Design Manual

Model F130
Multi-Spectrum IR
Flame Detector/Controller

70114

SST
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Model F130 Multi-Spectrum IR Flame Detector Design, Application and Installation

Overview

The protection of onshore and offshore hydrocarbon process and handling facilities against any loss from fires requires positive and fast–responding optical flame detectors, with no tolerance for false or nuisance alarms caused by either EMI, lightning, x-rays, gamma radiation, arc welding, reflected sunlight, or any light source such as mercury or quartz iodine flood lights. With traditional optical flame detectors oil mist or oil deposits on the lens can seriously diminish the response to a fire. Therefore, we do not recommend using these types of detectors in a hydrocarbon environment.

Figure 130-1 UV/IR Flame Detector

The SST Model F130 Multi-Band IR Optical Flame Detector uses the latest state of the art processor and circuitry, eliminating the shortcomings of currently available IR detectors which are subject to the aforementioned interferences. To insure reliable operation, the detector is equipped with an automatic Optical Self-Checking feature which continuously checks the optical viewing window for cleanliness.

Physical Description

The Model F130 Multi-Band IR Optical Flame Detector is self-contained in a two-piece explosion proof copper-free aluminum housing finished in a deep red color for rapid identification as a flame detector. A protective coating permits use in harsh environments, such as offshore platforms, without degradation. (An optional stainless steel housing is also available.) The detector is suitable for use in "classified" areas where ignitable concentrations of flammable gas normally exist. A sapphire window in the front of the housing assures detection of the Infrared wavelenghts produced by fire and provides exceptional durability. Electrical connections are made through a ¾ inch threaded outlet on the rear of the detector, suitable for connection to electrical conduit or a cable gland.

Operational Description

Contained within The Model F130 Multi-Band IR Optical Flame Detector housing are the multi-band IR and sensing elements and associated electronics, three (3) relays, and screw terminal blocks for wiring. The detector may be installed for completely self-contained operation, utilizing the relays to control local equipment directly. Additionally, the alarm and status conditions may be transmitted by the detector to a central control room. The relay contacts, if not being used for local control, may be hard-wired to the control room to transmit these conditions. All conditions may also be transmitted over a single wire by using the available 0-20 mA signal.

When the detector is installed and operating normally, the green "Ready" light will be visible through the detector window. This provides a rapid visual check of detector operation. The Model F130 Multi-Band IR Optical Flame Detector responds to a flame with a variety of sensitivity and time delay settings. A multi-position selector switch sets the detector sensitivity required for the exact conditions at your particular installation.When the detector is installed and operating normally, the green "Ready" light will be visible through the detector window. This provides a rapid visual check of detector operation. A multiposition selector switch sets the detector for the most appropriate mode for the exact conditions at your particular installation.

When flame radiation is initially detected, the Alarm Outputs, both relay contact and current loop, are instantly activated. A red Alarm light behind the viewing window in the detector is also activated. Should this flame persist for a user selectable period of time, the Delayed Alarm outputs (relay and current loop) will be activated.

The Model F130 Multi-Band IR Optical Flame Detector continuously monitors the detector optics for optimal performance. To accomplish this a source of IR radiation is transmitted, via a sapphire rod to the outside surface of the viewing window, and then passes through the window onto the sensor elements. Should the transmission of the window be degraded the yellow Malfunction LED in the detector will turn on, the malfunction relay contacts will transfer, and the 0-20 mA output will transmit a malfunction signal.

Approvals applicable to the Model F130

This device is suitable for use in both general purpose and hazardous locations. It is weatherproof and corrosion resistant. Approvals include:

Classified by Underwriters Laboratories for use in Class I, Groups B, C, and D; Class II, Groups E, F, and G Hazardous Locations. FTRV, File No. E162517(N)

Classified by Underwriters Laboratories for use in Class I, Groups B, C, and D; Class II, Groups E, F, and G Hazardous Locations per Canadian Standard C22.2 No. 30-M1986 and 25-1966. File No. E162517(N).

EEx dIIB T6 Flameproof enclosure per EN50018 for groups I, IIA and IIB and EN50014 Electrical Equipment for Potentially Explosive Atmospheres

The enclosure is rated NEMA type 4X, watertight and corrosion resistant.

Technical Specifications

Flame Sensitivity:	Reliably detects a 1 square foot gasoline fire at a distance of 200 feet in less than 5 seconds (user selectable).
Cone of Vision:	90 degrees
Spectral Sensitivity:	2.2u to 5.0u
Detection Modes:	IR flame signature
Optical Self-Test:	Automatic continuous optical path
Relay Outputs:	Alarm, Delayed Alarm, Malfunction
Relay Contact Ratings:	6 amps @ 28 VDC or 300 VAC resistive, 1/8 HP @ 120/240 VAC
Analog Output:	**S**elf-powered output transmits a 0-20 mA current into a load of 100 to 800 ohms to indicate operating mode of detector. Delayed Alarm selectable for latching or non-latching operation. 0 mA = Power Fault 2 mA = Malfunction 4 mA = Ready 12 mA = Alarm (radiation detected) 20 mA = Delayed Alarm

Alarm Reset:	Latched alarms are reset by either activating the Test/Reset Input or interrupting power to the unit.
Visual Indicators:	Detector Ready (Green) Malfunction (Yellow) Alarm/Delayed Alarm (Red)
Operating Temperature:	-40 to +85°C, -40 to +185°F
Power Requirements:	20 to 35 Volts DC 125 mA standby, 230 mA alarm at 24 VDC
Dimensions:	See Figure below
Relative Humidity:	0-100% Relative Humidity (non-condensing)

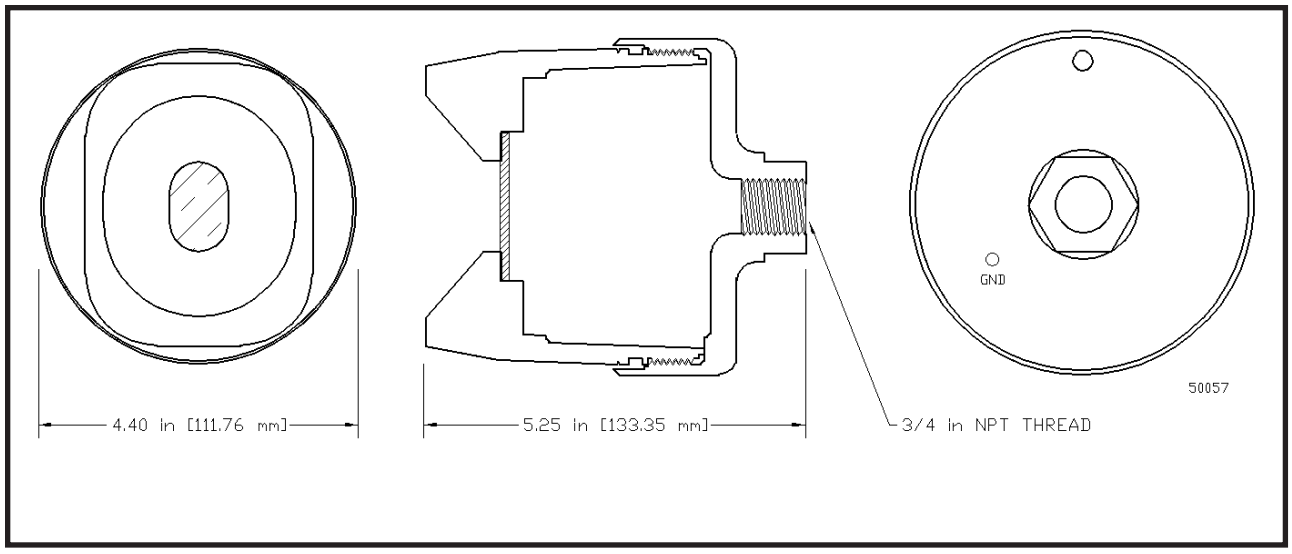


Figure 130-1 Housing Dimensions

Selecting the Proper Location for the Flame Detector

The Flame Detector must have an unobstructed view of the area it is intended to protect. When protecting an active work area (utilized by personnel or a machine) always place the detector at least 10 feet from the nearest person or active machine. This will insure that the operator does not obscure the detector's field of view.

Field of View

Flame detectors exhibit reduced sensitivity to flames that are not directly in front of them (on axis). Relative sensitivity at various off axis angles is described in the field of view diagram. It defines the detector sensitivity as a function of flame location in the field of view. For example, if the flame is located directly in front of the detector, at an angle of zero degrees (0°) the detector will respond to the standard 1 square foot gasoline fire at a distance of 200 feet. At 30° off axis, the sensor sensitivity is approximately 85% of the on-axis sensitivity; resulting in a reduction of the effective range of the detector to about 170 feet. Note that the worst case detection range for the detector will be a range of 100 feet at 45° off-axis.

Utilize the field of view diagram and a drawing of the area to be protected in specifying the mounting elevation and detector orientation. Where required, additional F130 units should be utilized to insure adequate coverage.

Orientation

The F130 will operate in any orientation. Recommended orientation is above the intended protective zone to insure a clear field of view and minimal accumulation of dust and debris on the lens surface. Mount the detector at a minimum declination of 20 degrees. The F130 detector housing is marked "TOP" to identify the recommended side of the detector that should be mounted facing up. This orientation provides a slight increase in the "self cleaning" action of the housing and lens well.

Avoiding potential sources of false alarms

Vibration

Due to the high sensitivity of the flame detector, it must be mounted to a rigid, stable support where no vibration is ever present. Just a very slight movement of the flame detector when viewing an object that is 200 feet away can produce a considerable variation in the radiation signature being received. Outdoors, avoid mounting the flame detector on a light pole whenever possible, and if this is not possible, be sure that the pole is rigid enough that there will be no vibration when a vehicle drives by. When viewing machinery such as a motor or turbine, mount the flame detector to stable supports that will not transmit the vibrations generated by the machines. When mounted on the end of a conduit run, be sure to provide support to the conduit near the flame detector.

Disassembling the F130 for Installation

Before installing the F130 detector, you must disassemble the unit into the three components shown in figure 130-2. Use a metric hex wrench to loosen the locking screw on the rear of the detector housing. Then unscrew the front housing from the rear housing.

Removal of the Electronics Module is most easily accomplished by gently rocking the board parallel to the Rear Housing terminal blocks. Place a finger under the top PC card, place another finger under the edge of this card on the opposite side. Gently rock the board, while pulling, to disengage the module from the rear housing. *Do not allow dirt or finger marks to get onto the face of the IR sensors in the top of the electronics module.*

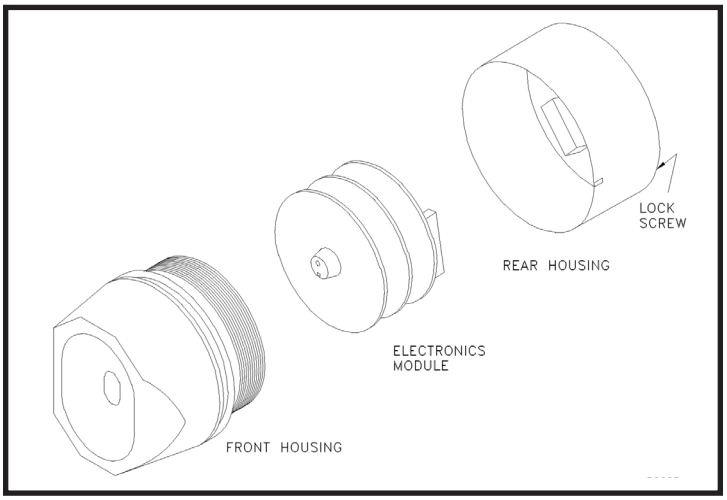


Figure 130-2 Basic Components

The locking screw in the rear cover must never be removed. Operating the detector without the screw in place could allow moisture to enter the detector, or cause an explosion. The stainless steel cover plate over the screw prevents it from being removed.

Note that there is a small alignment notch on both the front and rear housings. You will use these notches later as a guide to indicate when the housing is properly assembled. Inside the rear housing are two terminal blocks, clearly marked with wiring information. Two chassis ground terminals are provided, one inside the housing, and the other on the back outside of the rear housing. The threads on the housing, and the O-ring seal are lubricated to permit easy unscrewing of the front housing. Be careful not to remove this lubricant.

The Electronics Module is a set of printed circuit boards mounted in a rugged, compact stack. The two connectors that mate with the terminal block in the rear housing are keyed to prevent incorrect insertion of the module.

Mounting the Detector Rear Housing

The F130 rear housing is threaded for a standard ¾ inch rigid conduit connection. When using ridgid conduit, most installations require a swivel-mounting elbow to allow proper aiming of the Model F130 at a specific point in the protected area. See figure 130-4. The figure shows the detector mounted using swivel mounting assembly, part number 190-01, to provide the proper adjustments.

Figure 130-3 Detector Mounting Methods

IMPORTANT: When installing with conduit, you must use a conduit seal fitting in the conduit located no more than 18 inches (46 cm) from the flame detector. The wires passing through the conduit seal must be completely sealed with packing to prevent any water that condenses inside the conduits from entering the flame detector housing. Moisture inside the flame detector housing will destroy the electronics and make the flame detector inoperable. This conduit seal is also required whenever the flame detector is installed in hazardous areas that contain flammable gas or vapors to prevent explosions. In hazardous locations, the conduit seal must always be provided in compliance with local codes.

In locations where rigid conduit is not being used, we recommend that you use of the swivel bracket, part number 191-01 shown in the picture. Use a suitable cable gland with a ¾ inch NPT male thread installed in the conduit opening of the flame detector to properly seal a multi-conductor cable exiting the flame detector.

The F130 will operate in any position. After the rear housing has been mounted, adjust the swivel mechanism such that the detector, when installed, will be aimed at the desired protected area. If possible, now tighten the rear housing on the conduit until the metal nameplate on the

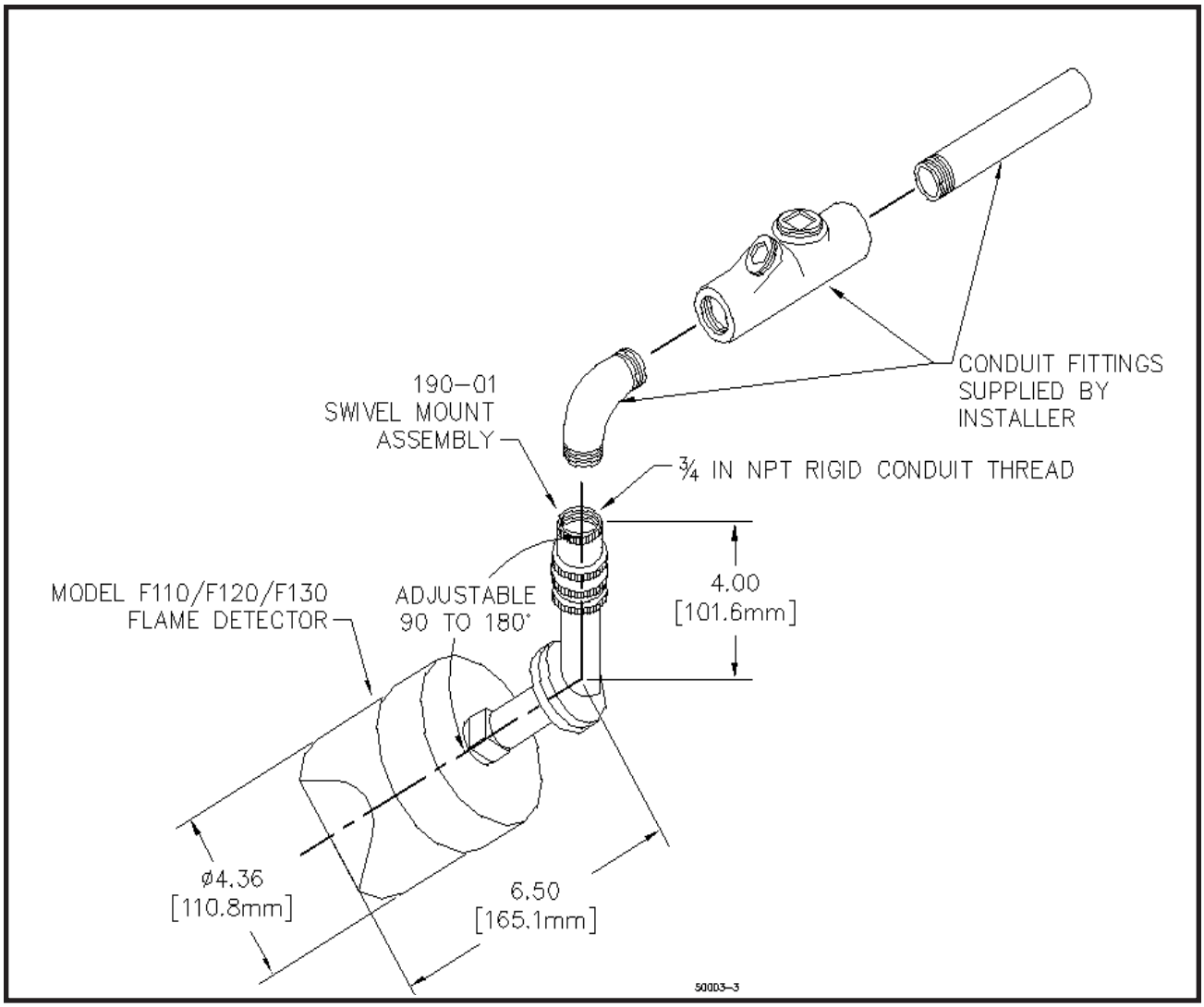


Figure 130-4 Basic Components

outside of the housing is facing downward. This will insure that the front housing will be in its preferred orientation when it is secured and aligned with the rear housing. The "TOP" label on the front housing will then be on top when it is installed. Mounting the detector in this orientation is necessary to prevent contamination of the automatic self-test radiation portal.

Connecting the Detector to Earth Ground

A Ground terminal is provided on both the inside and outside walls of the rear housing for use in applications where the conduit does not provide adequate grounding to the F130, or the System Designer determines that additional grounding is required. A minimum 18 gauge (0.75 mm^2) wire is required for the ground connection.

Circuitry that protects against damage from lightning, miscellaneous transients and power surges is internally connected to terminal #10 on the terminal block. As shipped from the factory, a jumper wire is installed between rear terminal #10 and the 0 volt terminal, thus connecting the transient protection to the grounded 0 volt power line. The 0 volt power line must always be grounded, either at the F130 or elsewhere in the system.

In areas subject to large transients or intense lightning storms, protection can be improved by removing the factory installed jumper between terminal 10 and 0 volts, and connecting terminal 10 directly to the chassis ground screw inside the detector housing. However, this scheme can be used only if the 0 volt side of the power supply is firmly grounded. A potential difference of more that 3.0 volts DC between chassis ground and the 0 volt line will damage the F130 detector.

Wiring Connections to the Rear Housing Terminal Blocks

The Rear Housing terminal blocks will accept one or two 14 AWG (2.5 mm^2) stranded wires. However, we recommend that you use 16 or 18 AWG (1.5 or 0.75 mm^2) wires whenever possible. Labels inside the Rear Housing clearly illustrate the connector assignments. These are also shown in Figure 130-4. When completed, all wiring should be tested for shorts, opens, grounds, proper voltage and polarity. Then the Electronics Module may be installed.

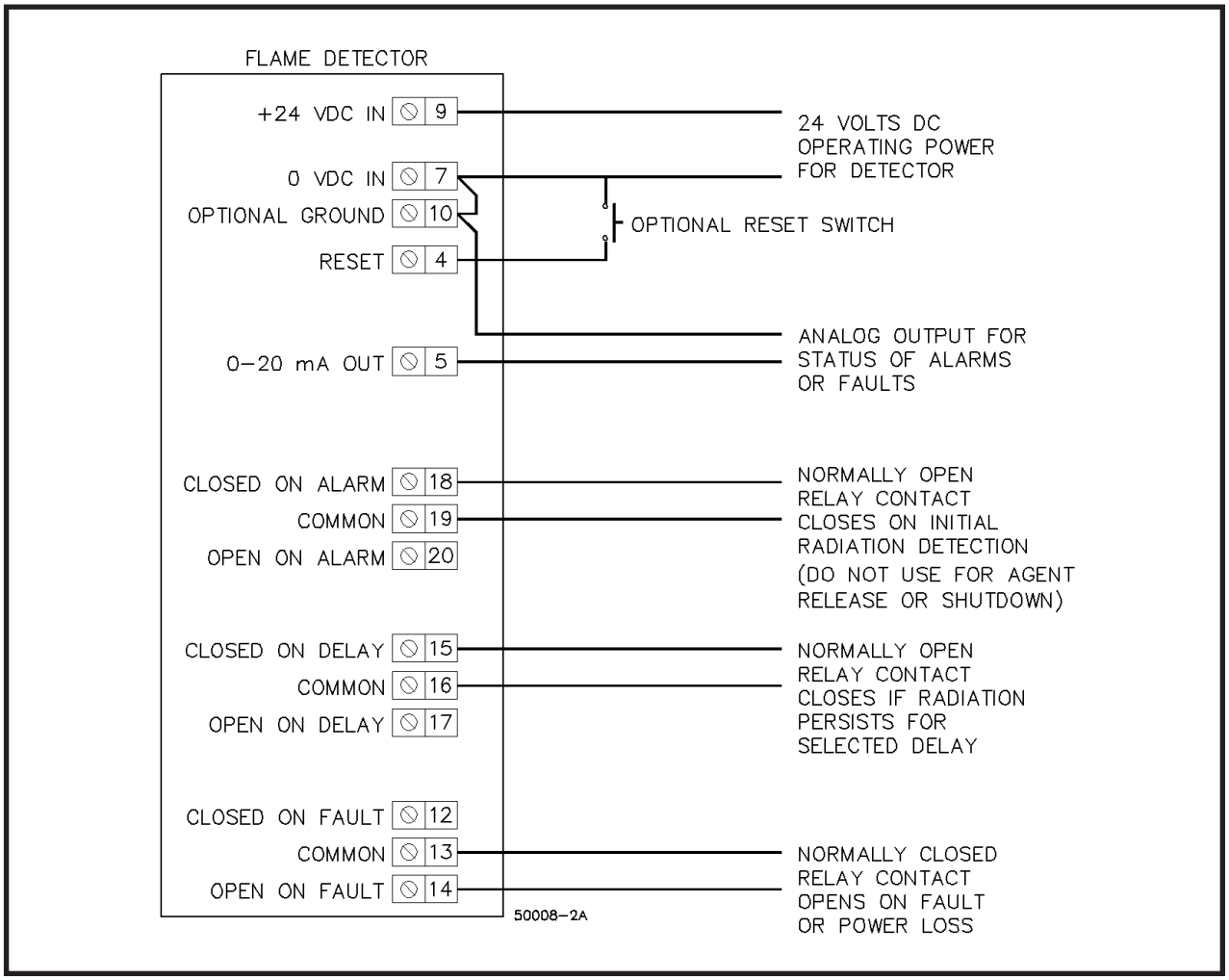
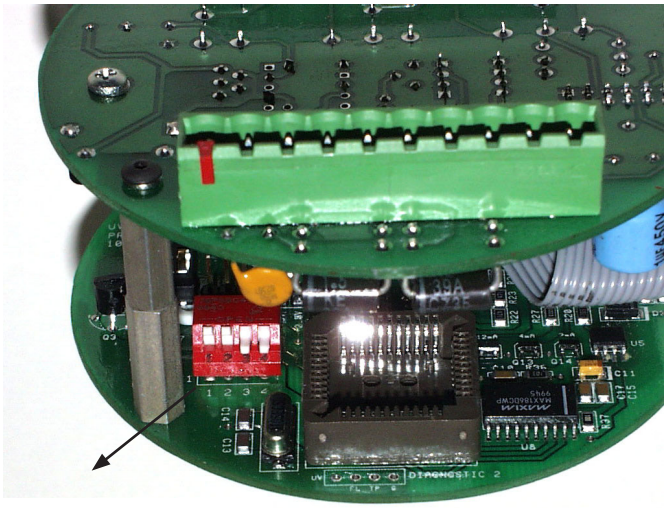
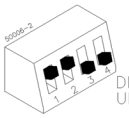


Figure 130-4 Field Wiring Connections

Installing the Electronics Module

When handling the electronics module, do not touch the front face of the IR detectors. Finger marks or dirt here will impair the operation of the detector.





DIP SWITCH SET TO
UP, UP, DOWN, DOWN

Setting the Detection Modes DIP switch

The operational modes of the detector are selected using the small "DIP" switch SW1 located on the underside of the upper board in the electronics module. Turn the electronics module upside down to easily view the switch, being careful not to disturb the four IR sensors. There are four switch sections; these are identified by the numbers 1 through 4 marked on the printed circuit board next to the switch. Most units are manufactured with switches that have the operating mechanism on the side of the switch, as shown in this picture. With this type of switch, which can be set in the Up or Down position, use the instructions immediately below to set the switches. Some units are manufactured with an alternate type of switch, which has the switch mechanism on the top of the switch. Instructions for this type of switch are listed under the "alternate" section below.

Setting Detection Mode

Reference to the UP position means that the switch is moved to the upper position, farthermost from the printed circuit board. Reference to the DOWN position means that the switch is moved to the lower position, closest to the printed circuit board.

Switches 3 and 4 select the **Detection Sensitivity** for the flames as follows:

3 DOWN	4 DOWN	High
3 DOWN	4 UP	Medium
3 UP	4 DOWN	Medium Low
3 UP	4 UP	Low

Switch 2 controls the time delay for the **Delayed Alarm** output.

2 DOWN	Sets the delayed (final) alarm at 6 seconds.
2 UP	Sets the delayed alarm at 3 seconds.

Switch 1 controls the **latching** of the delayed alarm output.

1 DOWN	Sets the delayed alarm to non-latched mode. The delayed alarm contacts will reset automatically when the flame detector no longer sees radiation.
1 UP	Sets the delayed alarm to latched mode. In this mode you must activate the manual reset input on the detector to clear the alarm.

Note: Units are shipped set for High Sensitivity, 3-second delay non-latching.

Installing the Electronics Module into the rear housing

Check Position of all Wires

Before installing the electronics module, make sure that all wires to the terminal blocks are properly located so that they do not interfere when the plug-in module is inserted. The wires must not protrude upward, above the terminal blocks.

Connect Polarized Terminal Blocks

The mating terminal blocks of the electronics module and the rear housing each have protective (red) polarizing keys. This key is to protect against improper installation. The red key of the Electronics Module WILL NOT FIT over the red key of the rear housing connector. Orient the electronics module so that the red keys are NOT aligned.

Notice the two screw heads on the top PC Board. Place a thumb over each screw and gently push the Electronics module in place, firmly seated in the Rear Housing Terminal blocks. Once the Electronics Module is firmly in place, the Front Housing can be installed.

Installation of the Front Housing

The Front and Rear Housing threads and O-Ring are shipped prelubricated. This lubrication is required. It insures the ease of assembly and future disassembly. It also increases the water resistance of the unit. Should the lubrication become inadvertently contaminated (dirt, etc.) or removed, the lubrication replacement procedure in the Maintenance Section must be followed.

Engage the threads of the front and rear housings. It is often helpful to rotate the front cover backwards (counterclockwise) one to two turns. This will assist in locating the threads prior to tightening the front housing into the rear. While rotating the front housing counterclockwise and applying slight rearward pressure, a slight "click" can be heard. The "click" is a useful indication that the front and rear housings are aligned and can be tightened together. Continue to tighten, BY HAND, the Front Housing into the Rear by turning it clockwise. If necessary, the Rear Housing can be held in correct orientation by placing a 1¼ inch open end wrench over the rear mounting hex shaped conduit entrance while tightening the Front Housing BY HAND.

! WARNING: Do not over tighten the front and rear housings. Do not use a wrench or other mechanical device to tighten the Front Housing. Over tightening may damage the threads and or prevent the unit from operating.

After five (5) complete turns, the O-Ring will begin to engage the Rear Housing. Take note of the alignment "V" groove (see figure 130-5) located on the Front Housing and alignment marks on both the Front and Rear Housings (figure 130-6). When the O-Ring disappears and the rear-most side of the alignment "V" groove has disappeared below the leading edge of the Rear Housing, the Front Cover is adequately engaged to insure an explosion proof and water resistant junction. It also indicates that the spring-loaded lamp contacts are engaging the top PC board. Continue to rotate the Front Housing until all of the alignment marks on the Front and Rear housings are aligned. When both alignment marks are aligned, the rear housing alignment screw must be fully seated to insure a water resistant seal.

! WARNING: The Alignment Screw must be fully seated to insure proper operation and flame detection protection. Neglecting to fully seat the alignment screw may cause moisture to accumulate in the F130, and can cause the housing to no longer be explosion proof.

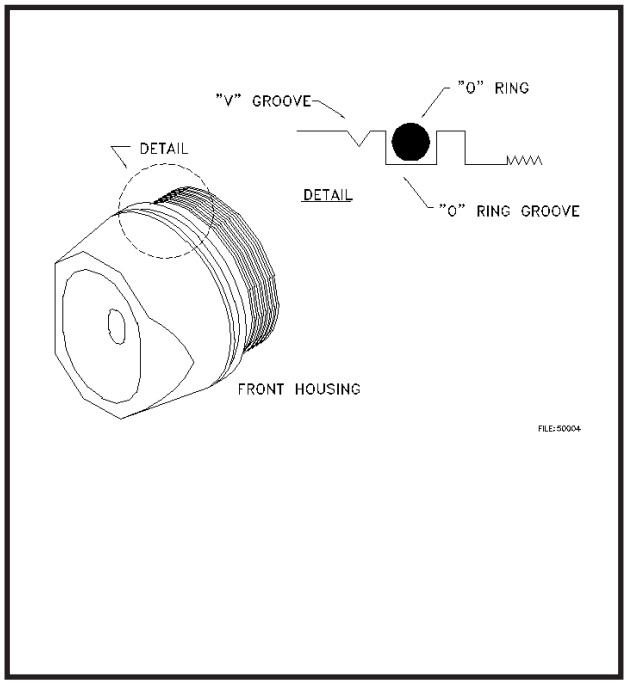


Figure 130-5 Housing "V" Groove

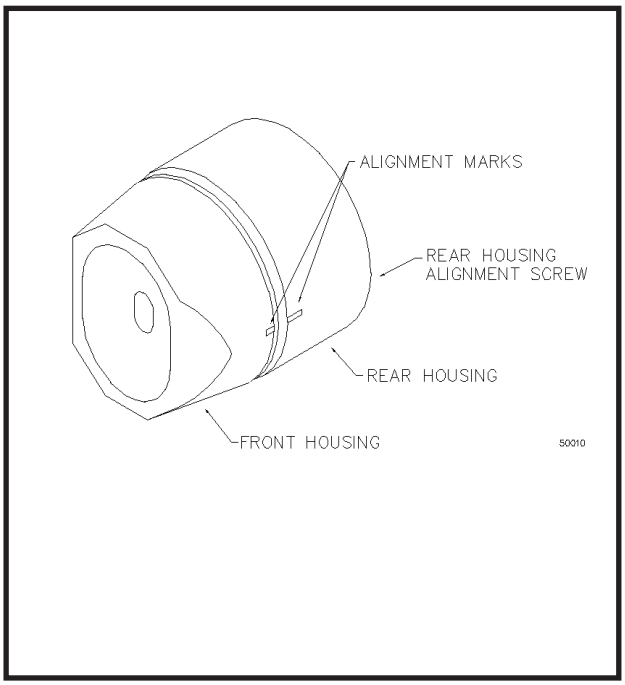


Figure 130-6 Alignment Marks

Applying power for the first time.

Power can be applied for the first time, when the Rear Housing has been properly mounted, wired and tested, the Electronics Module is in place and the Front Housing sufficiently tightened onto and aligned with the Rear Housing.

What to expect

On power up, the F130 goes through a "warm-up" phase. At this time, the green LED will flash once every second until the warm up is complete or about 3 minutes. After warm-up is complete the green LED becomes steady.

Automatic Self Check (ASC)

The model F130 continuously checkes the optical path for obstructions. If an obstruction is detected the yellow LED (Fault/Malfunction) will be activated and current loop signalling will drop to 2mA.

If the F130 signals a malfunction, check to make sure that the Front and Rear housings are sufficiently engaged and that the aligning notches and aligning screw is in position. Additional troubleshooting instructions can be found in the Troubleshooting Section of this Manual.

Normal Operation

Upon successful completion of ASC, the F130 enters "Protection Mode" and begins normal operation. Only the Green LED is on and will flash every 10 seconds. During normal operation, the current status of the F130 detector is shown by the three LED's (Red, Yellow and Green) visible from the front of the detector. These indications are:

GREEN	Indicates detector power is on
YELLOW	Indicates dirty window or detector fault
RED	Indicates detection of any IR flame signature

Final Operational Check-out

Once the model F130 has entered normal operation, a final comprehensive output test of all detector inputs and outputs can be performed. The test exercises all outputs, including ALARM and DELAYED ALARM states to verify installation wiring.

! WARNING: Do not execute the F130 Output Test until all external equipment connected to the F130 is properly configured to receive (and possibly ignore) alarm signals from the F130. Failure to do so may result in an unnecessary release of fire extinguishant or unnecessary dispatching of emergency personnel.

You will need a source of IR radiation to activate the F130 during these tests. If the protected area is known to be non-hazardous (no flammable gasses present), you can use a suitable flame. In hazardous areas, you must use a suitable IR test source. See the listing under Recommended Spare and Maintenance Parts.

Performing The Operational Test Sequence

Before starting the Test, the detector must be in normal operating mode, with no faults and no alarms. The analog output will be at 4 mA at this time. The following sequence is recommended:

Fault Test

This invisible test "light" shines through a tiny hole in the front cover, just in front of the viewingwindow, and through the window onto the self-test receiver. You can simulate a dirty lens fault by placing your finger or a piece of opaque tape over this hole.

Note the following:

- Yellow LED illuminates
- 0 to 20 mA Loop output changes to 2 mA
- Fault Relay toggles "Open on Fault" and "Closed on Fault" Outputs

Alarm Test

Activate the detector by placing the IR test source within the field of view.

After about 1 second note the following:

- Red LED begins flashing
- 0 to 20 mA Loop output changes to 12 mA
- First Alarm Relay is activated

After about 3 seconds (initial factory setting) note the following:

- Red LED goes steady
- 0 to 20 mA Loop output changes to 20 mA
- Second Alarm Relay is activated

Reset Test

If the delayed alarm is set for latching operation, the above conditions will remain upon completion of the Delayed Alarm Test. Activate the detector's Reset input to reset these outputs. Or you may momentarily interrupt the power to the F130 to reset. NOTE: This second option will cause the F130 to re-enter the wam-up phase.

Results:

- Red LED turns off; only Green LED remains on.
- 0 to 20 mA Loop output changes to 4 mA
- Delayed Alarm Relay returns to normal

Maintenance

Periodic Maintenance

Monthly Operational Test

Even though the flame detector has a number of built-in self checks, there can be cases where these checks cannot properly report a malfunction in the detector. Each flame detector should be exposed to a proper source of IR radiation on a regular basis to generate a test alarm. The SST Model FT196 Portable IR Test Lamp is the recommended for this purpose.

Quarterly Lens Cleaning

Cleaning the outside surface of the viewing lens of any accumulated dust, dirt, film or debris will insure trouble free operation. Use a clean rag or cloth dipped in water or alcohol to wipe the lens clean. Do not allow dirt or lint to accumulate in the small hole (see picture at left) adjacent to the lens that houses the self check test source lamp. Cleaning the lens once every 3 months will be sufficient in most cases. However, if the detector is located in a dirty area, a shorter period between cleanings may be necessary to eliminate faults due to a dirty lens.

VERY IMPORTANT: Never clean the sensor window with Windex or other commercial glass cleaners. They often contain silicone or other agent that may prevent the sensor from detecting a fire.

Front/Rear Housing Thread Lubrication

If contamination to the existing lubricant occurs during installation or inspection, replace with a high performance, high temperature, Molybdenum and Graphite grease. MOLYPLATE® and MOLY-GRAPH® are two readily available greases that meet the requirements.

O-Ring Lubrication

The Front Housing O-ring may require additional lubrication during removal or replacement of the Front Housing. A multipurpose synthetic lubricant with Teflon, such as SUPER LUBE® by Permatex Industrial should be utilized. Petroleum jelly should not be used as a lubricant. While it will not attack the Viton O-ring, it does not provide the same lasting protection available with synthetic Teflon based lubricants.

Troubleshooting

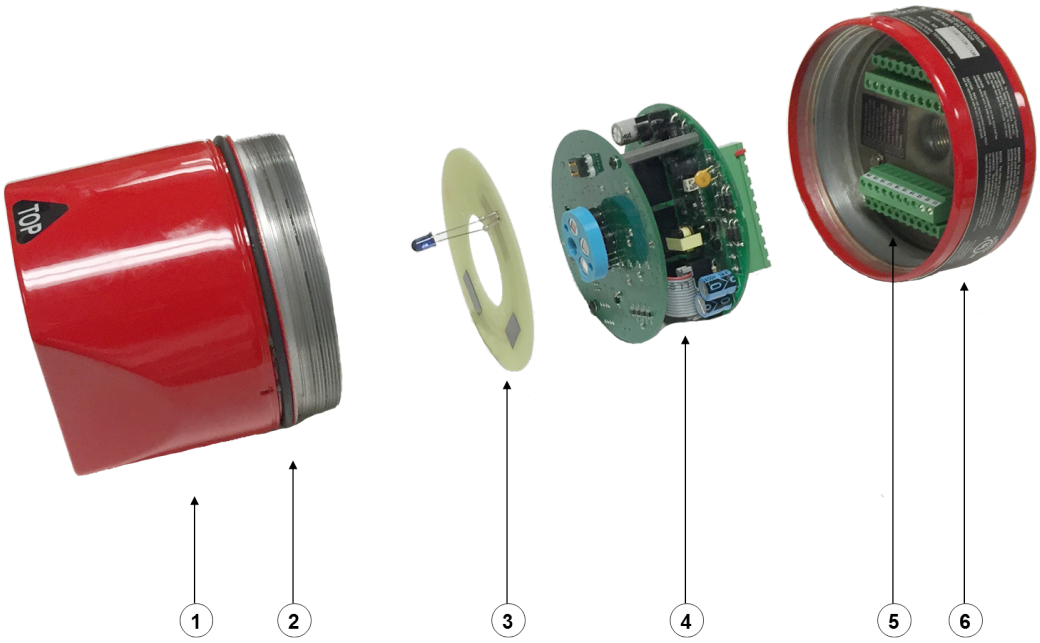
The model F130 Self Check is a comprehensive set of tests which insures proper operation of the detector. The Self Check is automatically performed during normal operation. Should the self check fail, the F130 will signal a fault condition and attempt continued operation. A fault at time of initial installation is usually due to incorrect assembly of the housing. Fault conditions reported in normal operation usually indicate a dirty or contaminated viewing window.

If the F130 signals a Fault condition

- ❑ Check the green LED power indicator. If it is not illuminated, confirm that +24 volt DC power exists between rear terminal block pin 9 (+24v) and pin 7 (0v). If +24 VDC power is not present, troubleshoot the conduit wiring and system power supply. Replace the Electronics Module if +24 VDC is present between rear housing terminal block pins 9 and 7 and the green LED does not operate.

- ❑ Confirm Front & Rear Housings are properly aligned, using alignment marks visible on front and rear housings.
- ❑ Confirm Rear Housing alignment and lock screw is engaged.
- ❑ Check to see if the front housing cover can be engaged 1 additional turn — without excessive force.
- ❑ Test the operation of the detector with a proper source of IR radiation. If the F130 reports the alarm condition, then the electronics module is working; in this case, the most likely trouble is a bad test IR emitter source in the detector front housing. Replace the IR emitter source. If the detector does not alarm, the electronics module should be returned to Safety Systems Technology for repair.

Recommended Maintenance and Spare Parts



Installations which wish to immediately return to service a F120 that has either been damaged in the field or is malfunctioning, should have on hand the following spare parts:

SST Part Number	Component
(1) 40130-7	Front Housing
(2) 20041-241	Viton O-Ring seal for housing front cover
(3) 40130-11	Replacement self-test IR emitter complete with ring-type PC board
(4) 40130-12	Plug-in Electronics Module complete with Multi-Spectrum IR sensors
(5) 20094-8	Terminal Blocks
(6) 40120-8	Rear Housing

Available portable flame detector test device:

196-1	Portable IR Flame Detector Test Device with 120 volt battery charger
196-2	Portable IR Flame Detector Test Device with replaceable “D” batteries
196-3	Portable UV/IR Flame Detector Test Device with 240 volt battery charger

Tools Required for Installation/Maintenance

The following standard hand tools, not provided by SST, are recommended:

Tool	Purpose
1¼ inch Wrench	Securing Rear Housing to Conduit Swivel Elbow
4 mm Metric Hex Key	Tighten Rear Housing Alignment/Lock Screw

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