

Instructions

95-8527

Protect•IR® Multispectrum IR Flame Detector
X3301



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Protect•IR®
Multispectrum IR Flame Detector
X3301

IMPORTANT

Be sure to read and understand the entire instruction manual before installing or operating the flame detection system. Any deviation from the recommendations in this manual may impair system performance and compromise safety.

ATTENTION

*The X3301 includes the Automatic Optical Integrity (oi) feature — a calibrated performance test that is automatically performed once per minute to verify complete detector operation capabilities. **No testing with an external test lamp is required.***

**DESCRIPTION**

The X3301 Protect•IR® is a multispectrum infrared (IR) flame detector. It provides unsurpassed detection of fires from light to heavy hydrocarbon fuels combined with the highest degree of false alarm rejection. The detector has Division and Zone explosion-proof ratings and is suitable for use in indoor and outdoor applications.

The X3301 contains three IR sensors with their associated signal processing circuitry. The standard output configuration includes fire, fault and auxiliary relays. Output options include:

- 4 to 20 mA output (in addition to the three relays)
- Pulse output for compatibility with existing controller based systems (with fire and fault relays)
- Eagle Quantum Premier (EQP) compatible model (no analog or relay outputs).

*oi is Detector Electronics' Trademark for its patented Optical Integrity Systems, U.S. Patent 3,952,196, United Kingdom Patent 1,534,969, Canada Patent 1,059,598. X3301 technology advancements are covered under the following U.S. Patents: 5,995,008, 5,804,825 and 5,850,182.

A multi-color LED on the detector faceplate indicates detector status condition.

Microprocessor controlled heated optics increase resistance to moisture and ice.

The X3301 housing is available in copper-free aluminum or stainless steel, with NEMA 4X and IP66 rating.

OUTPUTS**Relays**

The standard detector is furnished with fire, fault and auxiliary relays. All three relays are rated 5 amperes at 30 VDC.

The Fire Alarm relay has redundant terminals and normally open / normally closed contacts, normally de-energized operation, and latching or non-latching operation.

The Fault relay has redundant terminals and normally open contacts, normally energized operation, and latching or non-latching operation.

The Auxiliary relay has normally open / normally closed contacts, and is configurable for energized or de-energized operation, and latching or non-latching operation.

4 to 20 mA Output

A 4 to 20 mA output is available as an option (in addition to the three relays). This option provides a 4 to 20 mA dc current output for transmitting detector status information to other devices. The circuit can be wired in either an isolated or non-isolated configuration and can drive a maximum loop resistance of 500 ohms from 18 to 19.9 volts dc and 600 ohms from 20 to 32 volts dc. Table 1 indicates the detector status conditions represented by the various current levels. The output is calibrated at the factory, with no need for field calibration.

NOTE

The output of the 4 to 20 mA current loop is not monitored by the fault detection circuitry of the X3301. Therefore, an open circuit on the loop will not cause the fault relay to change state or the detector status LED to indicate a fault. The status of the LED always follows the status of the relays.

An alarm condition will normally over-ride a fault condition, unless the nature of the fault condition impairs the ability of the detector to generate or maintain an alarm output, i.e. loss of operating power.

Table 1—Detector Status Conditions Indicated by Current Level

Current Level (±0.3 mA)	Detector Status
0 mA	Power Fault
1 mA	General Fault
2 mA	Oi Fault
3 mA	Hi Background IR
4 mA	Normal Operation
20 mA	Fire Alarm

LON/SLC Output

The EQP model is designed for use exclusively with the Det-Tronics Eagle Quantum Premier system. The detector communicates with the system controller over a digital communication network or LON/SLC (Local Operating Network / Signalling Line Circuit). The LON/SLC is a fault tolerant, two wire digital communication network arranged in a loop configuration. Analog and relay outputs are not available on this model.

LED

A tricolor LED on the detector faceplate indicates normal, fire alarm and fault conditions. Table 2 indicates the condition of the LED for each status.

OPTICAL INTEGRITY (Oi)

Automatic oi

The X3301 includes the Automatic Optical Integrity (**oi**) feature — a calibrated performance test that is automatically performed once per minute to verify complete detector operation capabilities. No testing with an external test lamp is required. The detector automatically performs the same test that a maintenance person with a test lamp would perform — once every minute, 60 times per hour. However, a successful automatic **oi** test does not produce an alarm condition.

The Protect•IR signals a fault condition when less than half of the detection range remains. This is indicated by the Fault relay and is evident by the amber color of the LED on the face of the detector. See the "Troubleshooting" section for further information.

Magnetic oi / Manual oi

The detector also incorporates both magnetic **oi** and manual **oi** features that provide the same calibrated test as the automatic **oi**, and in addition actuates the Alarm relay to verify output operation for preventive maintenance requirements. These features can be performed at any time and eliminate the need for testing with a non-calibrated external test lamp.

CAUTION

These tests require disabling of all extinguishing devices to avoid release resulting from a successful test.

Table 2—Detector Status Indicator

Detector Status	LED Indicator
Power On/Normal Operation (no fault or fire alarm)	Green
Fault	Amber
Fire (Alarm)	Red
Low Sensitivity	One Amber Flash During Power-up
Medium Sensitivity	Two Amber Flashes During Power-up
Very High Sensitivity	Four Amber Flashes During Power-up

The magnetic **oi** test is performed by placing a magnet by the marked location (mag **oi**) on the outside of the detector. The manual **oi** test is accomplished by connecting the **oi** lead (terminal 22) to power supply minus via an external switch. The magnet or switch must be held in place for a minimum of 6 seconds to complete the test. Either of these test methods activates the calibrated IR emitters. If the resulting signal meets the test criteria, indicating that greater than half of the detection range remains, the Alarm relay changes state, the indicating LED changes to red, and the 4-20 mA current output goes to 20 mA. This condition remains until the magnet is removed or the switch is released, regardless of whether the relays are set for latching or non-latching operation.

If less than half of the detection range remains, no alarm is produced and a fault is generated. The fault indication can be reset by momentarily applying the magnet or manual **oi** switch.

NOTE

*Refer to Appendix A for FM verification of Det-Tronics' patented Optical Integrity **oi**TM function.*

COMMUNICATION

The X3301 is furnished with an RS-485 interface for communicating status and other information with external devices. The RS-485 supports MODBUS protocol, with the detector configured as a slave device.

NOTE

The EQP model uses LON/SLC communication. RS-485 communication is not available on the EQP model.

DATA LOGGING

Data logging capability is also provided. Status conditions such as normal, power down, general and **oi** faults, pre-alarm, fire alarm, time and temperature are recorded. Each event is time and date stamped, along with the temperature and input voltage. Event data is stored in non-volatile memory when the event becomes active, and again when the status changes. Data is accessible using the RS-485 port or the EQP controller.

INTEGRAL WIRING COMPARTMENT

All external wiring to the device is connected within the integral junction box. The screw terminals accept wiring from 14 to 24 AWG. The detector is furnished with four conduit entries, with either 3/4 inch NPT or 25 mm threads.

GENERAL APPLICATION INFORMATION

RESPONSE CHARACTERISTICS

Response is dependent on distance, type of fuel, temperature of the fuel, and time required for the fire to come to equilibrium. As with all fire tests, results must be interpreted according to an individual application. See Appendix A for fire test results.

IMPORTANT APPLICATION CONSIDERATIONS

In applying any type of sensing device as a fire detector, it is important to know of any conditions that can prevent the device from responding to fire, and also to know what other sources besides fire can cause the device to respond.

Welding

Arc welding should not be performed within 40 feet of the very high sensitivity detector, 10 feet of the medium sensitivity detector, or 5 feet of the low sensitivity detector. It is recommended that the system be bypassed during welding operations in situations where the possibility of a false alarm cannot be tolerated. Gas welding mandates system bypass, since the gas torch is an actual fire. Arc welding rods can contain organic binder materials in the flux that burn during the welding operation and are detectable by the X3301. Welding rods with clay binders do not burn and will not be detected by the X3301. However, system bypass is always recommended, since the material being welded may be contaminated with organic substances (paint, oil, etc.) that will burn and possibly trigger the X3301.

Artificial Lighting

The X3301 should not be located within 3 feet of artificial lights. Excess heating of the detector could occur due to heat radiating from the lights.

EMI/RFI Interference

The X3301 is resistant to interference by EMI and RFI, and is EMC Directive compliant. It will not respond to a 5 watt walkie-talkie at distances greater than 1 foot. Do not operate a walkie-talkie within 1 foot of the X3301.

Non-Carbon Fires

The X3301 is a multiple spectrum IR device with detection limited to carbonaceous fuels. It should not be used to detect fires from fuels that do not contain carbon, such as hydrogen, sulfur and burning metals.

IMPORTANT SAFETY NOTES

WARNING

Do not open the detector assembly in a hazardous area when power is applied. The detector contains limited serviceable components and should never be opened. Doing so could disturb critical optical alignment and calibration parameters, possibly causing serious damage. This type of damage could be undetected and could result in failure to see a fire and/or false alarm.

CAUTION

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with the NEC as well as all local ordinances. If in doubt, consult the authority having jurisdiction before wiring the system. Installation must be done by a properly trained person.

CAUTION

To prevent unwanted actuation or alarm, extinguishing devices must be disabled prior to performing system tests or maintenance.

ATTENTION

Remove the protective cap from the front of the detector before activating the system.

ATTENTION

Observe precautions for handling electrostatic sensitive devices.

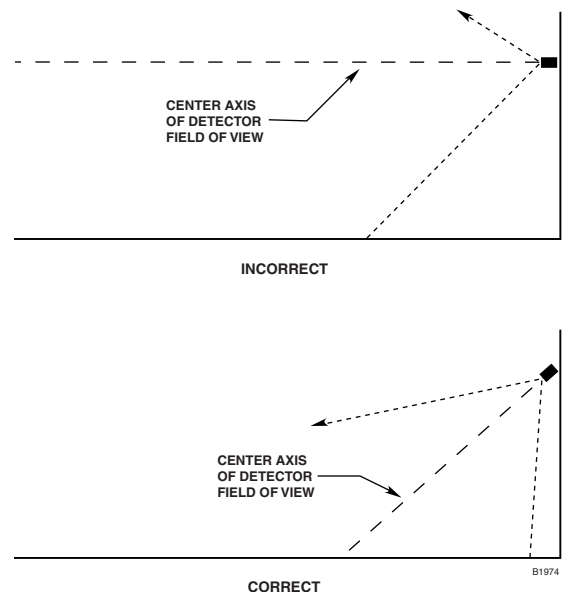
INSTALLATION

DETECTOR POSITIONING

Detectors should be positioned to provide the best unobstructed view of the area to be protected. The following factors should also be taken into consideration:

- Identify all high risk fire ignition sources.
- Be sure that enough detectors are used to adequately cover the hazardous area.
- Be sure that the unit is easily accessible for cleaning and other periodic servicing.
- Locate and position the detector so that the fire hazard(s) are within both the field of view and detection range of the device. Refer to Appendix A for specific information.

- The detector should be aimed downward at least 10 to 20 degrees to allow lens openings to drain. See Figure 1. **The detector should be positioned so that its field of view does not cover areas outside the hazardous area.** This will minimize the possibility of false alarms caused by activities outside the area requiring protection.
- For best performance, the detector should be mounted on a rigid surface in a low vibration area.
- Dense fog, rain or ice can absorb IR radiation and reduce the sensitivity of the detector.
- Although IR detectors are less affected by smoke than other detectors, the X3301 should not be placed where rising combustion products can obscure its vision. If smoke is expected before fire, smoke or other alternative detectors should be used in conjunction with the X3301. For indoor applications, if dense smoke is expected to accumulate at the onset of a fire, mount the detector on a side wall at least a few feet (approximately 1 meter) down from the ceiling.
- If possible, fire tests should be conducted to verify correct detector positioning and coverage.



NOTE: DETECTOR MUST ALWAYS BE AIMED DOWNWARD AT LEAST 10 TO 20 DEGREES.

Figure 1—Detector Orientation Relative to Horizon

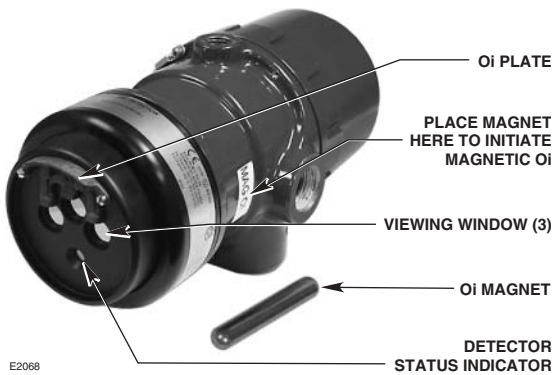


Figure 2—Front View of the X3301

DETECTOR ORIENTATION

Refer to Figure 2 and ensure that the **o_i** plate will be oriented as shown when the X3301 is mounted and sighted. This will ensure proper operation of the **o_i** system and will also minimize the accumulation of moisture and contaminants between the **o_i** plate and the viewing windows. The **o_i** plate includes an arrow, which should be pointed in the up direction, indicating that the **o_i** plate and detector are correctly oriented.

IMPORTANT

*The **o_i** plate **must** be securely tightened to ensure proper operation of the **o_i** system (40 oz./inches recommended).*

PROTECTION AGAINST MOISTURE DAMAGE

It is important to take proper precautions during installation to ensure that moisture will not come in contact with the electrical connections or components of the system. The integrity of the system regarding moisture protection must be maintained for proper operation and is the responsibility of the installer.

If conduit is used, drains must be installed at water collection points to automatically drain accumulated moisture. Conduit breathers should be installed at upper locations to provide ventilation and allow water vapor to escape. At least one breather should be used with each drain.

Conduit raceways should be inclined so that water will flow to low points for drainage and will not collect inside enclosures or on conduit seals. If this is not possible, install conduit drains above the seals to prevent the collection of water or install a drain loop below the detector with a conduit drain at the lowest point of the loop.

Conduit seals are not required for compliance with explosion-proof installation requirements, but are highly recommended to prevent water ingress in outdoor applications. Units with M25 thread must use an IP66 washer to prevent water ingress.

WIRING PROCEDURE

Wire Size and Type

The system should be wired according to local codes. The wire size selected should be based on the number of detectors connected, the supply voltage and the cable length. Typically 14 AWG (2.08 mm²) or 16 AWG (1.31 mm²) shielded cable is recommended. Wires should be stripped 3/8 inch (9 mm). A minimum input voltage of 18 vdc must be present at the X3301.

NOTE

Refer to “Power Consumption” in the “Specifications” section of this manual.

The use of shielded cable is required to protect against interference caused by EMI and RFI. When using cables with shields, terminate the shields as shown in Figures 7 through 12, and Figure 14. Consult the factory if not using shielded cable.

In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment.

If disconnection of power is required, separate disconnect capability must be provided.

CAUTION

Installation of the detector and wiring should be performed only by qualified personnel.

Detector Mounting

Install the swivel mounting bracket assembly on the wall. The installation surface should be free of vibration and suitable to receive 1/4 inch (M6) screws with a length of at least 1 inch (25 mm), and have sufficient capacity to hold the detector and bracket weight. Refer to Figure 3 for dimensions.

Relay and 4-20 mA Output Models

Follow the instructions below to install the X3301.

1. Make field connections following local ordinances and guidelines in this manual.
 - Figure 4 shows the wiring terminal strip located inside the detector's integral junction box.
 - Figure 5 shows the wiring terminal identification for the X3301 detector.
 - Figure 6 shows an EOL resistor installed within the integral wiring compartment of the detector (refer to "EOL Resistors" for details).
 - Figures 7 and 8 provide examples of typical installations with a X3301 wired to a fire alarm panel.
 - If the detector is equipped with a 4 to 20 mA output, refer to Figures 9 through 12.
2. Check all field wiring to be sure that the proper connections have been made.

IMPORTANT

Do not test any wiring connected to the detector with a meg-ohmmeter. Disconnect wiring at the detector before checking system wiring for continuity.

3. Make the final sighting adjustments and ensure that the mounting bracket hardware is tight.

EOL Resistors (Not Used with EQP Model)

To ensure that the insulating material of the wiring terminal block will not be affected by the heat generated by EOL resistors, observe the following guidelines when installing the resistors.

1. Required EOL resistor power rating must be 5 watts minimum.

NOTE

EOL resistors must be ceramic, wirewound type, rated 5 watts minimum, with actual power dissipation not to exceed 2.5 watts.

2. Resistor leads should be cut to a length of approximately 1 1/2 inches (40 mm).
3. Bend the leads and install the EOL resistor as shown in Figure 6.
4. Maintain a 3/8 inch (10 mm) minimum gap between the resistor body and the terminal block or any other neighboring parts.

NOTE

All cable entry devices and blanking elements shall be certified to "E-generation" or "ATEX" standards, in type of explosion protection increased safety "e" or flameproof enclosure "d" (as applicable), suitable for the conditions of use and correctly installed. They shall maintain the degree of ingress protection IP66 for the apparatus. Unused apertures shall be closed with suitable blanking elements.

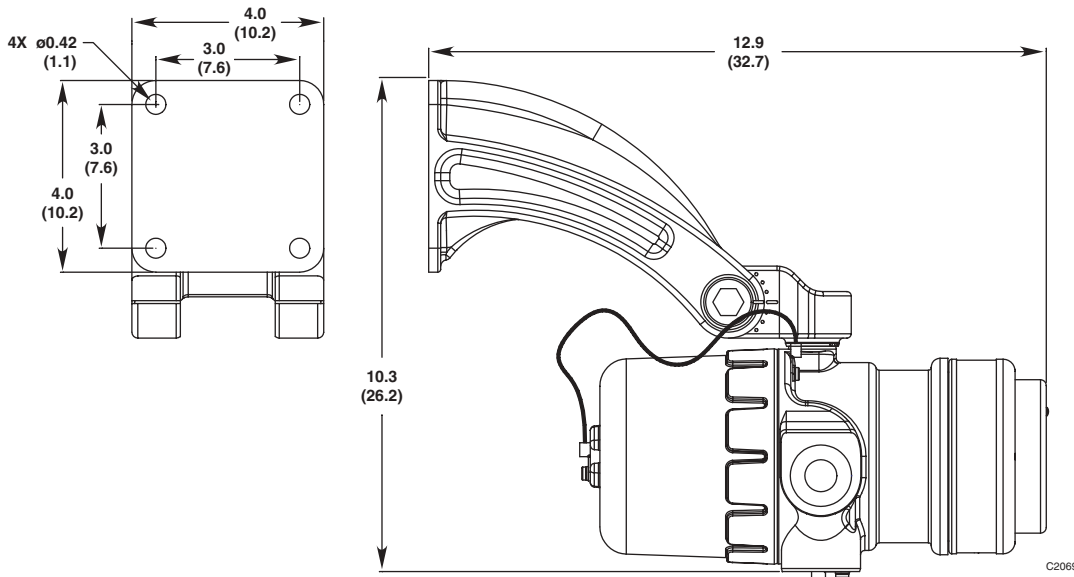


Figure 3—Q9033B Mounting Bracket Dimensions in Inches (cm)
(See Figure 1 for Correct Detector Orientation.)

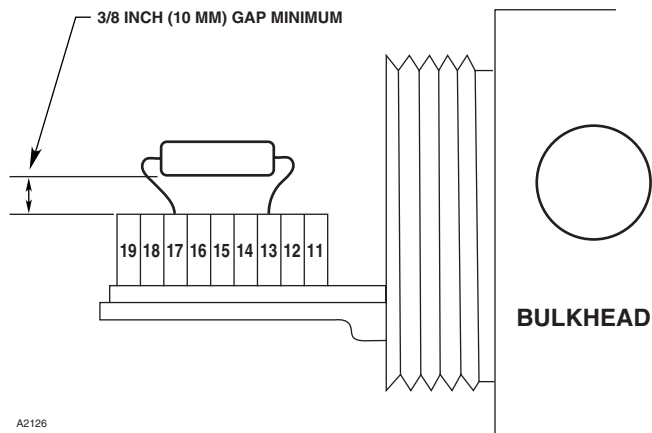


Figure 4—X3301 Terminal Block

9	4-20 mA +	19	4-20 mA -	SPARE	29
8	4-20 mA + REF	18	4-20 mA - REF	SPARE	28
7	COM FIRE	17	COM FIRE	COM AUX	27
6	N.O. FIRE	16	N.O. FIRE	N.O. AUX	26
5	N.C. FIRE	15	N.C. FIRE	N.C. AUX	25
4	COM FAULT	14	COM FAULT	RS-485 A	24
3	N.O. FAULT	13	N.O. FAULT	RS-485 B	23
2	24 VDC +	12	24 VDC +	MAN Oi	22
1	24 VDC -	11	24 VDC -	24 VDC -	21

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Figure 5—X3301 Wiring Terminal Identification



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Figure 6—EOL Resistor Installation

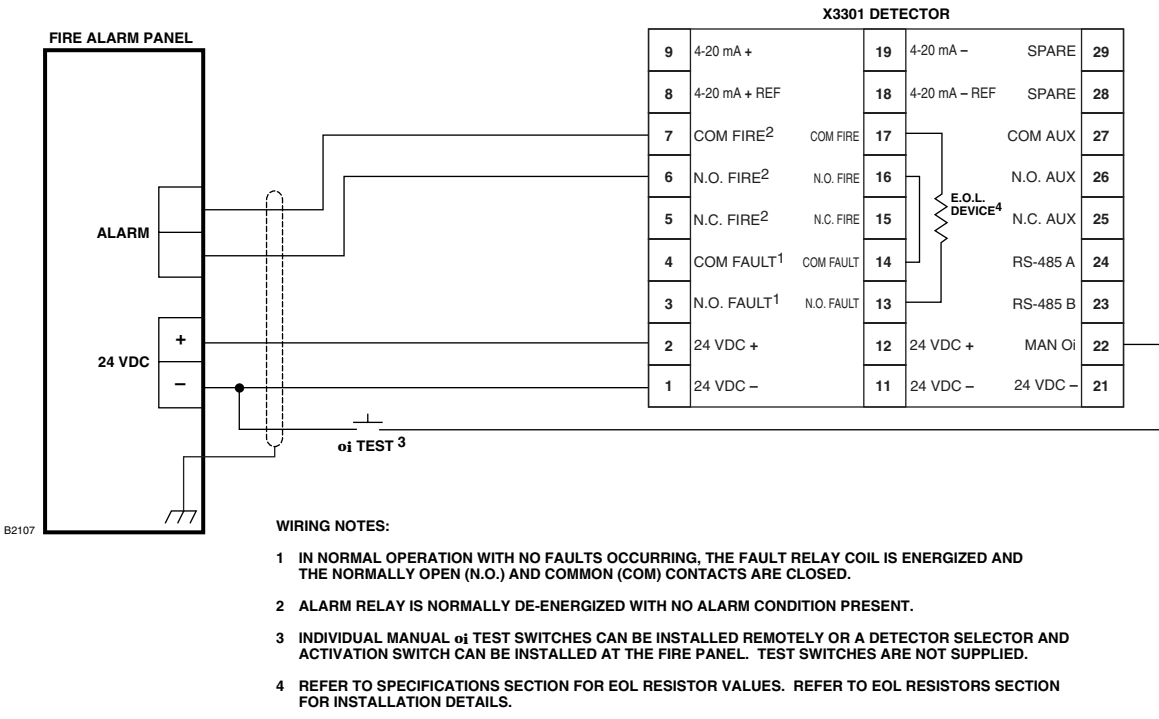


Figure 7—EEx d Wiring Option

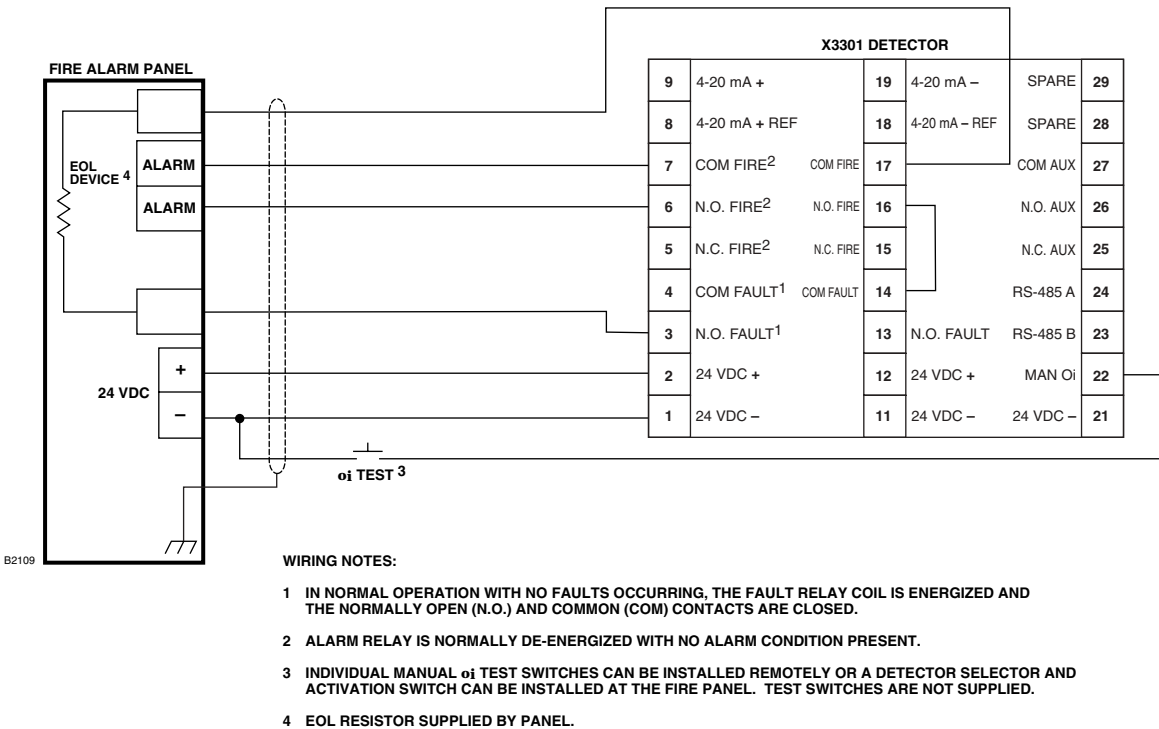


Figure 8—EEx e Wiring Option

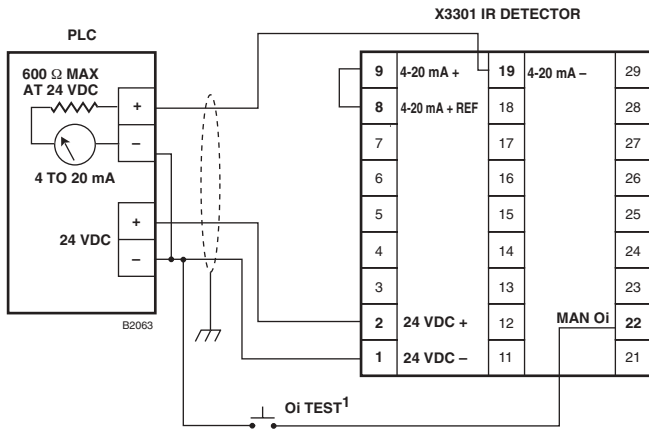


Figure 9—X3301 Detector Wired for Non-Isolated 4 to 20 mA Current Output (Sourcing)

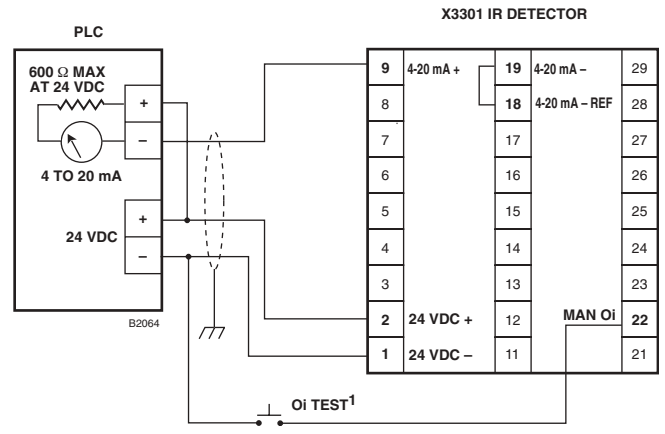


Figure 10—X3301 Detector Wired for Non-Isolated 4 to 20 mA Current Output (Sinking)

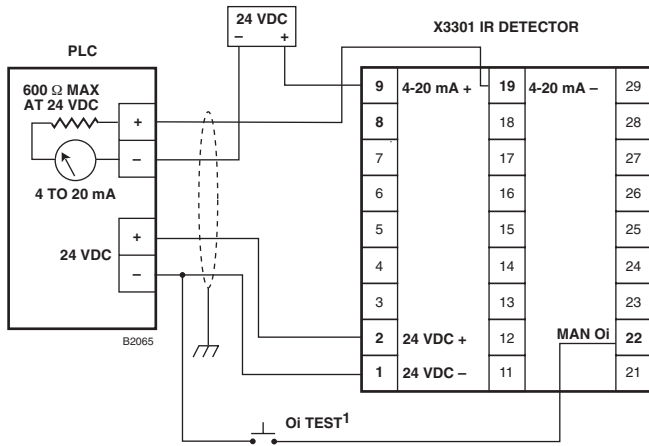


Figure 11—X3301 Detector Wired for Isolated 4 to 20 mA Current Output (Sourcing)

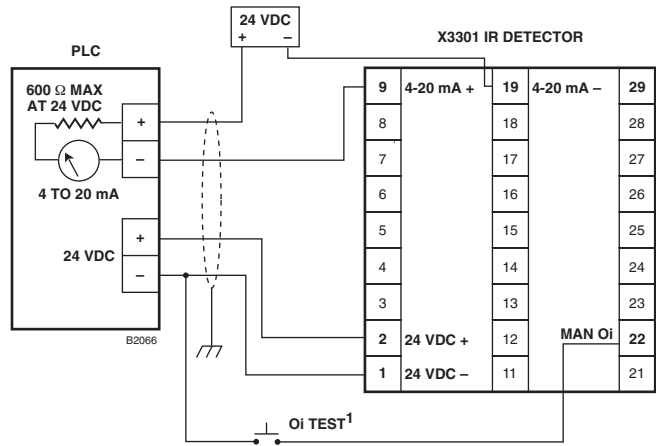


Figure 12—X3301 Detector Wired for Isolated 4 to 20 mA Current Output (Sinking)

NOTES: 1. INDIVIDUAL MANUAL oi TEST SWITCHES CAN BE INSTALLED REMOTELY OR A DETECTOR SELECTOR AND ACTIVATION SWITCH CAN BE INSTALLED AT THE FIRE PANEL. TEST SWITCHES ARE NOT SUPPLIED.

EQP Model

1. Connect external wires to the appropriate terminals inside the device junction box. (See Figure 13 for terminal identification.)
2. Connect the shield of the power cable to “earth ground” at the power source.
3. Connect shields for the LON cable as indicated. See Figure 14.

NOTE

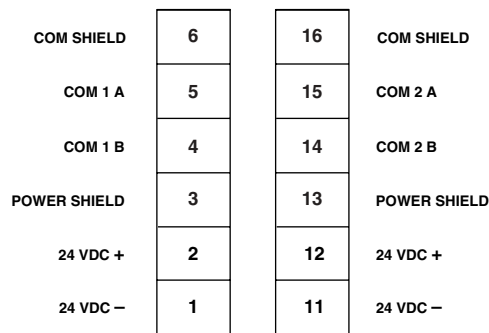
DO NOT ground any shields at the detector housing.

4. Set the device network address. (See “Setting Device Network Addresses” section of this manual for switch setting procedure.)

5. Check all field wiring to be sure that the proper connections have been made.
6. Replace the device cover.
7. Make the final sighting adjustments and ensure that the mounting bracket hardware is tight.

NOTE

Refer to the Eagle Quantum Premier system manual (number 95-8533) for information regarding power and network communication cable requirements.



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Figure 13—Wiring Terminal Identification for X3301 EQP Model

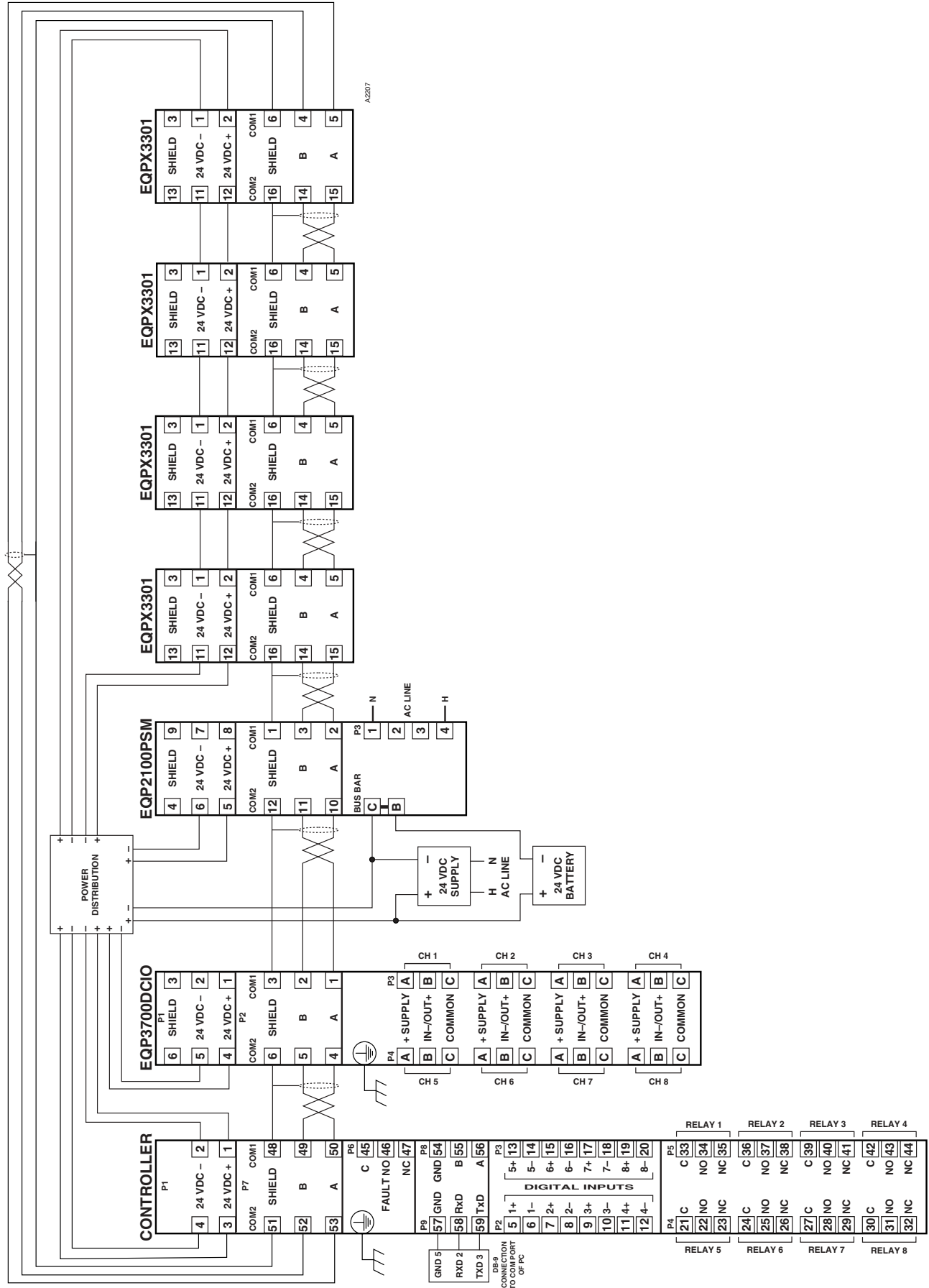


Figure 14—A Typical EQP System

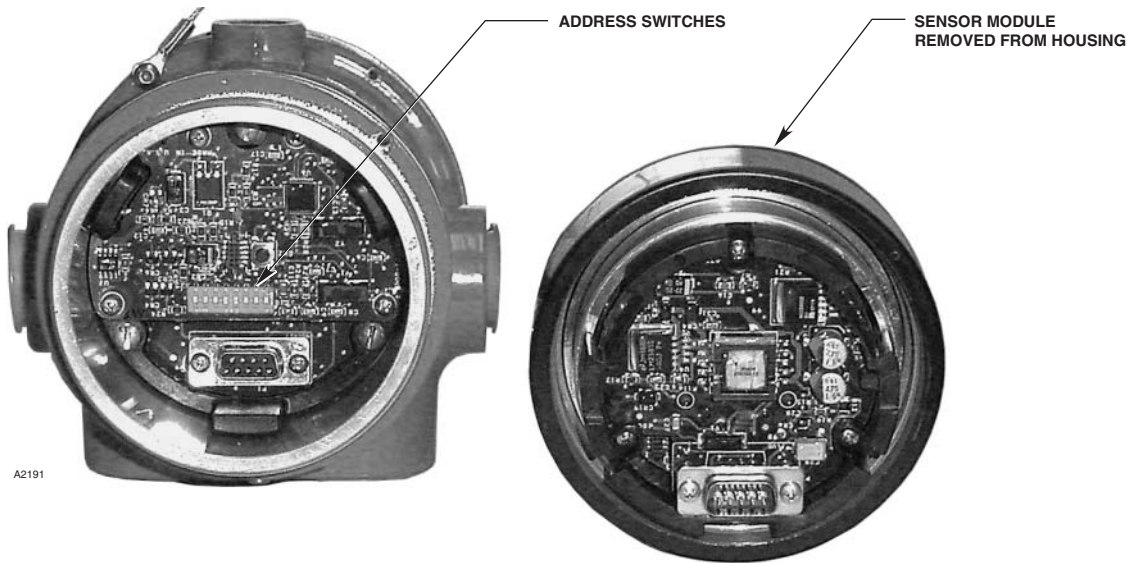


Figure 15—Location of Address Switches

SETTING DEVICE NETWORK ADDRESSES (EQP Model Only)

Overview of Network Addresses

Each device on the LON must be assigned a unique address. Addresses 1 to 4 are reserved for the controller. Valid addresses for field devices are from 5 to 250.

IMPORTANT

If the address is set to zero or an address above 250, the switch setting will be ignored.

Duplicated addresses are not automatically detected. Modules given the same address will use the number given and report to the controller using that address. The status word will show the latest update, which could be from any of the reporting modules using that address.

Setting Field Device Addresses

Selection of the node address is done by setting rocker switches on an 8 switch “DIP Switch Assembly” within the detector’s housing. Refer to Figure 15 for switch location.

WARNING

The network address switches are located within the detector housing. Disassembly of the detector head that contains powered electrical circuits is required to gain access to the network address switches. For hazardous areas, the area must be de-classified before attempting

disassembly of the device. Always observe precautions for handling electrostatic sensitive devices.

The address number is binary encoded with each switch having a specific binary value with switch 1 being the LSB (Least Significant Bit). (See Figure 16) The device’s LON address is equal to the added value of all closed rocker switches. All “Open” switches are ignored.

Example: for node No. 5, close rocker switches 1 and 3 (binary values 1 + 4); for node No. 25, close rocker switches 1, 4 and 5 (binary values 1 + 8 + 16).

NOTE

*The field device sets the LON address only when power is applied to the device. Therefore, it is important to set the switches **before** applying power. If an address is ever changed, system power must be cycled before the new address will take effect.*

After setting address switches, record the address number and device type.

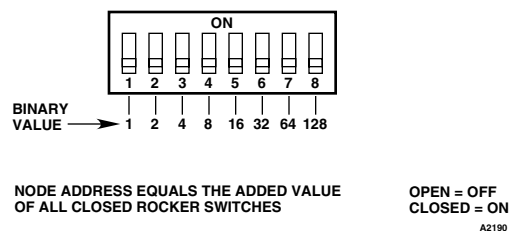


Figure 16—Address Switches for X3301

STARTUP PROCEDURE

When installation of the equipment is complete, perform the “Fire Alarm Test” below.

Allow 20 to 30 minutes for the detector’s heated optics to reach equilibrium.

FIRE ALARM TEST

1. Disable any extinguishing equipment that is connected to the system.
2. Apply input power to the system.
3. Initiate an **oi** test. (See “Magnetic **oi** / Manual **oi**” under Optical Integrity in the Description section of this manual.)
4. Repeat this test for all detectors in the system. If a unit fails the test, refer to the “Troubleshooting” section.
5. Verify that all detectors in the system are properly aimed at the area to be protected. (The Det-Tronics Q1201C Laser Aimer is recommended for this purpose.)
6. Enable extinguishing equipment when the test is complete.

TROUBLESHOOTING

WARNING

The sensor module (“front” half of the detector) contains no user serviceable components and should never be opened. The terminal compartment is the only part of the enclosure that should be opened by the user in the field.

1. Disable any extinguishing equipment that is connected to the unit.
2. Inspect the viewing windows for contamination and clean as necessary. The detector is relatively insensitive to airborne contaminants, however, thick deposits of ice, dirt, or oil will reduce sensitivity. (Refer to the “Maintenance” section for complete information regarding cleaning of the detector viewing windows.)

Table 3—Current Level Output Troubleshooting Guide

Current Level (±0.3 mA)	Status	Action
0 mA	Power Fault	Check system wiring.
1 mA	General Fault	Cycle power. ¹
2 mA	Oi Fault	Clean windows. ²
3 mA	Hi Background IR	Remove IR source or aim detector away from IR source.
4 mA	Normal Operation	
20 mA	Fire Alarm	

¹If fault continues, return device to factory for repair.

²See “Maintenance” section for cleaning procedure.

3. Check input power to the unit.
4. If the fire system has a logging function, check the fire panel log for output status information. See Table 3 for information regarding 4 to 20 mA output.
5. Turn off the input power to the detector and check all wiring for continuity. **Important: Disconnect wiring at the detector before checking system wiring for continuity.**
6. If all wiring checks out and cleaning of the **oi** plate/window did not correct the fault condition, check for high levels of background IR radiation by covering the detector with the factory supplied cover or aluminum foil. If the fault condition clears within 6 minutes or less, extreme background IR is present. Re-adjust the view of the detector away from the IR source or relocate the detector.

If none of these actions corrects the problem, return the detector to the factory for repair.

NOTE

It is highly recommended that a complete spare be kept on hand for field replacement to ensure continuous protection.

MAINTENANCE

IMPORTANT

Periodic flamepath inspections are not recommended, since the product is not intended to be serviced and provides proper ingress protection to eliminate potential deterioration of the flamepaths.

WARNING

The sensor module (“front” half of the detector) contains no user serviceable components and should never be opened. The terminal compartment is the only part of the enclosure that should be opened by the user in the field.

To maintain maximum sensitivity and false alarm resistance, the viewing windows of the X3301 must be kept relatively clean. Refer to the procedure below for cleaning instructions.

CLEANING PROCEDURE

CAUTION

Disable any extinguishing equipment that is connected to the unit to prevent unwanted actuation.

To clean the windows and **oi** plate, use Det-Tronics window cleaner (part number 001680-001) and a soft cloth, cotton swab or tissue and refer to the following procedure.

1. **Disable any extinguishing equipment that is connected to the unit.**
2. Since the X3301 is less affected by contamination than other detectors, removal of the **oi** plate is needed only under extreme conditions. In addition, it is not necessary to achieve perfect cleanliness, because IR is not significantly absorbed by slight films of oil and/or salt. If a fault condition is still indicated after cleaning, remove and clean the **oi** plate using the following procedure.
3. Clean all three viewing windows and reflector surfaces thoroughly using a clean cloth, cotton swab or tissue and Det-Tronics window cleaning solution. If a stronger solution is needed, isopropyl alcohol may be used.

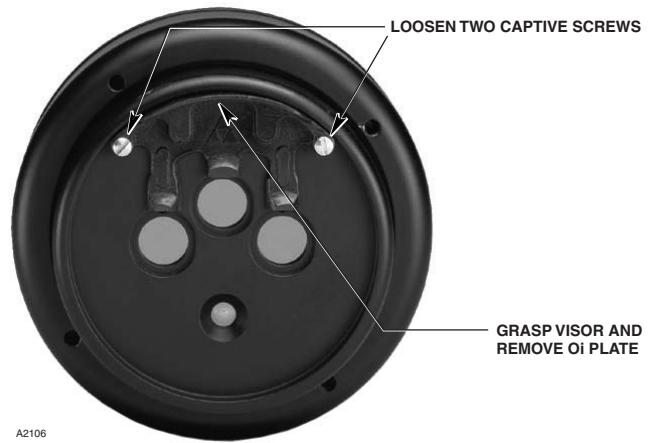


Figure 17—Oi Plate Removal

oi PLATE REMOVAL

1. **Disable any extinguishing equipment that is connected to the unit.**
2. Loosen the two captive screws, then grasp the **oi** plate by the visor and remove it from the detector. See Figure 17.
3. Thoroughly clean the **oi** plate reflective surfaces, holding it by its edges to avoid leaving fingerprints on the inside reflective surface.
4. Re-install the **oi** plate. Ensure that the plate is flat on the detector surface. Tighten the **oi** plate screws securely (40 oz/inches).

NOTE

If the **oi** plate is removed, be sure to install the original **oi** plate. **oi** plates are not interchangeable and should not be mixed with **oi** plates from other detectors. If corrosive contaminants in the atmosphere cause the **oi** plate surface to deteriorate to the extent that it is no longer possible to restore it to its original condition, it must be replaced. Consult factory for **oi** plate replacement procedure.

PERIODIC CHECKOUT PROCEDURE

A checkout of the system using the manual or magnetic **oi** feature should be performed on a regularly scheduled basis to ensure that the system is operating properly. To test the system, perform the "Fire Alarm Test" as described in the "Startup Procedure" section of this manual.

CLOCK BATTERY (Not used with EQP Model)

The real time clock has a backup battery that will operate the clock with no external power for nominally 10 years. It is recommended that the battery be replaced every 7 years. Return the device to the factory for battery replacement.

NOTE

If the backup battery is depleted, there is no effect on the operation of the flame detector, but the time stamping of the data log may be affected.

FEATURES

- Long detection range to carbonaceous fires.
- Unequaled false alarm rejection.
- Responds to a fire in the presence of modulated blackbody radiation (i.e. heaters, ovens, turbines) without false alarm.
- Microprocessor controlled heated optics for increased resistance to moisture and ice.
- Automatic, manual or magnetic optical integrity (**oi**) testing.
- Easily replaceable **oi** plate.
- Fire, fault and auxiliary relays standard.
- 4 to 20 mA isolated output (optional).
- Eagle Quantum Premier LON/SLC output (optional).
- Tricolor LED indicates normal operation, fire and fault conditions.
- Operates under adverse weather conditions and in dirty environments.
- Mounting swivel allows easy sighting.
- Integral wiring compartment for ease of installation.
- Explosion-proof/flame-proof detector housing. Meets FM, CSA, CENELEC (ATEX Directive Compliant) and CE certification requirements.
- Class A wiring per NFPA-72.
- Meets NFPA-33 response requirement for under 0.5 second (available when model selected).
- 5 year warranty.
- RFI and EMC Directive Compliant.

SPECIFICATIONS

OPERATING VOLTAGE—

24 volts dc nominal (18 vdc minimum, 32 vdc maximum). Maximum ripple is 2 volts peak-to-peak.

POWER CONSUMPTION—

Without heater: 4 watts at 24 vdc nominal;
5.2 watts at 24 vdc in alarm.
4.5 watts at 32 vdc nominal;
6.5 watts at 32 vdc in alarm.

Heater only: 8 watts maximum.

Total power: 17 watts at 32 vdc with EOL resistor installed and heater on maximum.

EOL resistor must be ceramic, wirewound type, rated 5 watts minimum, with actual power dissipation not to exceed 2.5 watts.

For HART model, refer to Addendum number 95-8577.

POWER UP TIME—

Fault indication clears after 0.5 second; device is ready to indicate an alarm condition after 30 seconds.

OUTPUT RELAYS—

Fire Alarm relay, Form C, 5 amperes at 30 vdc:

The Fire Alarm relay has redundant terminals and normally open / normally closed contacts, normally de-energized operation, and latching or non-latching operation.

Fault relay, Form A, 5 amperes at 30 vdc:

The Fault relay has redundant terminals and normally open contacts, normally energized operation, and latching or non-latching operation.

Auxiliary relay, Form C, 5 amperes at 30 vdc:

The auxiliary relay has normally open / normally closed contacts, normally energized or de-energized operation, and latching or non-latching operation.

CURRENT OUTPUT (Optional)—

4 to 20 milliampere (± 0.3 mA) dc current, with a maximum loop resistance of 500 ohms from 18 to 19.9 volts dc and 600 ohms from 20 to 32 volts dc.

LON OUTPUT—

Digital communication, transformer isolated (78.5 kbps).

TEMPERATURE RANGE—

Operating: -40°F to $+167^{\circ}\text{F}$ (-40°C to $+75^{\circ}\text{C}$).

Storage: -67°F to $+185^{\circ}\text{F}$ (-55°C to $+85^{\circ}\text{C}$).

Hazardous location ratings from -55°C to $+125^{\circ}\text{C}$.

HUMIDITY RANGE—

0 to 95% relative humidity, can withstand 100% condensing humidity for short periods of time.

CONE OF VISION—

The detector has a 90° cone of vision (horizontal) with the highest sensitivity lying along the central axis. Unlike conventional detectors, the X3301 provides full coverage at a minimum of 70% of the maximum detection distance.

Perfect cone of vision for methane fire detection — 100 feet on and off axis on “very high” setting.

Refer to Appendix A for FM Approved cone of vision data.

RESPONSE TIME—

Typical response times are under 10 seconds. Models are available that can respond to automotive paint gun fires in under 0.5 seconds. See Appendix A and “Automotive Addendum” (form number 95-8534) for actual response times.

DIMENSIONS—

See Figure 18.

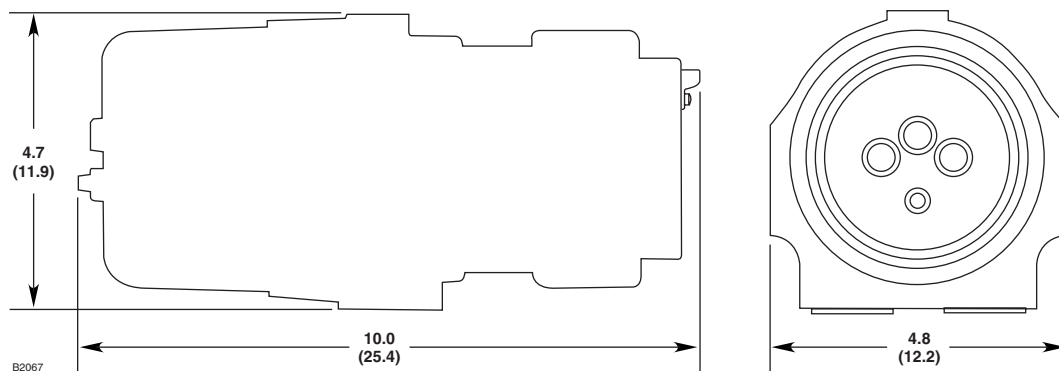


Figure 18—X3301 Dimensions in Inches (cm)

ENCLOSURE MATERIAL—

Copper-free aluminum (red-painted) or 316 stainless steel.

VIBRATION—

Conformance per FM 3260: 2000, MIL-STD 810C (Curve AW), DNV Note 2.4 (Class B).

WIRING—

14 AWG (2.08 mm²) or 16 AWG (1.31 mm²) shielded cable is recommended.

Important: 18 vdc minimum must be available at the detector. For ambient temperatures below -10°C and above +60°C use field wiring suitable for both minimum and maximum ambient temperature.

THREAD SIZE—

Conduit connection: Four entries, 3/4 inch NPT or M25. Conduit seal not required.

SHIPPING WEIGHT (Approximate)—

Aluminum: 6 pounds (2.7 kilograms).
Stainless Steel: 10 pounds (4.5 kilograms).
Swivel Mount: 14 pounds (6.4 kilograms).

WARRANTY PERIOD—

5 years.

CERTIFICATION—

For complete FM certification details, refer to Appendix A.



Class I, Div. 1, Groups B, C and D;
Class II, Div. 1, Groups E, F, and G;
Class I, Div. 2, Groups A, B, C and D (T3C);
Class II, Div. 2, Groups F and G (T3C);
Class III.

Enclosure NEMA/Type 4X.

(ULC Listed for models with relay outputs and HART model.)

Increased Safety Model

CE 0539 (E) II 2 GD
EEx de IIC T5-T6
DEMKO 01 ATEX 130204
T6 (T_{amb} = -55°C to +60°C).
T5 (T_{amb} = -55°C to +75°C).
IP66.

Flameproof Model

CE 0539 (E) II 2 GD
EEx d IIC T4-T6
DEMKO 01 ATEX 130204
T6 (T_{amb} = -55°C to +60°C).
T5 (T_{amb} = -55°C to +75°C).
T4 (T_{amb} = -55°C to +125°C).
IP66.

Conforms with: Low Voltage Directive (73/23/EEC).
Electromagnetic Compatibility Directive (89/336/EEC).
Explosive Atmosphere Directive (94/9/EC).
Construction Product Directive (89/106/EEC).

VdS Performance verified per EN54-10, Certificate G-202136.

DNV Type Approval Certificate Number A-8837.

Simtars Certificate of Conformity:
AUS Ex 03.2581X.

NOTE

Operational performance verified from -40°C to +75°C.

NOTE

An optional third party addressable module can only be used within the EEx d flameproof model unless the addressable module is component certified as EEx e for use within the EEx de increased safety model.

NOTE

Refer to “EOL Resistors” section for installation details. All cable entry devices and blanking elements shall be certified to “E-generation” or “ATEX” standards, in type of explosion protection increased safety “e” or flameproof enclosure “d” (as applicable), suitable for the conditions of use and correctly installed. They shall maintain the degree of ingress protection IP66 for the apparatus. Unused apertures shall be closed with suitable blanking elements.

REPLACEMENT PARTS

The detector is not designed to be repaired in the field. If a problem should develop, refer to the Troubleshooting section. If it is determined that the problem is caused by an electronic defect, the device must be returned to the factory for repair.

DEVICE REPAIR AND RETURN

Prior to returning devices, contact the nearest local Detector Electronics office so that a Return Material Identification (RMI) number can be assigned. **A written statement describing the malfunction must accompany the returned device or component to assist and expedite finding the root cause of the failure.**

Pack the unit properly. Always use sufficient packing material. Where applicable, use an antistatic bag as protection from electrostatic discharge.

NOTE

Inadequate packaging that ultimately causes damage to the returned device during shipment will result in a service charge to repair the damage incurred during shipment.

Return all equipment transportation prepaid to the factory in Minneapolis.

NOTE

It is highly recommended that a complete spare be kept on hand for field replacement to ensure continuous protection.

ORDERING INFORMATION

When ordering, please specify:

X3301 IR Flame Detector

Refer to the X3301 OS Matrix for details.

ACCESSORIES

Q9033B Swivel Mount Assembly is required for mounting the detector.

Q1116A Air Shield for use in dirty environments.

Q1201C Laser Aimer is recommended for verifying detector aiming.

Q2000 Weather Shield is available for outdoor environments.

REPLACEMENT PARTS

Part Number Description

001680-001	Window cleaner squeeze bottle (package of six bottles)
005003-001	Silicone-free grease

X3301 OS Matrix

MODEL	DESCRIPTION	
X3301	Multispectrum IR Flame Detector	
	TYPE	MATERIAL
	A	Aluminum
	S	Stainless Steel (316)
	TYPE	THREAD TYPE
	4M	4 PORT, METRIC M25
	4N	4 PORT, 3/4" NPT
	TYPE	OUTPUTS
	11	Relay
	13	Relay and 4-20 mA
	14	Eagle Quantum Premier
	15	Relay and Pulse
	16	Addressable Module Only (Third Party Type)
	21	Relay-Automotive
	23	Relay, 4-20 mA and HART
	TYPE	APPROVAL AGENCY
	W	FM/CSA/ULC*/CENELEC/CE
	TYPE	CLASSIFICATION**
	1	Division/Zone Ex de
	2	Division/Zone Ex d

*The LON output (Type 14) is not part of the ULC approval.

**Detectors are always Class I, Div. 1.

APPENDIX A

FM Approvals Description and Performance Report

THE FOLLOWING ITEMS, FUNCTIONS AND OPTIONS DESCRIBE THE FM APPROVAL:

- Explosion-proof for Class I, Div. 1, Groups B, C and D Hazardous (Classified) Locations per FM 3615.
- Dust-ignition proof for Class II/III, Div. 1, Groups E, F and G Hazardous (Classified) Locations per FM 3615.
- Explosion-proof for Class I, Div. 2, Groups A, B, C and D (T3C) Hazardous (Classified) Locations per FM 3611.
- Explosion-proof for Class II, Div. 2, Groups F and G (T3C) Hazardous (Classified) Locations per FM 3611.
- Enclosure rating NEMA/Type 4X per NEMA 250.
- Ambient Temperature Limits: –40°F to +167°F (–40°C to +75°C).
- Automatic Fire Alarm Signaling Performance verified per FM 3260 (2000).

The following performance criteria were verified:

OPTICAL INTEGRITY TEST:

The detector generated an optical fault in the presence of contamination on any single or combination of lens surfaces resulting in a loss of approximately 50% of its detection range, verifying that the detector performs a calibrated Automatic Optical Integrity (**oi**) test for each sensor. Upon removal of the contamination, the detector fault was cleared and the detector was verified to detect a fire.

The Manual / Magnetic **oi** performs the same calibrated test as the Automatic **oi**, and additionally actuates the alarm relay to verify output operation. If there is a 50% loss of its detection range, an alarm signal is not generated.

FM Approvals Description and Performance Report – Continued

RESPONSE CHARACTERISTICS:

Very High Sensitivity

Fuel	Size	Distance feet (m)	Average Response Time (seconds)***
n-Heptane	1 x 1 foot	210 (64)*	11
n-Heptane**	1 x 1 foot	210 (64)*	6
n-Heptane	1 x 1 foot	100 (30.5)	3
n-Heptane	6 in. x 6 in.	80 (24.4)	3
Isopropanol	6 in. x 6 in.	70 (21.3)	4
Diesel**	1 x 1 foot	150 (45.7)*	14
Methanol	6 in. x 6 in.	40 (12.2)	3
Methanol	1 x 1 foot	150 (45.7)*	18
Methanol**	1 x 1 foot	150 (45.7)*	7
Methane	30 inch plume	100 (30.5)	3
JP-5**	1x1 foot	150 (45.7)*	2
JP-5**	2 x 2 foot	210 (64)*	4
JP-5**	2 x 2 foot	100 (30.5)	2
Office Paper 0.5 lb.	19" x 19" x 8"	100 (30.5)	4
Corrugated Panel	18" x 36"	100 (30.5)	8

* Outdoor test condition.

** Pre-burn from ignition.

*** Add 2 seconds for EQP Model.

Medium Sensitivity

Fuel	Size	Distance feet (m)	Average Response Time (seconds)***
n-Heptane	1 x 1 foot	100 (30.5)	12
n-Heptane	1 x 1 foot	50 (15.2)	2
Diesel**	1 x 1 foot	70 (21.3)	4
Methanol	1 x 1 foot	70 (21.3)	10
Methane	30 inch plume	65 (19.8)	3
Methane	30 inch plume	55 (16.8)	2
JP-5**	2 x 2 foot	100 (30.5)	3
Office Paper 0.5 lb.	19" x 19" x 8"	50 (15.2)	6
Corrugated Panel	18" x 36"	50 (15.2)	2

** Pre-burn from ignition.

*** Add 2 seconds for EQP Model.

FM Approvals Description and Performance Report – Continued

Low Sensitivity

Fuel	Size	Distance feet (m)	Average Response Time (seconds)***
n-Heptane	1 x 1 foot	50 (15.2)	10
Methanol	1 x 1 foot	20 (6.1)	10
Methane	32 inch plume	15 (4.6)	9

*** Add 2 seconds for EQP Model.

RESPONSE CHARACTERISTICS IN THE PRESENCE OF FALSE ALARM SOURCES:

Very High Sensitivity

False Alarm Source	Distance feet (m)	Fire Source	Distance feet (m)	Average Response Time (seconds)***
Sunlight, direct, modulated, reflected	—	6-inch propane	6 (1.8)	< 10
Vibration	N/A	3-inch propane	10.5 (3.2)	< 10
Radio frequency interference	1 (0.3)	3-inch propane	12 (3.7)	< 10
Arc welding, #7014	40 (12.2)	1 x 1 foot n-Heptane	40 (12.2)	4
6 kw heater, modulated	80 (24.4)	1 x 1 foot n-Heptane	80 (24.4)	2
6 kw heater, unmodulated	10 (3)	1 x 1 foot n-Heptane	80 (24.4)	3
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	2
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	7
500 w shielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	80 (24.4)	2
500 w unshielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	80 (24.4)	3
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	80 (24.4)	5
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	3

*** Add 2 seconds for EQP Model.

FM Approvals Description and Performance Report – Continued

Medium Sensitivity

False Alarm Source	Distance feet (m)	Fire Source	Distance feet (m)	Average Response Time (seconds)***
Sunlight, direct, modulated, reflected	—	6-inch propane	6 (1.8)	< 4
Vibration*	N/A	N/A	N/A	N/A
Radio frequency interference	1 (0.3)	6-inch propane	6 (1.8)	< 1
Arc welding, #7014	10 (3)	1 x 1 foot n-Heptane	40 (12.2)	4
6 kw heater, modulated	60 (18.3)	1 x 1 foot n-Heptane	60 (18.3)	2
6 kw heater, unmodulated	10 (3)	1 x 1 foot n-Heptane	60 (18.3)	2
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	1
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	1
500 w shielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	60 (18.3)	1
500 w unshielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	60 (18.3)	1
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	60 (18.3)	6
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	2

* Fire was verified with very high sensitivity only.

*** Add 2 seconds for EQP Model.

Low Sensitivity

False Alarm Source	Distance feet (m)	Fire Source	Distance feet (m)	Average Response Time (seconds)***
Sunlight, direct, unmodulated, reflected*	—	1 x 1 foot n-Heptane	35 (10.7)	<13
Sunlight, direct, modulated, reflected*	—	1 x 1 foot n-Heptane	15 (4.6)	<14
Arc welding, steady, #7014	5 (1.5)	1 x 1 foot n-Heptane	50 (15.2)	11
Arc welding, modulated, #7014	5 (1.5)	1 x 1 foot n-Heptane	30 (9.1)	10
70 w sodium vapor, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	16
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	18
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	18
500 w shielded quartz halogen lamp, unmodulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	12
500 w shielded quartz halogen lamp, modulated	10 (3)	1 x 1 foot n-Heptane	50 (15.2)	11
1500 w electric radiant heater, unmodulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	12
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	30 (9.1)	11
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	14

* Outdoor test conditions.

*** Add 2 seconds for EQP Model.

FM Approvals Description and Performance Report – Continued

FALSE ALARM IMMUNITY:

Very High Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct, reflected	—	No alarm	No alarm
Vibration	N/A	No alarm	N/A
Radio frequency interference	1 (0.3)	No alarm (keyed)	No alarm (steady)
Arc welding	40 (12.2)	No alarm	No alarm
6 kw heater	3 (0.9)	No alarm	No alarm
250 w vapor lamp	3 (0.9)	No alarm	No alarm
300 w incandescent lamp	3 (0.9)	No alarm	No alarm
500 w unshielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
500 w shielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
1500 w electric radiant heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

Medium Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct, reflected	—	No alarm	No alarm
Vibration	N/A	No alarm	N/A
Radio frequency interference	1 (0.3)	No alarm (keyed)	No alarm (steady)
Arc welding	10 (3)	No alarm	No alarm
6 kw heater	3 (0.9)	No alarm	No alarm
250 w vapor lamp	3 (0.9)	No alarm	No alarm
300 w incandescent lamp	3 (0.9)	No alarm	No alarm
500 w unshielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
500 w shielded quartz halogen lamp	3 (0.9)	No alarm	No alarm
1500 w electric radiant heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

FM Approvals Description and Performance Report – Continued

Low Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct	—	No alarm	No alarm
Sunlight, reflected	—	No alarm	No alarm
Vibration	N/A	No alarm	N/A
Arc welding	5 (1.5)	No alarm	No alarm
70 w sodium vapor lamp	3 (0.9)	No alarm	No alarm
250 w mercury vapor lamp	3 (0.9)	No alarm	No alarm
300 w clear incandescent lamp	3 (0.9)	No alarm	No alarm
500 w shielded quartz halogen lamp	3 (0.9)	No alarm	No alarm
1500 w electric quartz heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

FM Approvals Description and Performance Report – Continued

FIELD OF VIEW:

Very High Sensitivity

Fuel	Size	Distance (feet (m))	Horizontal (degrees)	Avg. Horiz. Response Time (seconds)***	Vertical (degrees)	Avg. Vert. Response Time (seconds)***
n-Heptane	1 x 1 foot	150* (45.7)	+45 -45	12 14	+45 -30	13 5
n-Heptane	1 x 1 foot	100 (30.5)	+45 -45	6 3	+45 -30	3 2
n-Heptane	6 in. x 6 in.	80 (24.4)	+45 -45	5 6	+45 -30	4 4
Isopropanol	6 in. x 6 in.	70 (21.3)	+45 -45	5 5	+45 -30	4 6
Diesel**	1 x 1 foot	100 (30.5)	+45 -45	2 3	+45 -30	4 3
Methanol	6 in. x 6 in.	40 (12.2)	+45 -45	4 6	+45 -30	3 3
Methanol	1 x 1 foot	110 (33.5)	+45 -45	9 7	+45 -30	9 3
Methane	30 inch plume	100 (30.5)	+45 -45	7 3	+45 -30	2 2
JP-5**	1 x 1 foot	100 (30.5)	+45 -45	2 4	+45 -30	3 2
JP-5**	2 x 2 feet	180* (54.9)	+45 -45	2 5	+45 -30	3 2
JP-5**	2 x 2 feet	90 (27.4)	+45 -45	2 3	+45 -30	1 2
Office Paper 0.5 lb.	19" x 19" x 8"	80 (24.4)	+45 -45	4 2	+45 -30	2 1
Corrugated Panel	18" x 36"	80 (24.4)	+45 -45	1 1	+45 -30	3 2

* Outdoor test condition.

** Pre-burn from ignition.

*** Add 2 seconds for EQP Model.

FM Approvals Description and Performance Report – Continued

Medium Sensitivity

Fuel	Size	Distance feet (m)	Horizontal (degrees)	Avg. Horiz. Response Time (seconds)***	Vertical (degrees)	Avg. Vert. Response Time (seconds)***
n-Heptane	1 x 1 foot	75 (22.9)	+45 -45	9 6	+45 -30	10 7
n-Heptane	1 x 1 foot	50 (15.2)	+45 -45	4 3	+45 -30	3 3
Diesel**	1 x 1 foot	60 (18.3)	+45 -45	4 4	+45 -30	4 2
Methanol	1 x 1 foot	50 (15.2)	+45 -45	9 3	+45 -30	9 1
Methane	30 inch plume	45 (13.7)	+45 -45	3 3	+45 -30	7 1
JP-5**	2 x 2 feet	90 (27.4)	+45 -45	4 2	+45 -30	2 2
Office Paper 0.5 lb.	19" x 19" x 8"	40 (12.2)	+45 -45	2 1	+45 -30	1 1
Corrugated Panel	18" x 36"	40 (12.2)	+45 -45	2 1	+45 -30	1 1

* Outdoor test condition.

** Pre-burn from ignition.

*** Add 2 seconds for EQP Model.

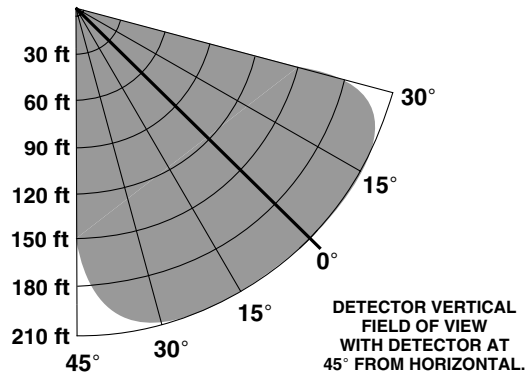
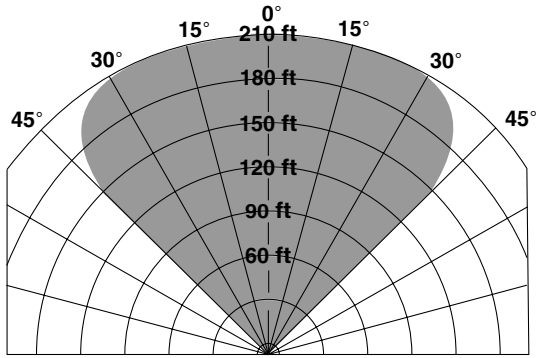
Low Sensitivity

Fuel	Size	Distance feet (m)	Horizontal (degrees)	Avg. Horiz. Response Time (seconds)***	Vertical (degrees)	Avg. Vert. Response Time (seconds)***
n-Heptane	1 x 1 foot	35 (10.7)	+45 -45	13 13	+45 -30	9 18
Methanol	1 x 1 foot	15 (4.6)	+45 -45	14 12	+45 -30	10 8
Methane	32 inch plume	15 (4.6)	+45 -45	10 11	+45 -30	8 10

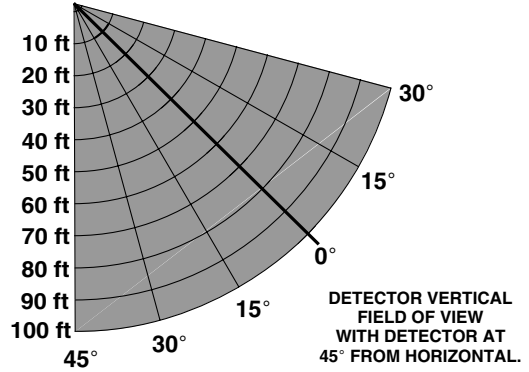
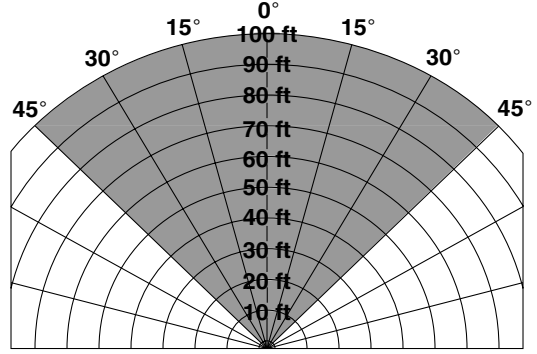
*** Add 2 seconds for EQP Model.

FM Approvals Description and Performance Report – Continued

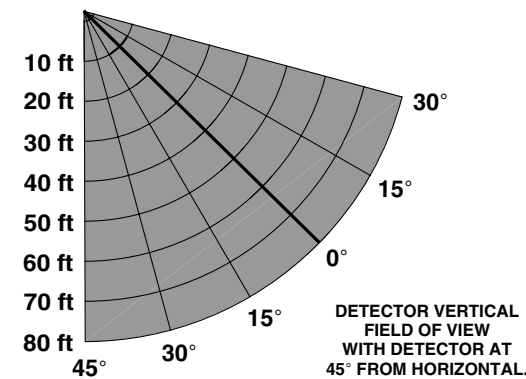
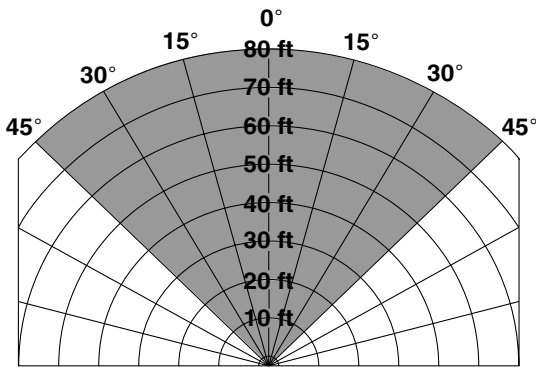
HIGH RESOLUTION FIELD OF VIEW



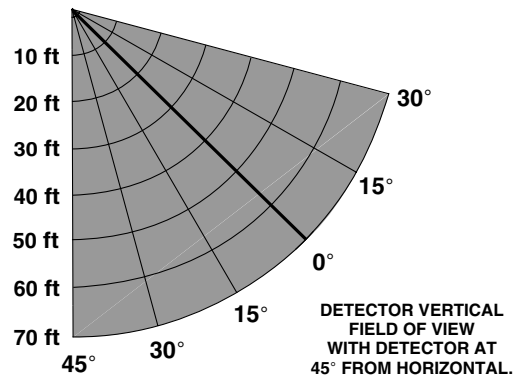
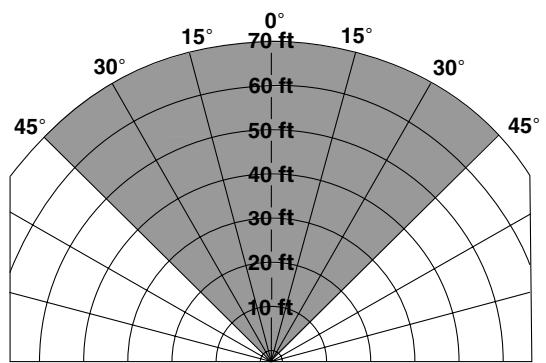
Field of View at Indicated Distance in Feet for
n-Heptane at **Very High** Sensitivity (1 x 1 foot)



Field of View at Indicated Distance in Feet for
Methane at **Very High** Sensitivity (30 inch plume)

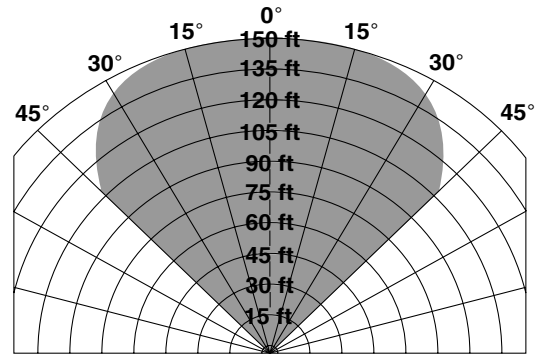
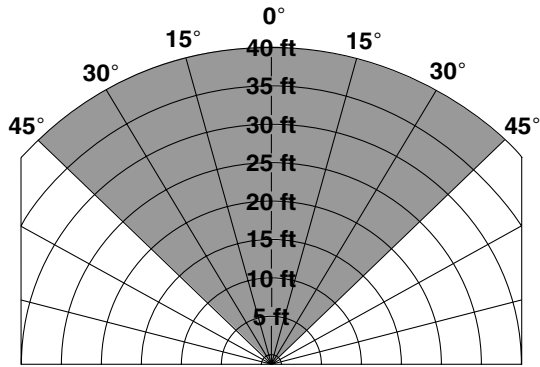


Field of View at Indicated Distance in Feet for
n-Heptane at **Very High** Sensitivity (6 in. x 6 in.)

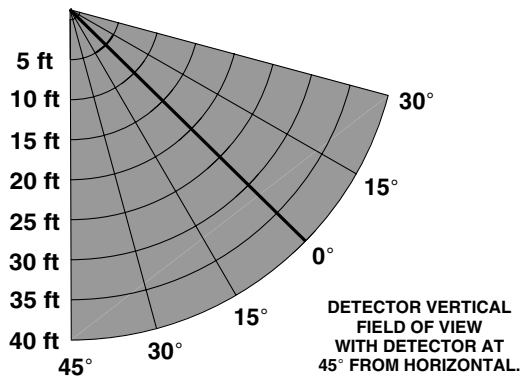


Field of View at Indicated Distance in Feet for
Isopropanol at **Very High** Sensitivity (6 in. x 6 in.)

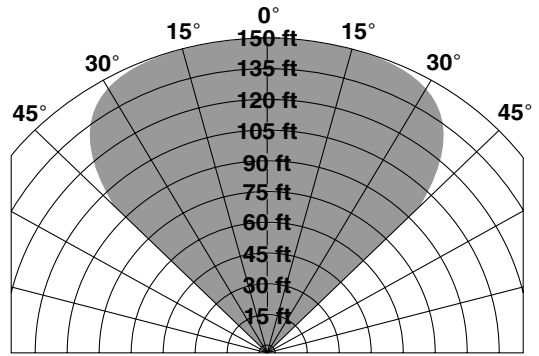
FM Approvals Description and Performance Report – Continued



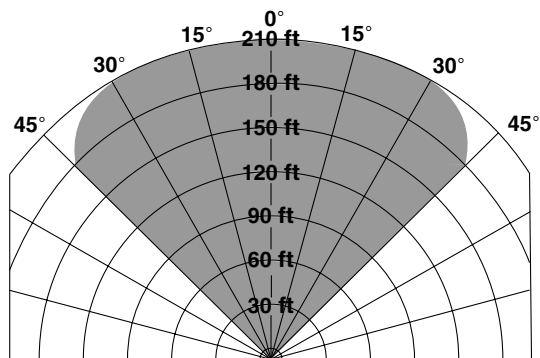
Field of View at Indicated Distance in Feet for Methanol at Very High Sensitivity (1 x 1 foot)



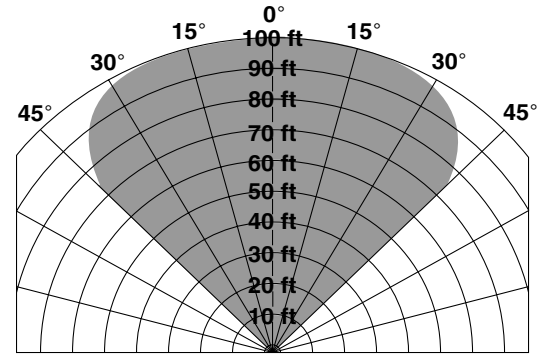
Field of View at Indicated Distance in Feet for Methanol at Very High Sensitivity (6 in. x 6 in.)



Field of View at Indicated Distance in Feet for Diesel at Very High Sensitivity (1 x 1 foot)

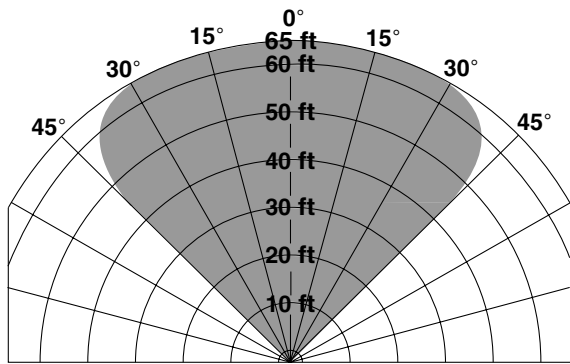


Field of View at Indicated Distance in Feet for JP-5 at Very High Sensitivity (2 x 2 feet)

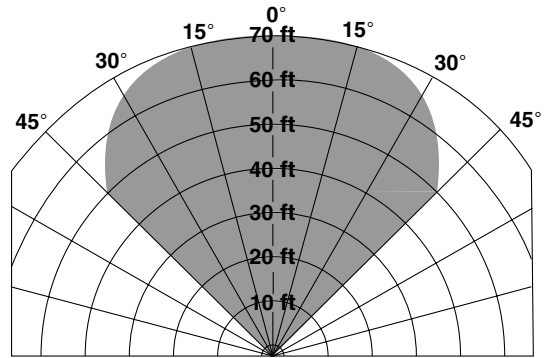


Field of View at Indicated Distance in Feet for n-Heptane at Medium Sensitivity (1 x 1 foot)

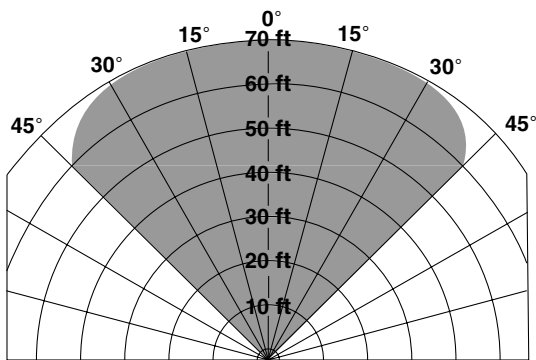
FM Approvals Description and Performance Report – Continued



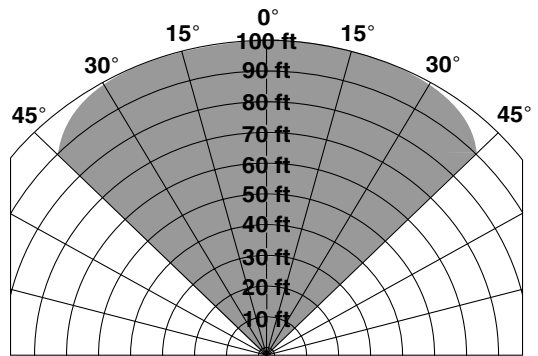
Field of View at Indicated Distance in Feet for
Methane at Medium Sensitivity (30 inch plume)



Field of View at Indicated Distance in Feet for
Methanol at Medium Sensitivity (1 x 1 foot)



Field of View at Indicated Distance in Feet for
Diesel at Medium Sensitivity (1 x 1 foot)



Field of View at Indicated Distance in Feet for
JP-5 at Medium Sensitivity (2 x 2 feet)

NOTE

FM Approvals minimum requirements are response distance measurements at 0° (on axis) and the limits of the field of view. These high resolution field of view diagrams show the measured response distances at all the indicated angles in the horizontal plane.



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