the spectral and dynamic characteristics of the measured infrared radiation, to identify fire events with exceptional sensitivity and extreme immunity to false alarms.

All 40/40 series detectors include a heated optical window for improved performance in ice, snow, and condensation conditions.

Detection performance can be easily adapted to all environments, applications, **and requirements, by changing the detector's configuration** parameters. Adjusting these parameters, as well as performing other maintenance and monitoring tasks, is possible by means of RS-485-based Modbus communication or HART communication (in models with 0–20mA output).

The detector enclosure is ATEX certified Exd flameproof with an integral, segregated, rear, Exe terminal compartment (avoiding exposure of the sensors and electronics to the surrounding environment). Hence the combined approval:

Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T96°C Db
(–55°C ≤ Ta ≤ +75°C)

or

Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T106°C Db
(–55°C ≤ Ta ≤ +85°C)

The SharpEye 40/40 detector is designed to operate as a stand-alone unit directly connected to an alarm system or an automatic fire extinguishing system. The detector can also be a part of a more complex system, where many detectors and other devices are integrated through a common control unit.

1.2 Model and Types

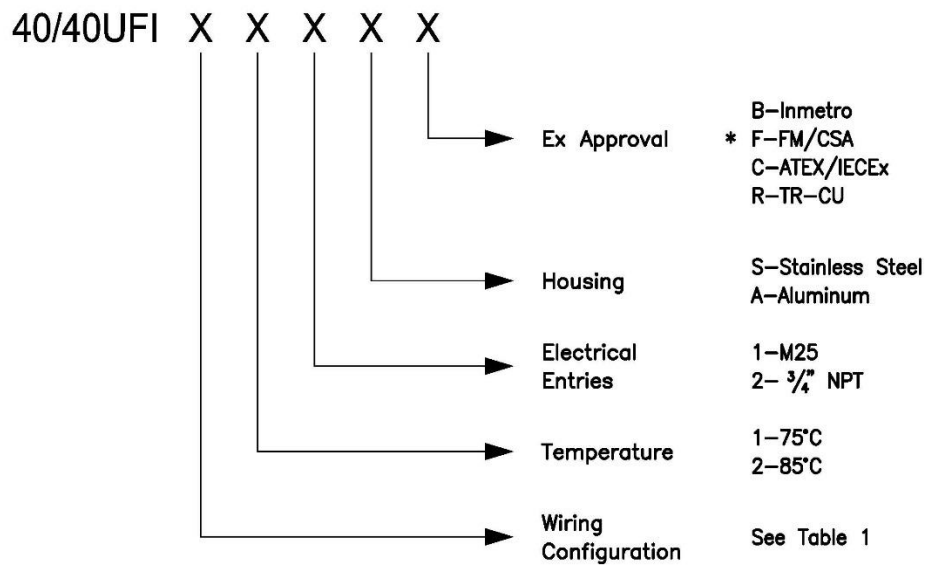
The 40/40UFI Flame Detector is provided in various configurations depending on:

- Wiring options
- Temperature ranges
- Type of cable entries
- Housing material type
- Required approval

The configuration detail is included in the product part number on the product label and takes the form: 40/40UFI-XXXXX, where XXXXX defines the model according to the above requirements.

To modify the default or pre-ordered configuration and perform maintenance tasks, please refer to the *HART Protocol TM777030*, the *RS-485 Manual TM 777050* or *TM777070*.

The Part Numbers are defined as:



Note:

*Aluminum housing is not available in the FM version.

Table 1 describes the wiring options in detail.

Table 1: Wiring Options

Wiring Option	Connections Provided						
	Power	Analog Output	Fault Relay N.C.	Alarm Relay N.O.	0-20mA Sink	RS-485	HART
1	Power	Analog Output	Fault Relay N.C.	Alarm Relay N.O.	0-20mA Sink	RS-485	HART
2	Power	Analog Output	Fault Relay N.C.	Alarm Relay N.O., N.C.	0-20mA Source	RS-485	HART
3	Power	Analog Output	Fault Relay N.O.	Alarm Relay N.O., N.C.	0-20mA Source	RS-485	HART
4	Power	Analog Output	Fault Relay N.C.	Alarm Relay N.O.	Auxiliary N.O.	RS-485	-
5	Power	Analog Output	Fault Relay N.O.	Alarm Relay N.O.	Auxiliary N.O.	RS-485	-

Note: Wiring option 1 is the **default**. The mA "Sink" output can be altered to "Source" type, with a link between terminals 1 and 8. No other wiring options can be changed onsite.

For example, product number 40/40UFI-321SC has the following options:

- **Wiring Option:** 3 (Power, Analog Output, RS-485, 0-20mA [Source] with the HART protocol, Fault Relay [N.O.], Alarm Relay [N.O., N.C.]
- **Temperature Range:** 2 (85°C)
- **Cable Entry:** 1 (M25)
- **Housing :** S (Stainless Steel)
- **Approval:** C (ATEX, IECEx)

Note: Check your specific part numbers against the information in *Checking the Product Type* on page 32.

1.3 Features and Benefits

- Detection Range: Up to 300ft/90m for a 1ft²/0.1m² n-heptane fire.
- High Speed Response: 50msec for 1ft diameter sphere methane-air mixture explosion at 20m.
- Ultra High Immunity to False Alarms: See Table 4 on page 23.
- Advanced Digital Processing of the Dynamic Characteristics of Fire: Flickering, threshold correlation and ratio.

- Multi IR Channels: Between 2–5 μ m.
- Field Programmable Sensitivity: 4 ranges to avoid zone crossover.
- Built In Test (BIT): Automatic (see **Built-In-Test (BIT)** on page 28).
- Heated Window: Prevents effects of ice, snow, and condensation.
- Electrical Interface:
 - Dry contact relays
 - Communication network RS-485
 - 0–20mA output
- HART Protocol: Communication protocol (see **HART Protocol** on page 17).
- Exde: Integral junction box for easy wiring.
- SIL-2: Per TÜV.
- Hazardous Area Certification: ATEX, IECEx, FM, and CSA.
- Functionality Approval:
 - EN54-10 approved per VdS
 - FM approved per FM3260
- Accessories are approved as part of ATEX and IECEx approval.

1.4 Principles of Operation

This section describes the 40/40UFI principles of operation and includes:

- Hydrocarbon Fire Detection, page 16
- Heated Optics, page 17
- HART Protocol, page 17
- RS-485 Modbus, page 18
- Product Certification, page 18

1.4.1 Hydrocarbon Fire Detection

The SharpEye 40/40UFI Detector is designed to detect flames in which carbon dioxide (CO₂) is produced in the combustion process. These include all hydrocarbon flames, as well as other types of flames and burning materials such as wood or alcohol.

The detector's principle of operation is based on patented IR3 technology. This technology identifies the unique spectral signature that hot CO₂ has in the infrared (IR), namely a peak of intensity at wavelengths of 4.2–4.7 μ m.

The original IR3 technique (such as implemented in the SharpEye 20/20I Flame Detector) utilizes 3 infrared sensors, each sensitive to its own wavelength range. The first sensor is sensitive to wavelengths within the emission peak of hot CO₂. The other 2 sensors are sensitive to wavelengths above and below this peak. In the event of fire, the signal measured in the first sensor is significantly higher than those measured in the other 2 sensors. In order to trigger a fire alarm, these and other conditions must be met (for example, radiation is flickering in frequencies typical of flames). The detector does not react when exposed to non-fire radiation sources.

The SharpEye 40/40UFI also includes an additional IR sensor, sensitive to a different band within the emission peak of hot CO₂. This **sensor's** signal is compared to those of the other 3, thereby increasing sensitivity for some types of flames, such as gas flames.

1.4.2 Heated Optics

The SharpEye 40/40 Flame Detector uses heated optics. The heater increases the temperature of the optical surface by 5–8°F / ~3–5°C above the ambient temperature to improve performance in ice, condensation, and snow conditions.

The heated optics can be set to one of the following:

- Not operated.
- On continuously.
- Automatic, per temperature change (default): you can define the start temperature below which the window is heated. (The default is 41°F/5°C.) This temperature can be defined from 32°F/0°C to 86°F/30°C. The heating stops when the temperature is 27°F/15°C above the start temperature.

For more information, see *Configuring Your Detector* on page 41.

1.4.3 HART Protocol

The 40/40 Flame Detectors use the HART protocol.

HART Communication is a bi-directional industrial field communication protocol used to communicate between intelligent field instruments and host systems. HART is the global standard for smart process instrumentation and the majority of smart field devices installed in plants worldwide are HART-enabled. HART is available in wiring options 1, 2, and 3, see Table 1, page 15.

HART technology is easy to use and very reliable.

Through the HART connection, you are able to perform:

- Detector setup
- Detector troubleshooting
- Detector health and status

For more details, refer to the *HART Manual TM 777030*.

1.4.4 RS-485 Modbus

For more advanced communications, the 40/40UFI detector has an RS 485 Modbus-compatible output that provides data communication from a network (up to 247 detectors) to a host computer or universal controller for central monitoring. This feature allows for reduced installation costs, easy maintenance, and local or remote diagnostic tools.

1.4.5 Product Certification

The 40/40UFI Flame Detectors have the following certifications:

- ATEX, IECEx, page 18
- FM, CSA, page 19
- SIL-2, page 19
- EN54-10, page 19
- Inmetro (UL), page 19
- TR CU/EAC, page 20

1.4.5.1 ATEX, IECEx

The 40/40UFI Flame Detector is certified to:

- ATEX per SIRA 07ATEX1250X and IECEx per IECEx SIR 07.0085X

Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T96°C Db
(-55°C ≤ Ta ≤ +75°C)

or

Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T106°C Db
(-55°C ≤ Ta ≤ +85°C)

The accessories, Tilt Mount P/N 40/40-001, Weather Cover P/N 777163 and P/N 777268, Duct Mount P/N 777670 and Air Shield P/N 777650 are included in the approval.

This product is suitable for use in hazardous zones 1 and 2 with IIC gas group vapors present, and zones 21 and 22 with IIIC dust type present.

1.4.5.2 FM, CSA

The 40/40UFI Flame Detector is approved per FM and CSA Explosion Proof and Functionality per FM3260:

- Class I, Division 1, Groups B, C and D.
- Dust Ignition Proof – Class II/III Division 1, Groups E, F and G.
- Ingress Protection – IP67, IP66, NEMA 250 Type 6P.
- Fuel Test Response including: Gasoline, N-Heptane, Diesel, JP5, Kerosene, Ethyl, Alcohol 95%, IPA, Methanol, Methane, LPG, Polypropylene, and Paper.
- For more details see FM Report Project ID3029553, and CSA Report No. 2451134.

1.4.5.3 SIL-2

The 40/40UFI Flame Detector is approved per SIL-2 requirement per IEC 61508.4, Chapter 3.5.12.

The alert condition according to SIL-2 can be implemented by:

- Alert signal via 0–20mA current loop
or
- Alert signal via alarm relay and fault relay
- For more details and guidelines for configuring, installing, operating, and service, see *SIL-2 Features* on page 81 and TÜV Report No. 968/EZ 348.04/16.

1.4.5.4 EN54-10

The 40/40UFI Flame Detector is approved per EN54-10 and CPD.

- The detector is listed as Class 1 for sensitivity settings 30, 45 and 65, and Class 2 for sensitivity setting 15.
- The detector is approved per EN54-10 by VdS.
- This test includes a functional test, environmental test, EMI/EMC test, and software check.
- For more details see VdS Report No. BMA 150190-AU01+BZA02-PB01.

1.4.5.5 Inmetro (UL)

The 40/40UFI Flame Detector is in compliance with the standards ABNT NBR IEC 60079-0, ABNT NBR IEC 60079-1, ABNT NBR IEC 60079-7, ABNT NBR IEC 60079-18, ABNT NBR IEC 60079-31, and INMETRO decree No. 179 as of May 18th, 2010. Further details may be found on Certificate of Compliance No. UL-BR 16.065XX.

1.4.5.6 TR CU/EAC

The 40/40UFI Flame Detector is in compliance with the standard TR CU 012/2011 per:

1Ex d e IIC T5 Gb X
Ex tb IIIC T96°C Db X
 $-55^{\circ}\text{C} \leq T_a \leq +75^{\circ}\text{C}$

or

1Ex d e IIC T4 Gb X
Ex tb IIIC T106°C Db X
 $-55^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$.

For more details, see TR CU certificate No. TR CU C- US.MIO62.B.04333.

1.5 Performance Considerations

This section describes performance aspects of the 40/40UFI and includes:

- Detection Sensitivity, page 20
- Cone of Vision, page 21
- False Alarm Prevention, page 23
- Visual Indicators, page 24
- Output Signals, page 25
- Detector Status, page 26
- Auxiliary Relay as End-of-Line , page 27

1.5.1 Detection Sensitivity

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

1.5.1.1 Standard Fire

Defined as a 1ft²/0.1m² n-heptane pan fire, with maximum wind speed of 6.5ft/sec / 2m/sec.

1.5.1.2 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 for the alarm distance.

Alarm response times for a standard fire at a specified range are shown Table 2.

Table 2: Sensitivity Range Levels

Level	Response Time (sec)	Sensitivity Range (ft/m)
1	3	66/20
2 Default	1	132/40
3	2	200/60
4	2	300/90

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.

1.5.1.3 Other Fuels

The detector reacts to other types of fire as follows:

- The baseline fire refers to n-heptane 1ft²/0.1m² and is defined as 100% sensitivity.
- For fuel fire – standard pan fire size: 1ft²/0.1m².
- For gas flame – 30"/0.75m high, 10"/0.25m width plume fire.
- Maximum Response Time: 2 sec for 1x1ft n-heptane fire at 131ft/40m
10 sec for 1x1ft n-heptane fire at 300ft/90m

Table 3: Fuel Sensitivity Ranges

Type of Fuel	Percent of Max. Distance at Each Sensitivity Range	Max. Distance (ft/m)
Gasoline	100%	300/90
N-Heptane	100%	300/90
JP5	70%	205/62
Kerosene	70%	205/62
Diesel Fuel	70%	205/62
Ethanol 95%	60%	185/55
IPA	60%	185/55
Methanol	55%	160/48
Methane*	70%	205/62
LPG*	70%	205/62
Paper	38%	115/34
Polypropylene	55%	160/48

*30"/0.75m high, 10"/0.25m width plume fire

1.5.2 Cone of Vision

- **Horizontal:** 90°
- **Vertical:** 90°

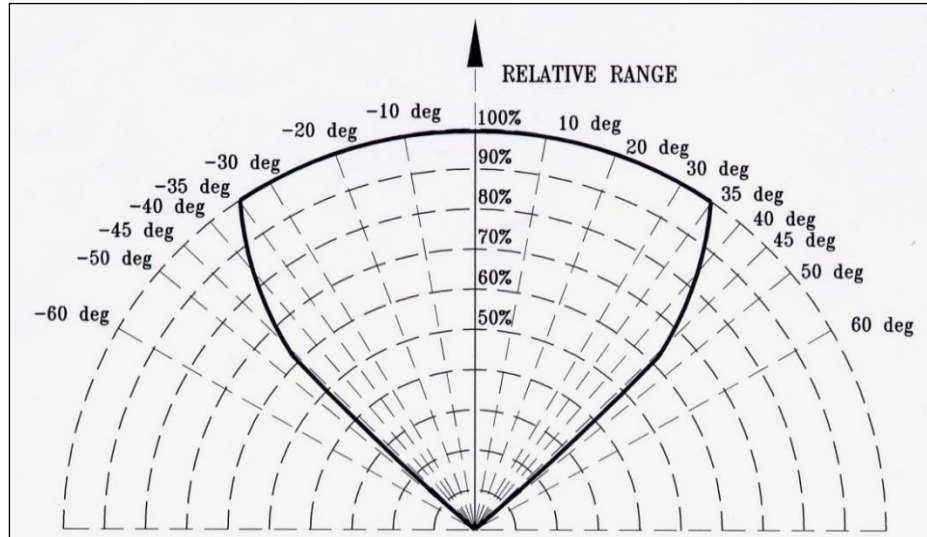


Figure 1: Field of View

1.5.3 False Alarm Prevention

To prevent false alarms, the detector will not alarm or react to the radiation sources specified in Table 4.

Table 4: Immunity to False Alarm Sources

Radiation Source	Immunity Distance ft/m
Indirect or reflected sunlight	IAD
Vehicle headlights (low beam) conforming to MS53023-1	IAD
Incandescent frosted glass light, 300W	IAD
Fluorescent light with white enamel reflector, standard office or shop, 70W (or 2 35W)	IAD
Electric arc [12mm / $15/32$ " gap at 4000V alternating current, 60Hz]	IAD
Arc welding [6mm / $5/16$ " rod; 210A]	See Table 5
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
Blue-green dome light conforming to M251073-1	IAD
Flashlight (MX 991/U)	IAD
Radiation heater, 3000W	>3/1
Radiation heater, 1000W with fan	IAD
Quartz lamp (1000W)	>3/1
Mercury vapor lamp	IAD
Grinding metal	IAD
Lit cigar	>1/0.3
Lit cigarette	>1/0.3
Match, wood, stick including flare up	>13/4

Notes:

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

Table 5: Welding Immunity Distance

Sensitivity Setting	Detection Range (ft/m)	Immunity Distance (ft/m)
1	66/20	>6/2
2	132/40	>12/4
3	200/60	>17/6
4	300/90	>25/7.5

1.5.4 Visual Indicators

One 3-color LED indicator is located inside the detector window, as shown in Figure 2. The detector statuses are listed in Table 6.

Table 6: LED Indications

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

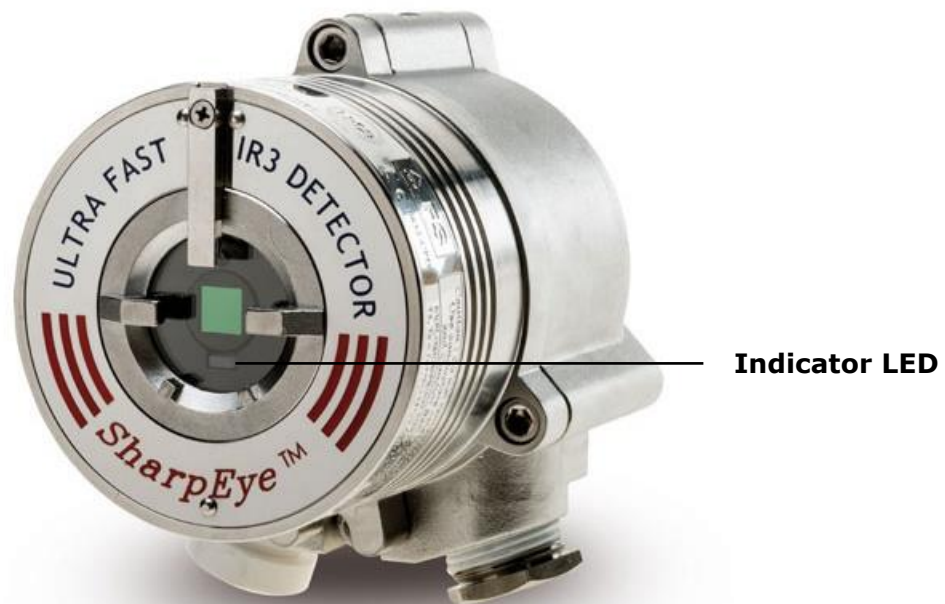


Figure 2: Indicator LED

1.5.5 Output Signals

Outputs are available according to the default configuration or the wiring options selected for the 40/40UFI detector. Determine the outputs for your model according to Table 7.

The detector incorporates several types of output suitable to different control systems:

- 0–20mA (stepped) with HART
- Relays (alarm, fault, auxiliary)
- RS-485 Modbus
- Analog Output: analog output proved ultra-fast, complying with 50msec detection

Table 7: Available Output Types

Output Type	Version	Detector Status
Alarm Relay	40/40UFI – Options 1XXXX, 4XXXX, and 5XXXX	The relay is N.O.
	40/40UFI – Options 2XXXX and 3XXXX	The relay is N.O. and N.C.
Auxiliary Relay	40/40UFI – Options 4XXXX and 5XXXX	The relay is N.O.
Fault Relay	40/40UFI – Options 1XXXX, 2XXXX, and 4XXXX	The relay is N.C. energized
	40/40UFI – Options 3XXXX and 5XXXX	The relay is N.O. energized
0–20mA Current Output	40/40UFI – Option 1XXXX	Sink with the HART protocol, (can be changed to Source – see Figure 9, Figure 10, and Figure 11)
	40/40UFI – Options 2XXXX and 3XXXX	Source with the HART protocol
RS-485	All versions	Modbus protocol

1.5.6 Detector Status

The possible detector function statuses are listed in Table 8. A more detailed fault analysis can be seen via HART or RS-485.

Table 8: Detector Status

Status	Description
Normal	Normal operation.
BIT	Built-In-Test being performed.
Warning	Fire detected - changed to Warning (pre-alarm state).
Alarm	Fire detected - changed to Fire Alarm state.
Latched Alarm (Optional)	The alarm outputs remain latched on following detection of a fire that has already been extinguished.
BIT Fault	A fault is detected during BIT sequence or other electric failure. The detector will continue to detect for fire.
Fault	A fault is detected when the power supply is too low, due to a software fault, or due to an electrical failure. The detector will NOT detect fire in this condition.

In each state, the detector activates different outputs, as specified in Table 9.

Table 9: Output Signals Versus Detector State

Detector State	LED Indicator	LED Mode	Alarm Relay	Auxiliary Relay	Fault Relay	mA output
Normal	Green	1Hz	Off	Off	On	4mA
Warning	Red	2Hz	Off	On ⁽⁴⁾	On	16mA
Alarm ⁽¹⁾	Red	Constant	On	On	On	20mA
Latched ⁽²⁾	Red	Constant	On	Off	On	20mA
				On ⁽⁴⁾	On	20mA
BIT Fault ⁽³⁾	Yellow	4Hz	Off	Off	Off	2mA
Warning at BIT Fault	Red	2Hz	Off	On ⁽⁴⁾	Off	16mA
Alarm at BIT Fault	Red	Constant	On	On	Off	20mA
Fault	Yellow	4Hz	Off	Off	Off	0mA

Notes:

- 1** The alarm outputs are activated while alarm conditions exist and will stop approximately 5 seconds after the fire is no longer detected.
- 2** The alarm state can be optionally latched via programmed function (default is non-latched).
- 3** The detector will remain in BIT Fault state until it has passed a successful BIT.

- 4 The auxiliary relay can be activated at the warning level or alarm level, depending on programmed function.
- 5 The outputs depend on the wiring options.

1.5.6.1 Optional Latching

Alarms are set as non-latching by default. However, the detector includes a latched alarm output capability, which operates according to the programmed function.

If selected, upon detection of a fire, the detection signal is latched until a manual reset is performed (disconnecting the power supply).

Latching affects the alarm relay, 0–20mA output, the alarm LED (the auxiliary relay will be latched only when the programmable function **auxiliary relay** is set to **YES**).

Notes:

- The auxiliary relay is available only in Models with suffix – 4XXXX and 5XXXX
- The 0–20mA is available only in Models with suffix – 1XXXX, 2XXXX, and 3XXXX

1.5.7 Auxiliary Relay as End-of-Line

The auxiliary relay can be used as End-of-Line in models with suffix– 4XXXX and 5XXXX only. In this case, the auxiliary relay is active as long as the detector is powered.

1.6 Internal Detector Tests

The detector performs 2 types of self-tests:

- Continuous Feature Test, page 27
- Built-In-Test (BIT), page 28

1.6.1 Continuous Feature Test

During normal operation, the detector tests itself continuously and indicates a fault if a failure is found. This type of test complies with SIL-2 requirements.

The detector continuously tests:

- Input voltage level
- All internal regulator voltage levels
- Voltage level status of sensor and sensor circuitry for noise or disconnection in the electronic circuitry
- 0–20mA level output
- Relays and heater operation
- Processor watchdog

- Software
- Memory
- Oscillator frequency

Response to Fault Indication

If a failure is found, the detector indicates by:

- Fault relay:
 - Opens in wiring options 1, 2, and 4
 - Closes in wiring options 3 and 5
- 0–20mA : indicates fault (0mA or 2mA) in wiring options 1, 2, and 3
- LED – Yellow flashes (4Hz)
- Correcting the fault

The fault indications remain until the detector’s power is removed. The fault indications return if the fault is still found when power is restored.

1.6.2 Built-In-Test (BIT)

The detector’s Built-In-Test (BIT) also checks the following:

- Electronic circuitry
- Sensors
- Window cleanliness

The detector can be set to perform the BIT in the following modes:

- Automatically

1.6.2.1 How the BIT Operates

- The detector's status remains unchanged if the result of a BIT is the same as the current status (Normal or BIT Fault).
- The detector’s status changes (from Normal to BIT Fault or vice versa) if the BIT differs from the current status.

Note: In “BIT Fault” status the detector can continue to detect a fire.

1.6.2.2 Automatic BIT

The detector automatically performs a BIT every 15 minutes. A successful BIT sequence does not activate any indicator.

All outputs of BIT results function as described in Table 10 and Table 11, and the BIT is automatically executed every 1 minute.

This sequence continues until a successful BIT occurs, when the detector resumes normal operation.

Table 10: Results of a Successful BIT

Output	Result
Fault Relay	<ul style="list-style-type: none"> • Model 1XXX, 2XXX, and 4XXX wiring options 1, 2, and 4: remains Closed • Model 3XXX and 5XXX wiring options 3 and 5: remains Open
0–20mA Output	Wiring options 1, 2, and 3: Normal (4mA)
Power LED	Green, Flashing, 1Hz On (Normal)

Table 11: Results of an Unsuccessful BIT

Output	Result
Fault Relay	<ul style="list-style-type: none"> • Wiring options 1, 2, and 4: changes to Open • Wiring options 3 and 5: changes to Closed
0–20mA Output	Wiring options 1, 2, and 3: BIT Fault (2mA)
Power LED	Yellow, Flashing, 4Hz
BIT Procedure	Performed every 1 minute

2 Installing the Detector

➤ In this chapter...

<i>General Guidelines</i>	<i>page 31</i>
<i>Unpacking the Product</i>	<i>page 32</i>
<i>Required Tools</i>	<i>page 33</i>
<i>Certification Instructions</i>	<i>page 33</i>
<i>Installation Cables</i>	<i>page 35</i>
<i>Installing the Tilt Mount</i>	<i>page 36</i>
<i>Connecting the Detector</i>	<i>page 38</i>
<i>Configuring Your Detector</i>	<i>page 41</i>

This chapter provides basic guidelines for installing the detector. It does not attempt to cover all of 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.

2.1 General Guidelines

To ensure optimal performance and an efficient installation, consider the following guidelines:

- **Sensitivity:** To determine the level of sensitivity, consider the following:
 - Size of fire at the required distance to be detected
 - Type of flammable materials
- **Wiring:**
 - The wire gauge must be designed according to the distance from the detector to the controller and the number of detectors on the same power line. See *Wiring Instructions* on page 63.
 - To fully comply with EMC directive and protect against interference caused by RFI and EMI, the cable to the detector must be shielded and the detector must be grounded. The shield should be grounded at the detector end.
- **Spacing and Location:** The number of detectors and their locations in the protected area are determined 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 detector's sensitivity and require more maintenance activities.
 - The presence of high intensity flickering IR sources may affect sensitivity.
- **Aiming the Detector:**
 - 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 45° angle to maximize coverage and prevent accumulation of dust and dirt.
 - Do not start an installation unless all conceivable considerations regarding detection location have been taken into account.

Installation should comply with **NFPA 72E or any other local and international regulations and standards**, as applicable to flame detectors and installation of Ex approved products.

2.2 Unpacking the Product

Upon receipt of your detector, verify that you have received the following contents:

- Delivery form
- Flame detector
- Plastic weather cover
- User manual
- Quality document
- Tool keys (per shipment)

Check and record the following:

- 1** Verify the appropriate Purchase Order.
- 2** Record the Part Number (P/N) and Serial Number of the detectors, and the installation date in an appropriate logbook.
- 3** Verify that all components required for the detector installation are readily available before beginning the installation. If the installation is not completed in a single session, secure and seal the detectors and conduits/cable entries.

2.2.1 Checking the Product Type

Check that your product has the configuration/options that you ordered. Check the detailed part number on the label and compare this information with the descriptions contained in *Model and Types* on page 14.

2.3 Required Tools

The detector can be installed using general-purpose common tools and equipment. Table 12 lists the specific tools required to install the detector.

Table 12: Tools

Tool	Function	Comments
Hex Key $\frac{3}{16}$ "	Open and close detector cover (for wiring)	Part of the kit
Hex Key $\frac{1}{4}$ "	Mount the detector on the tilt mount	Part of the kit
Extraction Key	For extraction of the detector cover	Part of the kit
Flat Screwdriver 6mm	Connect ground terminal	Standard tool
Flat Screwdriver 2.5mm	Connect wires to the terminal blocks	Standard tool

For wiring, use color-coded conductors or suitable wire markings or labels. 12–20AWG / 0.5–3.5mm² 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 (see *General Instructions for Electrical Wiring* on page 63).

2.4 Certification Instructions



Warning: Do not open the detector, even when isolated, in the presence of any open flame.

2.4.1 Special Instructions for Safe Use

- The dimensions of the flamepaths are other than the relevant minimum or maximum, as required by Table 2 of EN 60079-1:2014, as detailed below:

Flamepath Location	Type of Joint	Maximum Gap, i_c	Minimum Length, L
Sapphire Window	Flanged	0.04mm	10.5mm
Main Spigot	Cylindrical	0.15mm	15.5mm

Gaps, i_c , should not be modified to be any larger, and lengths, L, should not be modified to be any shorter than the values shown in the table above.

- Units may be painted or fitted with optional accessories, some of which are made of a non-metallic material or have a non-metallic coating which could potentially generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, these units should not be installed in a location where they may be subjected to external conditions (such as high-pressure steam) which might cause a build-up of electrostatic charges on the non-conducting surfaces. Cleaning of the equipment (except window) should be done only with a damp cloth.
- The 3 fastening screws used to screw on the cover of the flameproof compartment have a yield stress of 344N/mm². Any replacement fasteners must have a yield stress of at least this value.
- When the duct mount is fitted and the equipment is intended to be mounted to a heated/cooled air duct/process vessel, it should be verified that the temperature of the air duct/process vessel should not be capable of heating or cooling any part of the equipment enclosure to a temperature outside the marked maximum ambient temperature range prior to switching the equipment on, when taking into account surrounding ambient temperature.

2.4.2 General Instructions

- The cable entry point may exceed 167°F/75°C. Suitable precautions should be taken when selecting the cable.
- The equipment may be used with flammable gases and vapors with apparatus groups IIA, IIB, and IIC:
 - T4 in the ambient temperature range: -67°F/-55°C to +167°F/+75°C.
 - T4 in the ambient temperature range: -67°F/-55°C to +185°F/+85°C.
- Installation should be carried out by suitably trained personnel in accordance with the applicable code of practice such as. EN 60079-14:1997.
- Inspection and maintenance of this equipment should be carried out by suitably trained personnel in accordance with the applicable code of practice such as EN 60079-17.
- Repair of this equipment should be carried out by suitably trained personnel in accordance with the applicable code of practice such as EN 60079-19.
- The certification of this equipment relies upon the following materials used in its construction:
 - **Enclosure:** 316L Stainless Steel or Aluminum
 - **Window:** Sapphire Glass

- If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection provided by the equipment is not compromised:
 - Aggressive substances: acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials.
 - Suitable precautions: regular checks as part of routine inspections or **establishing from the material's data sheets that it is resistant to specific chemicals.**

2.5 Installation Cables

Follow this guideline for the cable installation:

- All cables to the detector must be well shielded in order to comply with EMC requirement (see Table 22).
- Ground the detector to the nearest ground point (not more than 3m from the detector location).
- Install the detector with the cable entries placed downwards.

2.5.1 Conduit Installation

The conduit used for the cabling must comply with the following:

- To avoid water condensation or water in the detector, install the detector with the conduits placed downward to include drain holes.
- When using the optional tilt mount, use flexible conduits for the last portion connecting to the detector.
- For installations in atmospheres as defined in group B of the NFPA 72E, seal the conduits' inlets.
- When pulling the cables through the conduits, ensure that they are not tangled or stressed. Extend the cables about 30cm/12" beyond the detector location to accommodate wiring after installation.
- After the conductor cables have been pulled through the conduits, perform a continuity test.

2.6 Installing the Tilt Mount

The tilt mount (P/N 40/40-001) enables the detector to be rotated up to 60° in all directions.

Figure 3 shows the detector mounted on the tilt mount.

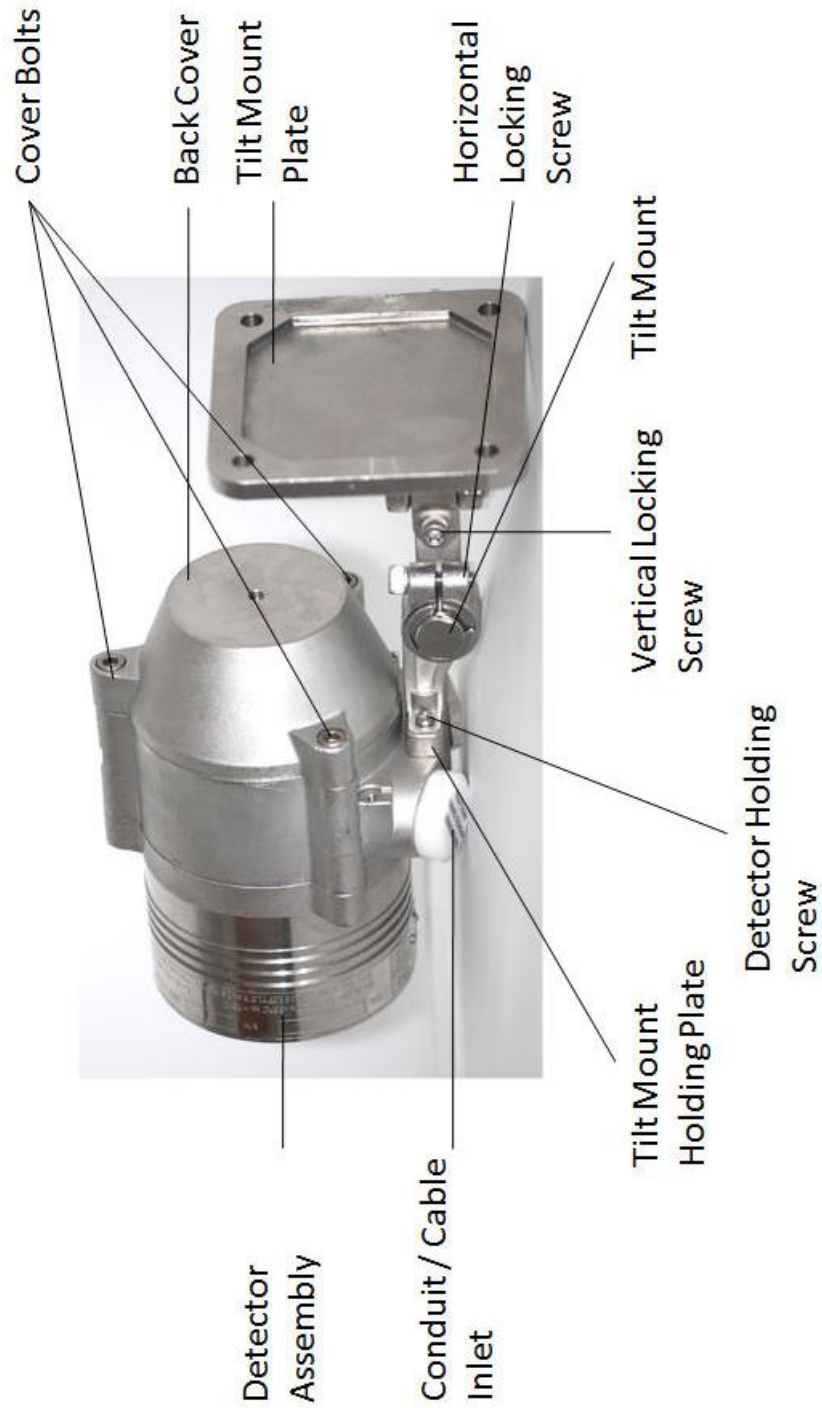


Figure 3: Detector with Tilt Mount

2.6.1 Tilt Mount Assembly

Figure 4 shows the tilt mount assembly.

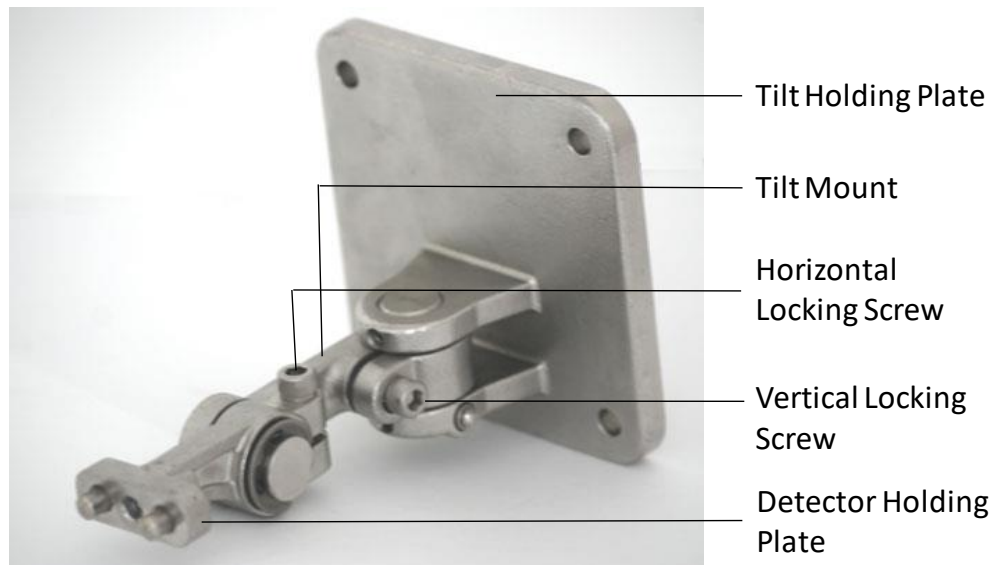


Figure 4: Tilt Mount Assembly

Figure 5 shows the tilt mount assembly with dimensions in both millimeters and inches.

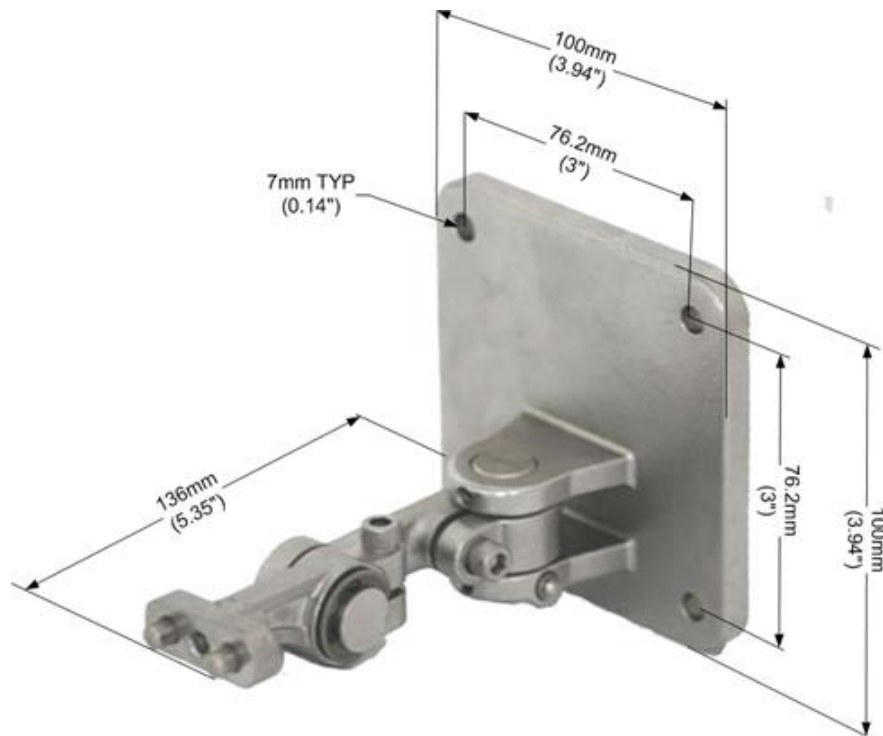


Figure 5: Tilt Mount Assembly (dimensions in millimeters and inches)

➤ **To install the tilt mount and detector:**

- 1 Place the tilt mount in its designated location and secure it with 4 fasteners through 4 holes 7mm in diameter. Use the 4 screws and spring washers according to the kit.

Note: Removing the detector for maintenance purpose does not require the tilt mount to be removed.

- 2 Unpack the detector.
- 3 Place the detector with its conduit/cable entries pointing downwards on the holding plate of the tilt mount. Secure the detector with $\frac{5}{16}$ " 18 UNC x 1" screw to the tilt mount.
- 4 Release the horizontal and vertical locking screws using $\frac{3}{16}$ " Hex Key so that the detector can be rotated. 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 on the tilt mount, making sure the detector is in the correct position.

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

2.7 Connecting the Detector

This section describes how to connect the electric cabling to the detector (Figure 6).

➤ **To connect the detector to the electrical cables:**

- 1 Disconnect the power.
- 2 Remove the back cover of the detector by removing 3 socket head-screws in the cover bolts. The terminal chamber is now revealed.
- 3 Remove the protective plug mounted on the detector conduit/cable entry; pull the wires through the detector inlet.
- 4 Use a $\frac{3}{4}$ " – 14 NPT explosion-proof conduit connection or M25x1.5 flameproof gland to assemble the cable/conduit to the detector.

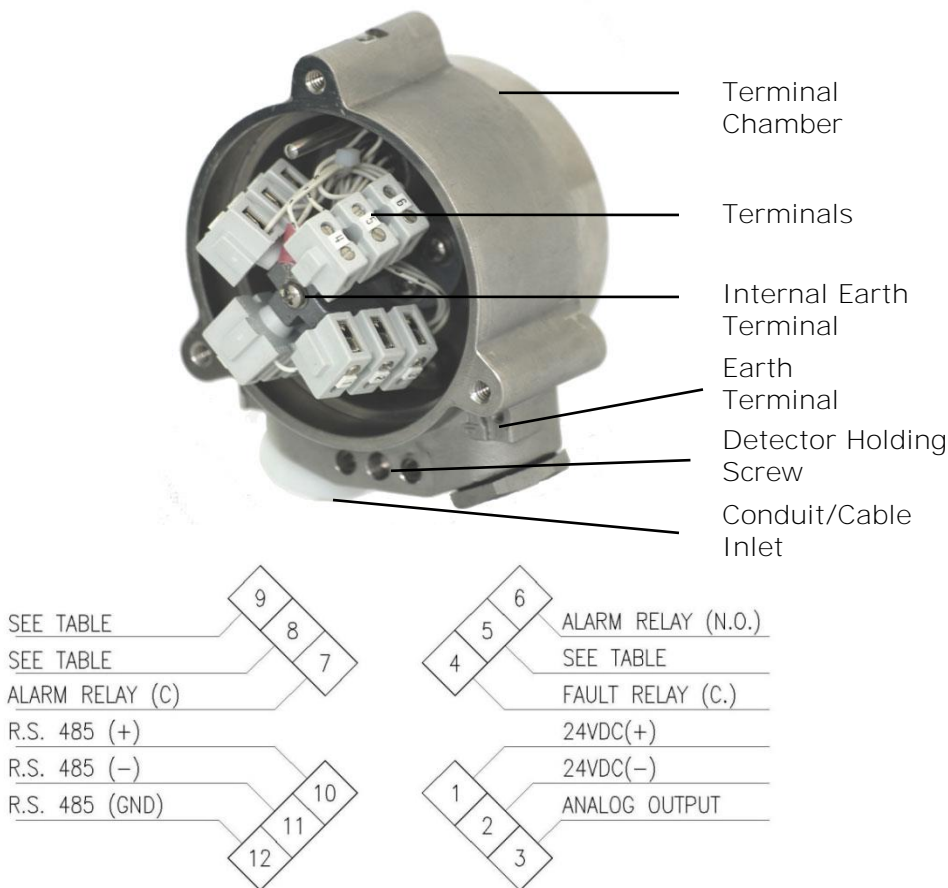


Figure 6: Detector with Cover Removed

- 5** Connect the wires to the required terminals on the Terminal Board according to the wiring diagram (Figure 6) and Table 13.
- 6** Connect the grounding (earth) wire to the ground (earth) screw outside the detector (earth terminal). The detector must be well grounded to earth ground.
- 7** Verify the wiring. Improper wiring may damage the detector.
- 8** Check the wires for secure mechanical connection and press them neatly against the terminal to prevent them from interfering while closing the back cover (Figure 6).
- 9** Place and secure the detector's back cover by screwing the 3 socket-head-screws in the cover bolts (Figure 3).

2.7.1 Verifying the Detector Wiring

The detector has 5 output wiring options within the Exde integral terminal section of the enclosure. There are 12 terminals labeled 1–12.

For more information on the wiring options, see *Wiring Instructions* on page 63.

For mA wiring options see Figure 9, Figure 10, Figure 11, and Figure 12.

For relay connection options see Figure 9.

Table 13 describes the function of each terminal for all the wiring options.

Table 13: Model 40/40UFI Wiring Options

Wire Terminal No.	Option 1 Default	Option 2	Option 3	Option 4	Option 5
1	+24VDC	+24VDC	+24VDC	+24VDC	+24VDC
2	0VDC	0VDC	0VDC	0VDC	0VDC
3	Analog Output	Analog Output	Analog Output	Analog Output	Analog Output
4	Fault Relay N.C.	Fault Relay N.C.	Fault Relay N.O.	Fault Relay N.C.	Fault Relay N.O.
5					
6	Alarm Relay N.O.	Alarm Relay N.O.	Alarm Relay N.O.	Alarm Relay N.O.	Alarm Relay N.O.
7	Alarm Relay C	Alarm Relay C	Alarm Relay C	Alarm Relay C	Alarm Relay C
8	0–20mA In	Alarm Relay N.C.	Alarm Relay N.C.	Auxiliary N.O.	Auxiliary N.O.
9	0–20mA Out*	0–20mA Out*	0–20mA Out*	Auxiliary C	Auxiliary C
10	RS-485+ (1)	RS-485+ (1)	RS-485+ (1)	RS-485+ (1)	RS-485+ (1)
11	RS-485- (1)	RS-485- (1)	RS-485- (1)	RS-485- (1)	RS-485- (1)
12	RS-485 GND	RS-485 GND	RS-485 GND	RS-485 GND	RS-485 GND

*Available with the HART protocol.

Notes:

- RS-485 is used for the communication network as specified in **Appendix C** (Terminals 10, 11, and 12) and to connect (in a safe area) to a PC or laptop for configuration and diagnostics.
- Alarm relay:
 - N.O. contact in wiring options 1, 4, and 5.
 - N.O. and N.C. in wiring options 2 and 3.
- 0–20mA is “Sink” in option 1 and “Source” in options 2 and 3.
- 0–20mA options 1, 2, and 3 are available with the HART protocol.
- In wiring option 1, link Terminals 1 and 8 to change the mA output to “Source.”

- The fault output is N.C. energized SPST relay. The contacts are closed when the detector is in its normal operational condition in options 1, 2, and 4, and available as N.O. energized in options 3 and 5.
- The auxiliary output is N.O. (SPST) relay. Depending on the function configuration, the auxiliary relay may act in parallel with the alarm relay to activate another external device, or it may provide a warning signal.

2.8 Configuring Your Detector

You can reprogram the function setup using the RS-485 connection or the HART protocol as follows:

- **Mini Laptop Kit** (P/N 777820): The mini laptop, pre-loaded with the SPECTREX host software, enables you to re-configure settings or perform diagnostics on all 40/40 series flame detectors.

Refer to manual TM777070 for programming instructions when using the Mini Laptop Kit.

- **USB RS-485 Harness Kit** (P/N 794079): The USB RS-485 Harness Kit with RS-485/USB converter, used with the SPECTREX host software, enables you to connect to any available PC or laptop to re-configure settings or perform diagnostics on all 40/40 series flame detectors.

Refer to manual TM777050 for programming instructions when using the USB RS-485 Harness Kit.

- **HART Protocol**: Refer to Manual TM 777030 for programming instructions.

These functions enable you to set:

- Sensitivity
- Alarm Delay
- Address Setup
- Mode of Operation
- Heated Optics Operation

The factory default settings listed for each function are:

- Sensitivity – 40
- Alarm Delay – 0
- Alarm Latch – No
- Automatic BIT – Yes
- Auxiliary Relay – No
- EOL – No
- Heated Optics – Auto
- Temperature – 41°F/5°C

2.8.1 Sensitivity

The detector offers 4 sensitivity settings. The settings refer to an n-heptane or gasoline fire of 1ft²/0.1m², from low sensitivity of 66ft/20m to 300ft/90m. For other types of fuel sensitivity, refer to Table 3.

Table 14: Sensitivity Settings

Sensitivity Setting	Detector Distance in feet	Detector Distance in meters
20	66	20
40 (default)	132	40
60	200	60
90	300	90

2.8.2 Alarm Delay

The detector is equipped with an alarm delay option, which provides programmable time delays with settings at:

- Antiflare* (default)

*The antiflare mode is selected to prevent false alarms in locations where fast flares may be present. The time delay for fire alarms in this mode ranges from 2.5–15 seconds, and is usually less than 10 seconds.

Other delay settings are available:

- 0, 3, 5, 10, 15, 20, or 30 seconds

When an alarm (detection) level condition occurs, the detector delays the execution of the alarm outputs by the specified period of time. The detector then evaluates 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 output relays and the 0–20mA. The LEDs and outputs indicate warning levels during the delay time only if the fire condition exists.

2.8.3 Address Setup

The detector provides up to 247 addresses that can be changed with the RS-485 communication link or the HART protocol.

2.8.4 Function Setup

You can select the desired functions as detailed in Table 15.

Table 15: Functions

Function	Setting
Alarm Latch	<ul style="list-style-type: none"> • Yes: Enable Alarm latching. • No: Disable Alarm latching (default).
Auxiliary Relay*	<ul style="list-style-type: none"> • Yes: Activate Auxiliary Relay at Warning level. • No: Activate Auxiliary Relay at Alarm level (default).
Automatic BIT	<ul style="list-style-type: none"> • Yes: Perform Automatic (default). • No: No BIT.
EOL*	<ul style="list-style-type: none"> • Yes: Auxiliary Relay is used as End of Line. • No: Auxiliary Relay operates in accordance with Functions 2 and 5 (default).

Note: * Only available in Models 40/40UFI-4XXXX and 5XXXX

2.8.5 Heated Optics

The heated optics can be defined as one of the following modes:

- Heated Mode
 - Off: Not operated
 - On: Continuously
 - Auto: Per temperature change

In **Auto** mode, the default **Heat On** setting is 41°F/5°C. Heating stops when the temperature is 27°F/15°C above the start temperature.

You can define the start temperature below which the window will be heated. The temperature can be defined between 32–86°F / 0–30°C.

3 Operating the Detector

➤ In this chapter...

<i>Powering Up</i>	<i>page 45</i>
<i>Safety Precautions</i>	<i>page 45</i>
<i>Testing Procedures</i>	<i>page 46</i>

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

3.1 Powering Up

This section describes how to power up the detector. Follow these instructions carefully to obtain optimal performance from the detector over its life cycle:

➤ To power up the detector:

- 1 Turn on the power.
- 2 Wait up to 60 seconds for the detector to finish the start-up procedure.

Applying power initiates the following sequence of events:

- The yellow LED flashes at 4Hz.
- BIT is executed.

If successful, the green LED flashes at 1Hz, the fault relay contacts close, and mA output is 4mA.

- 3 Enter Normal mode.

Note: The majority of detectors are used in the default non-latched alarm mode. Only perform a Reset when the latched alarm option has been programmed.

➤ To reset the detector when it is in a Latched Alarm state:

- Disconnect power (Terminal Number 1 or Terminal Number 2).

3.2 Safety Precautions

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

- Follow the instructions in this guide and refer to the drawings and specifications.
- Do not expose the detector to radiation of any kind unless required for testing purposes.

- Do not open the detector housing while power is connected.
- Do not open the electronic compartment. This part should be kept closed at all times and only opened in the factory. Opening the electronic component side invalidates the warranty.
- You should only access the wiring compartment to wire or remove the detector, or to access RS-485 terminals for maintenance.
- External devices, such as automatic extinguishing systems, must be disconnected before carrying out any maintenance.

3.2.1 Default Functions Settings

Table 16 lists the default function configuration supplied with the detector.

Table 16: Default Function Values

Function	Value	Notes
Sensitivity	40	
Alarm Delay	0	Antiflare.
Alarm Latch	No	
Auxiliary Relay	No	In wiring options 1, 2, and 3 the auxiliary relay is not available. This function is not used.
Automatic BIT	Yes	
EOL	No	In wiring options 1, 2, and 3 the auxiliary relay is not available. This function is not used.
Heat Mode	Auto	
Heat On	41°F/5°C	The detector starts heating the window for any temperature below this value (in degrees Celsius).

- In order to change the default function, use:
 - Mini Laptop Kit P/N 777820. Refer to manual TM777070 for programming instructions when using the Mini Laptop Kit.
 - USB RS-485 Harness Kit P/N 794079. Refer to manual TM777050 for programming instructions when using the USB RS-485 Harness Kit.
 - HART protocol, refer to Manual TM777030 for instructions.

3.3 Testing Procedures

This section describes the proof testing procedure for proper operation of the detector. The detector can be tested with SPECTREX Flame Simulator FS-1100.

The detector performs internal tests continuously and automatic BIT tests every 15 minutes. For more details refer to **Built-In-Test (BIT)** on page 28.

This section includes the following topics:

- Automatic BIT Test, page 47
- Testing with Flame Simulator Model FS-1100, page 47

3.3.1 Automatic BIT Test

Check that the indicators show normal conditions. See *Powering Up* on page 45.

3.3.2 Testing with Flame Simulator Model FS-1100

The Flame Simulator Model FS-1100 can be used to simulate 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. See *Flame Simulator FS-1100* on page 71 for more information.

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

➤ **To perform Flame Simulator Test:**

- 1 Power up the system and wait up to 60 seconds for the detector to turn to a normal state. The Power LED turns on.
- 2 Aim the SPECTREX Flame Simulator Model FS-1100 at the target point of the detector (Figure 14), such that the radiation emitted by it is facing directly towards the detector. (See *Flame Simulator FS-1100* on page 71).
- 3 Press the operation button once. After few seconds, a successful test shows the results listed in Table 17.

Table 17: Results of Successful Flame Simulator Test

Component	Action	Notes
0–20mA	Turn to 20mA	For a few seconds and then returns to 4mA
Alarm Relay	Activated	For a few seconds and then returns to Normal
Auxiliary Relay	Activated	For a few seconds and then returns to Normal
Fault Relay	Remains active during the test	
LED	Red, steady	

The detector is now ready for operation.

4 Maintenance and Troubleshooting

➤ In this chapter...

Maintenance *page 49*

Troubleshooting *page 51*

This chapter 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 SPECTREX or its authorized distributor for assistance.

4.1 Maintenance

This section describes the basic maintenance steps that should be taken to keep the detector in good working condition and includes the following topics:

- General Procedures, page 49
- Periodic Procedures, page 50
- Keeping Maintenance Records, page 50

4.1.1 General Procedures

Maintenance should be performed by suitably qualified personnel, who are familiar with local codes and practice. Maintenance requires ordinary tools.

4.1.1.1 Cleaning

The detector must be kept as clean as possible. Clean the viewing window and the reflector of the flame detector periodically.

The frequency of cleaning operations depends upon the local environmental conditions and specific applications. The fire detection system designer will give his recommendations.

➤ To clean the detector viewing window and reflector:

- 1** Disconnect power to the detector before proceeding with any maintenance including window/lens cleaning.
- 2** Use water and detergent, and then rinse the viewing window with clean water.
- 3** Where dust, dirt, or moisture accumulates on the window, first clean with a soft optical cloth and detergent only, and then rinse with clean water.

4.1.2 Periodic Procedures

In addition to preventive cleaning and maintenance, the detector should be functionally tested every 6 months or as dictated by local codes and regulations. These tests should also be conducted if the detector has been opened for any reason.

4.1.2.1 Power-Up Procedure

Perform the power-up procedure every time power is restored to the system. Follow the instructions described in *Powering Up* on page 45.

4.1.2.2 Functional Test Procedure

Perform a functional test of the detector as described in *Internal Detector Tests* on page 27.

4.1.3 Keeping Maintenance Records

Maintenance operations performed on a detector should be recorded in a log book. The record should include the following:

- Installation date
- Contractor
- Serial and tag number
- Entries for every maintenance operation performed, including a 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.

4.2 Troubleshooting

This section is a guide to correct problems which may happen during normal operation.

Table 18: Troubleshooting Table

Problem	Cause	Corrective Action
LEDs Off Fault Relay at N.O. 0–20mA at 0mA	No power to the unit	<ul style="list-style-type: none"> • Check that the correct power is sent to the detector. • Check power polarity. • Check wiring in the detector. • Send the detector back for repairs.
Yellow LED flashes at 4Hz Fault Relay at N.O. 0–20mA at 0mA	Fault Detector <ul style="list-style-type: none"> • Low Voltage • Faulty Detector 	<ul style="list-style-type: none"> • Check the voltage at the detector; verify at least 24V at the detector terminal. • Send the detector back for repairs.
Yellow LED flashes at 4Hz Fault Relay at N.O. 0–20mA at 2mA	BIT Fault <ul style="list-style-type: none"> • Faulty Detector 	<ul style="list-style-type: none"> • Clean detector window. • Re-power the detector. • Replace the detector.
Red LED constantly on	If no fire exists, then detector alarm latched	Perform a Reset .
Alarm Relay at On 0–20mA at 20mA	Alarm condition	<ul style="list-style-type: none"> • Check cause of alarm. • If no alarm, re-power the detector. • Send the detector back for repairs.

Appendix

A Specifications

➤ **In this appendix...**

<i>Technical Specifications</i>	<i>page 55</i>
<i>Electrical Specifications</i>	<i>page 56</i>
<i>Outputs</i>	<i>page 57</i>
<i>Approvals</i>	<i>page 59</i>
<i>Mechanical Specifications</i>	<i>page 59</i>
<i>Environmental Specifications</i>	<i>page 60</i>

A.1 Technical Specifications

Spectral Response	Three IR Bands			
Detection Range	Fuel	ft/m	Fuel	ft/m
(at highest Sensitivity Setting for 1ft ² /0.1m ² pan fire)	n-Heptane	300/90	Kerosene	205/62
	Gasoline	300/90	Ethanol 95%	185/55
	Diesel Fuel	205/62	Methanol	160/48
	JP5	205/62	IPA (Isopropyl Alcohol)	185/55
	Methane*	205/62	Polypropylene Pellets	160/48
	LPG*	205/62	Office Paper	115/34
	* 30"/0.75m high, 10"/0.25m width plume fire			
Response Time	2 sec for 1 x 1ft n-heptane fire at 131ft/40m 10 sec for 1 x 1ft n-heptane fire at 300ft/90m			
High Speed Response	50msec for 1ft diameter sphere methane air mixture explosion at 66ft/20m			
Adjustable Time Delay	Up to 30 seconds			
Sensitivity Ranges	4 sensitive ranges for 1ft ² /0.1m ² n-heptane pan fire from 66ft/20m to 300ft/90m			
Fields of View	Horizontal 90°, Vertical 90°			
Built-In-Test (BIT)	Automatic			

A.2 Electrical Specifications

Operating Voltage: 18–32VDC

Power Consumption: Table 19

Table 19: Electrical Specifications

Operating Voltage	Status	All Outputs	Without 0–20mA
Power Consumption (Max. 24VDC)	Normal	1.61W	1.56W
	Normal when Heater On	2.28W	2.16W
	Alarm	2.64W	2.28W
	Alarm when Heater On	3.24W	2.88W
Maximum Current (Max. 24VDC)	Normal	70mA	65mA
	Normal when Heater On	95mA	90mA
	Alarm	110mA	95mA
	Alarm when Heater On	135mA	120mA
Power Consumption (Max. 18–32VDC)	Normal	1.95W	1.85W
	Normal when Heater On	2.56W	2.45W
	Alarm	3.04W	2.56W
	Alarm when Heater On	3.68W	3.2W
Maximum Current (Max. 18–32VDC)	Normal	90mA	85mA
	Normal when Heater On	105mA	100mA
	Alarm	130mA	115mA
	Alarm when Heater On	160mA	145mA

Electrical Input Protection The input circuit is protected against voltage-reversed polarity, voltage transients, surges, and spikes according to MIL-STD-1275B

A.3 Outputs

Electrical Interface

There are 5 output wiring options. These options are defined at the factory per the customer order and cannot be changed at the customer facility.

See *General Instructions for Electrical Wiring* on page 63 for the wiring/terminal diagram for each option.

Unless otherwise specified, the default is option 1. The wiring arrangement is identified on the detector by the part number (see *Model and Types* on page 14).

- **Option 1:** Power, RS-485, Analog Output 0–20mA (Sink), Fault I Relay (N.C.), Alarm Relay, (N.O.) (see Figure 6).
- **Option 2:** Power, RS-485, Analog Output 0–20mA (Source) and HART protocol, Fault Relay (N.O.), Alarm Relay, (N.O.), (N.C.).
- **Option 3:** Power, RS-485, Analog Output 0–20mA (Source) and HART protocol, Fault Relay (N.O.), Alarm Relay (N.O., N.C.).
- **Option 4:** Power, RS-485, Analog Output Fault Relay (N.C.), Auxilliary Relay (N.O.), Alarm Relay, (N.O.).
- **Option 5:** Power, RS-485, Analog Output Fault Relay (N.O.), Auxilliary Relay (N.O.), Alarm Relay, (N.O.).

Electrical Outputs

- **Dry Contact Relays**

Table 20: Contact Ratings

Relay Name	Type	Normal Position	Maximum Rating
Alarm	SPDT	N.O., N.C.	2A at 30VDC
Auxilliary	SPST	N.O.	2A at 30VDC
Fault (see Notes 1 and 2)	SPST	N.C. or N.O.	2A at 30VDC

Notes:

1. The fault relay (in wiring options 1, 2, and 4) is normally energized closed during normal operation of the detector. The relay is de-energized open in a fault condition or low voltage situation.
 2. In wiring options 3 and 5 the relay is normally energized open during normal operation of the detector. The relay is de-energized close contact in a fault condition or low voltage situation.
- **0–20mA Current Output:** The 0–20mA can be Sink or Source according to the wiring option source (see *General Instructions for Electrical Wiring* on page 63). The maximum permitted load resistance is 600Ω.

Table 21: 20mA Current Output

State	Output
Fault	0 +1 mA
BIT Fault	2mA±10%
Normal	4mA±10%
Warning	16mA±5%
Alarm	20mA±5%

- **Analog Output**

The Analog Output is used for a fast detection signal of 50msec. It provides a 2V±5% output in a Normal state, a 5V±5% output in an Alarm state, and a <1V output in a Fault state.

- **HART Protocol**

The HART protocol is a digital communication signal at a low level on top of the 0–20mA . This bi-directional field communication protocol is used to communicate between intelligent field instruments and the host system. HART is available in wiring options 2 and 3.

Through the HART protocol the detector can:

- Display setup
- Reconfigure setup
- Display detector status and definition
- Perform detector diagnostics
- Troubleshoot

For more details refer to *HART Manual TM777030*.

- **Communication Network:** The detector is equipped with an RS-485 communication 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 standard Modbus controller (Master device) and a serial Network of up to 247 detectors.

Heated Optics

The front window can be heated to improve performance in ice, condensation, and snow conditions. The heater increases the temperature of the optical surface by 5–8°F / 3–5°C above the ambient temperature. The heated optics can be configured in 3 ways:

- **Off:** The optics are not heated
- **On:** The optics are heated continuously
- **Auto:** Operated only when the change of temperature requires the heating (default)

In **Auto** mode the start heating temperature can be defined between 32–86°F / 0–30°C. The detector stops heating the window when the temperature is 27°F/15°C above the start temperature.

A.4 Approvals

Hazardous Area Approvals

- FM, CSA
Class I Div. 1 Groups B, C, and D;
Class II/III Div. 1 Groups E, F, and G
- ATEX, IECEX
Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T96°C Db
(-55°C ≤ Ta ≤ +75°C)
or
Ex II 2G D
Ex db eb op is IIC T4 Gb
Ex tb op is IIIC T106°C Db
(-55°C ≤ Ta ≤ +85°C)
- TR CU / EAC
1Ex d e IIC T5 Gb X
Ex tb IIIC T96°C Db X
-55°C ≤ Ta ≤ +75°C
or
1Ex d e IIC T4 Gb X
Ex tb IIIC T106°C Db X
-55°C ≤ Ta ≤ +85°C

Functional Approvals

- EN54-10 approved per VdS
- FM approved per FM3260

A.5 Mechanical Specifications

Enclosure

- Stainless Steel 316
or
- Aluminum, heavy duty copper free (less than 1%), red epoxy enamel finish

Water and Dust Tight

- NEMA 250 type 6p.
- IP 66 and IP 67 per EN 60529

Electronic Modules

- Conformal coated

Electrical Connection (2 entries)

- ¾" - 14NPT conduit
or

- M25 x 1.5

Dimensions

- 4" x 4.6" x 6.18" / 101.6 x 117 x 157 mm

Weight

- Stainless Steel: 6.1lb/2.8kg
- Aluminum: 2.8lb/1.3kg

A.6 Environmental Specifications

The SharpEye 40/40UFI is designed to withstand harsh environmental conditions.

- | | |
|-------------------------|---|
| High Temperature | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 501.1 procedure II• Operating temperature: +167°F/+75 °C• Storage temperature: +185 °F/+85 °C |
| Low Temperature | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 502.1, procedure I• Operating temperature: -57°F/-50°C• Storage temperature: -65°F/-55°C |
| Humidity | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 507.1, procedure IV• Relative humidity of up to 95% for the operational temperature range |
| Salt Fog | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 509.1, procedure I• Exposure to a 5% Salt Solution Fog for 48 hours |
| Dust | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 510.1, procedure I• Exposure to a dust concentration of 0.3 grams/cubic ft at a velocity of 1750fpm, for 12 hours |
| Vibration | <ul style="list-style-type: none">• 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 | <ul style="list-style-type: none">• Designed to meet MIL-STD-810C, method 516.2, procedure I• Mechanical Shock of 30g half-sine wave, for 11 msec |

**Electromagnetic
Compatibility (EMC)**

Table 22: Electromagnetic Compatibility (EMC)

	Test Standard	Level Per
Electrostatic Discharge ESD	IEC 61000-4-2	IEC 61326-3
Radiated EM Field	IEC 61000-4-3	IEC 61326-3
Electrical Fast Transients	IEC 61000-4-4	IEC 61326-3
Surge	IEC 61000-4-5	IEC 61326-3
Conducted Disturbances	IEC 61000-4-6	IEC 61326-3
Power Frequency Magnetic Field	IEC 61000-4-8	IEC 61326-3
Radiated Emission	IEC 61000-6-3	EN 55022
Conducted Emission	IEC 61000-6-3	EN 55022
Immunity to Main Supply Voltage Variations	MIL-STD-1275B	

To fully comply with EMC directive 2014/30/EU and protect against interference caused by RFI and EMI, the cable to the detector must be shielded and the detector must be grounded. The shield should be grounded at the detector end.

B Wiring Instructions

➤ **In this appendix...**

General Instructions for Electrical Wiring page 63

Typical Wiring Configurations page 65

B.1 General Instructions for Electrical Wiring

Follow the instructions detailed in this section for determining the correct wire gauge to be used for the installation.

- 1 Use Table 23 to determine the required wire gauge/size for general wiring, such as relay wiring. Calculate the permitted voltage drop with respect to load current, wire gauge, and length of wires.

Table 23: Maximum DC Resistance at 68°F/20°C for Copper Wire

AWG #	mm ²	Ohm per 100ft	Ohm per 100m
26	0.12–0.15	4.32	14.15
24	0.16–0.24	3.42	11.22
22	0.30–0.38	1.71	5.60
20	0.51–0.61	1.07	3.50
18	0.81–0.96	0.67	2.20
16	1.22–1.43	0.43	1.40
14	1.94–2.28	0.27	0.88
12	3.09–3.40	0.17	0.55
10	4.56–6.64	0.11	0.35

- 2 Use Table 24 to select wire gauge for power supply wires. **DO NOT connect any circuit or load to detectors' supply inputs.**
 - Select **Number of detectors** connected in 1 circuit.
 - Select wiring **Length** per your installation requirements.
 - Refer to **Power Supply Range** for voltage extreme applied.

Table 24: Wiring Length in Feet/Meters

Number of Detectors	Recommended Wire Diameter (AWG)					Power Supply Range (VDC)
	18	16	14	-	-	
24	18	16	14	-	-	22-32
20	18	16	14	-	-	22-32
16	20	18	16	14	-	22-32
12	20	18	16	14	-	20-32
8	20	18	16	14	-	20-32
4 and less	20	18	16	16	14	20-32
ft/m	164/50	328/100	492/150	656/200	820/240	
Max. Length from Power Supply to Last Detector						

Calculation Formula

Use the following formula to calculate minimum wire gauge per wire length between the power supply (controller) and the detector, considering the number of detectors on the same power line, where:

L = Actual wire length between the detector and the power supply

N = Number of detectors per loop

R = Resistance of wire per 100m (see Table 23)

V = Voltage drop on the wire

Calculate the voltage drop on the wire as follows:

$$V = \frac{2L \times R}{100} \times N \times 0.2A$$

20+V = Minimum required voltage of the power supply

0.2A is the maximum power consumption of the detector

For example,

If N=1 (1 detector in loop)

$$L=1000m$$

Wire size = 1.5mm² (see Table 24, the resistance per 100m for 1.5mm² is **1.4Ω**)

You calculate the voltage drop in the wire as follows:

$$\frac{2 \times 1000 \times 1.4\Omega}{100} \times 1 \times 0.2A = 5.6V$$

The minimum voltage of the power supply should be 20V + 5.6V = 25.6V

B.2 Typical Wiring Configurations

This section describes examples of typical wiring configurations.

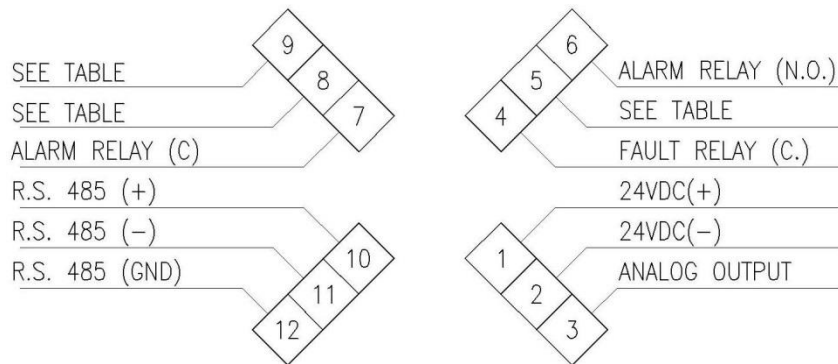


Figure 7: Wiring Terminals

Table 25: Wiring Connections

Wiring Option	Detector Model	Terminals		
		5	8	9
1	40/40UFI-1XXXX	Fault Relay (N.C.)	0-20mA (Sink)	0-20mA (Sink)
2	40/40UFI-2XXXX	Fault Relay (N.C.)	Alarm Relay (N.C.)	0-20mA (Source)
3	40/40UFI-3XXXX	Fault Relay (N.O.)	Alarm Relay (N.C.)	0-20mA (Source)
4	40/40UFI-4XXXX	Fault Relay (N.C.)	Auxiliary Relay (N.O.)	Auxiliary Relay (C)
5	40/40UFI-5XXXX	Fault Relay (N.O.)	Auxiliary Relay (N.O.)	Auxiliary Relay (C)

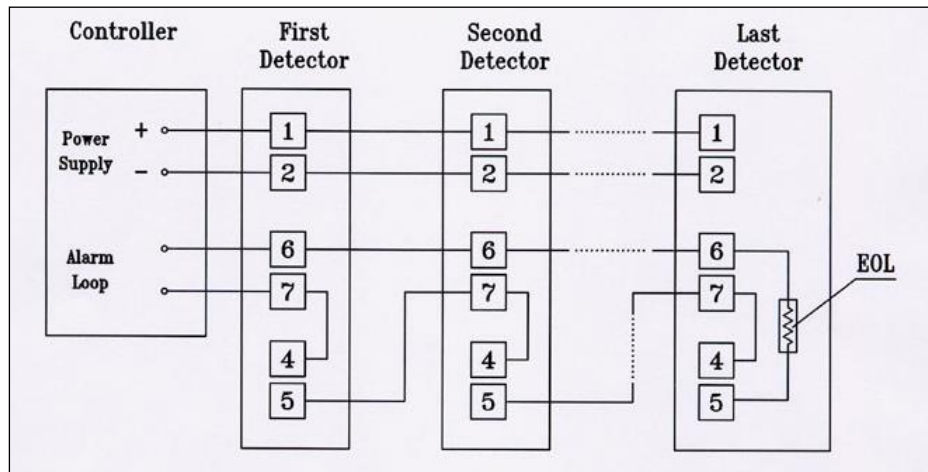


Figure 8: Typical Wiring for 4 Wire Controllers (Using Option 1 or 2 Wiring)

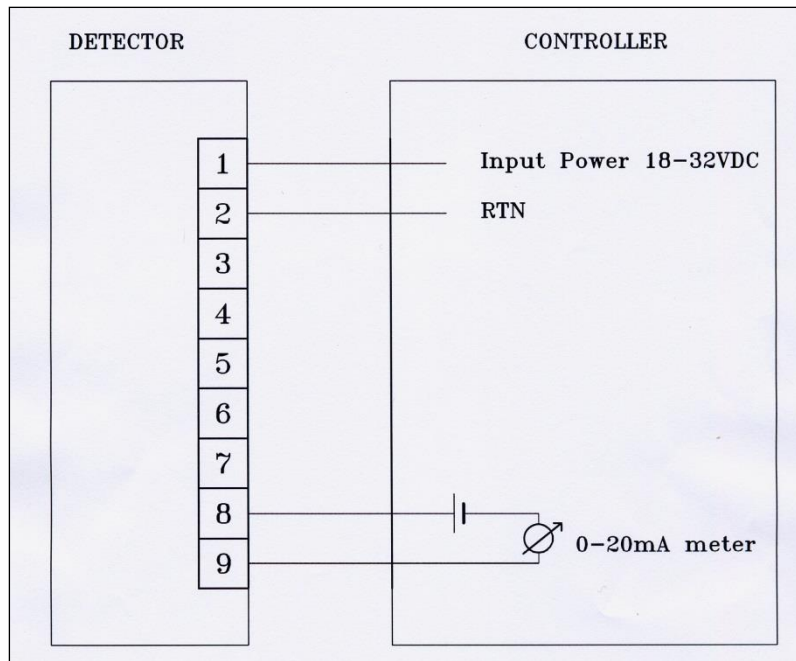


Figure 9: 0-20mA Wiring Option 1 (Sink 4-Wire) - Default

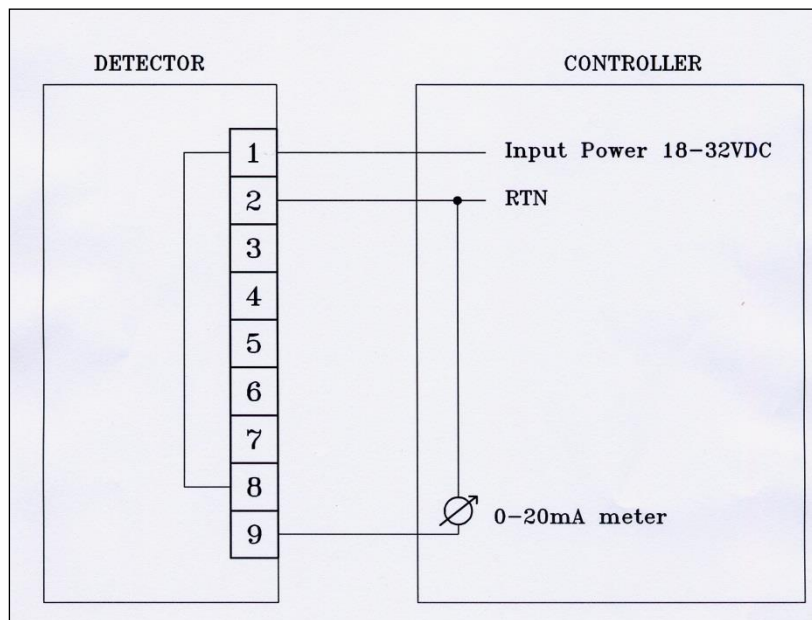


Figure 10: 0-20mA Wiring Option 1 (Converted to Source 3-Wire)

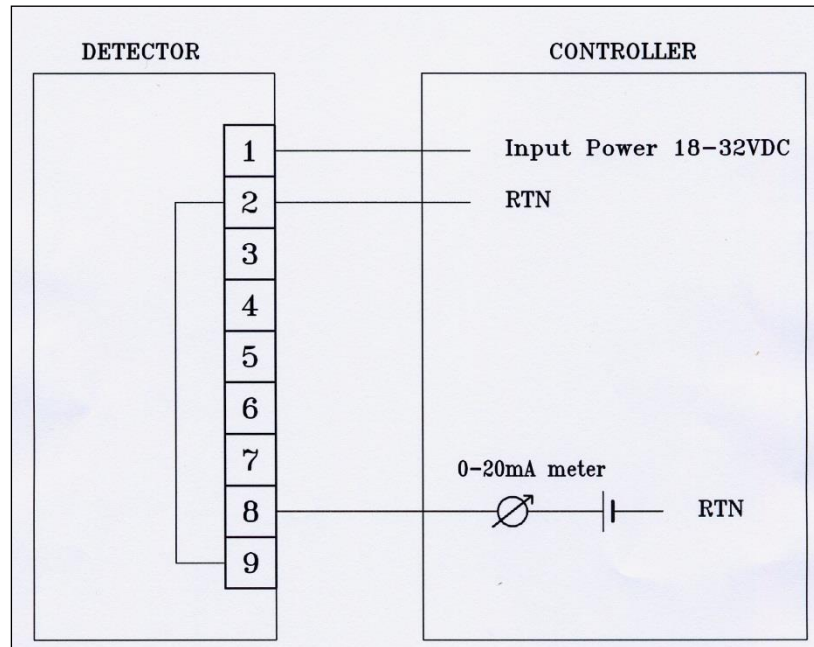


Figure 11: 0-20mA Wiring Option 1 (Non-isolated Sink 3-Wire)

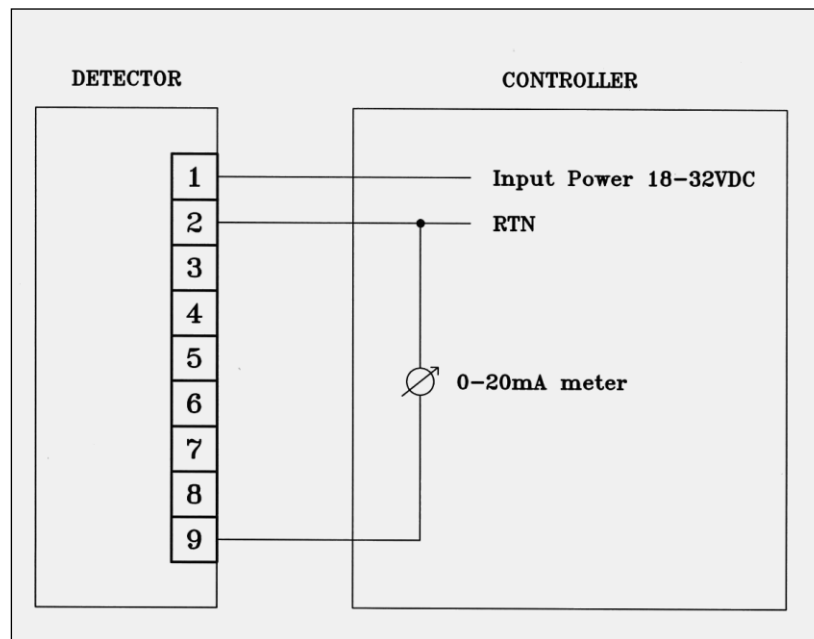


Figure 12: 0-20mA Wiring Option 2 and 3 (Source 3-Wire available with the HART Protocol)

Note: There are no 0-20mA outputs in wiring options 4 and 5.

C RS-485 Communication Network

➤ **In this appendix...**

RS-485 Overview

page 69

C.1 RS-485 Overview

By using the RS-485 network capability of the IR3detector and additional software, it is possible to connect up to 32 detectors in an addressable system with 4 wires only (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, it is possible to read each detector status (FAULT, WARNING, and ALARM) and to initiate a BIT for each detector individually.

For more details, contact SPECTREX.

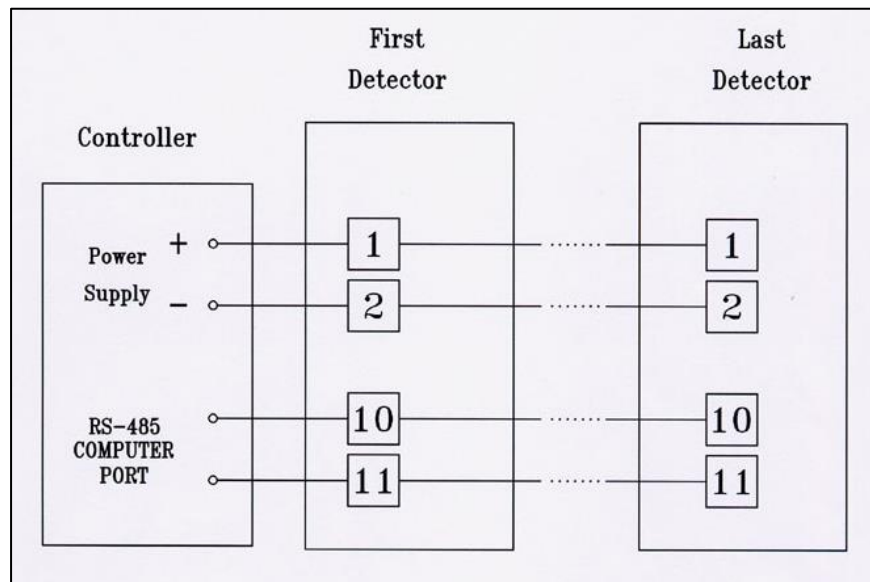


Figure 13: RS-485 Networking

D Accessories

➤ In this appendix...

<i>Flame Simulator FS-1100</i>	<i>page 71</i>
<i>Tilt Mount</i>	<i>page 76</i>
<i>Duct Mount</i>	<i>page 77</i>
<i>Weather Cover</i>	<i>page 78</i>
<i>Cone Viewer</i>	<i>page 79</i>
<i>Air Shield</i>	<i>page 80</i>

This appendix describes the accessories that can help you maximize fire detection with the SharpEye Ultra-Fast IR3 Flame Detector:

D.1 Flame Simulator FS-1100

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 FS-1100

D.1.1 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
- Charger
- Tool Kit
- Technical Manual TM380002

D.1.2 Unpacking

Verify that you have received the following contents:

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

D.1.3 Operating Instructions

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

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

➤ **To simulate a fire:**

- 1** Verify you are at the correct distance from the detector according to the type of detector and the detector sensitivity.
- 2** Using the mechanical sight, aim the flame simulator toward the center of the detector.

Push the activate button, and then use the laser spot for fine adjustment toward the center of the detector.
- 3** Keep the simulator aimed at the detector for up to 50 seconds, until you trigger an alarm.
- 4** Wait 20 seconds before repeating the test.

D.1.4 Range

Table 26: Sensitivity Ranges

Sensitivity	Detection Range (ft/m)	Standard Test Range (ft/m)
1 (Low)	66/20	13/4
2	133/40	26/8
3	200/60	40/12
4 (High)	300/90	50/15

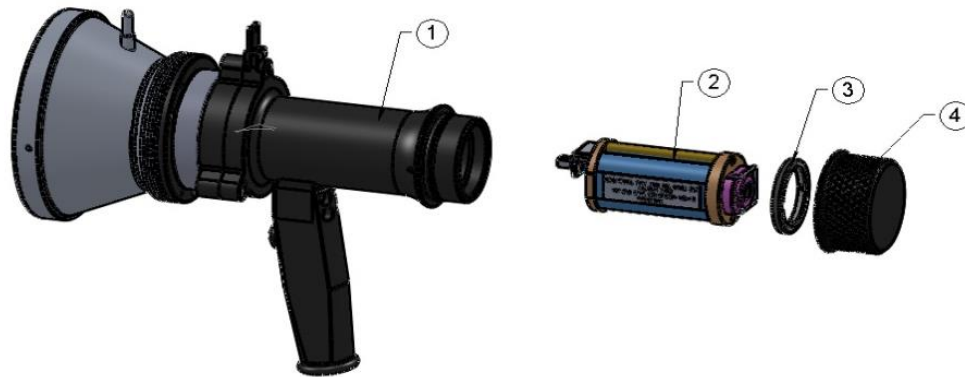
Notes:

- The minimum distance from the detector is 20"/50cm.
- At extreme temperatures, there is a 15% maximum reduction in the range.

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

D.1.5 Charging the Battery

The flame simulator uses lithium-ion batteries as a rechargeable power source. When the batteries are fully charged, the simulator operates at least 1,000 times without having to be recharged. The simulator will not operate when the voltage from the batteries is lower than the required operational level.



1	Simulator
2	Battery Pack
3	Locking Disc
4	Back Cover

Figure 15: Flame Simulator Battery Replacement

➤ **To charge the battery:**

Note: The item numbers shown in this procedure can all be found in Figure 15.

- 1** Place the flame simulator on a table in a safe area, not exceeding 104°F/40°C.
- 2** Release the locking screw.
- 3** Unscrew the battery back cover (Item 4) counterclockwise.
- 4** Unscrew the locking disc (Item 3) clockwise.
- 5** Pull out the battery from the flame simulator.
- 6** Connect the battery to the charger.
- 7** Charge for a maximum of 2–3 hours, until the green LED on the charger turns on.
- 8** Disconnect the charger.
- 9** Insert the battery into the Flame Simulator.
- 10** Screw on the locking disc (Item 3).
- 11** Screw on the back cover (Item 4).
- 12** Lock the back cover with the locking screw.

D.1.6 Battery Replacement

➤ **To replace the battery:**

Note: The item numbers shown in this procedure can all be found in Figure 15.

- 1** Place the flame simulator on a table in a safe area, not exceeding 104°F/40°C.
- 2** Release the locking screw.
- 3** Unscrew the battery back cover (Item 4) counterclockwise.
- 4** Unscrew the locking disc (Item 3) clockwise.
- 5** Pull out the battery from the flame simulator.
- 6** Insert the new battery pack in the simulator housing. Use only SPECTREX battery pack, P/N 380004.
- 7** Screw on the locking disc (Item 3).
- 8** Screw on the back cover (Item 4).
- 9** Lock the back cover with the locking screw.

Note: For more information refer to TM380002.

D.1.7 Technical Specifications

- General**
 - Temperature Range: -4°F to +122°F / -20°C to +50°C
 - Vibration Protection: 1g (10-50Hz)
- Electrical**
 - Power: 14.8V (4 X 3.7V rechargeable lithium-ion battery)
 - Max. Current: 4A
 - Battery Capacity: 2.2AH
 - Charging Time: 2A at 2hr
- Physical**
 - Dimensions: 230 x 185 x 136 mm
 - Weight: 5.5lb/2.5kg
 - Enclosure: aluminum, heavy duty copper free, black zinc coating
 - Explosion proof enclosure:
ATEX & IECEx
Ex II 2 G D
Ex d ib op is IIB +H2 T5 Gb
Ex ib op is tb IIIC T135°C Db
-20°C to +50°C / -4°F to +122°F

EMI Compatibility

Table 27: Immunity Tests

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	10Vrms (150kHz-80MHz)
Immunity to Main Supply Voltage Variations	MIL-STD-1275B	

Table 28: Emission Tests

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

D.2 Tilt Mount

The tilt mount (P/N 40/40-001) provides accurate directional selection for optimum area coverage.

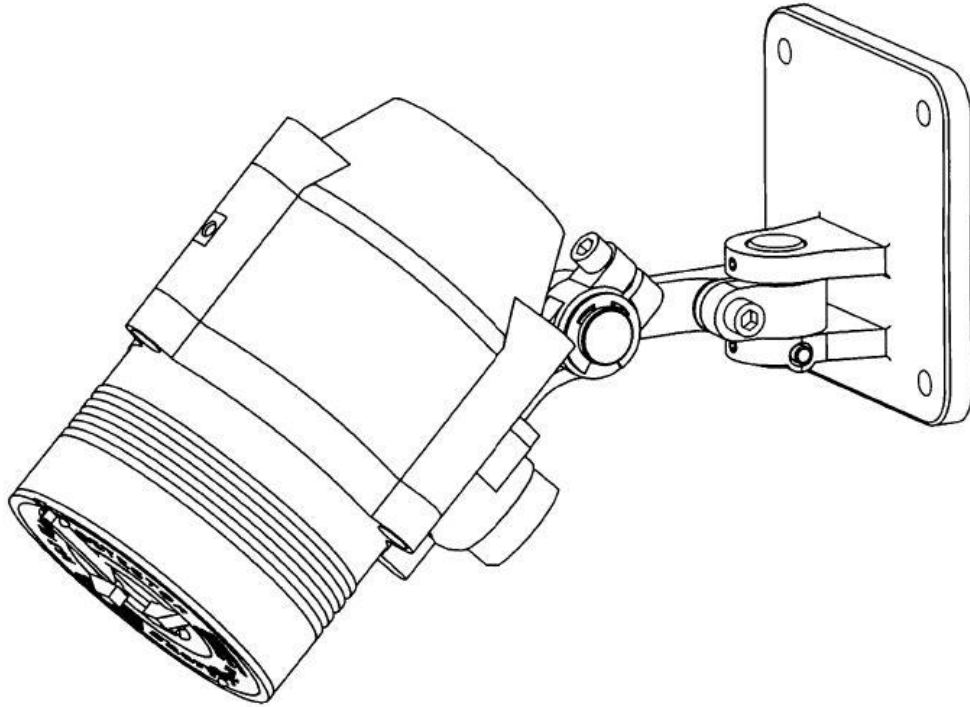


Figure 16: Tilt Mount

D.3 Duct Mount

The duct mount (P/N 777670) is suitable for use with the SharpEye 40/40 Series Optical Flame Detector 40/40UFI, for both the aluminum and st.st. enclosure.

The duct mount allows flame detection in areas where high temperatures exist or where the detector cannot be installed inside the area. It comprises a special duct mount arrangement with a specific optical window to allow installation in high temperature duct applications.

The duct mount limits the cone of vision of the installed detector to 65° horizontal and 65° vertical.

The temperature allowed for the duct mount to be installed is:
-55°C to +200°C / -67°F to +392°F.

For more instructions refer to TM777670.

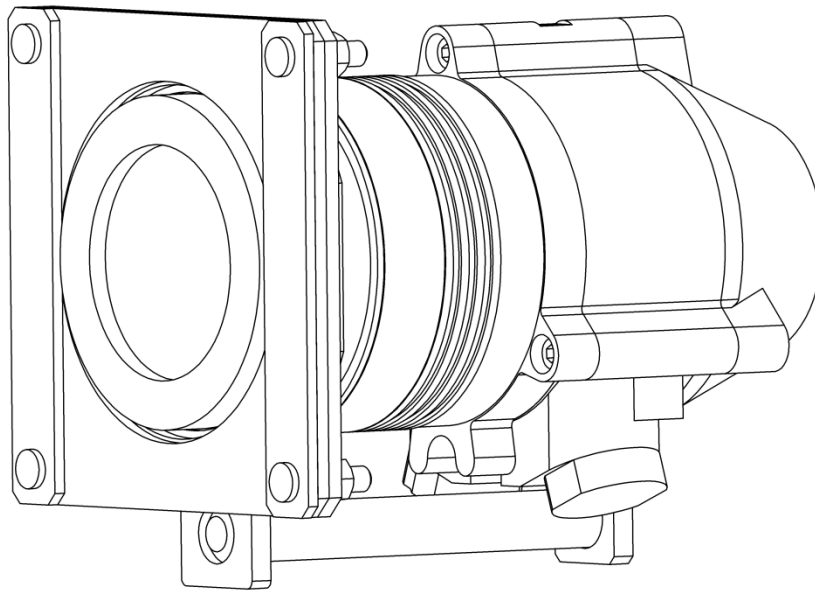


Figure 17: Duct Mount

D.4 Weather Cover

The weather cover (P/N 777163) protects the detector from different weather conditions, such as snow and rain.

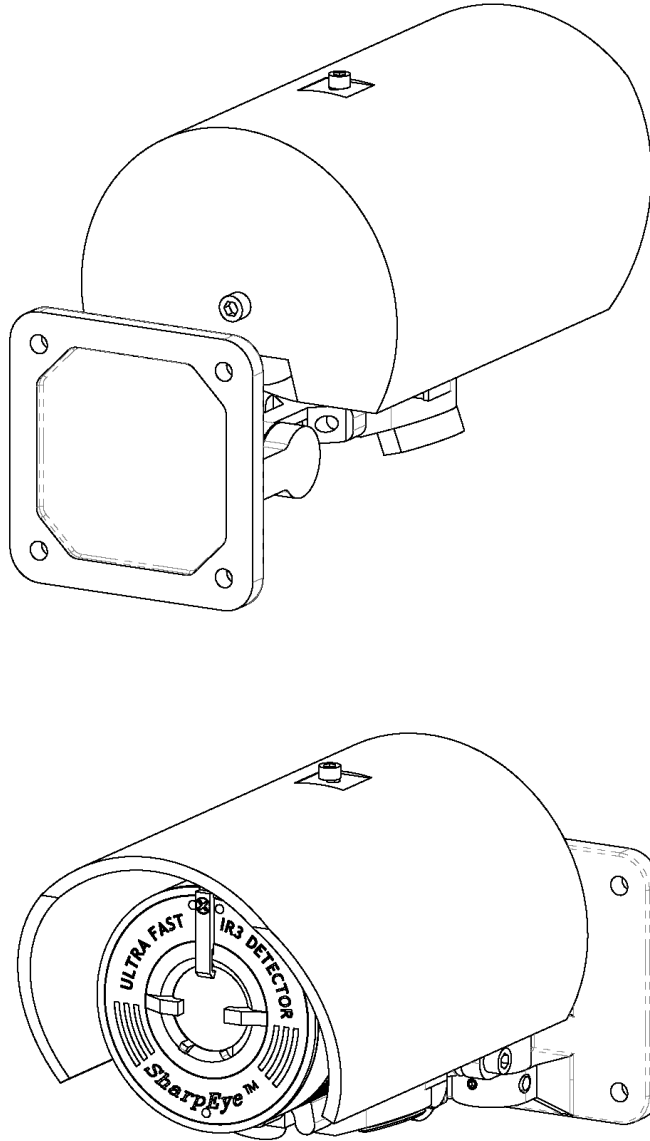


Figure 18: Weather Cover

D.5 Cone Viewer

The cone viewer (P/N 777166) evaluates detector coverage onsite. The device is an add-on accessory that enables designers and installers to optimize detector location and assess the actual coverage of installed detectors.

The device is universal and can be used with all 40/40 SharpEye Optical Flame Detectors.

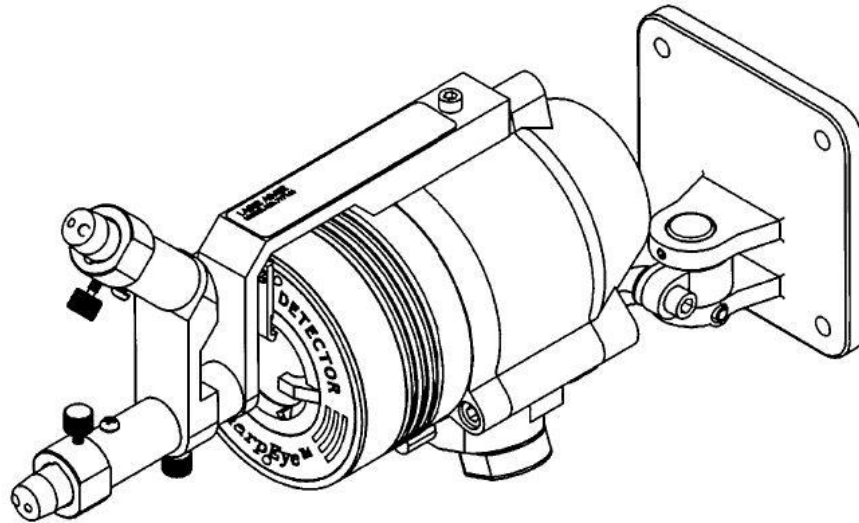


Figure 19: Cone Viewer

D.6 Air Shield

The air shield (P/N 777650) is suitable for use with the SharpEye 40/40 Series Optical Flame Detector 40/40UFI, for both the aluminum and st.st. enclosures.

Optical flame detectors are often used in highly polluted or dirty areas that force maintenance personnel to access the detector frequently in order to clean its optical window. The special air shield, developed for SharpEye 40/40 series optical flame detectors, allows their installation under environmental conditions where they may be exposed to oil vapors, sand, dust, and other particulate matter.

The temperature of the air supply to the air shield should not exceed 60°C/140°F at any time.

Air pressure source: Clean, dry, and oil-free air

Pressure: 2–3 bar / 30–45 psi

Fitting: 7/16" – 20UNF-2A

Operation Temperature: –55°C to +85°C / –67°F to +185°F

For more instructions, refer to TM777650.

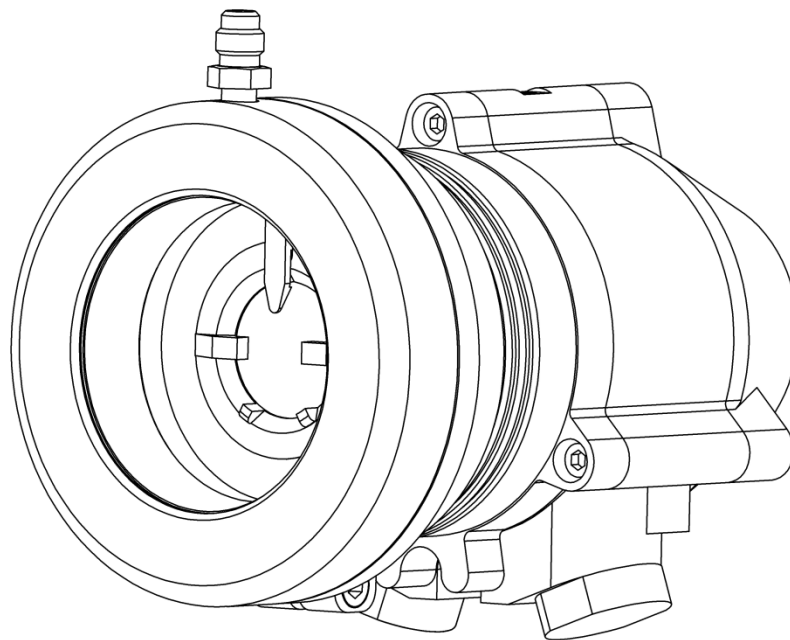


Figure 20: Air Shield

E SIL-2 Features

➤ **In this appendix...**

40/40UFI Flame Detector

page 81

E.1 40/40UFI Flame Detector

This appendix details the special conditions for compliance with the requirements of EN 61508 for SIL 2.

The 40/40UFI Flame Detector can only be used in low or high demand mode applications. See IEC 61508.4, Chapter 3.5.12.

E.1.1 Safety Relevant Parameters

Perform the following functional checks of the detector:

- **Alternative 1:** Functional check of the detector every 180 days:
 - HFT: 0
 - PFD: 3.1×10^{-4} ($\approx 3.1\%$ of SIL-2) if only alarm relay is used for alerting.
 - λ_{DU} : 1.4×10^{-7} if only alarm relay is used for alerting.
 - PFD: 3.3×10^{-4} ($\approx 3\%$ of SIL-2) if 0–20mA – interface is used as alarm.
 - λ_{DU} : 1.5×10^{-7} if 0–20mA – interface is used as alarm.
 - PFD: 2.9×10^{-4} ($\approx 2.9\%$ of SIL-2) if analog output interface is used as alarm.
 - λ_{DU} : 1.3×10^{-7} if analog output interface is used as alarm.
 - PFH: 1.5×10^{-7} 1/h ($\approx 14.9\%$ of SIL-2) for 0–20mA application.
 - SFF: 95% fulfills the conditions of EN 61508 for SIL2.
- **Alternative 2:** Functional check of the detector every 365 days:
 - HFT: 0
 - PFD: 4.6×10^{-4} ($\approx 5\%$ of SIL-2) if only alarm relay is used for alerting.
 - λ_{DU} : 1.4×10^{-7} if only alarm relay is used for alerting.
 - PFD: 5×10^{-4} ($\approx 5\%$ of SIL-2) if 0–20mA – interface is used as alarm.
 - λ_{DU} : 1.5×10^{-7} if 0–20mA – interface is used as alarm.
 - PFD: 4.3×10^{-4} ($\approx 4\%$ of SIL-2) if analog output interface is used as alarm.

- λ_{DU} : 1.3×10^{-7} if analog output interface is used as alarm.
- PFH: 1.5×10^{-7} 1/h ($\approx 14.9\%$ of SIL-2) for 0–20mA application.
- SFF: 95% fulfills the conditions of EN 61508 for SIL2.

E.1.2 Guidelines for Configuring, Installing, Operating, and Service

The alert conditions according to SIL 2 can be implemented by an:

- Alert signal via 20mA current loop
or
- Alert signal via alarm relay and the fault relay
or
- Alert signal via analog output interface.

E.1.2.1 Conditions for Safe Operating

- The flame detector must consist only of the approved hardware and software modules.
- The 24V power supply must fulfill the requirements for PELV/SELV of EN 60950.
- The automatic BIT (Built-In-Test) must be activated.
- The setup parameters must be verified (as described in *Using the 0–20mA Interface for Alerting* on page 82, point □; *Using the Alarm Relay Contact for Alerting* on page 83, point □; and *Using the Analog Output for Alerting* on page 83, point □). The function of the 40/40 Flame Detector (flame detection, function of the 0–20mA interface, and relay functions) must be checked completely.

E.1.2.2 Using the 0–20mA Interface for Alerting

- The following parameters should be set:
 - Automatic BIT test = on
 - Connected to 0–20mA Terminals
- The following allowed output current must be supervised with an accuracy of $\pm 5\%$:
 - Normal State = 4mA
 - Warning State = 16mA
 - Alarm State = 20mA
- The receiving device must be programmed to indicate a fault condition when current levels reach overcurrent or undercurrent.
- The 0–20mA can be used as low and high demand mode.

E.1.2.3 Using the Alarm Relay Contact for Alerting

- The following parameters should be set:
 - Automatic BIT Test = on
 - Connected to N.C. contact of alarm relay terminals
 - Connected to fault relay terminals
- The relay contacts (“alarm” and “faulty relay”) must be protected with a fuse rated at 0.6 of the nominal specified relay contact current.
- The maximum contact rating that is allowed per SIL-2 is 30VDC.
- The contact of the alarm relay opens if there is a fire alarm.
- During the forwarding and evaluation of the alarm, the relay contact opens.
- The alarm relay can be used as low demand only.

E.1.2.4 Using the Analog Output for Alerting

- The following parameters should be set:
 - Automatic BIT Test = on
 - Connected to analog output terminals
 - Connected to fault relay terminals
- The following allowed output values must be supervised with an accuracy of $\pm 5\%$:
 - Alarm State = 5V
 - Normal State = 2V
 - Fault State < 1V
- The Analog Output can be used in low demand mode only.

E.1.2.5 Other

- The complete function of the flame detector (flame detection, function of the 0–20mA interface, the relays, and the analog output interface) must be examined at least every 6 or 12 months (see ***Safety Relevant Parameters*** on page 81), or whenever the flame detector must be switched off and on.
- The window of the sensor must be examined at appropriate time intervals for partial contamination.
- The HART and the RS-485 interfaces must not be used for the transmission of safety-related data.

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