



# General Monitors

by MSA

## Models FL3100H/FL3101H

UV/IR and UV only  
Flame Detectors



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**Instruction Manual**

**DATE 01-16**

General Monitors reserves the right to change published specifications and designs without prior notice.



**Part No.**  
**Revision**

**MANFL3100/3101H**  
**H/01-16**



**DECLARATION OF CONFORMITY**

We, at General Monitors Inc, hereby declare that the equipment described below, both in its basic design and construction, and in the version or versions marketed by us, conforms to the relevant safety and health related requirements of the appropriate EC Directives, only as follows:

**Models: FL3100H & FL3101H Flame Detectors**

- a) Conform to the protection requirements of EMC Directive 2004/108/EC. *Report Number D90212Q1 (Dated 2/09) by Compatible Electronics, 19131 El Taro Rd, Lake Forest, CA 92676.*

Relevant Standards:  
EN 50130-4  
EN 61000-6-4

- b) Sira Certification Service, Unit 6 Hawarden Industrial Park, Hawarden, CH5 3US, United Kingdom, notified body number 0518 in accordance with Article 9 of Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres given in Annex II to the Directive. Certificate No. SIRA 09ATEX1198X.

Relevant Standards:  
EN 60079-0: 2012  
IEC 60079-1: 2014  
IEC 60079-31: 2013



II 2 G D  
Ex db IIB+H<sub>2</sub> T5 Gb  
Ex tb IIIC T100°C Db

It is ensured through internal measures, our ISO 9001:2008 and PQAN certifications as issued by Sira Certification, Notified Body 0518 for General Monitors Ireland and UL Demko, Notified Body 0539 for General Monitors Lake Forest that series production units conform at all times to the requirements of these current EC Directives and relevant standards.

The CE marking on the products and/or their packaging signifies that General Monitors holds the reference technical file available to the European Union authorities.

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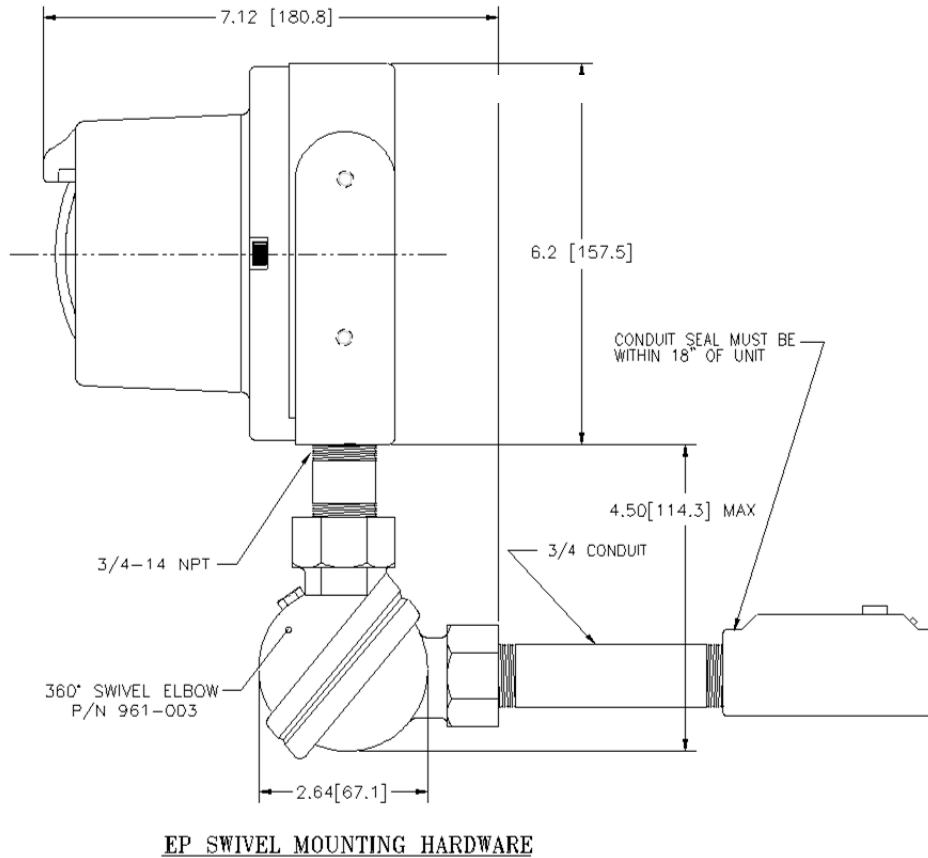
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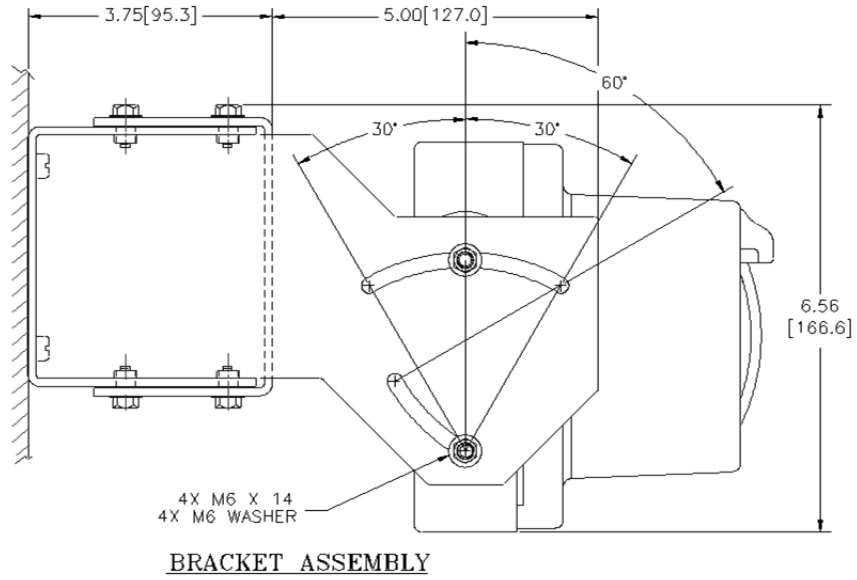
# Quick Start Guide

## Mount and Wire the Detector

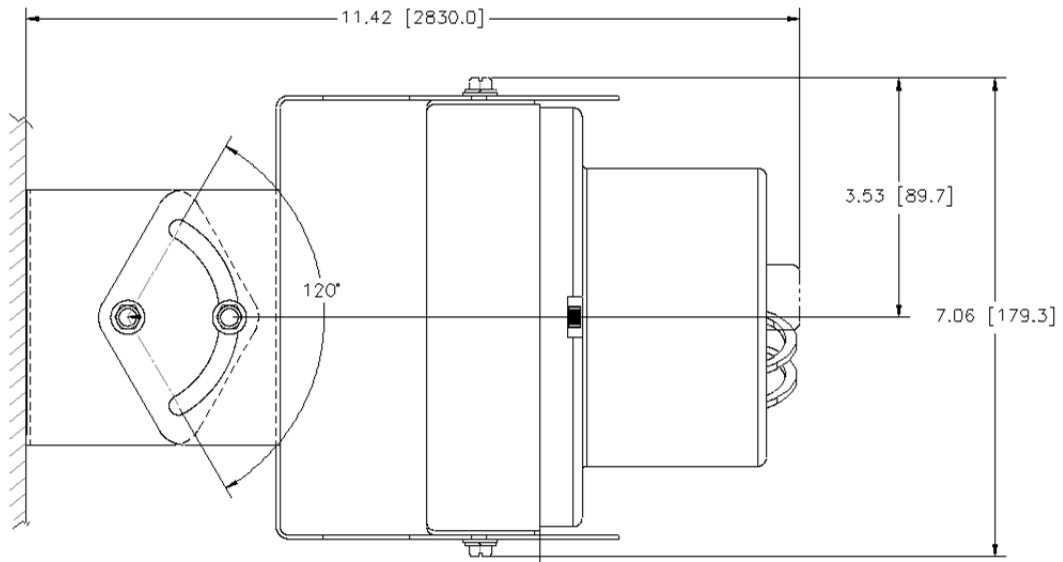
Pay special attention to the conduit seal entry (Canadian Electrical Code Handbook Part 1, Section 18-154). Also, lithium based grease is applied to the O-ring seal between the back-plate and housing, as additional protection to avoid water ingress into the housing. Mount detector using swivel mount or mounting bracket hardware.



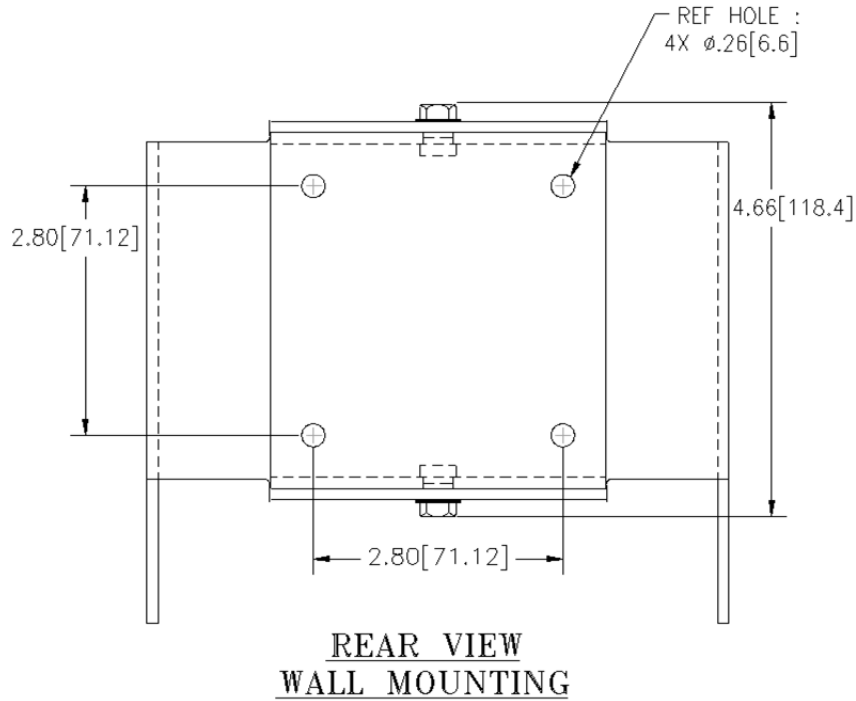
**Figure 1: P/N 961-004 Union Swivel Mounting Hardware**



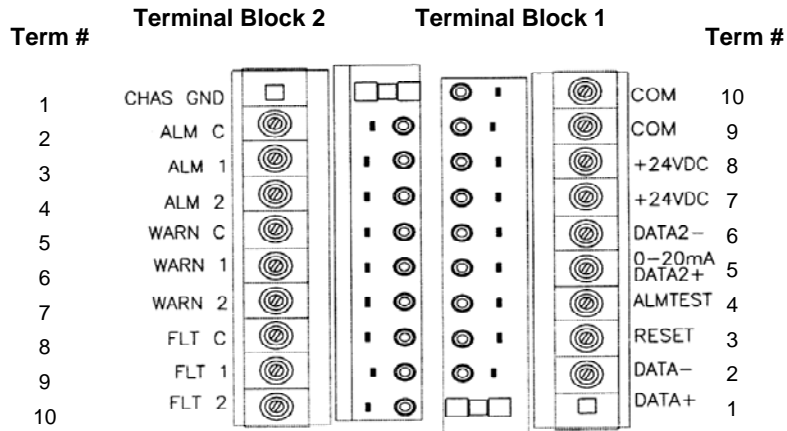
**Figure 2: P/N 71172 Side View Bracket Assembly**



**Figure 3: P/N 71172 Top View Bracket Assembly**



**Figure 4: P/N 71172 Rear View Bracket Assembly**



**Figure 5: Field Terminations**

## Apply Power to the Detector

Two light emitting diodes (LEDs) are visible through the UV window (the larger window on UV/IR units). Immediately upon powering up the detector, the LEDs will start blinking alternately - green and red in the two-color configuration and green, yellow, and red in the three-color configuration. The flashing pattern lasts 10 seconds. Upon the detector entering the "Ready" mode, the green LED will flash off 1 second, every 10 seconds. Section 10.2.6 (Three-color Visual Indicators) describes the flashing scheme of the product configuration with three LEDs.

## Testing the Detector Using the TL105

Test the integrity of your system by using the TL105 test lamp. The original configuration (i.e. sensitivity and relay options) can be changed by using the "Switch Selectable Options" (Table 11) and then changing the dipswitch settings located on the bottom of the power board (SW1).

The instrument is now ready to operate. Please consult the manual for more information on the instrument's many features.

---

**NOTE:** If you have any problems in the set-up or testing of the detector, please refer to the "Troubleshooting Section", or call the factory direct.

---

### Worldwide service is available by calling:

<b>Lake Forest, California (24 hr. service)</b>	Toll Free: +1-800-446-4872 Phone: +1-949-581-4464 Fax: +1-949-581-1151
<b>Houston, Texas</b>	Phone: +1-281-855-6000 Fax: +1-281-855-3290
<b>Ireland</b>	Phone: +353-91-751175 Fax: +353-91-751317
<b>Singapore</b>	Phone: +65-6748-3488 Fax: +65-6748-1911
<b>United Arab Emirates</b>	Phone: +971-4-294-3640
<b>United Kingdom</b>	Phone: +44-1625-619583 Fax: +44-1625-619098

# 1.0 Introduction

## 1.1 Protection for Life

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

This manual provides instruction for installing and operating General Monitors' Models FL3100H and FL3101H for UV/IR and UV Only Flame Detection. While the FL3100H/3101H is easy to install and operate, this manual should be read in full and the information contained herein understood before attempting to place the system in service.

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

## 1.2 Special Warnings



Through engineering design, testing, manufacturing techniques, and rigid quality control, General Monitors supplies the finest flame detection systems available. The user must recognize his responsibility for maintaining the flame detection system in operational condition. Installation and maintenance must be carried out by suitably skilled and competent personnel only.

The FL3100H UV/IR and FL3101H UV only flame detectors contain components, which can be damaged by static electricity. Special care must be taken when wiring the system, to ensure that only the connection points are touched.

### Special Conditions For Safe Use

- This equipment uses an external non-metallic coating and may therefore generate an ignition-capable level of electrostatic charge under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it may be subjected to external conditions (such as high-pressure steam) which might cause a build-up of electrostatic charge on non-conducting surfaces. Additionally, cleaning of the equipment should be done only with a damp cloth.
- In accordance with EN 60079-1:2014/ IEC 60079-1:Ed 7 Clause 11.3, the 4 x M6 housing retaining bolts are Class A2-70 304 Stainless Steel.
- In accordance with EN 60079-1:2014/ IEC 60079-1:Ed 7 Clause 5.1, the flameproof joints are not intended to be repaired.

## 1.3 System Integrity Verification

### Commissioning Safety Systems

Before power up, verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices

- Signaling / output devices
- Accessories connected to field and signaling devices

After the initial application of power (and any factory specified warm-up period) to the safety system, verify that all signal outputs, to and from devices and modules, are within the manufacturers' specifications. Initial testing should be performed per the manufacturers' recommendations and instructions.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur. Fault/Malfunction circuit operation should be verified.

#### **Periodic Testing of Field Devices**

Periodic testing should be performed per the manufacturers' recommendations and instructions. Testing procedures should include, but not be limited to:

- Verify integrity of all optical surfaces and devices
- For flame detectors, use the appropriate test lamp

When testing produces results outside of the manufacturers' specifications, replacement of the suspect device(s) should be performed as necessary.

#### **Periodic System Verification**

The following system verifications should be performed at least annually:

Verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

Proper system operation should be verified by performing a full, functional test of all component devices of the detection system, ensuring that the proper levels of alarming occur. Fault/Malfunction circuit operation should be verified.

Maintenance intervals should be independently established through a documented procedure, including a maintenance log maintained by plant personnel or third party testing services.

## 2.0 Product Description

### 2.1 General Description

Fire is usually manifested in heat (IR), smoke, light (visible), and flame (UV). Flame is the gaseous region of a fire where vigorous combustion chain reactions take place. These reactions emit radiation covering the Infrared, Ultraviolet and the Visible Spectral Regions.

The General Monitors' Model FL3100H is an ultraviolet/infrared (UV/IR) flame detector (Figure 6). It detects the ultraviolet and infrared spectral regions of flame to produce a system which is highly immune to false alarms caused by lightning, arc-welding, hot objects, and other sources of radiation. The Model FL3101H is an ultraviolet (UV) flame detector (Figure 7). It only responds to UV and has been optimized for speed of response.

Both units may be used with the General Monitors TA402A trip amplifier, FL802 controller, or with other equipment, which accepts the 4 to 20 mA output. They may also be interfaced directly with alarm/suppression devices or with switched input modules using integral relays. If HART is used with the above controllers, you must use the special 1.25 mA to 20 mA mode.

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**NOTE:** The Model FL802 is not CE Marked and, therefore, cannot be supplied to the EU.

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The Models FL3100H and FL3101H features include:

- Compact unitized design
- Continuous optical path monitoring (COPM)
- 4-20 mA, alarm relays, and Modbus RTU RS-485 standard (Dual Modbus optional) (HART optional)
- Wide field of view
- High false alarm immunity and visual indicators



**Figure 6: Model FL3100H**



**Figure 7: Model FL3101H**

## 3.0 Installation



**WARNING:** Suitably skilled and competent personnel must carry out installation and maintenance.

### 3.1 Tools Required

- “T” Allen head wrench to remove detector head from detector base (included with flame detector).
- Flat head screwdriver maximum 3/16 in (5 mm) width for terminal block connections.
- Adjustable wrench for conduit, or cable gland connections.

### 3.2 Choosing Product Locations

Several variables are involved in selecting the locations to install detectors to ensure proper flame detection. There are no hard and fast rules defining the optimum location. Following are some general suggestions that should be considered in regard to particular conditions at the site where the unit(s) are being installed:

#### 3.2.1 Detector Field of View

The FL3100H and FL3101H flame detectors have a maximum cone of vision of 120° and 140° maximum respectively. This cone has its vertex at the center of the detector (Figure 8 and Figure 10).

#### 3.2.2 Optical Sensitivity Range

The distance at which the detector will respond to a flame is a function of the intensity of that flame. The maximum distance is 50ft (15.2m) for a heptane fire with a surface area of 1 sq. ft. (0.093m<sup>2</sup>).

#### 3.2.3 Environmental Factors

Mounting should be as free from shock and vibration as possible and convenient for visual inspection and cleaning.

Detectors mounted in dirty atmospheric conditions will require frequent inspection, cleaning, and sensitivity checking. Make sure the field-of-view of the detector is not obstructed by the cover or nearby objects.

Observe the ambient temperature range for the specific model (Section 10.3.4). For outdoor installations or other areas exposed to intense, direct solar radiation, the detector may reach temperatures well above specifications. For these installations, a shade or cover may be required to keep the detector temperature within specifications.

Avoid conditions that would allow ice build-up on the optical detector windows. Complete icing over of the detector window(s) can result in fault conditions. Mount away from sources of electrical noise where possible. A constant UV source detected by the unit will cause the detector to go into FAULT after 9 – 10 minutes of exposure. The source must be removed or the detector must be repositioned. (UV detectors can pick-up arc welding up to 2–3 miles away). Users should be aware that any UV detector may be triggered by other sources of EMI, for instance X-rays, sunlight, reflected sunlight, Gamma rays, lightning, arc welding, industrial lighting, fluorescent lighting, etc., and due regard should be paid to the possible presence of such radiation.



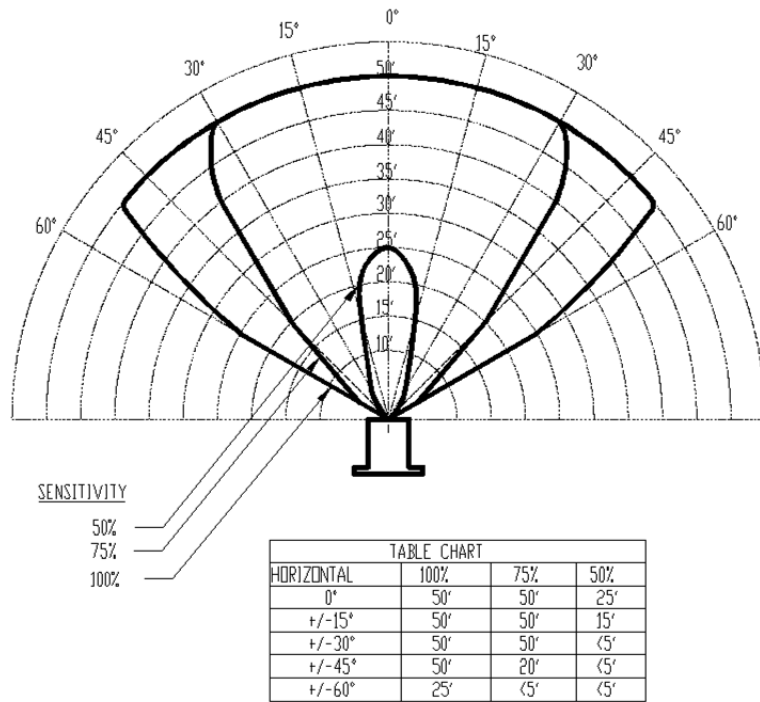


FIGURE 7: FL3100H (UV/IR) HORIZONTAL FIELD OF VIEW

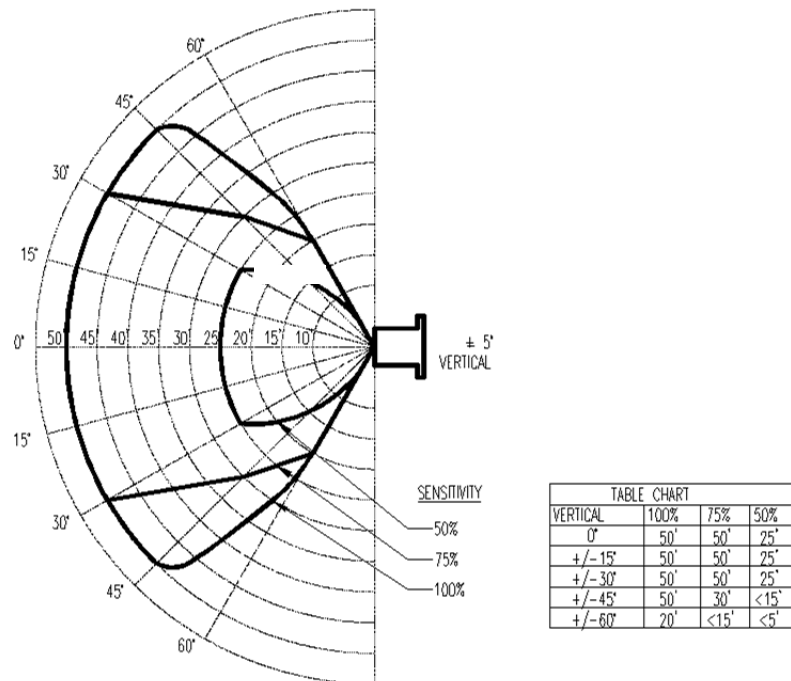
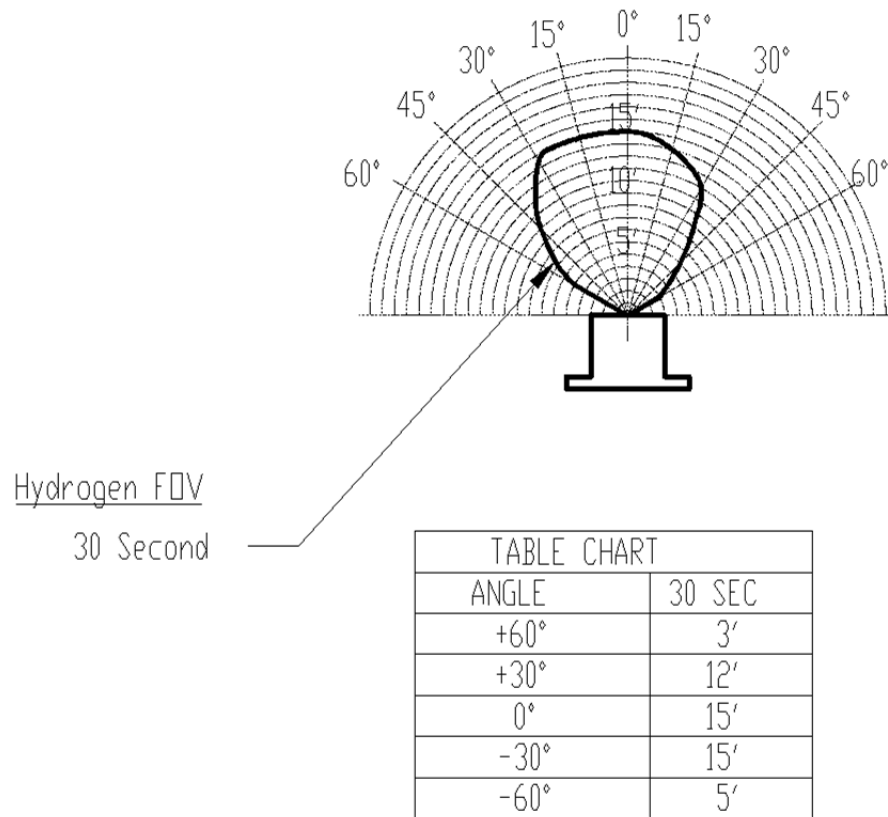


Figure 7: FL3100H (UV/IR) FIELD OF VIEW

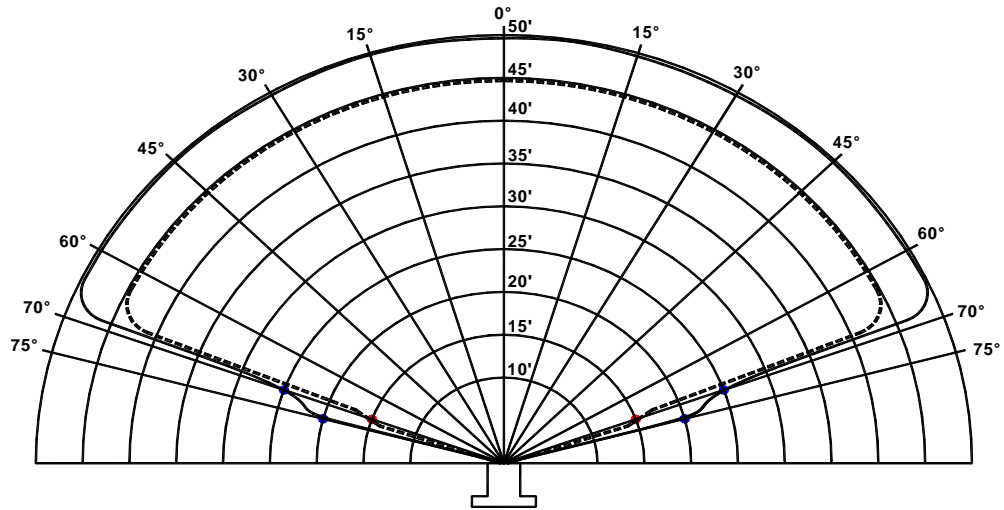
**Figure 8: FL3100H (UV/IR) Field of View**



**Figure 9: FL3100H (UV/IR) Hydrogen Flame Detector Field of View**

**NOTE:** Response Times and Field of View data have been derived by testing the Model FL3100H flame detector with a flame from a round 6 inch diameter burner. The hydrogen gas was supplied from a high pressure tank via a reducing regulator, set to 12 psi. This produces a flame 6 inches in height. The FL3100H-Hydrogen detector can be tested by the TL105 as far as 40 feet. These are typical values and different results may occur depending on the variation of each fire.

**NOTE:** The FL3100H-Hydrogen detector is not FM approved.



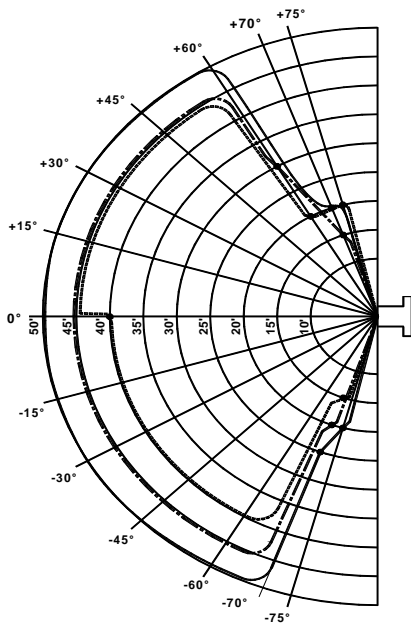
(±5°)

**HORIZONTAL**

SENSITIVITY

- 100%
- 75%, 50%

TABLE CHART			
HORIZONTAL	100%	75%	50%
0°	50'	45'	45'
± 15°	50'	45'	45'
± 30°	50'	45'	45'
± 45°	50'	45'	45'
± 60°	50'	45'	45'
± 70°	25'	<15'	<15'
± 75°	20'	<15'	<15'



(±5°)

**VERTICAL**

SENSITIVITY

- 100%
- 75%
- ..... 50%

TABLE CHART							
VERTICAL	100%	75%	50%	VERTICAL	100%	75%	50%
0°	50'	45'	40'	0°	50'	45'	45'
- 15°	50'	45'	40'	+ 15°	50'	45'	45'
- 30°	50'	45'	40'	+ 30°	50'	45'	45'
- 45°	50'	45'	40'	+ 45°	50'	45'	45'
- 60°	50'	45'	40'	+ 60°	50'	30'	20'
- 70°	25'	<20'	<15'	+ 70°	20'	<15'	<20'
- 75°	<20'	<20'	<15'	+ 75°	<20'	<15'	<20'

Figure 10: FL3101H (UV) Field of View

### 3.3 Mounting and Wiring



**WARNING:** The conduit entries should be sealed per the Canadian Electrical Code Handbook (Part 1, Section 18-154) or NEC 500-3d. An additional benefit of conduit seals is the prevention of water entering the housing through the conduit entry.

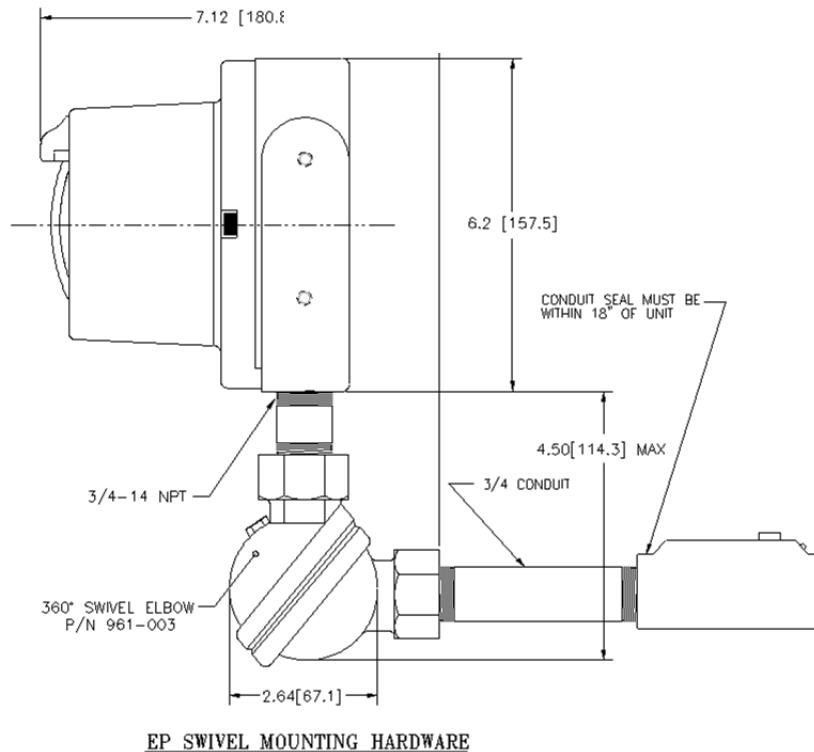


**WARNING:** Unused cable entry holes must be sealed with an approved stopping plug. Red caps supplied by GM are for dust protection only and must not be left on the unit when installed.

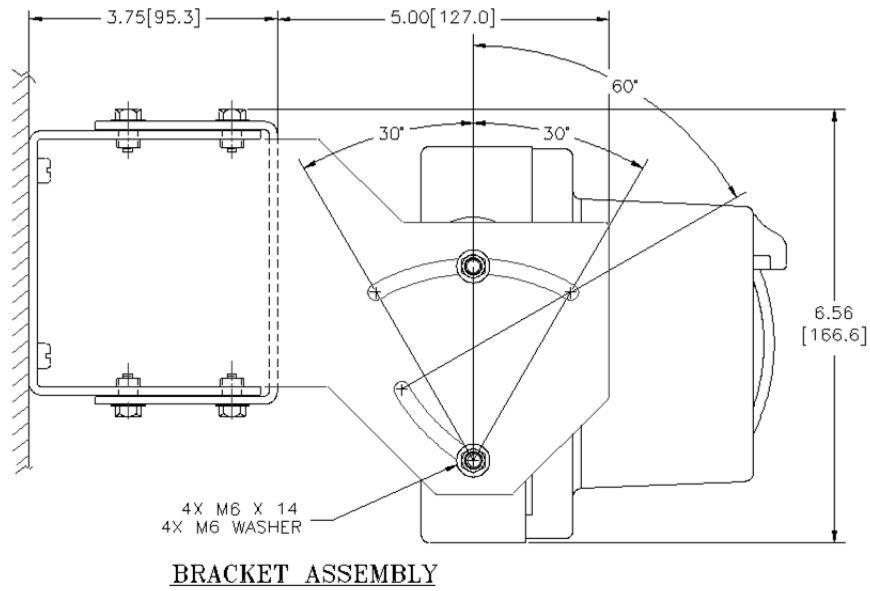
The FL3100H/FL3101H flame detectors should be mounted pointing downward so that dust/moisture will not accumulate on the optical window(s). The detector(s) should be mounted in locations which will inhibit people or objects from obscuring the detector's cone of vision.

**Detectors should be mounted such that the conduit or cable gland entries are pointed downward. See above warning for conduit entries. For cable glands and stopping plugs, the threads should be sealed with Castrol EP and boots fitted over the cable gland to prevent water ingress at the cable-to-gland junction. Mounting hardware should be used as shown in Figure 12, and Figure 13. The overall dimensions of the detector and mounting hardware are shown in Figure 15 and Figure 16.**

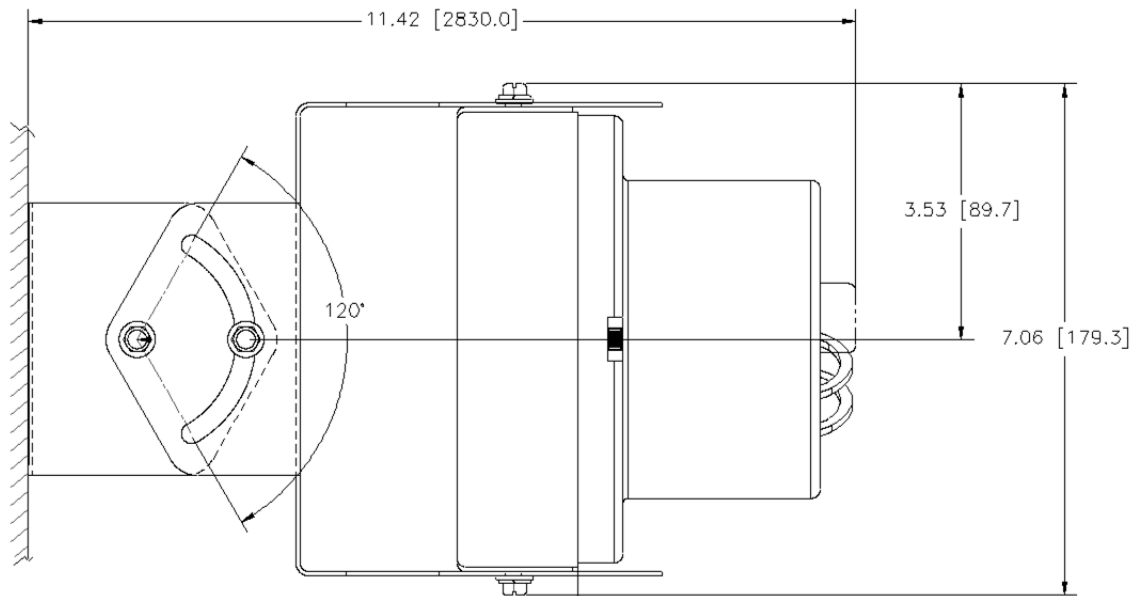
**NOTE:** General Monitors does not recommend the use of cable shoes or crimps on any junction box or housing wiring terminals. Poor crimping can cause a bad connection when the unit experiences temperature variations.



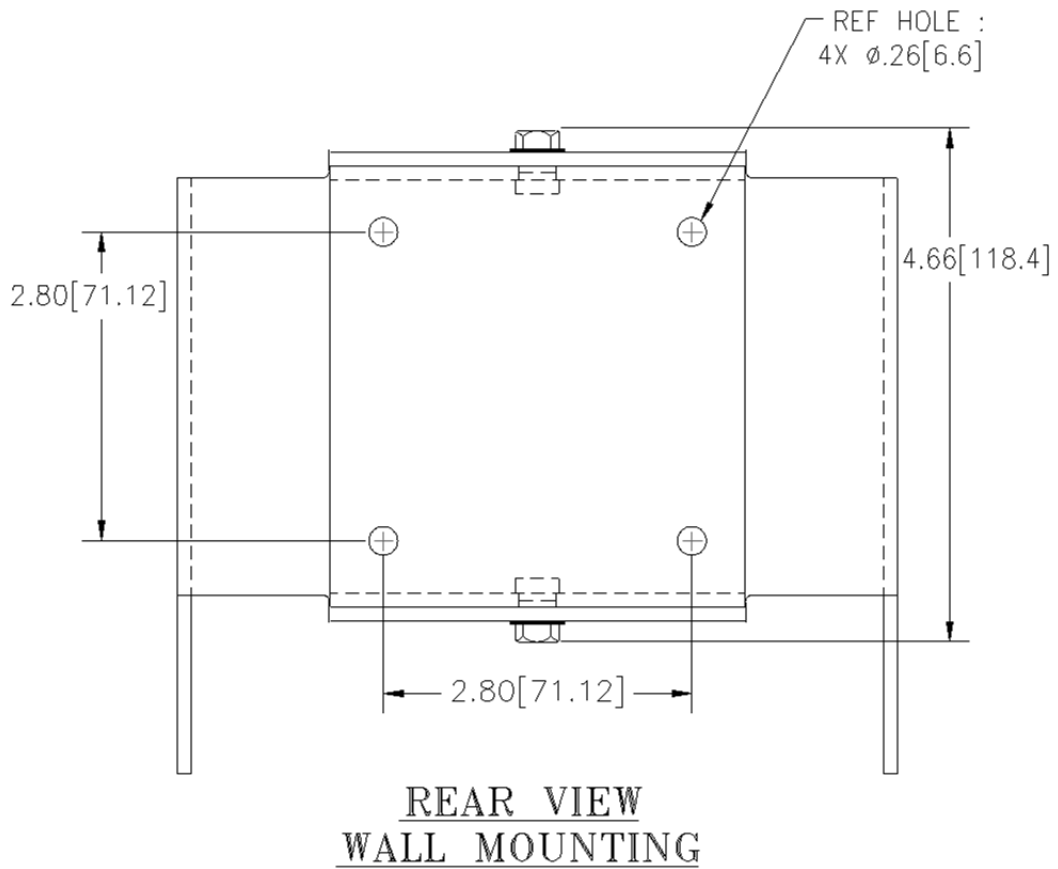
**Figure 11: P/N 961-004 Swivel Elbow Drawing**



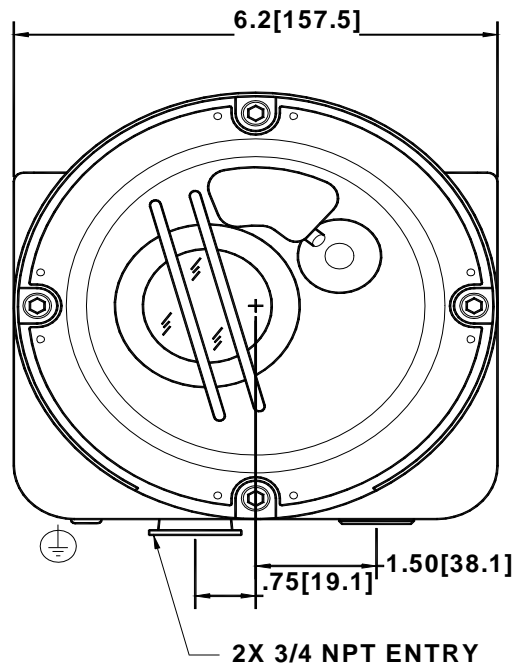
**Figure 12: P/N 71072 Side View Mounting Bracket Drawing**



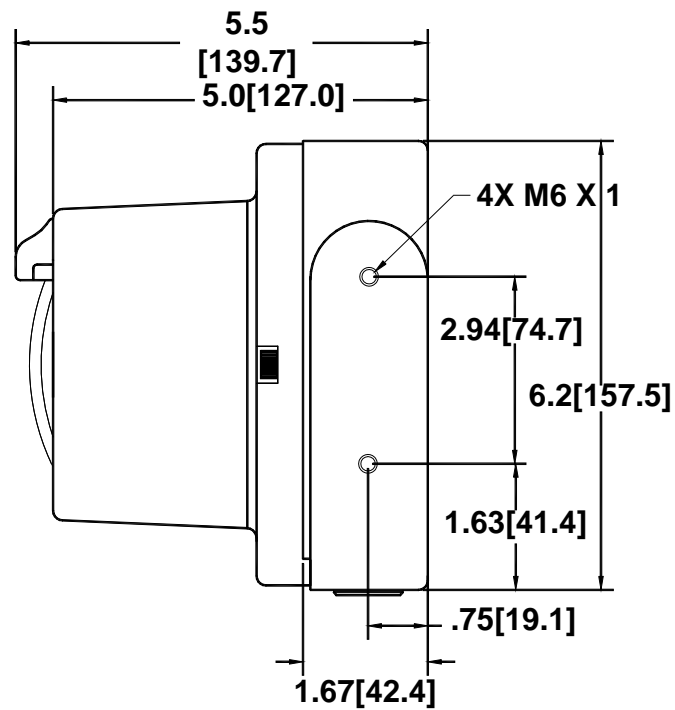
**Figure 13: P/N 71072 Top View Mounting Bracket Drawing**



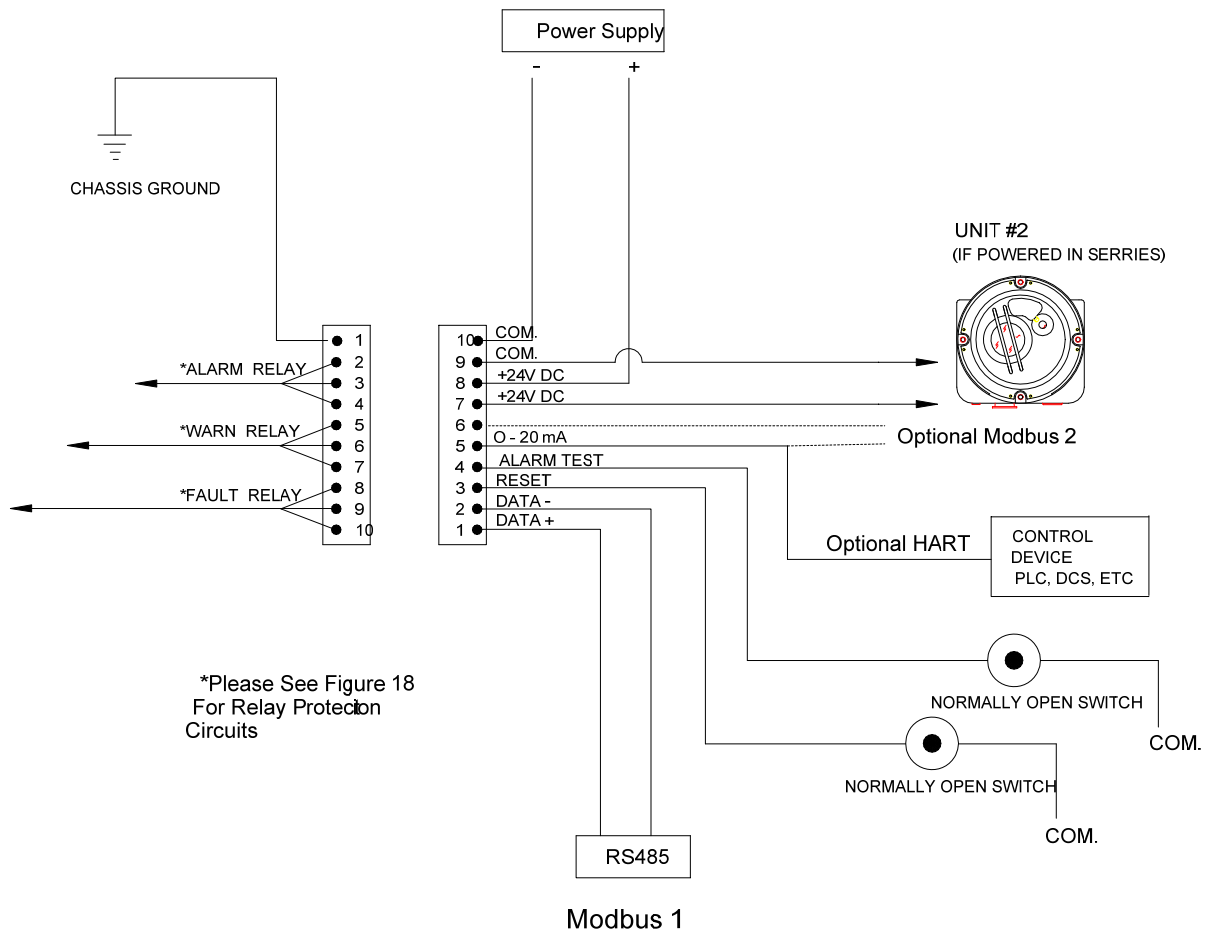
**Figure 14: P/N 71072 Rear View Mounting Bracket Drawing**



**Figure 15: FL3100H and FL3101H Outline Drawing**

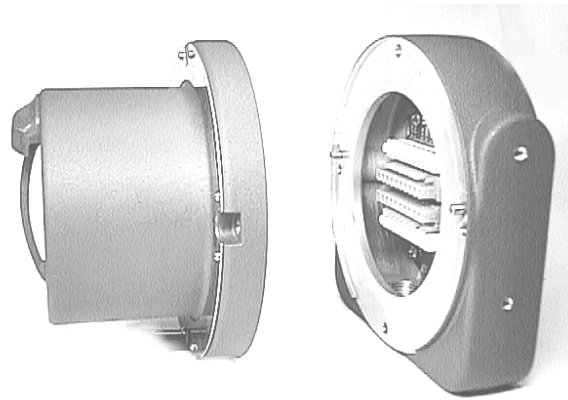


**Figure 16: FL3100H and FL3101H Outline Drawing**

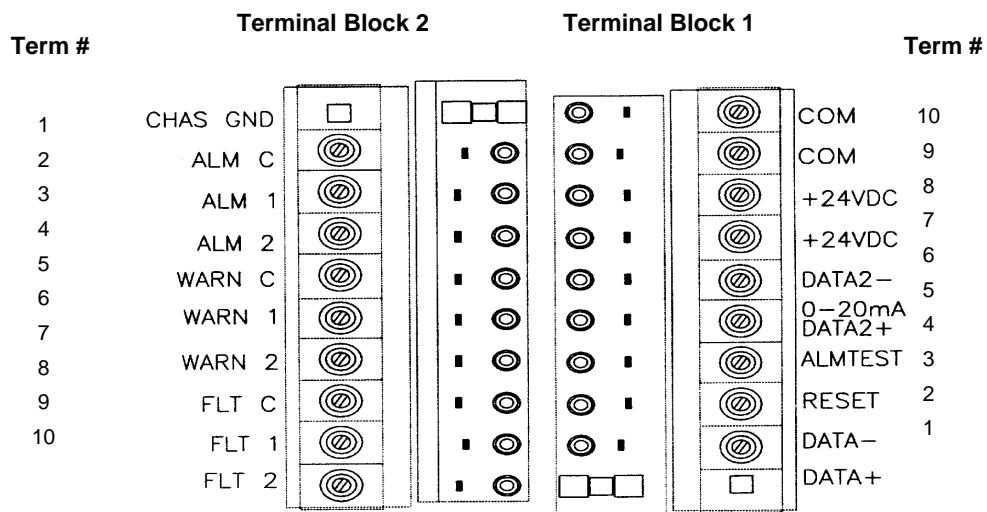


**Figure 17: FL3100H and FL3101H Field Terminations**





**Figure 18: Detector Housing and Base**



**Figure 19: Terminal Block Operation**

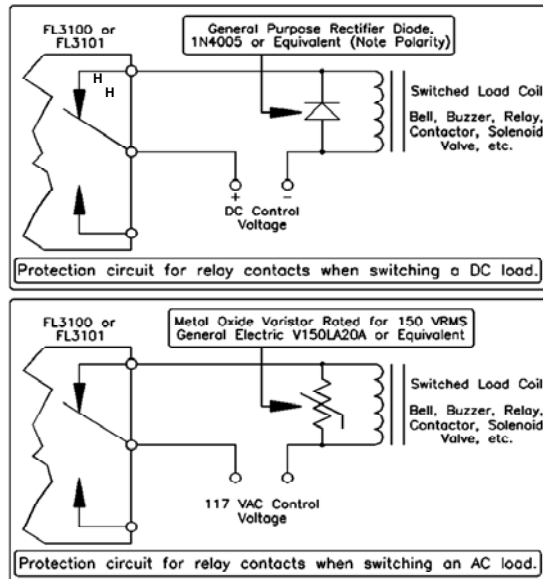
The optional HART signal will be on pin TB1- 5

### 3.3.1 Terminal Connections

All wire connections are made through the base entries to the terminal block (Figure 19). The terminal block accepts 14 AWG to 22 AWG (2.1 to 0.3 mm<sup>2</sup>) stranded or solid core wire. Each wire should be stripped to .25 in (.64 cm). To connect the wire to the terminal block, insert the conductor into the connection space as shown in Figure 19 and tighten the corresponding screw terminal. There are twenty terminal connections. The following pages contain descriptions and specifications for each connection.



**WARNING:** Relay contacts must be protected against transient and over-voltage conditions (Figure 20).



**Figure 20: Protection Circuits for Relay Contacts**

### 3.3.2 Terminal Block TB2 – Alarm Relay Connections

TB2 Position	Alarm Relays	Relay Contact (De-Energized)	Relay Contact (Energized)
2	C	Common	Common
3	1	Normally Closed	Normally Open
4	2	Normally Open	Normally Closed

**Table 1: TB2 Alarm Relay Connections**

These connections are for the SPDT ALARM relay. The ALARM output is time delayed for 2, 4, 8 or 10 seconds. This time<sub>d</sub> delay can be set by Modbus, HART, or by Dipswitch. The ALARM output can be normally energized or normally de-energized, latching or non-latching, and these options are also set via can be set by Modbus, HART, or by Dipswitch (Section 4.4). For all relay connections see Figure 20.

*North American Approved Applications:* The ALARM relay contact ratings are 8A @ 250 VAC and 8A @ 30 VDC resistive max.

*European Union (EU) Approved Applications:* The ALARM relay contact ratings are 8A, 30 V RMS/42.4 V peak or 8A @ 30 VDC resistive max.

### 3.3.3 Terminal Block TB-2 Warning Relay Connections

TB2 Position	Warn Relays	Relay Contacts (De-Energized)	Relay Contacts (Energized)
5	C	Common	Common
6	1	Normally Closed	Normally Open
7	2	Normally Open	Normally Closed

**Table 2: TB2 Warning Relay Connections**

These connections are for the SPDT WARN relay. The WARN output is immediate on the FL3100H/FL3101H. The WARN output can be normally energized or normally de-energized, latching or non-latching, and these options are also set via Modbus, HART, or by Dipswitch (Section 4.4).

The WARN relay contact ratings are 8A @ 250VAC and 8A @ 24VDC.



**CAUTION:** Inductive loads (bells, buzzers, relays, etc.) on dry relay contacts must be clamped down as shown in Figure 20. Unclamped inductive loads can generate voltage spikes in excess of 1000 Volts. Spikes of this magnitude may cause false alarms and contact damage.

*North American Approved Applications:* The WARN relay contact ratings are 8A @ 250 VAC and 8A @ 30 VDC resistive max.

*European Union (EU) Approved Applications:* The WARN relay contact ratings are 8A, 30 V RMS/42.4 V peak or 8A @ 30 VDC resistive max.

### 3.3.4 Fault Relay

These connections are for the SPDT FAULT relay. The FAULT output configuration is normally energized and non-latching. This is the standard configuration and it cannot be changed. The FAULT circuit will be activated during the time-out function, a low power or loss of power condition, and during a failed COPM check. During these conditions the FAULT relays will de-energize and the analog output signal will drop to 0 mA (2 mA for COPM faults) for the duration of the FAULT.

TB2 Position	Fault Relays	Relay Contacts (De-Energized)	Relay Contacts (Energized)
8	C	C	C
9	1	Normally Closed	Normally Open
10	2	Normally Open	Normally Closed

**Table 3: Fault Relay Connections**

*North American Approved Applications:* The FAULT relay contact ratings are 8A @ 250 VAC and 8A @ 30 VDC.

*European Union (EU) Approved Applications:* The FAULT relay contact ratings are 8A, 30 V RMS/42.4 V peak or 8A @ 30 VDC resistive max.

### 3.3.5 Alarm Reset Terminal

The RESET, when activated, returns a latched ALARM and/or WARN output that is no longer valid, to its original state. For this RESET function, place one contact of a normally open momentary switch to TB1 Terminal 3 and the other contact to DC COM (the detector's common). To activate, just press and release the switch.

TB1 Position	Relays
3	RESET
4	TEST
5	0-20 mA

**Table 4: Alarm Reset Terminal Connections**

By connecting one contact of a normally open, momentary switch, to TB1 Terminal 4 and the other contact to TB1 Terminals 9 and 10 (DC COM), the user can test the alarm outputs of the flame detector by activating this switch for two to ten seconds depending on the alarm time delay setting. The Alarm Test will activate the WARN and ALARM relay outputs as well as the appropriate analog output. The flame detector will remain in this state until the switch is released. Note: This function is also available via Modbus and HART.

**NOTE:** The latching WARN and/or ALARM will have to be RESET manually. The Alarm Test feature **cannot** be daisy chained between two or more FL3100H/FL3101H flame detectors.

### 3.3.6 Analog Output

The 0 to 20 mA output is a current signal that corresponds to the following signals:

Condition	Current Modbus	HART (Normal)	HART (Special)
<b>START UP:</b>	0 to 0.2 mA	3.5 ± 0.1 mA	1.25 ± 0.1 mA
<b>FAULT:</b>	0 to 0.2 mA	3.5 ± 0.1 mA	1.25 ± 0.1 mA
<b>COPM Fault:</b>	2.0 ± 0.1 mA	3.5 ± 0.1 mA	2.0 ± 0.1 mA
<b>Ready:</b>	4.05 ± 0.05 mA	4.05 ± 0.05 mA	4.05 ± 0.05 mA
<b>IR (FL3100H only):</b>	8.0 ± 0.1 mA	8.0 ± 0.1 mA	8.0 ± 0.1 mA
<b>UV (FL3100H only):</b>	12.0 ± 0.1 mA	12.0 ± 0.1 mA	12.0 ± 0.1 mA
<b>WARN:</b>	16.0 ± 0.1 mA	16.0 ± 0.1 mA	16.0 ± 0.1 mA
<b>ALARM:</b>	20.0 ± 0.1 mA	20.0 ± 0.1 mA	20.0 ± 0.1 mA

When HART is selected, the output current changes to comply with the HART Foundation requirements. The HART Foundation does not specify current below 3.5 mA. In normal HART mode, the actual current does not go below 3.5 mA. Modbus reports the analog output as if HART was not there, meaning it reports 2.0 mA for COPM. This allows users to use a constant Modbus program. The digital HART reports the actual current. When the alarm or warning

relays are latched, the highest output current is also latched. The output current will return to 4.0 mA after the relay reset is activated via Modbus, HART, or remote switch.

The HART special mode allows the current to go down to 1.25 mA. The HART will still function. This mode must be used with GMI's products that rely on 2 mA output for COPM and 1.5 for offline and zero for fault (TA402A).

---

**NOTE:** The maximum analog output load is 600 ohms, including wiring.

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### 3.3.7 Cable Requirements

For interfacing with 250 ohm input impedance devices, the following maximum cable lengths apply (maximum 50-ohm loop):

Cable AWG	Run Feet	Cable mm <sup>2</sup>	Run Meters
14	9000	2.50	2750
16	5800	1.50	1770
18	3800	1.00	1160
20	2400	0.75	730
22	1700	0.50	520

**Table 5: Maximum Cable Requirements**

### 3.3.8 Power

The supply voltage range is 20 to 36 VDC at the detector (low voltage is detected at approximately 18.5 VDC).

TB1 Position	Connection
7	+24 VDC
8	+24 VDC
9	COM
10	COM

**Table 6: Power Connections**

The following maximum cable lengths apply for a +24 VDC supply (maximum 20 ohm loop):

Cable AWG	Run Meters	Cable mm <sup>2</sup>	Run Feet
14	1370	2.5	4500
16	715	1.5	2340
18	470	1.00	1540
20	300	0.75	970
22	205	0.50	670

**Table 7: Maximum Cable Lengths for +24 VDC Supply**

### 3.3.9 Modbus Interface

The Modbus interface is used to either query the unit's status or to configure the unit. See Section 5.0 for detailed information on Modbus RTU Protocol.

TB1 Position	Connection
1	DATA +
2	DATA -

**Table 8: Connections for the Modbus Interface**

---

**NOTE:** If Dual Modbus output is ordered, then the 0-20 mA and HART output is not available and the wiring terminals for the second Modbus channels are as follows:

---

TB1 Position	Connection
5	DATA2 +
6	DATA2 -

**Table 9: Connections for the Second Modbus Interface**

### 3.3.10 Chassis Ground

This connection is available for use in wiring that requires a connection to chassis ground. It is recommended the chassis be grounded at all times.

TB2 Position	Connection
1	CHAS GND

**Table 10: Chassis Ground Connection**

### 3.3.11 Connection to Fire Cards/Panels

For detectors wired together for monitoring via standard fire cards, GM will factory-fit EOL and alarm resistors. If this special option is required, please specify at time of order and provide the following information:

- Specify one or two resistors (i.e. alarm only, or alarm resistor and EOL).
- Specify value of resistors.

Where detectors are used in conjunction with a GM Model IN042 card, values would be 470-ohm alarm resistor and 5.6K EOL. The EOL resistors are onboard the IN042, selectable by DIP-switches.

---

**NOTE:** Contact General Monitors or an authorized representative for further details.

---

*European Union (EU) Approved Applications:* Interconnecting cables must have an overall screen or screen and armor. Cables BS5308 Part 2, Type 2, or equivalents are suitable. Note that the terms 'screen' and 'shield' are equivalent for the purpose of this manual. The cable armor must be terminated in a suitable cable gland at the detector to ensure a positive electrical connection.

### 3.3.12 Cable Termination in the Non-Hazardous Area

- The cable **armor** must be connected to **safety earth** in the safe area.
- The cable **screen** (drain wire) must be connected to an **instrument earth** in the safe area.
- The power supply **OV return** must be connected to an **instrument earth** in the safe area.
- The interconnecting cables should be segregated from power and other noisy cables. Avoid proximity to cables associated with radio transmitters, welders, switch mode power supplies, inverters, battery chargers, ignition systems, generators, switch gear, arc lights and other high frequency or high power switching process equipment. In general, maintain separation of at least 1m between instrument and other cables. Greater separations are required where long parallel cable runs are unavoidable. Avoid running instrument cable trenches close to lightning conductor earthing pits.
- Complete all cable insulation testing before connecting the cable at either end.



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

## 4.0 Operation

### 4.1 Checklist

Prior to starting the system verify the following:

- Inhibit any external devices, such as automatic extinguishing fire suppression systems or others, which you do not want activated.
- Verify that the DIP-switch settings are set for the desired configuration.
- Verify that the unit is properly mounted. Ensure the conduit/cable gland entries are pointed downward.
- Verify the field of view for each detector covers the area intended for flame detection.
- Verify that the wiring is correct.
- Verify that the power supply is connected properly. The detector is powered by +24 VDC (20 to 36 VDC voltage range). The detector will output a low voltage fault at 18.5 VDC or below.

### 4.2 Start Up

To start up the system, apply power to the flame detectors. Each detector will begin its self-test start up sequence. For the first 10 seconds, the unit will output 0 mA, the fault relay stays de-energized, and the green and red LED will flash alternately. Each is on for about 300 ms. After this 10-second period, the unit will output 4 mA, the fault relay will energize, the red LED will turn off, and the green LED will turn on constant and briefly flash off every 5 seconds. The dual Modbus version does not have a current output.

---

**NOTE:** If you ordered unit with three-color LED option, please refer to section 10.2.6 “Three-color Visual Indicators” for the LED status.

---

### 4.3 System Test

To test the system, use the General Monitors Test Lamp Model TL105 (Section 7.3.2).

### 4.4 User Selectable Options/Factory Defaults

All settings on the Models FL3100H and FL3101H are done via a DIP switch on the Power/Relay Board or via Modbus or HART which will override the dipswitch settings. To set these options, remove the detector head from the base assembly and locate the DIP switch (Figure 21). On the DIP switch, ON/CLOSED means the switch is pushed in on the side labeled ON or CLOSED (opposite the OPEN side). OFF/OPEN means the switch is pushed in on the side with the number corresponding to the switch position or the side labeled OPEN. Refer to Table 11 for the switch assignments. The settings for the WARN and ALARM outputs have been covered in Section 3.3. The time delay specifies the amount of time a WARN condition persists before an ALARM condition will occur. If the HART option is ordered the current you desire must be selected (1.25 mA or 3.5 mA). Factory default is 3.5 mA to 20 mA. HART current is only HART or Modbus selectable, not DIP switch selectable.



Option	Off	On
1. 100% Sens – 1 ft <sup>2</sup> @ 50 ft	1, 2	
2. 75% Sens – 1 ft <sup>2</sup> @ 35 ft	2	1
3. 50% Sens – 1 ft <sup>2</sup> @ 25 ft	1	2
4. 2 Second ALARM Time Delay	3	4
5. 4 Second ALARM Time Delay	3, 4	
6. 8 Second ALARM Time Delay	4	3
7. 10 Second ALARM Time Delay		3, 4
8. ALARM non-latching	5	
9. ALARM latching		5
10. WARN non-latching	6	
11. WARN latching		6
12. ALARM normally energized		7
13. ALARM normally de-energized	7	
14. WARN normally energized		8
15. WARN normally de-energized	8	

Table 11: DIP Switch Options

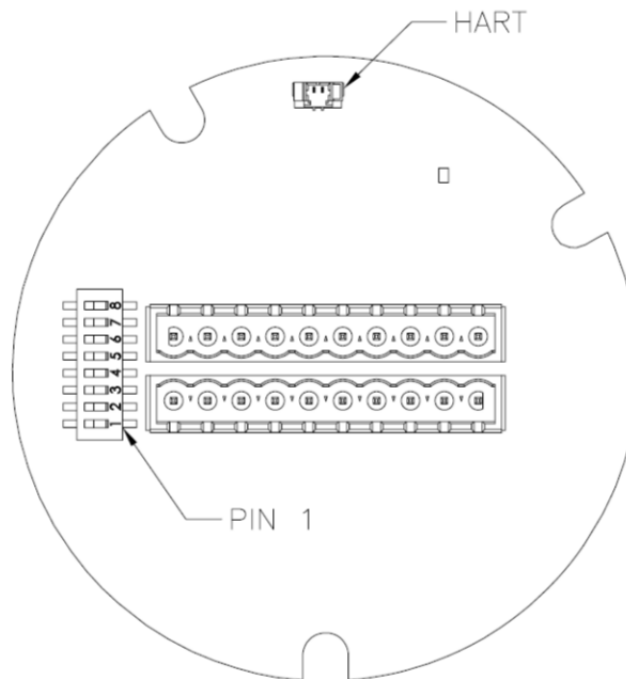


Figure 21: DIP switch Location

## 5.0 Modbus Interface

Standard FL3100H or FL3101H flame detectors include a single Modbus that is referenced as Comm 1. A dual Modbus feature is optional, which includes two independent communications channels referenced as Comm 1 and Comm 2.

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**NOTE:** If the dual Comm option is ordered, the analog output and HART will not be available.

---

### 5.1 Baud Rate

The Baud Rate is a selectable setting via the Modbus communications interface. The selectable baud rates are 19.2K, 9600, 4800, or 2400 bits per second.

### 5.2 Data Format

The Data Format is a selectable setting via the Modbus communications interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

Table 12: Data Format

### 5.3 Modbus Read Status Protocol (Query/Response)

#### 5.3.1 Modbus Read Query Message

Byte	Modbus	Range	Referenced to FL3100H / FL3101H
1 <sup>st</sup>	Slave Address	1-247 *	FL3100H / FL3101H ID (Address) (X = 0 or 1 Model Type)
2 <sup>nd</sup>	Function Code	03	Read Holding Registers
3 <sup>rd</sup>	Starting Address Hi**	00	Not Used by FL3100H / FL3101H
4 <sup>th</sup>	Starting Address Lo**	00-FF (Hex)	FL3100H / FL3101H Commands
5 <sup>th</sup>	No. of Registers Hi	00	Not Used by FL3100H / FL3101H
6 <sup>th</sup>	No. of Registers Lo	01	No. of 16 Bit Registers
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 13: Modbus Query Messages

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**NOTE\***: Address 0 is reserved for broadcast mode and will not be supported at this time.

**NOTE\*\***: Start Address can be a maximum of 247 Address Locations (0000-0x00F7)

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### 5.3.2 Modbus Read Response Message

Byte	Modbus	Range	Referenced to FL3100H, FL3100H1
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	FL3100H / FL3101H ID (Address)
2 <sup>nd</sup>	Function Code	03 or 04	Read Holding Registers
3 <sup>rd</sup>	Byte Count	02 – FF (Hex)	No. of Data Bytes
4 <sup>th</sup>	Data Hi	00-FF (Hex)	FL3100H / FL3101H Hi Byte Status Data
5 <sup>th</sup>	Data Lo	00-FF (Hex)	FL3100H / FL3101H Lo Byte Status Data
6 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
7 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 14: Modbus Read Response Messages

**NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

## 5.4 Modbus Write Command Protocol (Query/Response)

### 5.4.1 Modbus Write Query Message

Byte	Modbus	Range	Referenced to FL3100H / FL3101H
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	FL3100H / FL3101H ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi**	00	Not used by FL3100H / FL3101H
4 <sup>th</sup>	Register Address Lo**	00-FF (Hex)	FL3100H / FL3101H Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	FL3100H / FL3101H Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	FL3100H / FL3101H Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 15: Modbus Write Query Message

**NOTE\***: Address 0 is reserved for broadcast mode and will not be supported at this time.

**NOTE\*\***: Start Address can be a maximum of 247 Address Locations (0000-0x00F7).

### 5.4.2 Modbus Write Response Message

Byte	Modbus	Range	Referenced to FL3100H / FL3101H
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	FL3100H / FL3101H ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi**	00	Not used by FL3100H / FL3101H
4 <sup>th</sup>	Register Address Lo**	00-FF (Hex)	FL3100H / FL3101H Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	FL3100H / FL3101H Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	FL3100H / FL3101H Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

**Table 16: Modbus Write Response Message**

**NOTE\***: Address 0 is reserved for broadcast mode and is not supported at this time.

**NOTE\*\***: Start Address can be a maximum of 247 Address Locations (0000-0x00F7).

### 5.4.3 Function Codes Supported

Function Code 03 or 04 (Read Holding Registers) is used to read status from the slave unit. Function Code 06 (Preset Single Register) is used to write a command to the slave unit.

## 5.5 Exception Responses and Exception Codes

In a normal exchange, the master device sends a query to the FL3100H / FL3101H. The FL3100H / FL3101H receives the query and returns a normal response to the master. If a normal communications error occurs, there are 4 possible responses from the FL3100H / FL3101H:

1. If the FL3100H / FL3101H does not recognize the query due to a communications error, then no response is returned from the FL3100H / FL3101H and the master device will eventually process a timeout condition for the query.
2. If the FL3100H / FL3101H receives the query, but detects a communication error (CRC, etc.), then no response is returned from the FL3100H / FL3101H and the master device will eventually process a timeout condition for the query.
3. An exception code is returned when the FL3100H / FL3101H receives the query without a communications error, but cannot process it due to reading or writing to a non-existent or illegal Function Code, Illegal Command Starting Address or Register Address, or Illegal Data Value. The exception response message has two fields that differentiate it from a normal response. See the next section for more information.

### 5.5.1 Exception Responses

Byte	Modbus	Range	Referenced to FL3100H / FL3101H
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	FL3100H / FL3101H ID (Address)
2 <sup>nd</sup>	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3 <sup>rd</sup>	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See below)
4 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
5 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 17: Exception responses

#### 5.5.1.1 Exception Code Field

In a normal response, the FL3100H / FL3101H returns data and status in the data field, requested in the query from the master. In an exception response, the FL3100H / FL3101H returns an exception code in the data field, which describes the condition that caused the exception. Below is a list of exception codes that are supported by the FL3100H / FL3101H:

Code	Name	Description
01	Illegal Function	The function code received in the query is not an allowable action for the FL3100H / FL3101H.
02	Illegal Data Address	The data address received in the query is not an allowable address for the FL3100H / FL3101H.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the FL3100H / FL3101H.
04	Slave Device Failure	An unrecoverable error occurred while the FL3100H / FL3101H was attempting to perform the requested action.
05	Acknowledge	The FL3100H / FL3101H has accepted the request and is processing it, but a long duration of time will be required. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The FL3100H / FL3101H is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

Table 18: Exception Code Field

## 5.6 Command Register Locations

### 5.6.1 Operational Mode Commands

See section number listed below and reference Section 5.7 for details of each register.

**NOTE:** The FL3100H has Modbus error reporting. The optional dual Modbus has error reporting for each channel. It can also provide simultaneous block mode.

**R - indicates Read Only Access**

**R/W - indicates Read/Write Access**

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr	Refer to Section
Analog	0-20 mA Current Output	Value	16-Bit	R	0000	40001	
Mode	Indicates Fire Status Mode	Value	(0-11)	R	0001	40002	
Status/Error	Indicates Error	Bit	16-Bit	R	0002	40003	
UV/IR Only	Indicates Detection of UV Only or IR Only (FL3100H only)	Bit	2-Bit	R	0003	40004	
Model Type	Identifies the Model FL3100H / FL3101H	Decimal	310X	R	0004	40005	
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006	
COPM Fault	UV/IR COPM Fault	Bit	2-Bit	R	0006	40007	
Override	Override Dipswitch Settings	Bit	1-Bit	R/W	0007	40008	
Options	Indicates Unit Options	Bit	8-Bit	R/W	0008	40009	
Comm 1 Address	Unit Address	Decimal Hex	(1-247) (01-F7)	R/W	0009	40010	
Not Used					000A	40011	
Comm 1 Baud Rate	Baud Rate (2400, 4800, 9600, 19.2K)	Value	(0-3)	R/W	000B	40012	
Comm 1 Data Format	Data Format (8N-1, 8E-1, 8O-1, 8N-2)	Value	(0 - 3)	R/W	000C	40013	
UV Sig Count	Indicates No. of UV Signal Pulses within 500 ms	Value	16-Bit	R	000D	40014	
IR Sig Count	Indicates No. of IR Signal Pulses within 500 ms	Value	16-Bit	R	000E	40015	
UV Fault Total	Indicates Total No. of UV COPM Faults	Value	16-Bit	R	000F	40016	
IR Fault Total	Indicates Total No. of IR COPM Faults	Value	16-Bit	R	0010	40017	
Remote Reset	Remotely Resets the Alarm and Warn Relays	Bit	1-Bit	R/W	0011	40018	

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr	Refer to Section
Remote Alarm Test	Remotely Activates Alarm Test	Bit	1-Bit	R/W	0012	40019	
Clear COPM Faults	Clears UV/IR COPM Fault Counters	Bit	1-Bit	R/W	0013	40020	
	NOT Used				0014	40021	
Serial Number	Serial Number Upper	Value	16 bit	R	0015	40022	
Serial Number	Serial Number Lower	Value	16 bit	R	0016	40023	
	NOT Used				0017-1C	40024-40029	
Optional HART	HART Enable	Bit	1 bit	R/W	001D	40030	
All "1" or "0"	HART Test 0 off 1, 2	Bit	2 Bit	R/W	001E	40031	
	Not Used				001F	40032	
Comm 1 Register errors	Total # of Register Errors	Value	16-Bit	R	0020	40033	
Comm 1 Bus Activity Rate %	Bus Activity Rate in % Of this Addressed Node vs. Other Addressed Nodes	Decimal Hex	(0-100%) (0-64)	R	0021	40034	
Comm 1 Function Code Errors	Total # of Function Code Errors	Value	16-Bit	R	0022	40035	
Comm 1 Starting Address Errors	Total # of Starting Addresses Errors	Value	16-Bit	R	0023	40036	
Comm 1 Total Receive Errors	Total # of Comm 1 Receive Errors	Value	16-Bit	R	0024	40037	
Comm 1 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	0025	40038	
Comm 1 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	0026	40039	
Comm 1 Overrun Errors	Total # of Overrun Errors	Value	16-Bit	R	0027	40040	

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr	Refer to Section
Comm 1 Parity Errors	Total # of Parity Errors	Value	16-Bit	R	0028	40041	
Comm 1 Framing Errors	Total # of Framing Errors	Value	16-Bit	R	0029	40042	
Comm 1 UART errors	Total # of UART errors	Value	16 Bit		002A	40043	
Comm 1 Total Receive Errors	Total # of Comm 1 Receive Errors	Value	16-Bit	R	002B	40044	
Comm 1 Clear UART	Clear UART errors	Bit	1-Bit	R/W	002C	40045	
Comm1 Clear Stats	Clear Comm Stats	Bit	1-Bit	R/W	002D	40046	
HART Current Range	3.5 ma to 20 ma 1.25 ma to 20 ma	Bit	1-Bit	R/W	002E	40047	
Comm 2 Address	Unit Address	Decimal Hex	(1-247) (01-F7)	R/W	002F	40048	
Comm 2 Baud Rate	Indicates present Baud Rate (2400, 4800, 9600, 19.2K)	Value	(0-3)	R/W	0030	40049	
Comm 2 Data Format	Indicates present Data Format (8N-1, 8E-1, 8O-1, 8N-2)	Value	(0-3)	R/W	0031	40050	
	Not Used				0032	40051	
Input Voltage	Indicates the 24 volts	Value	16-Bit	R	0033	40052	
Voltage at the alarm input	Indicates alarm test input voltage	Value	16-Bit	R	0034	40053	
Voltage at the Reset input	Indicates reset input voltage	Value	16-Bit	R	0035	40054	
The position of the dip switch	Dip Switch Data	Bits	16-Bit	R	0036	40055	
	Not used				0037 003F	40056 40064	



Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr	Refer to Section
EVENT LOGGING	Event logging See Section 6.0	Value			0040 0067	40065 40104	
USER INFO	User Information	Value	16-Bit	R/W	0068 0077	40105 40120	
Comm 2 Register errors	Total # of Register Errors	Value	16-Bit	R	0078	40121	
Comm 2 Bus Activity Rate %	Bus Activity Rate in % Of this Addressed Node vs. Other Addressed Nodes	Decimal Hex	16-Bit	R	0079	40122	
Comm 2 Function Code Errors	Total # of Function Code Errors	Value	16-Bit	R	007A	40123	
Comm 2 Starting Address Errors	Total # of Starting Addresses Errors	Value	16-Bit	R	007B	40124	
Comm 2 Total Receive Errors	Total # of Comm 2 Receive Errors	Value	16-Bit	R	007C	40125	
Comm 2 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	007D	40126	
Comm 2 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	007E	40127	
Comm 2 Overrun Errors	Total # of Overrun Errors	Value	16-Bit	R	007F	40128	
Comm 2 Parity Errors	Total # of Parity Errors	Value	16-Bit	R	0080	40129	
Comm 2 Framing Errors	Total # of Framing Errors	Value	16-Bit	R	0081	40130	
Comm 2 UART errors	Total # of UART errors	Value	16-Bit	R	0082	40131	
	Not Used				0083	40132	
Comm 2 Clear UART	Clear UART errors	Bit	1-Bit	R/W	0084	40133	
Comm2 Clear Stats	Clear Comm Stats	Bit	1-Bit	R/W	0085	40134	

**Table 19: Operational Mode Commands**

## 5.7 FL3100H / FL3101H Operational Mode Command Register Details

### 5.7.1 Analog (00H)

A read returns a value which is proportional to the 0-20 mA output current. The current is based on a 16-bit value. The master scaling is 0-65535 decimal, which corresponds to the FL3100H / FL3101H scaling which is 0-20 mA.

### 5.7.2 Mode (01H)

A read returns the fire status mode of the FL3100H / FL3101H.

Mode	Decimal Value
Power-up Delay	1
Warn Non-latching Only	2
Warn and Alarm Non-Latching	3
Warn Latching Only	4
Alarm Latching Only	5
Warn and Alarm Latching	6
Ready State (No Fire)	7
UV Only Fire (FL3100H Model Only)	8
IR Only Fire (FL3100H Model Only)	9
Alarm Test	10
COPM Fault Detected	11

Table 20: Fire Status Mode

### 5.7.3 Status/Error (02H)

A read returns the errors that are occurring, which are indicated by bit position.

Byte	Function Bit	Position	Hex
High	Reset Line Shorted	8	0x8000
	UV 10 Minute	7	0x4000
	Not Used	6	0x2000
	Not Used	5	0x1000
	Output Current Fault	4	0x0800
	Not Used	3	0x0400
	Not Used	2	0x0200
	Not Used	1	0x0100
Low	Flash Checksum	8	0x0080
	EEPROM Checksum	7	0x0040
	RAM Test	6	0x0020
	Low Line Voltage Check	5	0x0010
	UV COPM	4	0x0008
	IR COPM	3	0x0004
	Not Used	2	0x0002
	Internal Voltage	1	0x0001

Table 21: Status/Error

### 5.7.4 Faults

**Reset Line Shorted:** The FL3100H sees a continuous short. Check TB1-3.

**UV 10 Minute:** The UV detector sees a constant source of UV. Check for welding, arcing, very bright lights or other sources of UV.

**Output Current Fault:** There is an error in the current output circuit. Return for service.

**Flash Checksum:** The main program memory is not functioning properly. Return for service.

**EEPROM Checksum:** There are two sources of EEPROM error. One is recoverable, the other must be sent back to the factory. The recoverable error can be reset by turning the power on and off. The user then must check all the FL3100H options; Latch/Non-latch, Energized/De-energized, Baud rate etc.

**RAM Test:** The memory is not functioning. Return for service.

**Low Line Voltage Check:** The input voltage is low. Check the input voltage with a meter or via HART or Modbus.

**UV COPM:** The UV window needs to be cleaned.

**IR COPM:** The IR window needs to be cleaned.

**Internal Voltage:** The FL3100H monitors various internal voltages. Return for service.

### 5.7.5 UV/IR Only (03H)

A read indicates the detection of UV Only or IR only when using the UV/IR Model FL3100H.

UV Only Detected = 01 (Lo Data Byte)

IR Only Detected = 02 (Lo Data Byte)

The High Data Byte is Not Used.

### 5.7.6 Model Type (04H)

A read returns the Decimal Value 3100 or 3101, which identifies each particular type of unit by model number.

Model	Configuration	HART ID	Modbus ID
FL3100	Standard UV/IR	NA	3100 0x0C1C
FL3100H	Standard UV/IR	0x90	3103 0x0C1F
FL3100H	Long Range	0x90	3106 0x0C22
FL3100H	Hydrogen	0x90	3105 0x0C21
FL3101	Standard UV	NA	3101 0x0C1D
FL3101H	UV only	0x90	3104 0x0C20

Table 22: Model Type

### 5.7.7 Software Revision (05H)

A read returns the software revision of the FL3100H / FL3101H in 2 ASCII characters. (REV "A" appears as a blank and the letter A).

### 5.7.8 COPM Fault (06H)

A read returns the type of Continuous Optical Path Monitoring (COPM) Fault which is an UV COPM Fault or an IR COPM Fault, or both. The UV COPM and/or the IR COPM Faults indicate that the UV and/or IR windows are dirty and need to be cleaned, or that there is a hardware problem with the UV and/or IR detection circuitry.

UV COPM Fault = 01 (Lo Data Byte)

IR COPM Fault = 02 (Lo Data Byte)

The High Data Byte is Not Used.

### 5.7.9 EEPROM Override (07H)

A read indicates the status of the EEPROM Override bit. A write command changes the state of the EEPROM Override bit. When the EEPROM Override bit is enabled, the options for the Detector Sensitivity, Relay Delay, Relay Latching/Non-Latching and Relay Energized/Non-Energized features are now controlled by the data stored in the EEPROM and are no longer controlled by the 8-position DIP switch located on the bottom of the Power/Relay Board. When the EEPROM Override bit is disabled the options are under the control of the 8-position DIP switch. The EEPROM Override bit is located in the LSB of the Low Data Byte and the High Data Byte is not used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

**Table 23: EEPROM Override**

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**NOTE:** By grounding the ALARM TEST input during power-up cycle (approximately 10 seconds), the FL3100H / FL3101H will disable the EEPROM Override and set the Bit = 0, thus enabling the 8-position DIP switch.

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### 5.7.10 Options (08H)

A read returns the status of the settings for the Detector Sensitivity, Relay Delay, Relay Latching/Non-Latching and Relay Energized/Non-Energized features either from the Options Dipswitch or the EEPROM depending on the setting of the EEPROM Override bit listed above. A write command changes the settings for the EEPROM only when the EEPROM Override bit is set.

**EXCEPTION** - If an attempt to change the EEPROM Options is made while the EEPROM Override bit is not set, then the unit shall return an Exception Code 01 (Illegal Function).

These functions are indicated on the Low Data Byte and the High Data Byte is not used.

Function	Bit Position	Conditions				Access
Warn Energized	8 (MSB)	1 = Energized 0 = Non-Energized				Read/Write
Alarm Energized	7	1 = Energized 0 = Non-Energized				Read/Write
Warn Latched	6	1 = Latched 0 = Non-Latched				Read/Write
Alarm Latched	5	1 = Latched 0 = Non-Latched				Read/Write
		10	8	4	2	Time Delay in Seconds
Alarm Time Delay 2	4	1	0	0	1	Read/Write
Alarm Time Delay 1	3	1	1	0	0	Read/Write
		100	75	50		% Sensitivity
Sensitivity 2	2	0	0	1		Read/Write
Sensitivity 1	1 (LSB)	0	1	0		Read/Write

**Table 24: Setting Options**

### 5.7.11 Comm 1 Address (09H)

A read returns the Comm 1 address of the FL3100H / FL3101H. A write changes the address to the requested address. The range of the address is 1 to 247 (01 to F7 Hex). After the address has been changed to the slave unit, the Modbus communications will cease because the address has changed; therefore the master will have to change its query address to the slave's new address in order to restart the communications.

**EXCEPTION** - If an illegal data value is entered (must be between 1, 0x00F7), then the Exception Code 03 (Illegal Data Value) is returned.

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H / FL3101H Address will default to 1.

### 5.7.12 Comm 1 Baud Rate (0BH)

A read returns the Comm 1 baud rate of the FL3100H / FL3101H. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the Modbus communications will cease because the baud rate has changed; therefore the master will have to change its baud rate to the slave's new baud rate in order to restart the communications.

Baud Rate	Low Data Byte	Access
19.2K	03	Read/Write
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

**Table 25: Comm 1 Baud Rate**

This function is indicated on the Low Data Byte (the High Data Byte is not used).

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H, and FL3101H Baud Rate will default to 19.2K.

### 5.7.13 Comm 1 Data Format (0CH)

A read returns the Comm 1 data format of the FL3100H / FL3101H. A write changes the data format to the requested data format. After the data format has been changed to the addressed unit, the Modbus communications may cease or start producing Comm errors because the data format has changed; therefore the master will have to change its data format to the slave's new data format in order to restart or provide proper communications.

Data	Parity	Stop	Format	Low Data Byte	Access
8	None	1	8-N-1	00	Read/Write
8	Even	1	8-E-1	01	Read/Write
8	Odd	1	8-O-1	02	Read/Write
8	None	2	8-N-2	03	Read/Write

**Table 26: Comm 1 Data Format**

This function is indicated on the Low Data Byte and the High Data Byte is not used.

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H, and FL3101H Data Format will default to 8-N-1.

### 5.7.14 UV Signal Count (0DH)

A read indicates the number of UV Signal Counts that have occurred within 500 ms, which is the time duration that is required to detect a fire in the UV spectrum.

### 5.7.15 IR Signal Count (0EH)

A read indicates the number of IR Signal Counts that have occurred within 500 ms which is the time duration that is required to detect a fire in the IR spectrum.

### 5.7.16 UV Fault Total (0FH)

A read indicates the total number of UV COPM Faults for an indefinite period of time until the Clear COPM Fault command is activated. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### 5.7.17 IR Fault Total (10H)

A read indicates total number of IR COPM Faults for an indefinite period of time until the Clear COPM Fault command is activated. The maximum count is 65535 and then the counter rolls back to zero and begins counting again.

### 5.7.18 Remote Reset (11H)

Writing a 1 to the bit activates the Remote Reset function that resets the Alarm and Warn Relays. The function is active momentarily and resets automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

**Table 27: Remote Reset**

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

### 5.7.19 Remote Alarm Test (12H)

Writing a 1 to the bit activates the Remote Alarm Test function, which activates the Warn and Alarm relay and causes the Analog current to show warn then alarm. Once the Alarm Test is complete, the Remote Alarm Test function should be disabled by writing a zero to the Remote Alarm Test and then resetting the Alarm and Warn relays by writing a one to the Remote Reset (referenced above).

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

**Table 28: Remote Alarm Test**

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

### 5.7.20 Clear COPM Faults (13H)

Writing a 1 to the bit activates the Clear COPM Faults function that resets both the UV and IR COPM faults. The function is active momentarily and resets automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

**Table 29: Clear COPM Faults Function**

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

### 5.7.21 Serial Number (15/16H)

The serial number is a 32-bit word but the value is only 23 bits long. The upper bits are always zero. This is done to keep the same serial number as the HART serial number. Address 0x16 contains the lower part of the number and address 0x15 contains the upper part.

### 5.7.22 HART Enable (1D)

This command enables or disables HART. A "0" is HART disabled. A "1" is HART Enabled. This is an option that must be ordered. If HART is not installed, an exception will be returned.

### 5.7.23 HART Test (1E)

This command is used to test the HART output. It produces constant zeros or constant ones on the HART output. This is only available if the HART option was purchased.

Code	Results
0	Normal
1	Constant ones
2	Constant zeros

#### **5.7.24 Not Used (1F)**

#### **5.7.25 Comm 1 Total Illegal number of registers Errors (20H)**

A read indicates the total illegal number of registers errors on the Modbus. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

#### **5.7.26 Comm 1 Bus Activity Rate % (21H)**

A read indicates the Comm 1 Bus Activity Rate in percent of this Slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64), which translates to decimal (0-100%).

#### **5.7.27 Comm 1 Function Code Errors (22H)**

A read indicates the number of Comm Function Code Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

#### **5.7.28 Comm 1 Starting Address Errors (23H)**

A read indicates the number of Comm 1 Starting Address Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

#### **5.7.29 Comm 1 Total Receive Errors (24H)**

A read indicates the total Modbus Comm 1 Only Receive Errors that occurred in the slave device. These are address, function, etc. type of errors. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

#### **5.7.30 RXD CRC Errors Hi (25h)**

A read indicates the number of RXD CRC Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

#### **5.7.31 RXD CRC Errors Lo (Same as Hi) (26h)**

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**NOTE:** Since the FL3100H has a 16 bit CRC, the Hi and Lo CRC errors are now reported in the same 16 bit word. A read from either the old high Hi or Lo CRC address will return the same count.

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#### **5.7.32 Comm 1 Overrun Errors (27H)**

A read indicates the number of Comm 1 Overrun Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

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**NOTE:** An overrun error occurs when the next received byte of data tries to overwrite an existing received data byte, which has not been processed. Therefore, the next received byte of data is lost. This can be controlled by implementing the proper DCS or PLC Error Handling Timing Setting (ex. Reply Timeout Setting, Delay Time, and Number of Retries) and proper Baud Rate Setting.

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#### **5.7.33 Comm 1 Parity Errors (28H)**

A read indicates the number of Comm 1 Only Parity Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.



**5.7.34 Comm 1 Framing Errors (29H)**

A read indicates the number of Comm 1 Framing Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

**5.7.35 Comm 1 Total UART Receive Errors (2AH)**

A read indicates the total Modbus Comm 1 Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again. The total errors are an accumulation of the individual Comm errors such as Overrun, CRC, Parity and Framing errors.

**5.7.36 Comm 1 Total Receive Errors (2BH)**

A read indicates the total Modbus Comm 1 Only Receive Errors that occurred in the slave device. These are address, function, etc type of errors. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

**5.7.37 Clear Comm 1 UART Errors (2CH)**

Writing a 0 to the bit activates the Clear Comm 1 Errors function, which resets all of the Modbus UART Comm Error counters to zero. The function is active momentarily and will reset automatically after being used.

**5.7.38 Clear Comm 1 Modbus Errors (2DH)**

Writing a 0 to the bit activates the Clear Comm 1 Errors function, which resets all of the Modbus Comm Error counters to zero. The function is active momentarily and resets automatically after being used.

**5.7.39 HART Current (2E)**

Normally in HART mode the low current does not go below 3.5 mA. In order for the current to distinguish between COPM Fault and Fault there is a HART setting that allows the current to go as low as 1.25 mA. A read returns “1” or “0”.

Condition	Normal HART Current	HART Expanded Scale	Units
Run	4 ,8, 12,16, 20	4 ,8, 12,16, 20	mA
COPM Fault	3.5	2.0	mA
Fault	3.5	1.25	mA

**5.7.40 Comm 2 Address (2FH)**

A read returns the Comm 2 address of the FL3100H / FL3101H. A write changes the address to the requested address. The range of the address is 1 to 247 (01 to F7 Hex). After the address has been changed to the slave unit, the Modbus communications will cease because the address has changed. Therefore, the master will have to change its query address to the slave’s new address in order to restart communications.

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H / FL3101H Address defaults to 2.

### 5.7.41 Comm 2 Baud Rate (30H)

A read returns the Comm 2 baud rate of the FL3100H / FL3101H. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the Modbus communications ceases because the baud rate has changed. Therefore, the master will have to change its baud rate to the slave's new baud rate in order to restart communications.

Baud Rate	Low Data Byte	Access
19.2K	03	Read/Write
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

**Table 30: Comm 2 Baud Rate**

This function is indicated on the Low Data Byte (the High Data Byte is not used).

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

---

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H / FL3101H Baud Rate will default to 19.2K.

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### 5.7.42 Comm 2 Data Format (31H)

A read returns the Comm 2 data format of the FL3100H / FL3101H. A write changes the data format to the requested data format. After the data format has been changed to the addressed unit, the Modbus communications may cease or start producing Comm errors because the data format has changed. Therefore, the master will have to change its data format to the slave's new data format in order to restart or provide proper communications.

Data	Parity	Stop	Format	Low Data Byte	Access
8	None	1	8-N-1	00	Read/Write
8	Even	1	8-E-1	01	Read/Write
8	Odd	1	8-O-1	02	Read/Write
8	None	2	8-N-2	03	Read/Write

**Table 31: Comm 2 Data Format**

This function is indicated on the Low Data Byte (the High Data Byte is not used).

**EXCEPTION** - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

---

**NOTE:** By grounding the RESET input during power-up cycle (approximately 10 seconds), the FL3100H / FL3101H Data Format will default to 8-N-1.

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### 5.7.43 Not Used (32H)

### 5.7.44 Input Voltage (33H)

A read returns the input voltage. This allows the user to remotely read the actual input voltage via Modbus. If the measured voltage is below the required 20 volts measures should be taken or low line faults may occur.

### **5.7.45 Alarm Test Voltage (34H)**

This is useful if the Alarm test button is located a long distance from the FL3100H or the ground is not a good ground. A read returns the Alarm input voltage. If the voltage is below 3.5 volts, the Alarm test is activated.

### **5.7.46 Reset Relays Voltage (35H)**

This is useful if the Reset test button is located a long distance from the FL3100H or the ground is not a good ground. A read returns the Reset input voltage. If the voltage is below 3.5 volts, the Reset is activated.

### **5.7.47 Dip Switch Settings (36H)**

A read returns a digital copy of the dip switch. This is useful to check the FL3100H configuration.

### **5.7.48 Not Used (37 – 3FH)**

### **5.7.49 See Event Logging - Section 6.0 (40H – 67H)**

### **5.7.50 User Information (68h to 77h)**

There is a section in memory that allows the user to store information. This is useful if the physical location or other user identification is required. The only restriction on the information is it must be Modbus compatible. Only one word can be written per command. There are a total of 16 words for the user.

---

**NOTE:** The following information only applies if the dual Modbus configuration was purchased.

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### **5.7.51 Comm 2 Total Illegal Number of Registers Errors (78H)**

A read indicates the total illegal number of registers errors on the Modbus. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.52 Comm 2 Bus Activity Rate % (79H)**

A read indicates the Comm 2 Bus Activity Rate in percent of this slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64), which translates to decimal (0-100%).

### **5.7.53 Comm 2 Function Code Errors (7AH)**

A read indicates the number of Comm 2 Function Code Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.54 Comm 2 Starting Address Errors (7BH)**

A read indicates the number of Comm 2 Starting Address Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.55 Comm 2 Total Receive Errors (7CH)**

A read indicates the total Modbus Comm 2 Only Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

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### **5.7.56 RXD CRC Errors Hi (7DH)**

A read indicates the number of RXD CRC Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.57 RXD CRC Errors Lo (Same as Hi) (7EH)**

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**NOTE:** Hi and Lo CRC errors are reported in the same word. A read from either Hi or Lo will return the same count.

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### **5.7.58 Comm 2 Overrun Errors (7FH)**

A read indicates the number of Comm 2 Only Overrun Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

---

**NOTE:** An overrun error occurs when the next received byte of data tries to overwrite an existing received data byte, which has not been processed. Therefore, the next received byte of data is lost. This can be controlled by implementing the proper DCS or PLC Error Handling Timing Setting (ex. Reply Timeout Setting, Delay Time, and Number of Retries) and proper Baud Rate Setting.

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### **5.7.59 Comm 2 Parity Errors (80H)**

A read indicates the number of Comm 2 Parity Flag Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.60 Comm 2 Framing Errors (81H)**

A read indicates the number of Comm 2 Framing Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.61 Comm 2 Total UART Receive Errors (82H)**

A read indicates the total Modbus Comm 2 UART Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

### **5.7.62 Not Used (83H)**

### **5.7.63 Clear Comm 2 UART Errors (84H)**

Writing a 0 to the bit activates the Clear Comm 2 UART Errors function, which resets all of the Modbus UART Error counters to zero. The function is active momentarily and will reset automatically after being used.

### **5.7.64 Clear Comm 2 Modbus Errors (85H)**

Writing a 0 to the bit activates the Clear Comm 2 Modbus Errors function, which resets all of the Modbus Error counters to zero. The function is active momentarily and will reset automatically after being used.

## 6.0 Event Logging

### 6.1.1 Faults

- Whenever the fault word changes, the time will be recorded.
- The time of the fault will be saved.
- The quantity of faults will be saved in a counter.
- When the fault is removed, it is not saved and the counter is not incremented.
- A fault event is logged for every 30 seconds recorded.
- There are a total of 10 event time stamps stored.

### 6.1.2 Warning

At the time the fire level reaches the Warning level, the time is recorded. Each time this happens a counter is incremented and saved. The end of the event is after the fire has gone away and the latching state has been reset. There are a total of 10 event time stamps stored.

### 6.1.3 Alarm

At the time the fire level reaches the Alarm level, the time is recorded. Each time this happens a counter is incremented and saved. The end of the event is after the fire has gone away and the latching state has been reset. There are a total of 10 event time stamps stored.

### 6.1.4 Maintenance

At the time an alarm test occurs, the time is saved in the maintenance event log. Each successful test increments and saves the maintenance counters. There are a total of 10 event time stamps stored.

### 6.1.5 Setting Clock

Please see the table below.

Address (hex)	Parameter	Function	Data Type	Data range	Access
40	Seconds Time Hi	Seconds Time Hi	Numeric value	0 – 65535	<b>Timer Sec</b>
41	Seconds Time Low	Seconds Time	Numeric value	0 – 65535	<b>Timer Sec</b>
42	Real Time Clock Year, Month	Read/Set year and month of RTC	2 Numeric Values	0-99 year, 1 – 12 month	<b>Timer Struct</b>
43	Real Time Clock Day, Hour	Read/Set day and hour of RTC	2 Numeric Values	1 – 31 day, 0 – 23 hour	
44	Real Time Clock Minute, Second	Read/Set minutes and seconds of RTC	2 Numeric Values	0 – 59 minute, 0 – 59 second	<b>Timer Struct</b>
46	Event Index	Event index of Logged Event	Numeric value	0 - 9	<b>Index</b>
47	Warn Seconds Time Hi	Seconds Time Hi for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>

Address (hex)	Parameter	Function	Data Type	Data range	Access
48	Seconds Time Low	Seconds Time Low for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
49	Structure time Hi	Hi byte – year, low byte – month for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
4A	Structure time Mid	Hi byte – day, low byte – hour warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
4B	Structure time Low	Hi byte – min, low byte – sec for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
4C	Reserved	Reserved	Numeric value	0	
4D	Reserved	Reserved	Numeric value	0	
4E	Warn Event Count	Warning Event Count	Numeric value	0 – 65535	<b>Warn</b>
4F	Alarm Seconds Time Hi	Seconds Time Hi for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
50	Seconds Time Low	Seconds Time Low for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
51	Structure time Hi	Hi byte – year, low byte – month for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
52	Structure time Mid	Hi byte – day, low byte – hour alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
54	Reserved	Reserved	Numeric value	0	
55	Reserved	Reserved	Numeric value	0	
56	Alarm Event Count	Alarm Event Count	Numeric value	0 – 65535	<b>Alarm</b>
57	Fault Seconds time Hi	Seconds Time Hi for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
58	Seconds time Low	Seconds Time Low for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>

<b>Address (hex)</b>	<b>Parameter</b>	<b>Function</b>	<b>Data Type</b>	<b>Data range</b>	<b>Access</b>
59	Structure time Hi	Hi byte – year, low byte – month for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
5A	Structure time Mid	Hi byte – day, low byte – hour alarm event log entries	Numeric value	0 – 65535	<b>Fault</b>
5B	Structure time Low	Hi byte – min, low byte – sec for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
5C	Fault code	Fault code. Same code as register 2	Numeric value	0 – 65535	<b>Fault</b>
5D	Reserved	Reserved	Numeric value	0	
5E	Fault Event Count	Fault Event Count	Numeric value	0 – 65535	<b>Fault</b>
5F	Maintenance Seconds time Hi	Seconds Time Hi for event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
60	Seconds time Low	Seconds Time Low for event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
61	Structure time Hi	Hi byte – year, low byte – month for event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
62	Structure time Mid	Hi byte – day, low byte – hour event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
64	Maintenance code	Cal check	Numeric value	0	<b>Maintenance</b>
65	Reserved	Reserved	Numeric value	0	
66	Maintenance Count	Maintenance Count	Numeric value	0 – 65535	<b>Maintenance</b>
67	Reset Event Counters	Reset Event Counters	Numeric value	1	<b>Reset</b>

**Table 32: Event Logging Registry Table**

## 7.0 Maintenance

### 7.1 General Maintenance

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



**WARNING:** Disconnect or inhibit external devices, such as automatic extinguishing or fire suppression systems before performing any maintenance.

---

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

---

During routine maintenance of the equipment, if the base plate is removed, the flame path should be replenished with grease compound.

*European Union (EU) Approved Applications:* The following grease compound is recommended for use: High Vacuum Grease (or equivalent), as a jointing compound on flameproof electrical enclosures. This is available from General Monitors Ireland.

The viton o-ring gasket should also be lubricated with Castrol EP (P/N 916-062) or High Vacuum (916-078) grease available from General Monitors should it become dry.

The removal of dust and film build-up on the windows is necessary to ensure proper sensitivity of the system. Windows may be cleaned periodically, to avoid a COPM fault being triggered by build-up, dirt or debris.

### 7.2 Cleaning the Lenses/Light Rods

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**NOTE:** DO NOT USE A COMMERCIAL GLASS CLEANER OTHER THAN "INDUSTRIAL STRENGTH WINDEX<sup>®</sup> with Ammonia D". The lenses are not glass. The UV lens material is quartz and the IR lens material is sapphire. The cleaning solution should be General Monitors' P/N 10272-1 ("Industrial Strength Windex<sup>®</sup> with Ammonia D").

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A clean, soft, lint-free cloth, tissue or cotton swab should be used to apply the cleaning solution. Do not touch the lenses or light rods with fingers.

1. Wet the window with the cleaning solution.
2. Rub with a dry, unsoiled cloth until the window is clean.
3. Let the window dry completely.
4. Repeat steps 1, 2 and 3 for the light rods (Figure 22). Take care only to clean the non-coated (non - aluminum) areas of the light rods.

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

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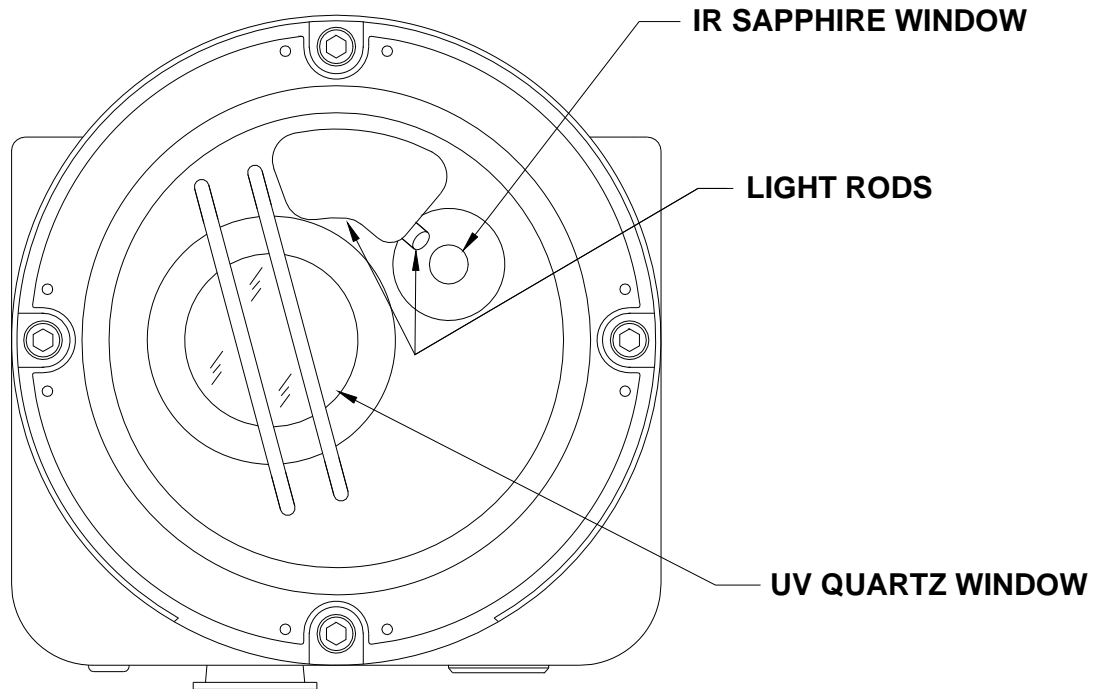


Figure 22: UV and IR Windows

## 7.3 Sensitivity Check

To verify that each detector is functioning correctly, the General Monitors TL105 Test Lamp and/or the ALARM TEST function should be used.

### 7.3.1 Alarm Test

The Models FL3100H and FL3101H flame detectors have a built-in Alarm Test feature. By connecting one contact of a SPST momentary switch to TB1 position 4 and the other contact to DC COM TB1, position 9 or 10 (Section 3.3.1), the user can test the alarm outputs of the flame detector by activating this switch for two to ten seconds depending on the Alarm Time Delay Setting.

If the flame detector detects these sources, it will immediately go into WARN and then into the time delayed ALARM. After two to ten seconds the flame detector will reset the non-latching WARN and/or ALARM. A latching WARN and/or ALARM will remain latched until manually reset. If the flame detector does not respond to the sources, it will output a FAULT condition and will retest every ten seconds, as in the COPM FAULT case.

### 7.3.2 TL105 Test Lamp

The General Monitors TL105 Test Lamp is a battery operated, rechargeable test source specifically designed to test General Monitors' UV and UV/IR flame detectors.



It consists of a high-energy broadband radiation source, which emits sufficient energy in both the Ultraviolet and Infrared spectra to activate UV and/or IR detectors. To simulate a fire, the test lamp automatically flashes at the proper rate for different models. See TL105 instruction manual.

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The Model TL105, rated explosion-proof, is CSA certified for use in Class I, Groups C and D areas.

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The test lamp operates on internal batteries which, when fully charged, will operate continuously for 30 minutes. An internal circuit will prevent operation when the batteries are low.

### 7.3.3 TL105 Operating Instructions

It is always important to start a series of TL105 checks with a fully charged unit. Stand within 20 feet (FL3100H), 40 feet (FL3100H-Hydrogen), or within 35 feet (FL3101H) of the unit to be tested and aim the TL105 squarely into the detector face. Shaking the lamp from side to side or up and down will increase the simulation of flame flicker, and improve the response of the flame detector to the lamp.

If the system is operating normally, the detector will go into a WARN condition after a few flashes of the test lamp. If the lamp remains ON for the time-delayed period of the DIP switch setting, the detector will go into ALARM.

To conserve charge, do not operate the test lamp longer than is necessary to test each detector. When the battery level drops below the level required to maintain the proper intensity of the lamp, an internal low voltage circuit will shut the lamp off until the batteries have been recharged.

### 7.3.4 TL105 Recharging Instructions

Insert the charging plug into the receptacle. Complete recharging takes less than 2 hours. A schedule of testing should be established and followed.



**WARNING:** Replace the knurled plug after charging is complete. Charging must be carried out in a non-hazardous area. The charging receptacle is located inside the housing adjacent to the ON button. To gain access, it is necessary to unscrew the knurled plug from the body of the unit. The plug is secured to the ON button by a safety strap to keep it from being lost. It is recommended that the TL105 be kept on charge when not in use to prevent excessive battery discharge. The batteries may be charged an average of 500 times and the battery pack is replaceable.

Additional information can be found in the TL105 operating manual.

## **7.4 Storage**

General Monitors Flame Detectors should be stored in a clean, dry area and within the temperature and humidity ranges quoted in the Appendix, under Environmental Specifications.

When prolonged storage is anticipated, detectors should be sealed together with a desiccant into plastic bags and double wrapped for protection. They should not be subjected to shock or vibration as this may cause damage. Ideally, the detectors should remain packed in the molds as shipped by General Monitors. Insert red dust caps into vacant cable entry holes.

## 8.0 Troubleshooting

### 8.1 Troubleshooting



**CAUTION:** Component level repair must be undertaken either by General Monitors' personnel or by competent authorized service engineers. SMT PCB repair shall only be performed at a GM facility.

#### 8.1.1 Introduction

Included in this section is a troubleshooting table. The information included is designed to cope with the more common faults, which occur during commissioning and operation and which are repairable by a competent operator. Should the various actions suggested in the table fail to restore normal operation, the unit should be returned to General Monitors for repair. A complete written description of the problem should be included.

Be sure to inhibit or disconnect external alarm wiring before making any check that might send the unit into alarm.

**NOTE:** On no account should repair of the electronic circuit be undertaken by anyone other than General Monitors' personnel or authorized representative. Failure to comply with this requirement will invalidate the warranty.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
No output signal and green LED in UV window is off.	No DC Power to the Unit	Be sure the +24 VDC is applied with the correct polarity.
No output signal and green LED in UV window is rapidly blinking; in three-color LED configuration: in addition to blinking green LED, yellow LED is on.	Low voltage FAULT (voltage at unit less than +18 VDC).	Be sure that the unit is powered with at least +20 VDC under load.
2mA signal and green LED in UV window is slowly blinking; in three-color LED configuration: in addition to blinking green LED, yellow LED is on.	COPM FAULT, dirty or obscured optical path (UV or IR window)	Clean UV and IR window and associated source light rods.
Constant 12 mA signal with no known radiation to detector (FL3100H only).	Background UV radiation at detector.	Cover UV portion of FL3100H for ten seconds to determine if there is background UV. If there is, remove UV radiation source or change FL3100H location. If there is no background UV, replace UV detector tube in FL3100H.
Constant 16 mA or 20 mA signal (WARN or ALARM) with no known radiation at detector (FL3101H only).	Background UV radiation at detector.	Cover UV portion of FL3101H for ten seconds to determine if there is background UV. If there is, remove UV radiation source or change FL3101H location. If there is no background UV, replace UV detector tube in FL3101H.

**Table 33: Troubleshooting Table**

## 9.0 Customer Support

Area	Phone/Email
<b>UNITED STATES</b> 26776 Simpatica Circle Lake Forest, CA 92630	Phone: +1-949-581-4464. 800-446-4872 Email: info.gm@MSAsafety.com
9776 Whithorn Drive Houston, TX 77095	Phone: +1-281-855-6000
<b>UNITED KINGDOM</b> Heather Close Lyme Green Business Park Macclesfield, Cheshire, United Kingdom, SK11 0LR	Phone: +44-1625-619-583
<b>IRELAND</b> Ballybrit Business Park Galway Republic of Ireland, H91, H6P2	Phone: +353-91-751175
<b>SINGAPORE</b> No. 2 Kallang Pudding Rd. #09-16 Mactech Building Singapore 349307	Phone: +65-6-748-3488
<b>MIDDLE EAST</b> PO Box 54910 Dubai Airport Free Zone United Arab Emirates	Phone: +971-4294 3640

**Table 34: Locations**

Additional locations can be found on our web site, [www.MSAsafety.com](http://www.MSAsafety.com)

### 9.1 Other Sources of Help

Extensive documentation, white papers, and product literature for our complete line of safety products can be found at <http://www.MSAsafety.com/detection>

## 10.0 Appendix

### 10.1 Warranty

General Monitors warrants the Models FL3100H and FL3101H to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

General Monitors will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped to General Monitors' plant or representative from which the original shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and does not cover products which have been modified or repaired without General Monitors' approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

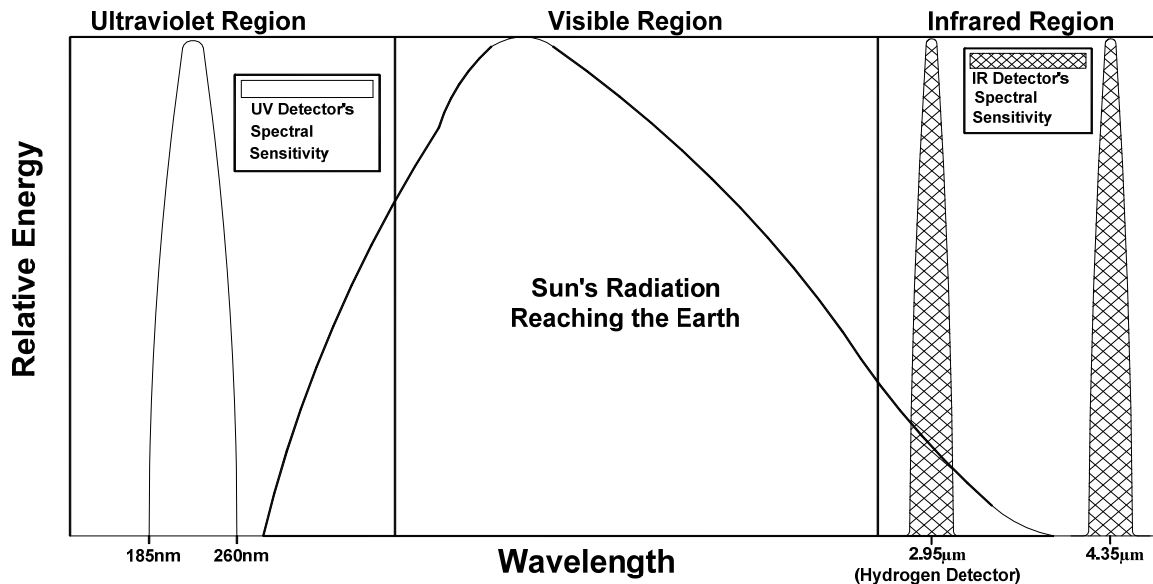
### 10.2 Principle of Operation

#### 10.2.1 UV Detector - FL3100H and FL3101H

The Model FL3101H is a flame detector, which contains an ultraviolet phototube that responds to ultraviolet (UV) radiation in the 185 to 260 nanometer region (Figure 23). When radiation from a flame reaches the cathode plate within the UV detector tube, electrons are ejected from the cathode plate. These electrons are accelerated towards the positively charged anode of the tube. They collide with molecules of an ionizable gas, with which the tube is filled. This emits more electrons and produces an avalanche condition. More electrons are released which creates a momentary electron flow from the cathode to the anode. This momentary current (pulse) recurs at a rate proportional to the intensity of the UV radiation.

The Model FL3101H UV Flame Detector processes these UV pulses with a microcomputer and produces the following outputs:

- 4 to 20 mA signal
- Immediate WARN relay contacts
- Time delayed ALARM relay contacts
- FAULT relay contacts
- RS-485 Modbus RTU output
- Optional: HART communication
- Optional: Redundant RS-485 Modbus RTU output



**Figure 23: Spectral Response of UV and IR Detectors**

(See Sections 3.0 and 5.2 for more information on detector outputs.)

### 10.2.2 UV/IR Flame Detector - FL3100H

The Model FL3100H is a discriminating UV/IR Detector, which makes use of an ultraviolet radiation sensitive phototube in addition to an infrared detector. This combination provides a flame detector which is highly immune to false alarms.

The UV portion of the detector, as described in the previous section, is combined with an infrared detector, which responds to changes in the intensity of infrared radiation. By sensing very specific wavelengths in both the UV and IR spectra (Figure 23) and then processing these signals with a microcomputer, a very high degree of discrimination is achieved.

Incorporated in the IR circuitry is a flicker discrimination circuit. This permits the detector to ignore steady IR sources such as hot objects. The inherent flickering of a flame provides the necessary modulation to activate the IR circuit.

Since a flame is a copious source of both ultraviolet and infrared radiation, discrimination is provided when both UV and IR emissions are detected. If only UV is detected, as in the case of arc welding, no alarm is given. If only IR is detected, such as a large modulating hot object, no alarm is given. However, if both conditions are met in the correct combination and intensity, as determined by an algorithm in the microcomputer, a fire is identified and the alarm outputs are activated.

### 10.2.3 COPM Circuitry

A self-testing feature called Continuous Optical Path Monitoring (COPM) checks the optical path, the detector(s), and the related electronic circuitry once every minute. If foreign material impairs the optical path of the UV detector tube (both Models FL3100H and FL3101H) or the infrared detector (Model FL3100H only) for two consecutive checks, the unit will indicate FAULT. The optical FAULT outputs are a 2.0 mA signal, de-energizing of the FAULT relay, and RS-485 output signal (Section 3.3.1). After a COPM FAULT, a COPM check is performed every 12 seconds until the fault condition is removed. Then the COPM check will resume a once per minute check.



**WARNING:** Dirty or partially blocked windows can significantly reduce the detector's field of view and detection distance.

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**NOTE:** Since the optical path is checked once per minute and it requires two check failures to produce a FAULT, it may take up to two minutes for the unit to detect an obstruction.

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#### **10.2.4 Alarm Test**

The Models FL3100H and FL3101H flame detectors have a built-in Alarm Test feature. By connecting one contact of a SPDT momentary switch to TB1 position 4 and the other contact to DC COM TB1, position 9 and 10 (Section 3.3.1), the user can test the alarm outputs of the flame detector by activating this switch for one to eight seconds depending on the Alarm Time Delay Setting.

If the flame detector detects these sources, it will immediately go into WARN and then into the time delayed ALARM. After one to eight seconds the flame detector will reset the non-latching WARN and/or ALARM. A latching WARN and/or ALARM will remain latched until manually reset. If the flame detector does not respond to the sources, it will output a FAULT condition and will retest every ten seconds, as in the COPM FAULT case.

#### **10.2.5 Two-color Visual Indicators**

Two light emitting diodes (LED's) are visible through the UV window (the larger window). LED's are provided for a visual indication that corresponds with the detectors outputs. The following blinking sequence indicates the standard operation condition:

- Timeout (10 seconds when the unit is first powered) - Green and Red LED's blinking alternately
- Ready - Green LED that flashes off 1 second, every 5 seconds
- WARNING - Slow blinking Red LED with Green LED off
- ALARM - Fast blinking Red LED with Green LED off
- COPM FAULT - Slow blinking Green LED
- Low Voltage FAULT/Shorted Reset Switch - Fast blinking Green LED

#### **10.2.6 Three-color Visual Indicators**

For a unit with three color LED's, the following blinking sequence indicates the operating condition:

- Timeout (10 seconds when the unit is first powered) – Green, Red and Yellow LED's blinking alternately
- Ready - Green LED on steady with Red and Yellow LED off
- WARNING - Fast blinking Red LED with Green LED on steady. Yellow LED is off.
- ALARM - Red LED on steady with Green LED on steady. Yellow LED is off.
- COPM FAULT - Slow blinking Green LED with Yellow LED on steady. Red LED is off.
- Low Voltage FAULT/Shorted Reset Switch - Fast blinking Green LED with Yellow LED on steady. Red LED is off.



## 10.3 Specifications

### 10.3.1 System Specifications

<b>Application:</b>	FL3100H UV/IR Flame Detection FL3101H UV Flame Detection FL3100H-H <sub>2</sub> UV/IR Hydrogen Flame Detection
<b>Detector Location:</b> <b>(FL3100H/FL3101H/FL3100H-Hydrogen)</b>	Class I, Division 1, Groups B, C and D; Class II, Division 1, Groups E, F and G; Class III Ex db IIC T5 Gb; Ex tb IIIC T100°C Db
<b>Environmental Ratings:</b>	Type 4x, IP66/IP67
<b>UV Detector Pass Band:</b>	185 to 260 nanometers
<b>IR Detector center wavelength:</b>	4.35 μm, 2.7-3.2 μm for Hydrogen
<b>Typical Alarm Activation Response Times*:</b>	FL3100H < 3 s for 1 x 1 ft <sup>2</sup> heptane fire when detector is on axis to fire source and the distance of the detector to the fire is 15 -50 ft FL3101H < 1 s @ 50 ft (15.2 m) FL3100H-H <sub>2</sub> < 3 s @ 15 ft (4.6 m)
<b>Minimum Detector Response Times:</b>	FL3100H < 500 ms FL3101H < 100 ms
<b>Zeta Value:</b>	Zeta = -0.001 (The margin of error in the range measurement is estimated at ± 5 feet due to wind conditions and flame turbulence)
<b>Field of View*:</b>	FL3100H 120° maximum conical FL3101H 140° maximum conical FL3100H-H <sub>2</sub> 120° maximum conical

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**NOTE**<sup>2</sup>: Response Times and Field of View data have been derived by testing the Models FL3100H/FL3101H flame detectors with a 1 square foot heptane fire. One cup of heptane on top of a one-inch layer of water was ignited for each test. These are typical values and different results may occur depending on the variation of each fire.

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### 10.3.2 Mechanical Specifications

<b>Enclosure Material:</b>	Aluminum (AL) A-356 or Stainless Steel (SS): Natural 316
<b>Color:</b>	Aluminum Red
<b>Finish:</b>	Aluminum: Chemical Film per MIL-C-5541, Epoxy Powder Coated
<b>Height:</b>	6.0 in (15.2cm)
<b>Width:</b>	6.0 in (15.2cm)
<b>Depth:</b>	5.5 in (14.0cm)
<b>Weight:</b>	5 lbs (2.3 kg) AL 16 lbs (7.3 kg) SS
<b>Cable Entry:</b>	2 x 25 mm ISO or 2 x PG 13.5 or 2 x 20 mm ISO or 2 x ¾" NPT. Each unit has an Ex d approved stopping plug installed, plus a Red Dust cap. Dust caps must be replaced by Ex d IIC approved cable glands and <b>must not</b> be left on the unit when powered up.
<b>Cable Requirements:</b>	Screened or screened and armored to BS5308 Part 2, Type 2 or equivalent. Note that terms "Screen" and "Shield" are used interchangeably.

### 10.3.3 Electrical Specifications

*European Union (EU)*

*Approved Applications:*

PSU noise and ripple voltage 1.0Vpp max. The customer  
supplied PSU must comply with IEC 61010-1, limiting  
current to 8A under Fault conditions, in order to comply  
with CE Marking requirements.

<b>Nominal supply voltage:</b>	24 VDC
<b>Supply voltage range:</b>	20 to 36 VDC
<b>Maximum supply current:</b>	400 mA during COPM only
<b>Typical current:</b>	80 to 150 mA Depends on relays ETC
<b>Maximum output signal load:</b>	600 ohms
<b>Output signal range:</b>	0 to 20 mA *
<b>FAULT signal:</b>	0 to 0.2 mA *
<b>COPM fault signal:</b>	2.0 ± 0.2 mA *
<b>Ready signal:</b>	4.0 ± 0.2 mA
<b>IR only signal (FL3100H only):</b>	8.0 ± 0.2 mA
<b>UV only signal (FL3100H only):</b>	12.0 ± 0.2 mA
<b>WARN signal:</b>	16.0 ± 0.2 mA
<b>ALARM signal:</b>	20.0 ± 0.2 mA
<b>Relay Contact Ratings:</b>	<i>North American Approved Applications:</i> SPDT, 8A, @ 250VAC, or 8A @ 30 VDC resistive max. <i>European Union (EU) Approved Applications:</i> SPDT, 8A 30V RMS/42.4V Peak, 8A @ 30 VDC, resistive max.

<b>RS-485 Output:</b>	Modbus RTU 128 units in series max. (247 units with repeaters) Baud Rate: 2400, 4800, 9600 or 19200 BPS Optional: Dual Modbus RTU Communications available (See Section 3.3 Terminal Connections, for Alarm Output Connections)
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<b>HART:</b>	Fully HART Foundation compliant. See separate HART manual for use of HART.
<b>HART Impedance:</b>	$R_x = 50\text{ K}$ $C_x = 5\text{ nF}$
<b>AMS Aware:</b>	Certified by AMS
<b>RFI/EMI Protection:</b>	Complies with EN 50130-4, EN 61000-6-4
<b>Status Indicator:</b>	Two LED's indicate status, fault, and alarm conditions**

\* Normal non-HART version. See analog output Section 3.3.6 for other currents.  
\*\* Standard configuration has two single-color LED's, green and red, while three-color LED configuration offers green, red, and yellow. Red and yellow are from a single bi-color LED.

### 10.3.4 Environmental Specifications

<b>Operating temperature range:</b>	-40°F to 185°F (-40°C to 85°C)
<b>Storage temperature range:</b>	-40°F to 185°F (-40°C to 85°C)
<b>Humidity range:</b>	0% to 95% RH non-condensing

## 10.4 Approvals

CSA, FM, ATEX, IECEx, GOST, INMETRO, HART Registered, SIL 3 suitable and AMSAware. The FL3100H-Hydrogen flame detector is not FM approved.

## 10.5 Accessories

### 10.5.1 Mounting Swivel/Union

A mounting swivel and union are available to connect ¾" conduit into the base of the Model FL3100H/FL3101H. The swivel design allows for optical alignment adjustments for the flame detectors when using rigid conduit.

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**NOTE:** Swivel is not approved for ATEX requirements.

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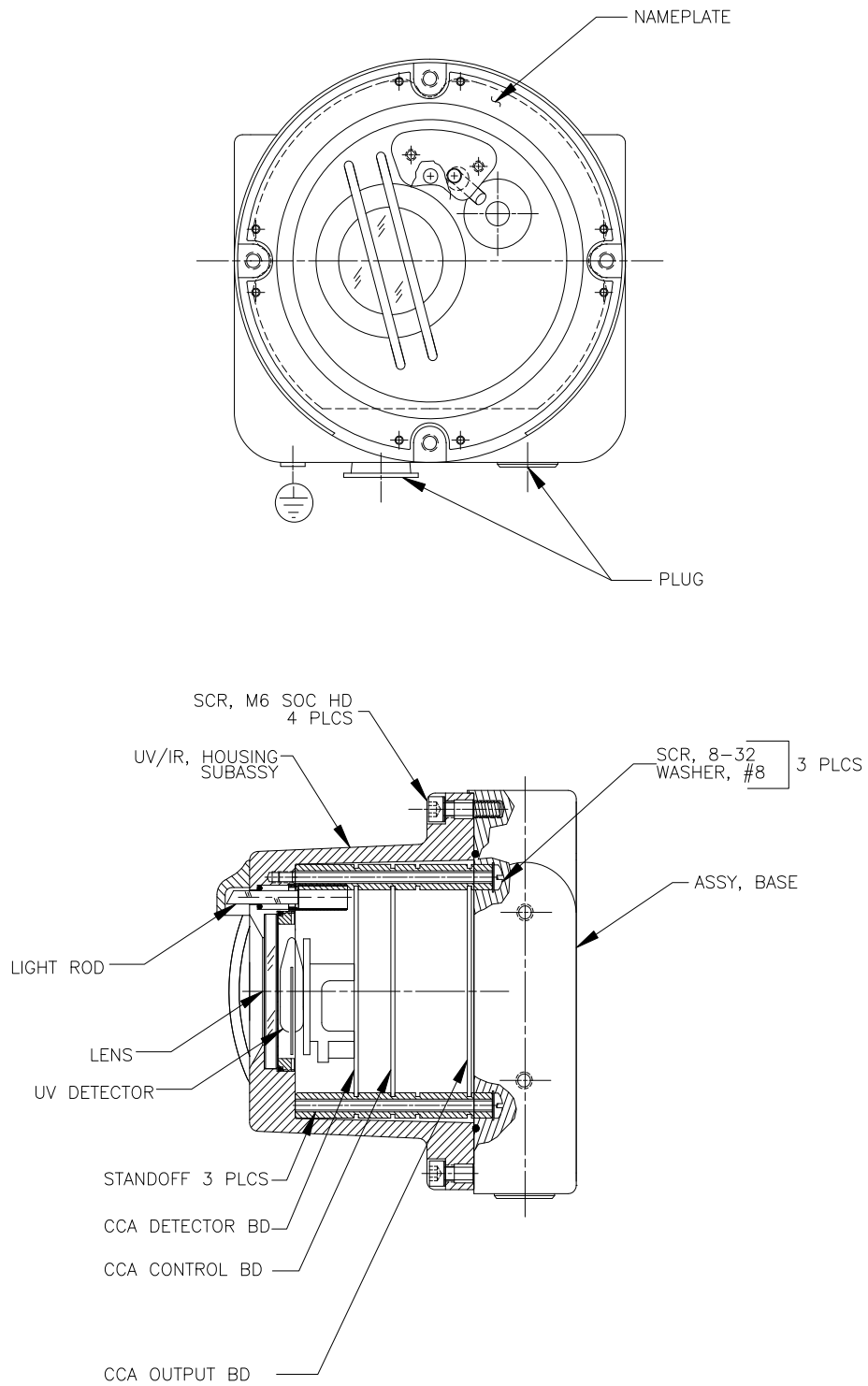
### 10.5.2 Mounting Bracket

A mounting bracket is available to mount the FL3100H/FL3101H to a wall, pole, etc. The mounting bracket design allows for optical alignment adjustments for the flame detectors when installed to a fixed installation.

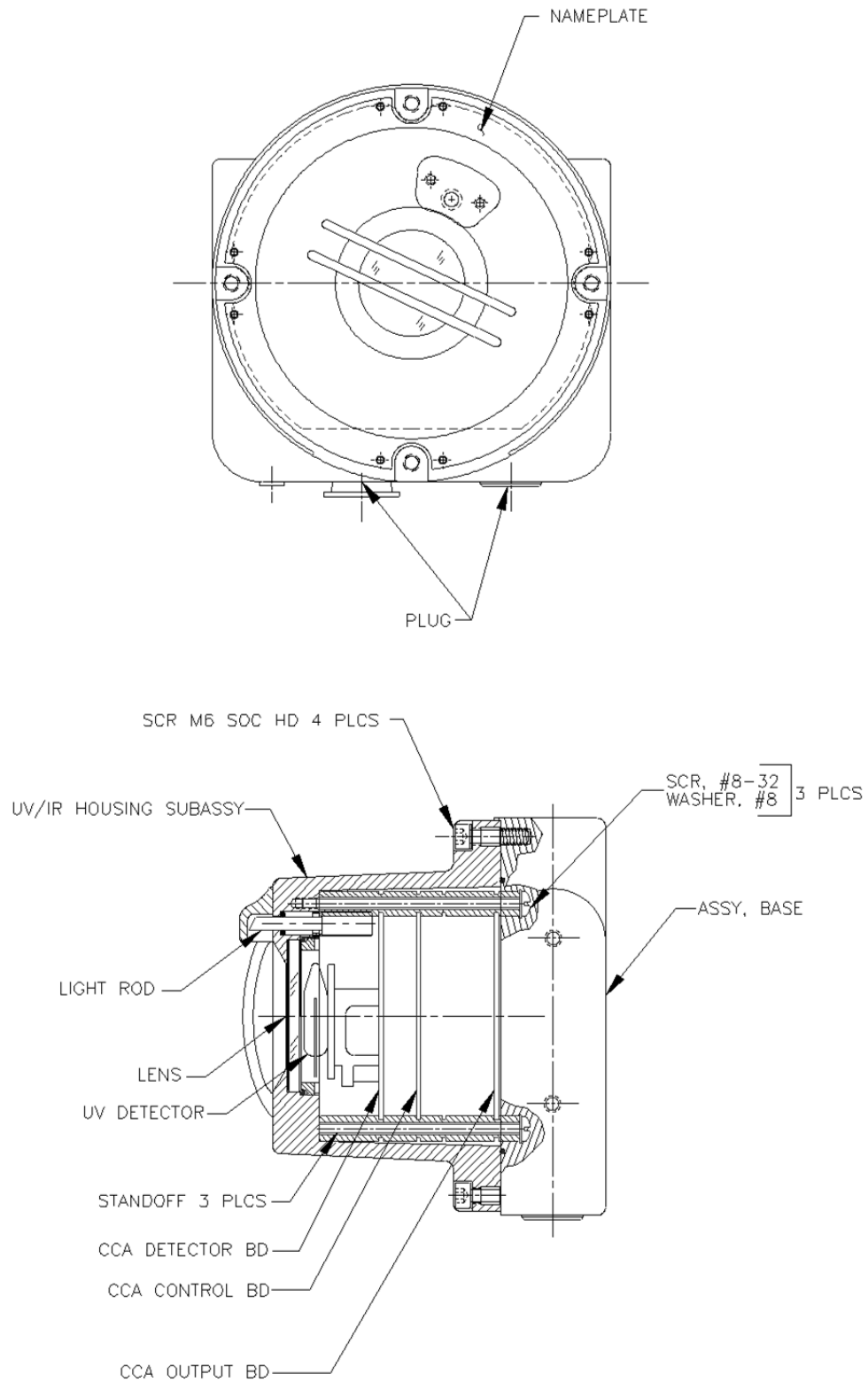
## 10.6 Storage

The flame detectors should be stored in a clean, dry area and within the temperature and humidity ranges mentioned in Section 10.3.4.

### 10.7 Final Assembly



**Figure 24: P/N 71450 FL3100H (UV/IR), Final Assembly**



**Figure 25: P/N 71451 FL3101H (UV), Final Assembly**



## ADDENDUM

This product may contain hazardous and/or toxic substances.

EU Member states shall dispose according to WEEE regulations. For further WEEE disposal information please visit: [www.MSAafety.com](http://www.MSAafety.com)

All other countries or states: please dispose of in accordance with existing federal, state and local environmental control regulations.