

## FSX™ Fire and Flame Detectors

### Model FS20X™ Series

FS20X UV/VIS/Dual IR



Standard Model



EN54 Model

## User Manual

Multi-Spectrum Infrared/Ultraviolet Electro-Optical  
Multi-Spectral Digital WideBand IR Sensor with Ultraviolet  
Phototube Radiant Energy Fire and Flame Detector



# Read and understand this manual before installing or operating equipment.

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### Introduction

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### Restricted Materials Chart for China RoHS

| 部件名称  | 有害物质   |        |        |              |            |              |
|-------|--------|--------|--------|--------------|------------|--------------|
|       | 铅 (Pb) | 汞 (Hg) | 镉 (Cd) | 六价铬 (Cr(VI)) | 多溴联苯 (PBB) | 多溴二苯醚 (PBDE) |
| 感光探测器 | X      | 0      | 0      | 0            | 0          | 0            |

本表格中未列出的所有部件和配件包含的有害物质都没有超过 GB/T 26572 所要求的限制。

本表格依据 SJ/T 11364 的规定编制

○ : 表示该有害物质在该部件所有均质材料中的含量均在 GB/T26752 规定的限量要求以下。

× : 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T26572 规定的限量要求。

Re-order code: 2004Y2007C\_2 A05095 China RoHS Declaration 07 (Pb Det)

### WEEE Directive Disposal Chart

**EN**

**EU Directive 2012/19/EU: Waste Electrical and Electronic Equipment (WEEE)**

This symbol indicates that the product must not be disposed of as general industrial or domestic waste. This product should be disposed of through suitable WEEE disposal facilities. For more information about disposal of this product, contact your local authority, distributor or the manufacturer.

**FR**

**DIRECTIVE 2012/19/UE: Relative aux déchets d'Equipements Électriques et Électroniques (DEEE)**

Ce symbole indique que le produit ne doit pas être éliminé en tant que déchet industriel ou ménager. Ce produit doit être envoyé vers des sites de valorisation ou élimination des D3E. Pour plus d'informations sur la mise au rebut de ce produit, contactez les autorités compétentes, votre distributeur ou le fabricant.

**IT**

**DIRETTIVA 2012/19/UE: Rifiuti di Apparecchiature Elettriche ed Elettroniche (RAEE)**

Questo simbolo indica che il prodotto non deve essere trattato come rifiuto industriale o domestico. Questo prodotto deve essere smaltito in idonei impianti di smaltimento specifici per RAEE. Per ulteriori informazioni sullo smaltimento di questo prodotto contattare l'ente locale preposto, il distributore o il produttore

**ES**

**DIRECTIVA 2012/19/UE: Residuos de Aparatos Eléctricos y Electrónicos (RAEE)**

Este símbolo indica que el producto no puede ser desechado como residuo doméstico o industrial genérico. Este producto debe ser desechado en instalaciones de reciclado RAEE adecuadas. Para más información acerca del desecho de este producto, contacte con su autoridad local, el distribuidor o el fabricante.

**NL**

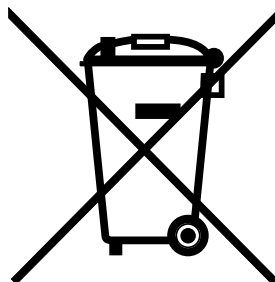
**RICHTLIJN 2012/19/EU: Betreffende Afgedankte Elektrische en Elektronische Apparatuur (AEEA)**

Dit symbool geeft aan dat het product niet als algemeen industrieel of huishoudelijk afval mag worden weggegooid. Het product dient te worden afgevoerd via geschikte afvalverwijderingsinstallaties voor AEEA. Neem voor meer informatie over de afvoer van dit product contact op met uw lokale overheid, distributeur of de fabricant.

**DE**

**RICHTLINIE 2012/19/EU: über Elektro- und Elektronik-Altgeräte**

Dieses Symbol zeigt an, dass dieses Produkt nicht als Hausmüll oder kommunaler Müll entsorgt werden darf. Es sollte zum Recycling zu einer geeignete WEEE Entsorgungsanlagen gegeben werden. Um weitere Informationen zum Recycling dieses Produkts zu erhalten wenden Sie sich an Ihre Kommunalbehörde, Ihren Lieferanten oder den Hersteller.



2004Y3100 Issue 1 04-18 A05095

### Safety Information

**WARNING**

Warnings contain information that could prevent injury or equipment damage.

**CAUTION**

Cautions contain information that could prevent equipment damage.

**NOTICE**

Notices contain helpful information.

### Contacting Honeywell Analytics

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## Product Overview

The model FS20X™ fire and flame detector senses the ultraviolet and wideband infrared radiant energy of blackbody particulate and molecular emissions generated by both hydrocarbon and non-hydrocarbon flames and fires. The wideband spectral radiant energy wavelengths sensed by its four sensors span approximately 0.185 to 0.26 microns and 0.7 to 3.5 microns.

The detector is designed and Factory Mutual approved for use in Class I, Division 1 and 2, Class II, and Class III; AEX d/Ex d IIC, and ATEX/IECEX Ex db IIC, Ex tb IIIC hazardous locations.



Figure 1. FS20X detectors; aluminum enclosure (left), stainless steel enclosure (right)

The detector is available in a copper-free aluminum enclosure or a 316 stainless steel enclosure (see [Figure 1](#)).



Figure 2. EN54 enclosure

The EN54 version is shown in [Figure 2](#).

The detector's electro-optical electronics module is a replaceable hard black enclosure of anodized aluminum that provides ruggedness, handling, ease of installation, and protection against electromagnetic interference and radio-frequency interference (EMI/RFI).

## Principle of Operation

Honeywell Analytics' Multi-Spectrum, Multi-Spectral, and MultiBand™ infrared (IR) and ultraviolet (UV) fire and flame detectors are sophisticated, state of the art, electro-optical digital radiant energy devices that sense the wideband radiant energy emitted by combustion processes that include the molecular emissions and hot particulate blackbody emissions in flames. Radiant energy fire detectors respond much faster to flames and fires at longer distances than conventional photoelectric and ionization smoke and heat detectors because a fire radiates energy at the speed of light. High speed of response is critical for detecting flaming fires in time to activate suppression systems, close fire doors, etc. Seconds can make the difference between suppressing a small fire with little or no damage or having a disastrous fire which overwhelms a suppression system and fails to stop the fire.

Infrared light consists of spectral wavelengths longer than red while ultraviolet light consists of wavelengths shorter than violet. IR and UV wavelengths are invisible to humans. The FS20X™ detector operates from approximately 185nm to 260nm. Additionally, the detector monitors the visible spectrum, from about 400 to 700 nanometers (0.4 to 0.7 microns.) The visible band is used to discriminate against false alarm sources. The detector senses radiant energy from both hydrocarbon and non-hydrocarbon fires. Built-in microprocessors use digital signal processing (DSP) to distinguish between radiant energy from a real fire and that from a false alarm source. Honeywell Analytics has developed and refined these complex proprietary and patented WideBand IR and UV algorithms for over 30 years, beginning in 1981. These patented algorithms perform real-time DSP, and precisely analyze the signals in high-resolution frequency and time domains. This decision-making process involves thousands of real-time calculations every second. Honeywell Analytics FSX™ detectors use solid-state high speed quantum sensors (not heat sensors such as pyroelectric or thermopile) that all respond to the fire's radiant energy emissions. The quantum sensors convert the rate of photonic energy directly into analog electrical signals. These analog signals are converted to high resolution digital values for real-time microprocessor analysis.

The detector microprocessors incorporate random access memory (RAM), read-only memory (ROM), and non-volatile flash memory. When the microprocessors determine that a fire has been detected, the pre-alarm digital sensor data (FirePic™) and the event information are recorded in flash memory. Depending on the configuration, other actions may include activating one or more status LEDs, relays, a current loop, or sending digital data such as the RS-485 FireBusII™ and Modbus. If the microprocessor determines, based on internal and "through-the-window" testing, that the detector is not operating correctly, it records the fault data in flash memory and activates the fault outputs and the yellow status LED. The digital data in the detector can easily be accessed with a PC for analysis and record-keeping using Honeywell Analytics' Windows®-based PC software and FSIM USB Interface Unit.



## Features and Benefits

- Selectable sensitivity (four settings)  
User can set the detector to any of four detection distances (see [“Configuring the Detector” on page 27](#)).
- Selectable relay options  
User-configurable for a variety of dry contact relay interface options (see [“Configuring the Detector” on page 27](#)).
- Selectable 4 – 20 mA output  
Source or sink output options (see [“Configuring the Detector” on page 27](#)).
- Selectable communications  
Configurable for analog or digital communication outputs such as ModBus (see [“Configuring the Detector” on page 27](#)).
- Selectable digital communication address  
The user can select a unique 7-bit code (128 addresses, see [“Configuring the Detector” on page 27](#)).
- Lower power consumption  
Requires smaller external power supplies and fewer system backup batteries.
- Multiple microprocessors  
Reduces the number of discrete detector components, provides larger programming and memory capacity, and provides redundant self-checking.
- Wider range of applications  
Primary applications include long range, fast response to fires such as acetylene, silane, hydrogen, etc.
- Wider operating temperatures  
-40°F to +185°F (-40°C to +85°C) standard
- Built-in automatic “through-the-window” self-test  
Monitors window obscuration and checks the operation of the detector’s sensor array and electro-optical electronics module with built-in IR and UV self-tests.
- Anodized removable aluminum detector module  
Rugged, superior protection against EMI/RFI and handling plus simple field installation and replacement.
- Three bright LEDs (red, yellow, green)  
Field status indicators with individual LEDs for alarm, fault, and normal conditions. Provides superior detector status viewing in bright outdoor environments (see [“Fault Conditions” on page 32](#), [LED Status Indicators” on page 30](#)).
- Windows-based PC interface  
User can perform remote FS20X Detector diagnostics, real-time status, Real-Time Graphing (RTG™), SnapShot™ data recording, and downloading FirePics™ with Honeywell Analytics’ exclusive FSIM-2 USB Interface Unit and easy-to-use Windows-based PC Software.
- Designed to detect both hydrocarbon and non-hydrocarbon fires with a single FSX™ detector  
All fire and flame threats are sensed, not just hydrocarbon fires as with triple IR flame detectors.
- FM 3260 approved  
Third-party tested and certified for industrial and commercial applications.
- Designed, manufactured, and tested by Honeywell Analytics  
Over thirty years of proven fire/flame detection product excellence worldwide.

## Typical Applications

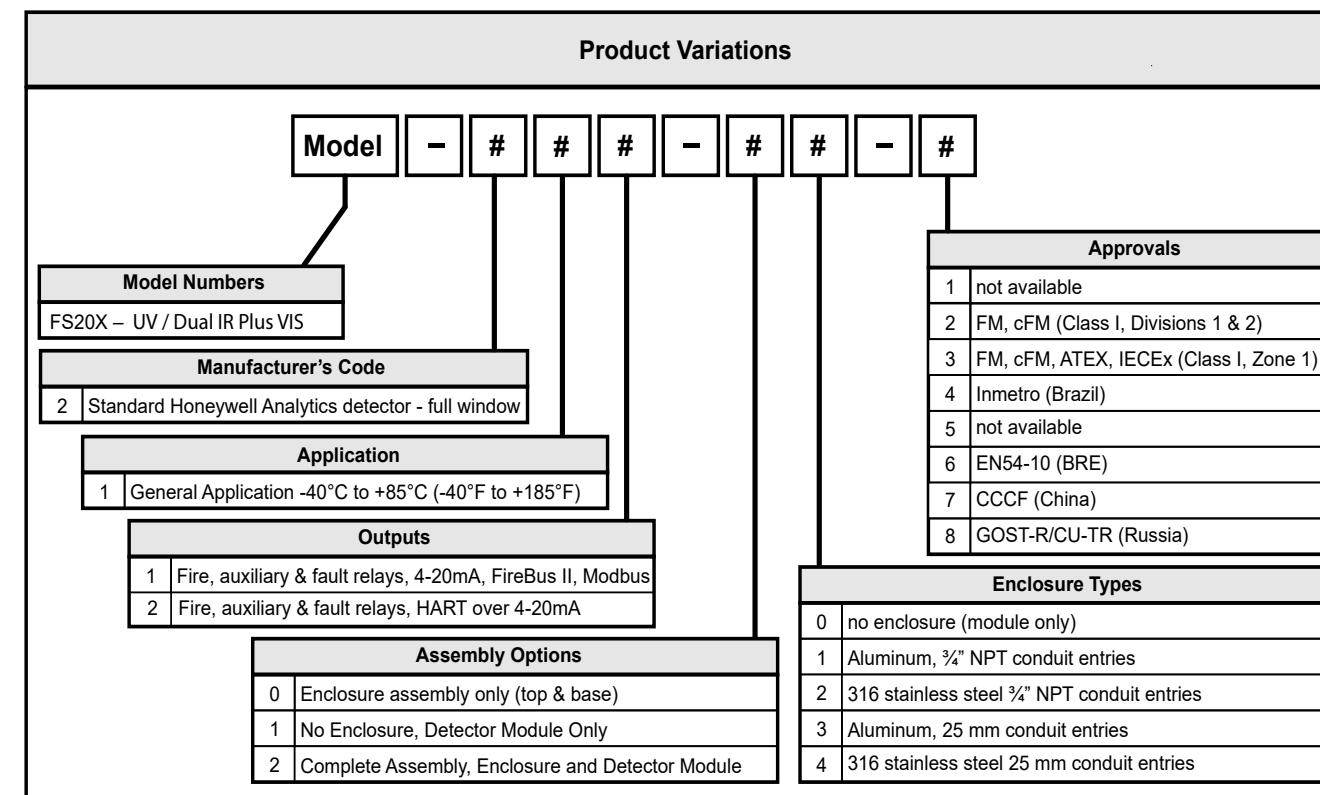
- Refineries
- Offshore drilling and production platforms
- Petrochemical plants
- Petroleum product pipelines and pumping stations
- Gas compressor buildings
- Gas collection facilities
- Gas processing plants
- Gas turbine enclosures
- Gasoline loading terminals
- LNG storage/distribution
- LPG storage/distribution
- Cogeneration plants
- Crude and product tank farms
- Aerosol filling facilities
- Commercial and military aircraft hangars
- Engine test cells
- Marine engine rooms
- Marine terminals
- Paint and solvent storage
- Power plants
- Product storage terminals
- Rail and truck Loading and Unloading terminals
- Silane gas cabinets
- Silane gas manufacturing
- Hydrogen plants
- Hydrogen storage
- General warehouses

**Glossary**

| Term                              | Meaning   |
|-----------------------------------|---|
| algorithm                         | a computational procedure   |
| cycling power                     | turning the detector off and then powering it up again  |
| DSP                               | digital signal processing   |
| end-to-end test                   | the complete system, from detection through suppression, is tested  |
| FireBusII                         | communications protocol used for transmitting data from a detector to a Windows-based computer  |
| FirePic                           | retrievable pre-fire data storage protocol, used for analysis and postulation of the cause of a fire  |
| frequency domain                  | signal analysis based on frequency instead of time  |
| IR                                | infrared; the wavelengths of light from approximately 700 nanometers to 1 millimeter  |
| Modbus                            | a serial communication protocol developed by Modicon in 1979  |
| nanometer                         | unit of measure equal to one one-billionth (10 <sup>-9</sup> ) of a meter; designated <i>nm</i>   |
| NC                                | normally closed (electrical short circuit, by default)  |
| NO                                | normally open (electrical open circuit, by default)   |
| non-volatile flash memory         | data stored on a chip that is not lost when the detector's power is cycled.   |
| micron                            | unit of measure equal to one one-millionth (10 <sup>-6</sup> ) of a meter and 1000 nanometers; designated <i>μm</i>                                 |
| RAM                               | random access memory or read and write memory   |
| ROM                               | read-only memory  |
| real-time                         | near-instantaneous analysis and response by a device, usually measured in milliseconds or microseconds  |
| self-test                         | a test of all of the system's components is performed automatically on start-up, and a self-test is performed periodically during normal operation. |
| time domain                       | signal analysis based on time   |
| through-the-window remote testing | testing a detector with an external test lamp   |
| UV                                | ultraviolet; the wavelengths of light from approximately 10 nanometers to 400 nanometers.   |
| wideband                          | a broad range of wavelengths within the infrared spectrum   |

**Product Variations**

Product variations beyond those field-selectable by the user are available for customers with specialized needs. This illustration shows how these variations are coded:



**FS20X-211-22-2**

UV / Dual IR Plus VIS detector, general applications with relays, 4-20mA output, FireBus II / Modbus, 316 stainless steel enclosure with 3/4 NPT conduit entries, Class I, Divisions 1 & 2, Groups B, C & D, Class II, Groups E, F & G, Class III; Class I, Zone 1 AEx d/Ex d IIC: Ex db IIC, Ex tb IIIC; IR and UV self-tests, approvals: FM, cFM, ATEX, IECEx, LPCB EN 54-10:2002.

## Test Lamps

Some manufacturers claim that their detectors do not need remote testing with an external test lamp because it tests itself. Even though Honeywell Analytics detectors also perform “through-the-window” self-testing, Honeywell Analytics, in compliance with NFPA 72 codes, has developed portable test lamps for end-to-end remote testing.

Internal detector testing and window cleanliness testing cannot ensure that a detector is aimed properly, that its view of the threat area has not been blocked, or that its alarming circuitry and outputs (i.e., relays, 4-to-20 mA, etc.) are operating properly. Remote test lamps can perform these functions.

### **WARNING**

Use test lamp model TL-1055 in non-hazardous locations only. For hazardous locations, use model TL-2055 as described below.

### Test lamp TL-1055

Model TL-1055 is a general purpose NEMA 1 handheld rechargeable test lamp designed for testing FSX detectors in non-hazardous locations only. The test lamp (see [Figure 3](#)) is supplied with a universal charger (110 VAC and 220 VAC).



Figure 3. TL-1055 handheld test lamp (NEMA 1)

In normal operation, an FS20X detector will alarm to a fully charged TL-1055 test lamp at a distance of 1 to 25 feet. This complies with NFPA 72 codes.

### Test lamp TL-2055

Model TL-2055 is designed for handheld testing of FSX detectors in hazardous locations. The test lamp, shown in [Figure 4](#), is explosion-proof and carries Class I, Division 1 approval. It also is supplied with a universal, 110VAC/220VAC charger.



Figure 4. TL-2055 handheld test lamp (Class I, Division 1)

In normal operation, an FS20X detector will alarm to a fully charged TL-2055 test lamp at a distance of 1 to 25 feet. This complies with NFPA 72 codes.

### **NOTICE**

Test lamps do not represent one-square-foot fires; they demonstrate that a detector will respond to radiant energy sources within its field of view.

## Field of View Restrictor

Certain specialized applications may require a restricted field of view in order to prevent the detector from alarming to a known (friendly) fire/flame source such as a flare stack. The model FVR-01 field-of-view restrictor ([Figure 5](#)) has been developed for these unique applications. The restrictor can be easily modified in the field with a hacksaw. Use of the restrictor has not been certified to the EN54-10 standard.



Figure 5. FOV-01 field of view restrictor



### HART Module

For HART applications, order part number FSX-A014. This module will allow for HART communication as well as SINK and SOURCE mA loop.

### Installation

#### Installation Practices

For installations in a Hazardous Classified Area, consult the *National Electrical Code Handbook*, articles 500 through 517 for the proper installation practices. For locations outside the United States, observe local and regional regulations.

#### CAUTION

The detector's metal conduit plug by itself will not provide a weathertight seal. To maintain the detector's weatherproof integrity and satisfy local and regional regulations, apply an approved sealant to the threads.

Before completing the installation, verify that the detector has been configured correctly for the application. The factory default settings are as follow:

| FS20X Settings for SW VER I/F 6175009G and earlier             |                          |           |
|--|--------------------------|-----------|
| Description  | Setting                  |           |
| Alarm relay outputs are non-latching and normally de-energized | SW2-1 off                | SW2-7 off |
| Detector range/sensitivity is medium                           | SW2-2 off                | SW2-3 on  |
| Auxiliary relay Verify Time is set to 5 seconds                | SW2-4 on                 | SW2-5 off |
| Factory use only   | SW2-6 off                |           |
| Fault relay output is normally energized                       | SW2-8 on                 |           |
| Communication is set to FireBusII                              | SW3 is set to position 4 |           |
| Factory use only   | SW1-1 through SW1-3 off  |           |
| Digital communication address is set to 127                    | SW1-4 through SW1-10 on  |           |

#### NOTICE

Refer to SW1-2 setting below for SW VER I/F 6175009H and later

| SW1.2 | POSITION OF SW1.2<br>ON | POSITION OF SW1.2<br>OFF<br>(This is Default Factory Position) |
|-------|-------------------------|--|
| 8 mA  | ENABLED                 | DISABLED   |
| 12 mA | ENABLED                 | DISABLED   |
| 16 mA | ENABLED                 | DISABLED   |

If the detector's application requires different settings, refer to ["Configuring the Detector" on page 27](#) for detailed descriptions.

Before applying power to the detector

- Verify that all wire connections are correct (["Detector Connections" on page 20](#)). Each wire must be stripped properly to the correct length, loose wire strands must be removed, and securely screwed clockwise in the connector.
- When using conduit, ensure that a proper conduit seal (appropriate for the area classification) has been installed and appropriate measures to prevent moisture ingress have been taken.
- Consult Honeywell Analytics for dimensional information on flameproof joint specifications.
- Verify that the detector is securely mounted, its window is clean, and it has an unobstructed view of the area of coverage (see ["Installation Practices" on page 12](#)).
- Shield the detector face from strong light sources when first energized.
- Ensure the mounting guidelines are followed (["Mounting Instructions" on pages 13-16](#)).

The detector is now ready for use. On power-up, the fault relay will change status if the default setting is used (see ["FS20X Settings for SW VER I/F 6175009G and earlier" on page 12](#)).

#### Mounting Instructions

Consider the following guidelines when selecting a detector location:

1. Avoid areas containing radiant energy sources (e.g., radiant heaters, high intensity lamps, flare stacks, etc.) that would be near the detector's field of view.

2. Install the detector with the base horizontal. The view angle in this direction is 90° horizontal as shown in the illustration. (The vertical angle is 80°, 45° below the center line and 35° above it).

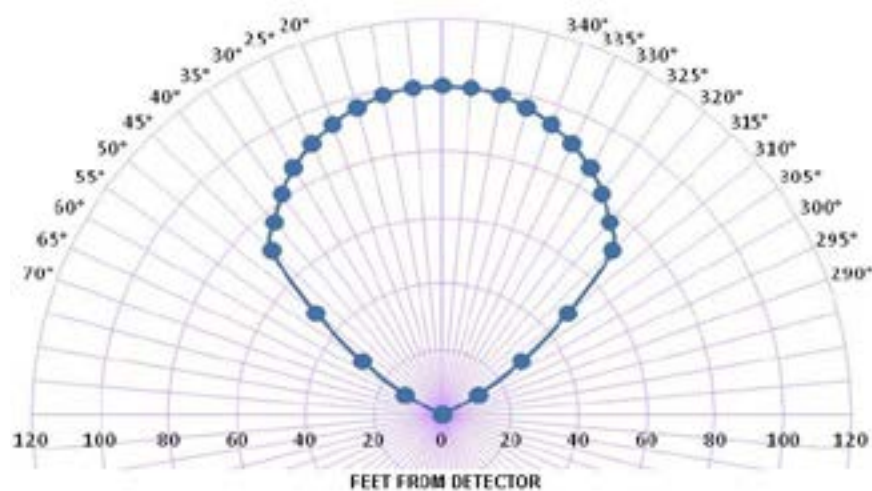


Figure 6. FS20X horizontal field of view

To comply with the requirements of FM3260, the maximum field of view (FoV) is the angle at which the device can detect a flame at 50% of the maximum specified distance. Similarly, to comply with the requirements of EN54-10:2002, the maximum field of view (FoV) is the angle at which the device can detect a flame at 70% of the maximum specified distance. To comply with the directional dependence requirements of EN 54-10:2002, an angle of  $\pm 40^\circ$  ( $80^\circ$ ) from  $0^\circ$  (where  $0^\circ$  is the orientation of the detector in the same axes as the flame source) must not be exceeded.

The FS20X UVIR Flame Detector Field of View, as tested to EN54-10, is  $\pm 40$  degrees in the horizontal plane and  $+30/-40$  degrees in the vertical plane, as shown below:

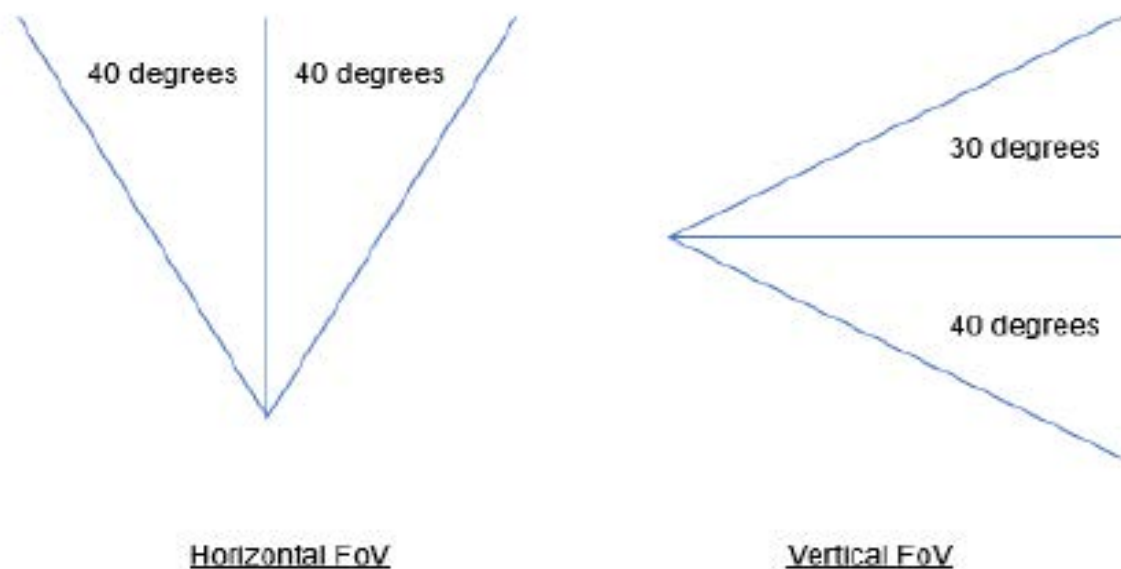


Figure 6b: FS20X EN54-10 FoV (Field of View)

Model SM4 is a 316 stainless steel swivel mount designed for the FS20X enclosure. The adapter plate (with the two screw holes) is attached to the base of the detector (see Figure 7). The mounting plate (four screw holes), can be secured to a solid surface. Angle adjustments are in  $10^\circ$  increments along either axis. For single-axis adjustments, the center section need not be installed. Do not mount the detector facing horizontally or above the horizon. Use at least a  $30^\circ$  downward angle with the swivel mount. This is especially critical outdoors.

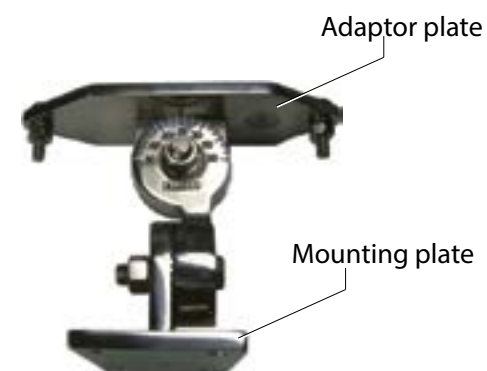


Figure 7. SM4 swivel mount

3. Provide the detector an unobstructed view of the threat area. Obstructions between the detector and a fire may prevent it from being detected.
4. Mount the detector in an area where temperatures will not exceed the specified operating temperature range (see “Environmental” on page 35 and “Hazardous Area Classifications” on page 35).
5. Conduit entries
  - a. If only one conduit entry is used, install and seal the conduit plug on the unused entry ( $\frac{3}{4}$  in. NPT or 23 mm, as shown in Figure 8).

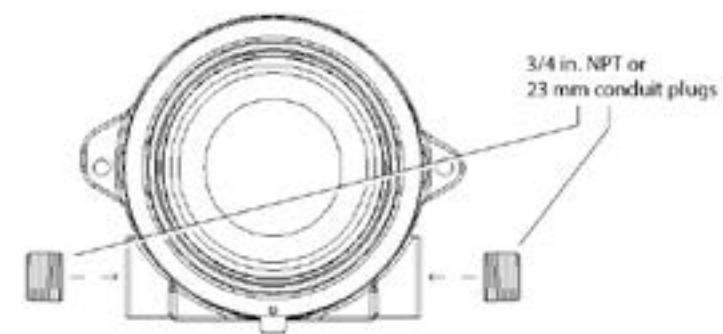


Figure 8. Detector, front view

- b. Install an approved conduit condensation trap or drain as shown in [Figure 9](#) (if required to meet hazardous area classifications per NFPA 70: National Electrical Code, latest revision).

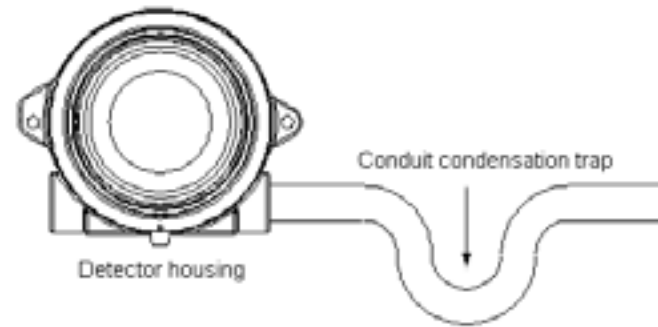


Figure 9. Conduit trap

### Opening the Detector

**CAUTION**

Use a wrist strap connected to earth ground and follow other static protection procedures when handling connectors and wiring the electronics module to the detector.

**NOTICE**

Do not touch the sensor windows on the front of the detector's electronics module (see [Figure 10](#)). If necessary, they can be cleaned gently with alcohol and a cotton swab see "Maintenance" on page 33.



Figure 10. Electronics module sensor windows

**The electronics module must be removed from the enclosure for access to the field connections.**

1. Loosen the enclosure's setscrew (see [Figure 11](#))

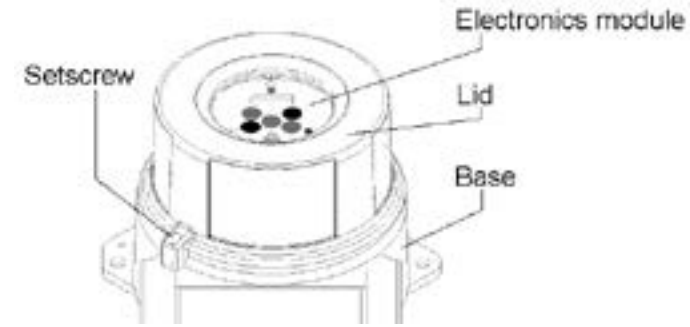


Figure 11. FS20X enclosure

2. Unscrew and remove the enclosure lid ([Figure 12](#)).

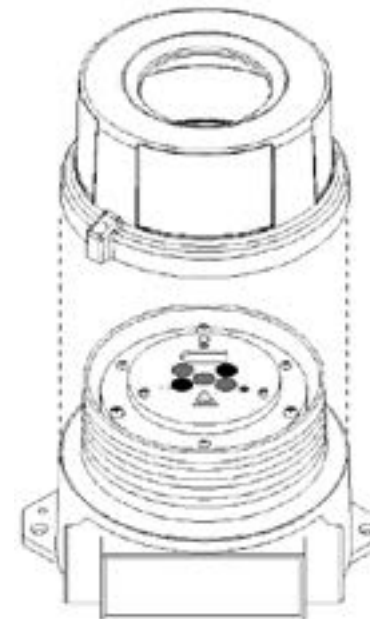


Figure 12. Removing the enclosure lid

- Loosen the electronic module's three captive screws (Figure 13).

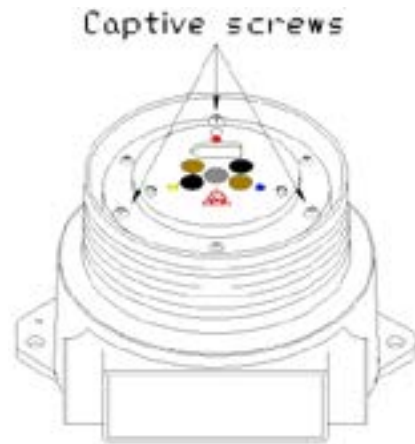


Figure 13. Loosening the captive screws

- Slide the module out of the enclosure base (Figure 14).

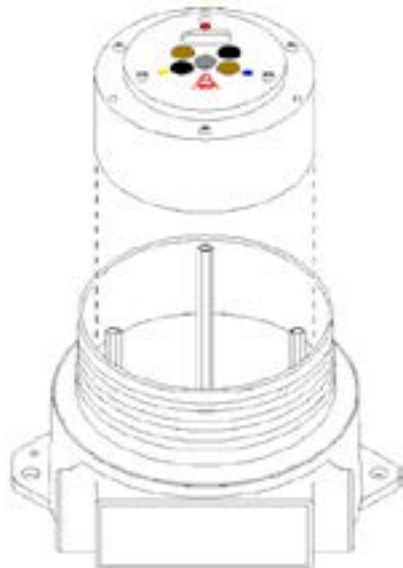


Figure 14. Removing the electronics module

### Field Connectors

There are two field connection options:

- A removable ten-pin screw terminal connector (J2) for hardwired relay applications.
- A removable six-pin screw terminal connector (J1) for analog output or RS-485 digital communication applications.

**The removable connectors provide quicker installation and allow the detector's enclosure to be installed before the electronics module.**

### User-selectable Configuration Switches

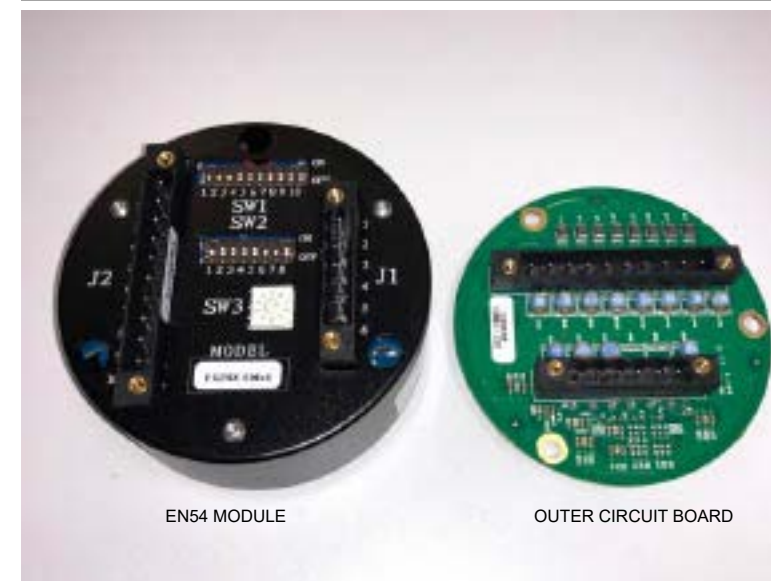
- The ten-pin DIP switch (SW1) is used to select a unique digital address (128 choices).
- The eight-pin DIP switch (SW2) is used to select the detector's sensitivity and relay options.
- The ten-position rotary switch allows selection of the analog and digital communication protocol.



Figure 15. Electronics module (rear view)

### NOTICE

For EN54 units (FS20X-6 suffix), the outer circuit board must be removed to set the user configurations and then placed back onto the module after making the adjustments.



EN54 MODULE

OUTER CIRCUIT BOARD



### Detector Connections

The electronics module has six-pin and ten-pin, removable connectors with female screw terminal plugs. These connect to the two respective male connectors with analog, digital, and relay interfaces (see Figure 16). Use the ten-pin plug (J2) and connector for relay configurations. For digital and analog configurations, use the six-pin plug (J1) and connector.

| J2 Connector |               | J1 Connector |               |
|--------------|---------------|--------------|---------------|
| Pin          | Connection    | Pin          | Connection    |
| 1            | Auxiliary NC  | 1            | DC return     |
| 2            | Auxiliary NO  | 2            | RS-485-A      |
| 3            | Auxiliary COM | 3            | RS-485-B      |
| 4            | Alarm NC      | 4            | +24 VDC       |
| 5            | Alarm NO      | 5            | 4-20mA source |
| 6            | Alarm COM     | 6            | 4-20mA sink   |
| 7            | Fault NO      |              |               |
| 8            | Fault COM     |              |               |
| 9            | +24 VDC       |              |               |
| 10           | DC return     |              |               |



Figure 16. Electronics module, rear view (contacts shown with no power applied)

### NOTICE

Do not open the electronics module as this will void all warranties.

Avoid wire splices whenever possible. Good wiring practices simplify installation, improve reliability, and facilitate maintenance. If wire splices are necessary, solder and properly insulate them.

### Wiring and Terminal Connections

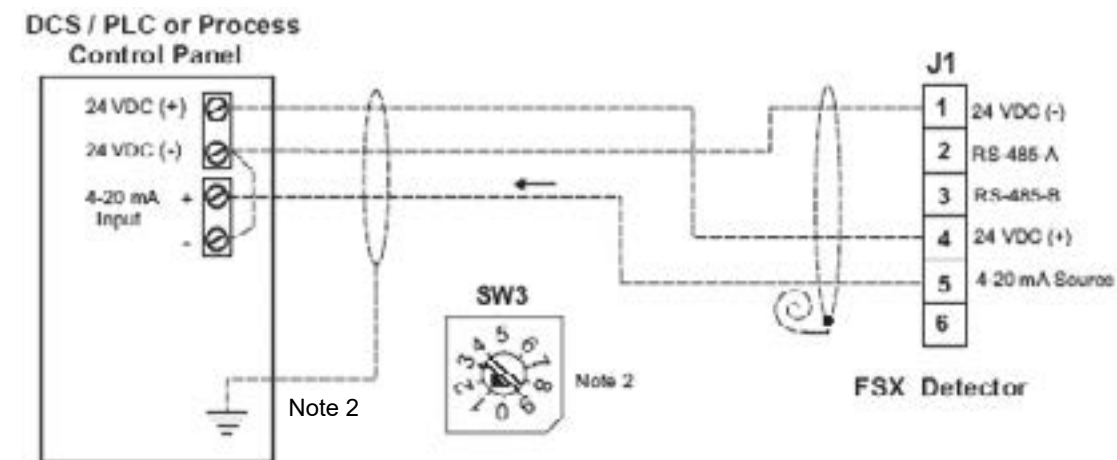


Figure 17. Typical wiring for 4-20 mA (sourcing) analog output

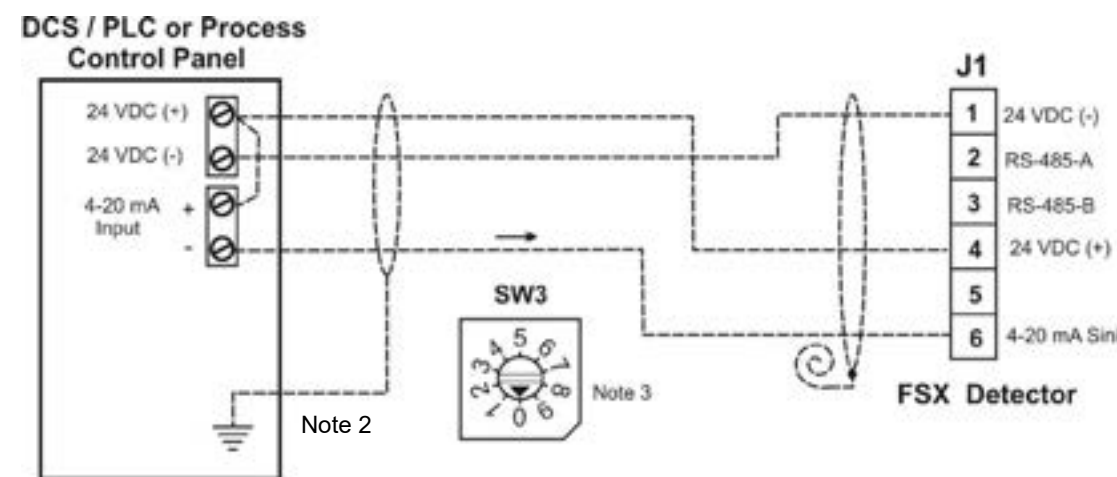


Figure 18. Typical wiring for 4-20 mA (sinking) analog output

#### Notes:

1. The cable shield must be grounded at one end only, at the control panel.
2. Coil and tape the cable shield at the detector end.
3. Set rotary switch SW3 to position 1 for source current wiring (Figure 17) or to position 0 for sink current wiring (Figure 18).



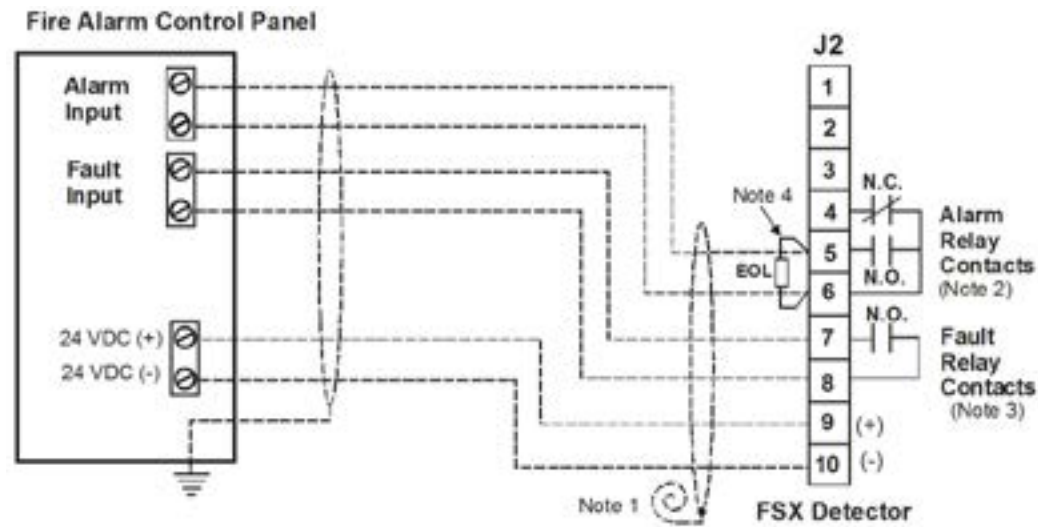


Figure 19. Typical relay output wiring for monitoring separate alarm and fault contacts

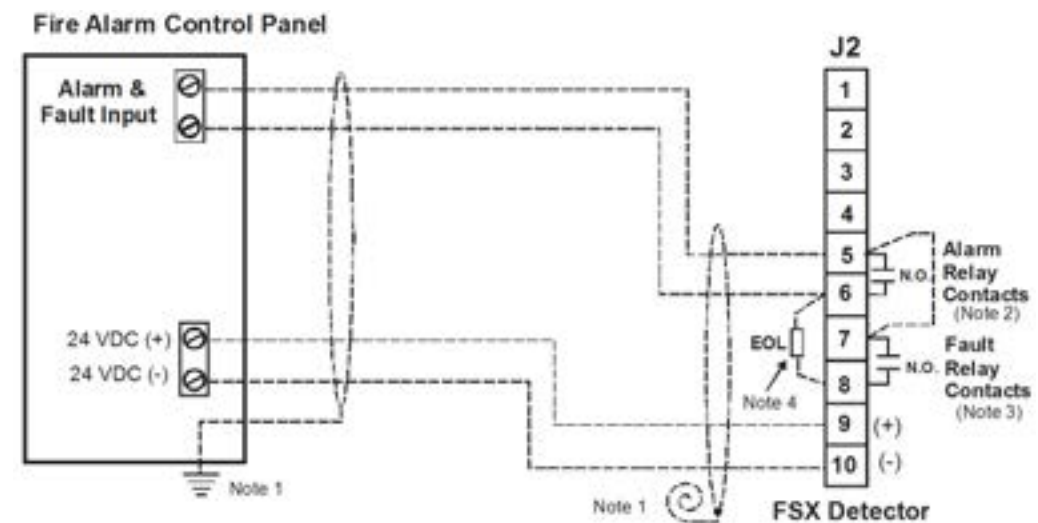
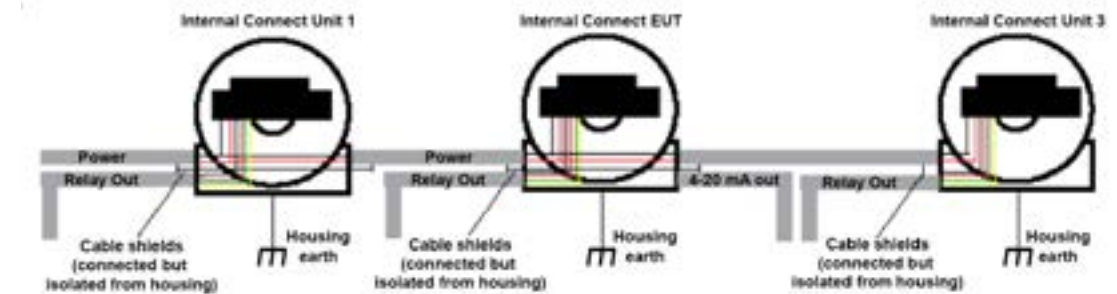
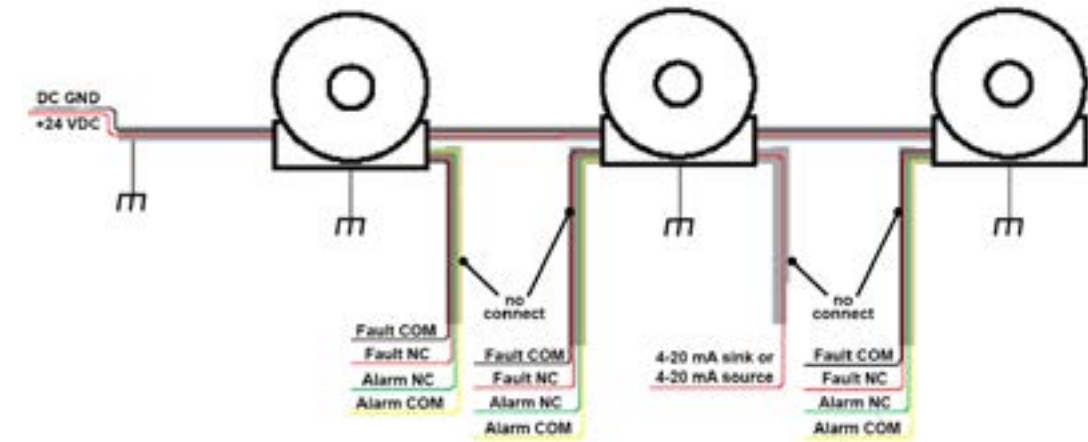


Figure 20. Typical relay output wiring for monitoring alarm and fault contacts on a single two-wire input

**Notes:**

1. The cable shield must be earth grounded at one end only, at the control panel. Coil and tape the cable shield at the detector end.
2. The alarm relay contacts are shown with no power applied. The alarm relay is de-energized during normal operation and with no alarm. This relay will energize during alarm conditions.
3. Fault relay contacts are also shown with no power applied. During normal operation and with no fault, this relay will energize and the N.O. contacts will close.
4. Install an E.O.L. device as required and supplied by the fire alarm panel.



- 1.) Cable shields are connected and earth grounded at the supply only.
- 2.) Housings are connected independently to earth via external cables.
- 3.) Housings and cable shields are isolated from each other.

Figure 21. Recommended wiring configurations

**Changing Detector Settings**

1. Verify that the external 24 VDC power is turned off before connecting the detector.
2. After applying 24 VDC power, after tests (i.e., butane lighter, FSC test lamp, or test fires), or after resetting the detector, wait at least thirty seconds to allow its sensors to normalize to the spectral background conditions.
3. To activate SW1/SW2/SW3 setting changes, reset the detector by cycling the power.
4. For applications requiring analog/digital communications, refer to [“Configuring the Detector” on page 27](#).

**Start-up and commissioning****⚠ CAUTION**

During start-up and commissioning, disable all outputs from the detector to any control panels or other control devices.

**Testing the detector**

After the detector is powered, thoroughly test it using a hand-held test lamp to ensure the detector has an unobstructed view of the threat area.

Honeywell Analytics FSX detectors feature automatic electronics and internal software testing every three seconds. This includes a through-the-window test that verifies the cleanliness of the viewing window. As with all other optical fire and flame detectors, this does not constitute a fully functional “end to end” test. Self-tests can only partially check and test the operational readiness of a detector. In order to thoroughly test the readiness of any fire or flame detector (without starting a real fire, which is not permitted in hazardous areas), the detector must be tested with a test lamp. This is the only safe and non-hazardous method to test any detector’s sensors, internal electronics, alarm activation software, viewing window cleanliness, terminal wiring integrity, relay activation, and the functionality of all of its outputs. Since most detectors are installed in fire alarm systems, this is the only method to test a complete system, ensuring that all of the system wiring and the control panel are properly installed.

Additionally, using an external test lamp eliminates these conditions:

- The window being covered (with, for example, paint overspray, hanging garments, etc.)
- The detector being improperly positioned or oriented
- The detector’s line of sight being blocked (i.e., by recently installed air ducts or pipes, storage boxes, vehicles, etc.) preventing the threat area from being fully protected. Optical fire and flame detectors are line-of-sight devices so they must be properly positioned and oriented with unobstructed views of their threat areas.

To test the full functionality of the detector, use test lamp model TL-1055 or TL-2055 in the manner prescribed in [“Test Lamps” on page 10](#) . These are the only test lamps that can activate FSX detectors. Do not use them with other Honeywell Analytics detectors or with those of other manufacturers.

1. Disable the outputs (a full functional test includes activating the alarm outputs).
2. Aim the test lamp at the front of the detector (within a distance of about 1 to 25 feet and on-axis as much as possible).
3. Press and hold the test lamp’s pushbutton.
4. While watching the alarm LED on the face of the detector, slowly move the test lamp’s boresight to ensure that the detector receives its full intensity. Practicing this technique will help optimize the testing of other detectors. The LED will illuminate, usually within three to ten seconds. The alarm relay outputs will also activate and the 4-20 mA analog output will increase to 16mA (±0.6mA), then 20mA (±0.6mA) after the Verify Time is exceeded.

5. If the detector does not respond within thirty seconds:

- a. Verify that the test lamp has been charged sufficiently.
- b. Verify that the test-lamp-to-detector distance is between one and twenty-five feet.
- c. Verify that the testing technique described above has been followed. If the detector still does not respond, contact Honeywell Analytics.

## Drawings

### Dimensions

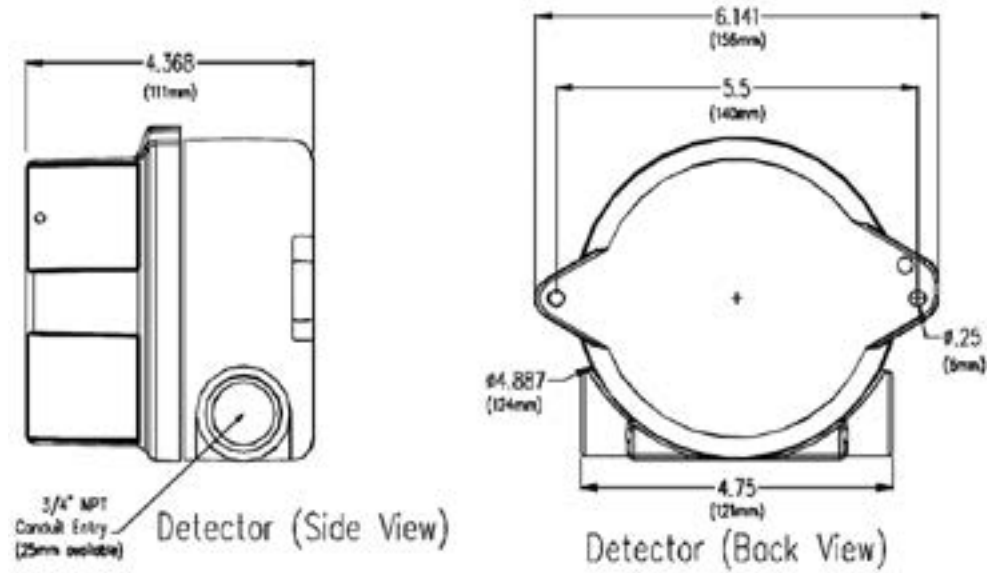


Figure 22. FS20X dimensions

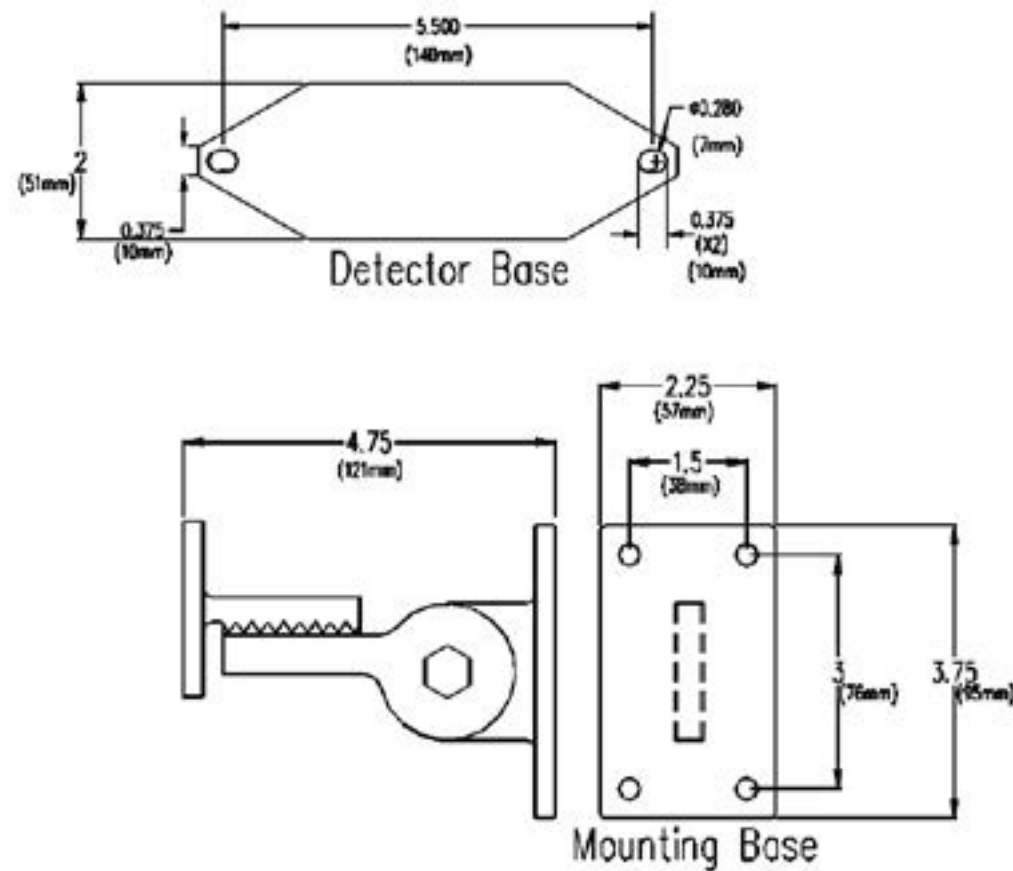


Figure 23. SM4 outline and dimensions

## Operation

### Configuring the Detector

#### NOTICE

To activate changes to the settings using SW1, SW2, or SW3, reset the detector by cycling the 24 VDC power.

#### DIP Switch SW1

The digital address for RS-485 communication can be set using positions 4 through 10 on DIP switch SW1, shown in Figure 24. (Do not change switch positions 1, 2, or 3 on SW1; they are for factory use only.)



Figure 24. Ten-position DIP switch SW1.

| SW1 Configuration |     |     |     |     |     |     |     |     |     |     |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Digital Address   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| 000               | off | off | off | off | off | off | off | off | off | off |
| 001               | off | off | off | off | off | off | off | off | off | on  |
| 002               | off | off | off | off | off | off | off | off | on  | off |
| 003               | off | off | off | off | off | off | off | off | on  | on  |
| 124               | off | off | off | on  | on  | on  | on  | on  | off | off |
| 125               | off | off | off | on  | on  | on  | on  | on  | off | on  |
| 126               | off | off | off | on  | on  | on  | on  | on  | on  | off |
| 127 (default)     | off | off | off | on  | on  | on  | on  | on  | on  | on  |

DIP Switch SW2



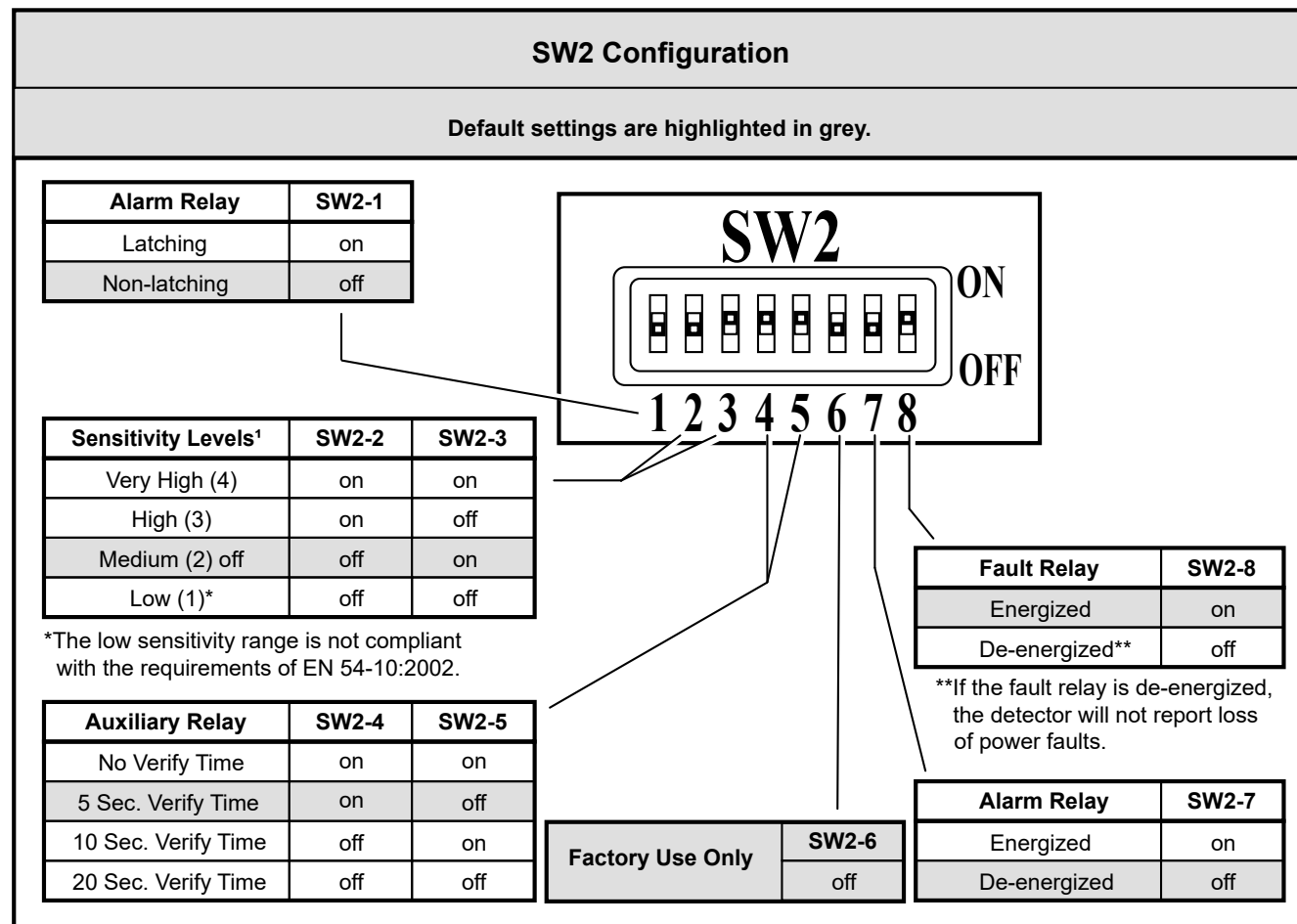
Figure 25. Eight-position DIP switch SW2

Rotary Switch SW3



Figure 26. Ten-position rotary switch SW3.

The detector has a variety of analog and RS-485 digital communication options. Analog and digital outputs are available in addition to relay outputs. Select from two analog outputs or two digital outputs using the ten-position rotary switch SW3. When '4-20mA sink' or '4-20mA source' are selected, the default RS-485 protocol is FireBusII. 4-20mA Source is only available when position 1 is selected on SW3 (rotary switch). If position 2 (Modbus) or position 4 (FirebusII), the 4-20mA current sourcing output is inhibited. FireBusII (position 4) is the default setting (highlighted in grey in the table below). Use [Figure 26](#) and this table to configure SW3:



| SW3 Configuration |                  |
|-------------------|------------------|
| Position          | Output Selection |
| 0                 | 4-20 mA sink     |
| 1                 | 4-20 mA source   |
| 2                 | RS-485 Modbus    |
| 3                 | Factory use only |
| 4                 | RS-485 FireBusII |
| 5                 | Factory use only |
| 6                 | Factory use only |
| 7                 | Factory use only |
| 8                 | Factory use only |
| 9                 | Factory use only |

<sup>1</sup>Tested using a one square foot n-heptane pan fire at the following distances:  
 Very High = 200 feet      High = 150 feet  
 Medium = 100 feet      Low = 50 feet



## LED Status Indicators

The detector status is indicated by three LEDs:

- Green
  - blinking (flashing) once every ten seconds indicates a normal, safe operational condition (i.e., no faults or alarms).
  - off when no external input power is applied to the detector.
- Yellow
  - blinking (flashing) when the window is dirty
  - on steadily for all other fault conditions
- “Red flashes while FirePic is being stored”
- “Red turns on when a fire is alarmed”

## Normal Operation

In normal operation<sup>1</sup> the green LED, shown in [Figure 27](#), blinks every ten seconds. If one of the 4-20 mA options is selected (see “[SW1 Configuration](#)” on [page 27](#)), the current, sink, or source will be 4.0 mA  $\pm$ 0.6 mA. Only the current source mode has been certified to the EN54-10 standard.

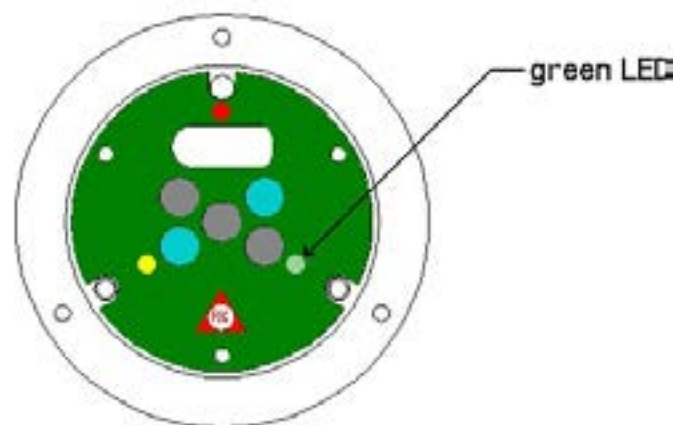


Figure 27. Green LED location

<sup>1</sup> Normal operation is defined as the detector with 24 VDC applied without alarm or fault conditions.

## Alarm Condition

When an alarm condition occurs, the red LED shown in [Figure 28](#) will turn on. The factory setting for the auxiliary relay is 5 seconds.

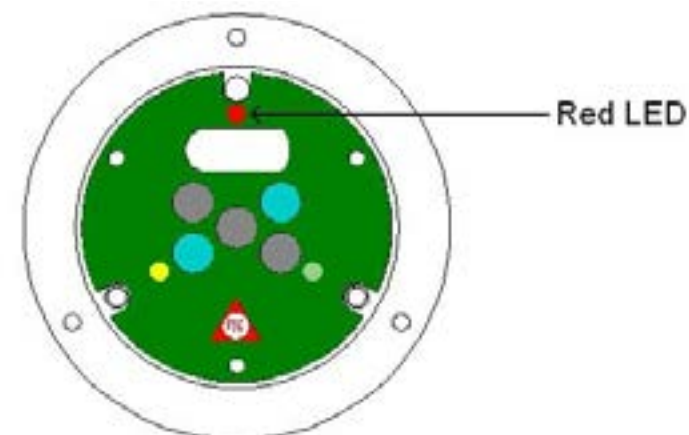


Figure 28. Red LED location

## Alarm condition outputs

- Alarm Relay activation
- Auxiliary Relay activation<sup>2</sup>

## Only one active alarm output from this group:

- 4-20 mA (sink 16 mA) Alarm Output
- 4-20 mA (source 16 mA) Alarm Output
- 4-20 mA (sink 20 mA) Auxiliary Output
- 4-20 mA (source 20 mA) Auxiliary Output

## Only one active alarm from this group:

- RS-485 FireBusII Alarm Notification
- RS-485 ModBus Alarm Notification

<sup>2</sup> verified alarm output



## Fault Conditions

When a fault (trouble) condition occurs, the yellow LED will illuminate. See Figure 3-6 for the location of the Yellow LED.

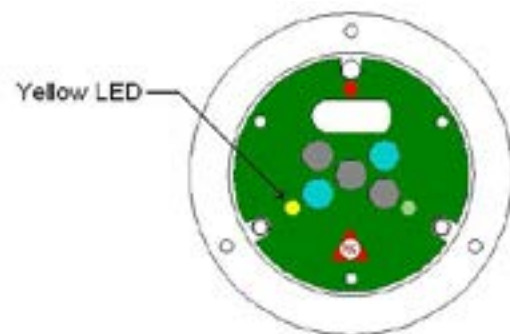


Figure 29. Yellow LED location

### Fault condition output

#### Fault relay activation

##### 4-20mA output

4-20 mA (sink) output<sup>3</sup>

2 mA (self-test/window obscuration fault)

0 mA (all other faults)

##### 4-20 mA (source) output<sup>4</sup>

2 mA (self-test/window obscuration fault)

0 mA (all other faults)

#### RS-485 output

RS-485 FireBusII fault notification

RS-485 Modbus fault notification

### Causes of fault conditions:

- Under voltage input power (<18 VDC).
- Over voltage input power (>32 VDC).
- Over temperature (>85 °C or 185 °F for the standard version).
- Under temperature (<-40 °C or -40 °F for the standard version).
- One or more microprocessor failures.
- One or more relay coil failures.
- Communication fault.
- Electronic self-test failure.
- Dirty window (flashing yellow LED)

<sup>3</sup> only one active fault output from these three

## Maintenance

After the detector is installed and commissioned, little maintenance is required. However, a test of the entire fire detection system should be performed periodically, depending on the application. Additionally, semi-annual or quarterly testing should be performed with the appropriate Honeywell Analytics test lamp (TL-1055 or TL-2055) to ensure the integrity of the system.

Establish a periodic cleaning schedule. Some industrial environments may require more frequent cleaning of the detector's window than others.

Clean the detector's window any time it is dirty or contaminated, every time the enclosure lid is handled, if the detector fails the built-in test, or if the detector fails an end-to-end test with the test lamp. If necessary, clean the detector module sensors whenever the detector has been disassembled.

Use a blast of clean air or an oil-free cloth to clean the enclosure window (oil degrades the performance of UV detectors). Do not use commercial or silicone-based window cleaning products; they also will degrade the detector's performance. Occasional use of a solvent such as 6% isopropyl alcohol is acceptable. No disassembly of the detector is required for this.

### **WARNING**

To avoid electrostatic discharge, wipe the enclosure only with a damp cloth.

## Specifications

### Mechanical

| Description         |                 | Value  |
|---------------------|-----------------|--|
| Enclosure Materials |                 | copper-free aluminum (red)<br>316 stainless steel        |
| Dimensions          | Assembly        | 4.35 in. (110.49 mm) H × 4.81 in. (122.24 mm) Dia        |
|                     | Mounting holes  | ¼ in. (6.35 mm) Dia, 5½ in. (139.70 mm) center-to-center |
|                     | Conduit entries | Two ¾ in. NPT or two 25 mm                               |
| Weight              | Aluminum        | 3 lbs. 11 oz. (1.7 kg) approximately                     |
|                     | Stainless steel | 7 lbs. 7 oz. (3.4 kg) approximately                      |
| Enclosure Rating    |                 | IP66, NEMA 4, NEMA 4X                                    |
| Vibration           |                 | meets or exceeds Mil Spec 810C, Method 514.2, Curve AW   |

### Electrical

| Description                             |   | Value  |
|---|---|--|
| Input voltage range                     |   | 18 VDC to 32 VDC   |
| Normal operation current                |   | 85 mA (nominal), 175 mA (nominal with heater <sup>1</sup> )                            |
| Maximum fire alarm current              |   | 135 mA (maximum), 220 mA (maximum with heater <sup>1</sup> )                           |
| Relay contact rating                    |   | 1 Amp @ 24 VDC resistive   |
| Analog current output <sup>2, 3</sup>   | 0.0 to 20.0 mA (Non-isolated source or sink, user selectable) |  |
|   | 0.0 mA (<0.6 mA) = Fault                                      |  |
|   | 2.0 mA (±0.6 mA) = Dirty window                               |  |
|   | 4.0 mA (±0.6 mA) = Normal, safe (no fault, no fire)           |  |
|   | 8.0 mA (±0.6 mA) = Background IR                              |  |
|   | 12.0 mA (±0.6 mA) = Background UV                             |  |
|   | 16.0 mA (±0.6 mA) = Fire alarm                                |  |
| 20.0 mA (±0.6 mA) = Verified fire alarm |   |  |
| Screw terminal wire sizes               |   | 12 AWG to 22 AWG (2.50 mm to 0.762 mm; use stranded conductors, <b>not</b> solid core) |

<sup>1</sup> The heater circuit turns on only when the temperature drops below 0° F (-17° C).

<sup>2</sup> 400 ohms maximum load (loop resistance)

<sup>3</sup> If the "verify time" is not zero, the alarm level = 16 mA and the verify level = 20 mA. If the verify time **is** zero, alarm level = 20 mA and the verify level = 20 mA.

### Environmental

| Description                     | Value   |
|---------------------------------|---|
| Operating Temperature, Standard | -40° F to +185° F (-40° C to +85° C)                            |
| Operating Temperature, EN54-10  | -14° F to +131° F (-10° C to +55° C)<br>(full range of EN54-10) |
| Operating Humidity Range        | 0 to 95% RH, 100% RH condensing for short periods of time       |
| Storage Temperature             | -67° F to +221° F (-55° C to +105° C)                           |

### Performance

| Description             | Value   |
|-------------------------|---|
| Field of View           | cone of view is 90° horizontal and 80° vertical (35° above the center line and 45° below it)                          |
| Sensitivity             | 1 sq. ft. heptane fire at 200 feet (± 45° from axis)  |
| Speed of Response       | typically 2 to 5 seconds  |
| Spectral Sensitivity    | ~0.185 to 0.26 microns and 0.4 microns to 3.5 microns   |
| Wire Temperature Rating | must be rated at least 10°C above the rated service temperature (120°C for T4 applications, 85°C for T5 applications) |

### Extended Field of View

| Description   | Value   |
|---------------|---|
| Field of View | ±60 vertical and horizontal                               |
| Sensitivity   | 1 sq. ft. heptane fire at 40 feet = 7 seconds (or less)   |
| Sensitivity   | 2 in. diameter IPA fire at 3 feet = 3.5 seconds (or less) |

### Hazardous Area Classifications

(See "Hazardous Location Detector Markings" on page 37)

| Description                             |                                  |
|---|----------------------------------|
| Class I, Division 1, Groups A, B, C & D |                                  |
| Class II, Division 1 Groups E, F & G    | Class I, Zone 1, AEx d/ Ex d IIC |
| Class III Ex db IIC, Ex tb IIIC         |                                  |
| T4: Ta = -40°C to +110°C                | T4: Ta = -40°C to +110°C         |
| T5: Ta = -40°C to +75°C                 | T5: Ta = -40°C to +75°C          |
| T6: Ta = -40°C to +60°C                 | T6: Ta = -40°C to +60°C          |

### Performance Certifications

(See "Hazardous Location Detector Markings" on page 37)

| Agency | Standard               | Certificate    | Notes   |
|--------|------------------------|----------------|---|
| LPCB   | EN 54-10:2002 +A1:2005 | 1175a/01       | Sensitivity settings: Very High, High, Medium<br>EN 54-10 Class 1 |
| CPR    | EN 54-10:2002 +A1:2005 | 2831-CPR-F0515 |   |

### Additional Performance Specifications

#### Flame Response Sensitivity

This table provides typical response times for various fuels:

| MultiBand IR plus UV Detector |  |   |                 |                                 |
|-------------------------------|--|---|-----------------|---------------------------------|
| Location                      | Fuel   | Fire Size   | Distance (ft/m) | Typical Response Time (seconds) |
| Indoors                       | Acetylene                                      | 12 in (0.30 m) plume - medium flame               | 35/10.7         | 2                               |
|                               | Acetylene                                      | 10 - 12 in (0.25 - 0.30 m) plume - lazy flame     | 40/12.2         | < 2                             |
|                               | Diesel   | 6 in X 6 in (15.2 cm X 15.2 cm)                   | 87/26.5         | < 3                             |
|                               | Ethanol  | 12 in X 12 in (0.3 m X 0.3 m)                     | 50/15.2         | < 3                             |
|                               | Hydrogen                                       | 3/8 in dia. (9.5 mm) orifice, 32 in (0.8 m) plume | 85/25.9         | < 3                             |
|                               | IPA  | 6 in X 6 in (15.2 cm X 15.2 cm)                   | 87/26.5         | < 3                             |
|                               | JP4  | 6 in X 6 in (15.2 cm X 15.2 cm)                   | 75/22.9         | < 3                             |
|                               | JP8  | 6 in X 6 in (15.2 cm X 15.2 cm)                   | 87/26.5         | 3                               |
|                               | Methane  | 3/8 in dia. (9.5 mm) orifice, 32 in (0.8 m) plume | 70/21.3         | < 3                             |
|                               | Methanol                                       | 12 in X 12 in (0.3 m X 0.3 m)                     | 40/12.2         | < 3                             |
|                               | n-Heptane                                      | 6 in X 6 in (15.2 cm X 15.2 cm)                   | 87/26.5         | < 3                             |
| Silane                        | 1/32 dia (0.8 mm) orifice, 12 in (0.3 m) plume | 30/9.1  | < 2             |                                 |
| Outdoors                      | Acetylene                                      | 12 - 16 in (0.30 - 0.41 m) plume - large flame    | 100/30.5        | < 3                             |
|                               | Acetylene                                      | 12 in (0.30 m) plume - medium flame               | 100/30.5        | < 4                             |
|                               | Acetylene                                      | 10 - 12 in (0.25 - 0.30 m) plume - lazy flame     | 90/27.4         | < 3                             |
|                               | Diesel   | 12 in X 12 in (0.3 m X 0.3 m)                     | 150/45.7        | 4                               |
|                               | Ethanol  | 12 in X 12 in (0.3 m X 0.3 m)                     | 60/18.3         | < 3                             |
|                               | Hydrogen                                       | 3/8 in dia. (9.5 mm) orifice, 32 in (0.8 m) plume | 75/22.9         | < 3                             |
|                               | IPA  | 12 in X 12 in (0.3 m X 0.3 m)                     | 150/45.7        | < 3                             |
|                               | JP4  | 12 in X 12 in (0.3 m X 0.3 m)                     | 150/45.7        | < 4                             |
|                               | JP8  | 12 in X 12 in (0.3 m X 0.3 m)                     | 150/45.7        | < 4                             |
|                               | Methane  | 3/8 in dia. (9.5 mm) orifice, 32 in (0.8 m) plume | 60/18.3         | 2                               |
| Methanol                      | 12 in X 12 in (0.3 m X 0.3 m)                  | 40/12.2   | < 2             |                                 |
| n-Heptane                     | 12 in X 12 in (0.3 m X 0.3 m)                  | 200/61.0  | < 4             |                                 |
| Silane                        | 1/32 dia (0.8 mm) orifice, 12 in (0.3 m) plume | 50/15.2   | < 3             |                                 |

### False Alarm Immunity

The second column in this table shows the minimum distance at which a detector exposed to various false fire sources did not alarm or show any signs of instability. The third column shows the sensitivity to a one-foot square n-Heptane reference fire in the presence of those false fire sources.

| False Alarm Immunity      |                                |                               |
|---------------------------|--------------------------------|-------------------------------|
| False Fire Source         | Minimum Distance with No Alarm | Sensitivity to Reference Fire |
| Direct Sunlight           | No alarm                       | 50 ft (15.24 m)               |
| Modulated Sunlight        | No alarm                       | 25 ft (7.62 m)                |
| Modulated Arcwelding      | 9 ft 9 in (3 m)                | Source at 30 ft (9.14 m)      |
|                           |                                | Fire at 30 ft (9.14 m)        |
| Continuous Arcwelding     | 9 ft 9 in (3 m)                | Source at 30 ft (9.14 m)      |
|                           |                                | Fire at 30 ft (9.14 m)        |
| Resistive Electric Heater | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |
| Flourescent Lamp          | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |
| Halogen Lamp              | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |
| Sodium Vapor Lamp         | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |
| Pelican Flashlight        | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |
| Incandescent Lamp         | 1 ft (30.48 cm)                | Source at 3 ft (91.44 cm)     |
|                           |                                | Fire at 200 ft (60.96 m)      |

### Hazardous Location Detector Markings

| Series | 1 - North America   | 2 - IECEx   | 3 - ATEX  | 4 - CPR   | 5 - South Korea | 6 - Brazil   | 7 - EU WEE | 8 - China RoHS | 9 - Electrical Rating  |
|--------|---|---|---|---|-----------------|--|------------|----------------|--|
| FS20X  | CLASS I DIV. 1, GRPS ABCD<br>CLASS III/II, DIV. 1, GRPS EFG<br>T4 T135°C Ta = -40°C to +110°C<br>T5 T135°C Ta = -40°C to +75°C<br>T6 T135°C Ta = -40°C to +60°C<br>IP66, NEMA Type 3, Type 4, Type 4X | Ex db IIC<br>Ex tb IIIC T135°C IP66<br>T4 Ta = -40°C to +110°C<br>T5 Ta = -40°C to +75°C<br>T6 Ta = -40°C to +60°C<br>IECEX FMG14.0027X | II 2 G Ex db IIC<br>II 2 D Ex tb IIIC T135°C IP66<br>T4 Ta = -40°C to +110°C<br>T5 Ta = -40°C to +75°C<br>T6 Ta = -40°C to +60°C<br>FM14ATEX0058X<br>CE Notified Body #: 2809 | 1175a/01<br>0832-CPR-F0515<br>WideBand IR™/UV<br>CE Notified Body #: 2811 | N/A             | Ex d IIC T6... T4<br>Gb IP66<br>EX tb IIIC T80 °C...<br>T130 °C IP66 | Required   |                | ELEC (MAX): 32 VDC, 150 mA<br>RELAY: 24 VDC, 1 A<br><br>For Brazil:<br>ELET.(MAX): 32 Vcc, 150 mA<br>RELÉ: 24 Vcc, 1 A |

## Warranty

Honeywell Analytics warrants the FS20X fire and flame detector against defects in material and workmanship under normal use and service for a period of three years from the date of shipment. Honeywell Analytics, at its option, will repair or replace, at no charge detectors found to be defective during the warranty period they are returned in accordance with the terms of this warranty. Replaced parts are warranted for the balance of the original applicable warranty period. All replaced parts become the property of Honeywell Analytics. This express limited warranty is extended by Honeywell Analytics to the original purchaser only and is not assignable or transferable to any other party. This is the complete warranty for FS20X fire and flame detectors. Honeywell Analytics assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of Honeywell Analytics. Honeywell Analytics does not warrant the installation, maintenance, or service of its products. Honeywell Analytics is not responsible for ancillary equipment not furnished by Honeywell Analytics, which is attached to or used in connection with its products or for operation of the products with ancillary equipment and all such equipment if expressly excluded from this warranty. This warranty sets forth the full extent of Honeywell Analytics' responsibility regarding the detector's repair or replacement at Honeywell Analytics' options and is the exclusive remedy.

This warranty is given in lieu of all other express warranties and implied warranties, including without limitation implied warranties of merchantability and fitness for a particular purpose and is limited to the duration of this limited warranty. In no event shall Honeywell Analytics be liable for damages in excess of the purchased price of the product, for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings, or other incidental, special, or consequential damages arising from or in connection with the use or inability to use the detector, to the full extent such may be disclaimed by law.

## This warranty does not cover:

- Defects or damage resulting from use of the detector in other than its normal and customary manner.
- Defects or damage from misuse, accident, or neglect.
- Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- Detectors subjected to unauthorized modifications, disassemblies, or repairs including, without limitation, the addition to the detector of non-Honeywell Analytics equipment which adversely affects the performance of the detector to interfere with Honeywell Analytics' normal warranty inspection and testing of the detector to verify any warranty claim.
- Detectors whose serial numbers have been removed or made illegible
- Freight costs to the repair facility.
- Detectors which, due to unauthorized alteration of their software or firmware, do not function in accordance with Honeywell Analytics' specifications.
- Cosmetic damage to detectors' surfaces that do not affect their operation.
- Normal and customary wear and tear.

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