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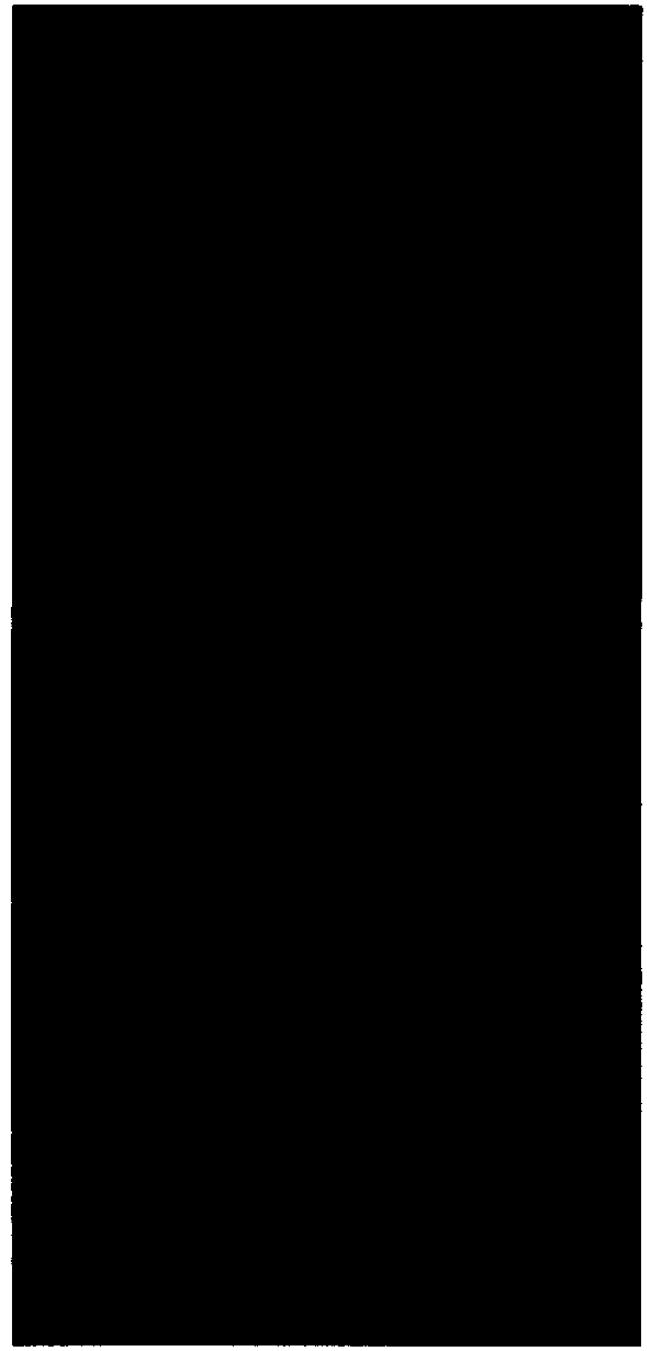

INSTRUCTIONS

Intrinsically Safe
Single Frequency Infrared
Fire Detection Sytem
U7698D

7/90 Form 95-8372

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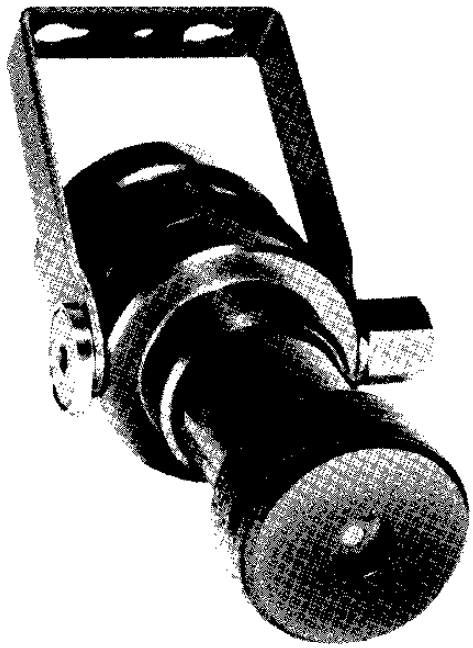
DET-TRONICS®

INSTRUCTIONS

Intrinsically Safe Single Frequency Infrared Fire Detection System U7698D



SYSTEM APPLICATION

The Intrinsically Safe U7698D Unitized Single Frequency Infrared (IR) Fire Detector/Controller provides fire protection in areas that can present problems for other types of detectors. Typical applications for the U7698D include areas where:

- Harsh salt water conditions exist.
- Oil films on the optical surfaces would blind ultraviolet detectors.
- Arc welding is common.
- A high concentration of ultraviolet attenuating vapors is present.
- A hazardous environment requires a detector with a rugged weatherproof enclosure.
- An explosive environment requires a detector that is intrinsically safe.

The U7698D Detector/Controller contains high quality electronic sensing and switching components in a single enclosure. The circuitry is suited for applications that require an intrinsically safe design. Input power for intrinsically safe operation must be connected through a certified 28 volt, 300 ohm barrier. A solid state sensor detects a narrow but intense band of radiation in the 4.2 to 4.7 micron range. This band is specific to hot carbon dioxide (CO_2), one of the products of combustion in the burning of hydrocarbons. Through the use of optical filters and signal processing circuitry, the U7698D is solar blind and insensitive to signals from arc welding and lightning, making it suitable for a variety of indoor and outdoor applications.

FEATURES

- Responds to an intense flickering IR source in 3 seconds.
- Provides two red latching Fire LEDs on the front of the detector/controller to indicate a fire has been sensed.
- Designed for use in conventional two-wire control systems.
- Latching fire alarm condition.
- Choice of aluminum or stainless steel enclosure.
- Reduces the risk of false alarms caused by arc welding, lightning, and sunlight.
- BASEEFA/CENELEC approved intrinsically safe device. Designed to meet FM and CSA standards for intrinsically safe devices.

THEORY OF OPERATION

Every fire has characteristics or elements that distinguish it as a fire such as heat, smoke, visible light, invisible (to the human eye) ultraviolet (UV) and infrared (IR) radiation, and flame flicker. These characteristics are important because fire is a chemical process and chemical processes can vary significantly, depending on the elements and conditions. A simple fire detector can be designed to detect any one of the elements but unless this detector can discriminate, it will be subject to false alarms. Discrimination can be achieved by using more than one element as criteria to determine a fire.

The U7698D detects two elements of fire: IR radiation and flame flicker. IR radiation is found throughout nature, but few things emit IR at the flicker frequency of a fire, which makes the U7698D a reliable fire detector. To further enhance the reliability of the U7698D, optical filters are incorporated that narrow IR response to the bandwidth from 4.2 to 4.7 microns. This bandwidth is significant for two reasons:

1. Hydrocarbon fires emit intense IR radiation in this band (see Figure 1).

2. Atmospheric transmission of IR from the sun in this range is practically zero, making the U7698D solar blind (see Figure 2).

See Figure 3. A pyroelectric sensor converts infrared energy to an electrical output. The flicker filter circuit rejects any signal that does not meet the flicker frequency requirements, such as steady state emission of infrared radiation. The electrical signal is processed by internal circuitry to trigger an output circuit that turns on and latches the Fire LEDs until reset. The detector/controller is connected to a control unit whereby an alarm condition is signalled by a large increase in operating current. The U7698D is reset by removing power so that there are 0 volts at the detector/controller for at least 0.1 second.

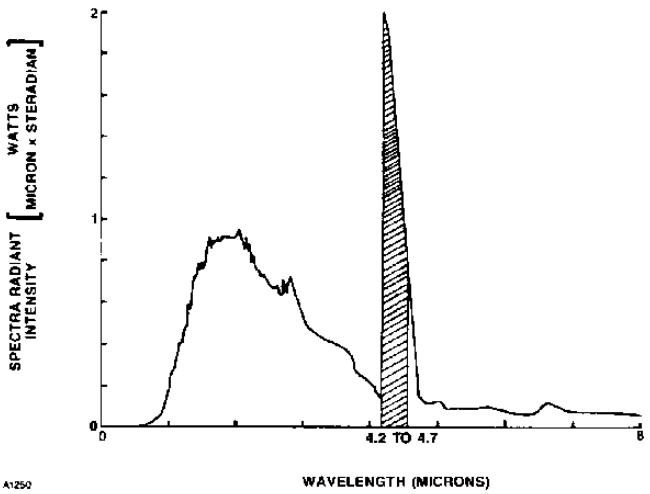


Figure 1—Spectral Sensitivity of the U7698D IR Detector as Related to Hydrocarbon Fuel Fire Spectra

APPLICATION INFORMATION

As part of the application for the U7698D, it is important to know of any conditions that can prevent the unit from responding to fire and also to know what source besides fire will cause the U7698D to respond. The U7698D reliably responds to infrared radiation emitted from hydrocarbon fires while remaining insensitive to solar radiation and artificial lighting.

Any object with a temperature greater than 0° Kelvin (–273°C) emits infrared radiation. The hotter the object, the greater the intensity of IR radiation emitted at 4.4 microns (see Figure 4). The U7698D ignores steady state infrared sources that do not have a flicker frequency characteristic of a fire. It should be noted that if these steady state infrared sources are hot enough to emit adequate amounts of infrared radiation in the 4.2 to 4.7 micron range and if this radiation becomes interrupted from the detector's view in a pattern characteristic of a flickering flame, the U7698D can respond and go into alarm. The closer the infrared source is to the U7698D and the stronger the source, the greater the potential of a false alarm.

Arc welding should be conducted no nearer than 10 feet to the U7698D. Though the level of radiation emitted by the welding in the 4.4 micron range is low, the heated metal can become a false alarm source.

The U7698D is a single frequency infrared device with detection limited to the hot CO_2 emission peaks, therefore, it cannot be used to detect fires that do not contain carbon, such as hydrogen, sulfur, and burning metals. Because large accumulations of smoke and oil/dirt buildup on the window of the U7698D are shown to diminish its response, IR fire detection should be thought of as resistant to, rather than immune from, attenuation. A thin film of ice on the window of the U7698D will blind the detector.

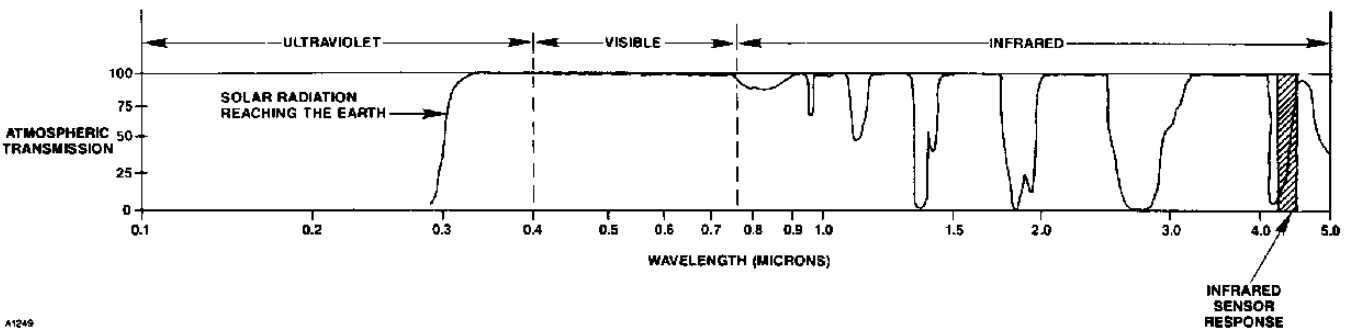


Figure 2—Atmospheric Transmission of the Sun's Radiation

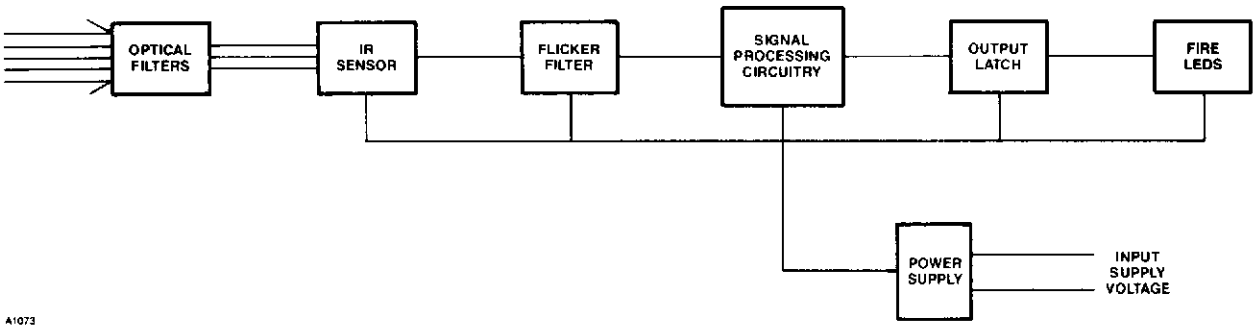


Figure 3—U7698 Block Diagram

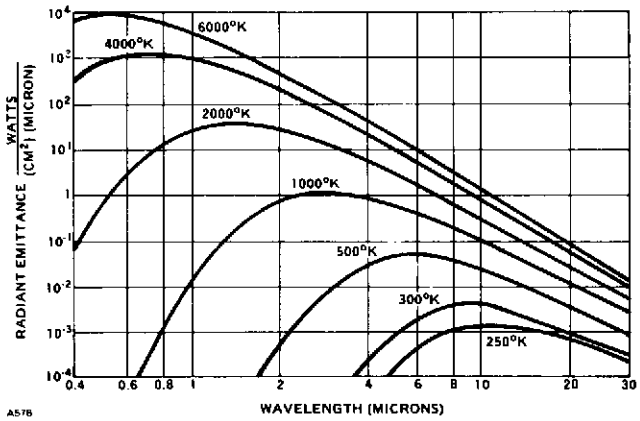


Figure 4—Blackbody Spectral Emittance

SPECIFICATIONS

OPTICAL SENSITIVITY RANGE—
The U7698D has a 90 degree cone of vision with the highest sensitivity lying along its central axis. See Figure 5.

FLAME SENSITIVITY—
The response time of the detector is a function of fuel, fire size, distance, and orientation of the fire source. Typically, the U7698D will respond in 3 seconds to a high intensity flickering IR source and within 5 seconds to a 1 square foot gasoline fire at 65 feet (approximately 0.1 square meter at 20 meters).

SPECTRAL SENSITIVITY RANGE—
The U7698D is equipped with a series of optical filters to narrow the sensitivity range from 4.2 to 4.7 microns, a spectral area for fire detection.

DIMENSIONS—
See Figure 6.

ELECTRICAL—
Supply Voltage: 16 vdc minimum, 24 vdc typical, 28 vdc maximum (to maintain intrinsically safe operation, supply voltage must be no greater than that required by the barrier being used).

Operating Current: 270 microamperes at 16 to 28 vdc.

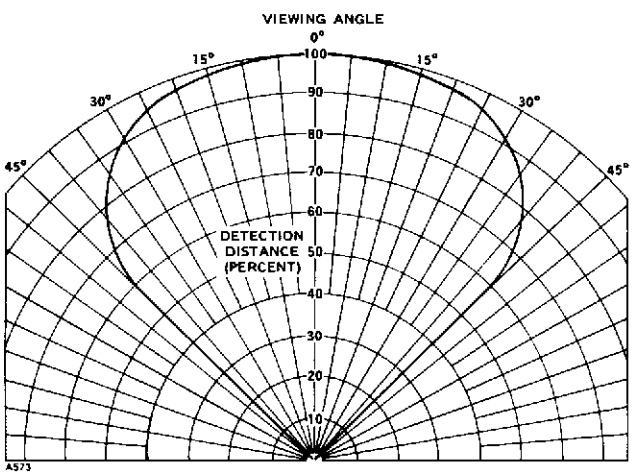


Figure 5—Cone of Vision

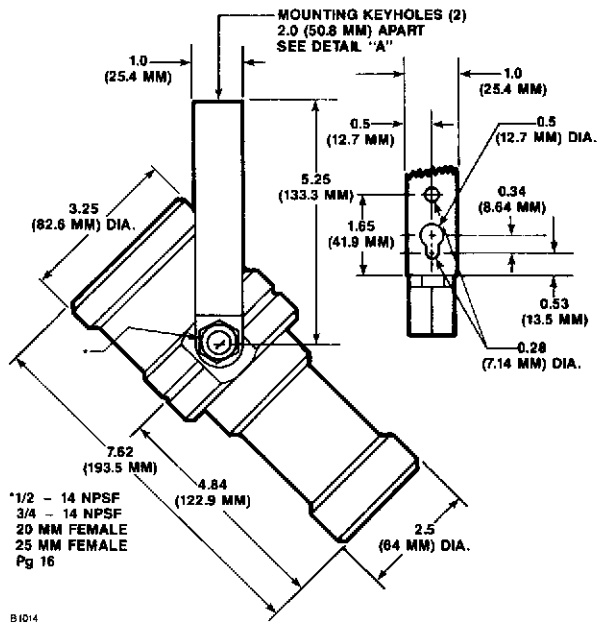


Figure 6—U7698 Dimensions in Inches (Millimeters)

Alarm Current: 20 milliamperes at 16 vdc, 40 milliamperes at 28 vdc when used with a 300 ohm barrier.

Alarm Indicators: Two red latching LEDs visible from detector front and sides (120° range).

Wiring Configuration: 2-wire model.

Reset Time: Requires 0 volts at detector/controller for 0.1 second.

Power On Delay: 15 seconds.

STORAGE TEMPERATURE RANGE—
–40°F to +185°F (–40°C to +85°C).

OPERATING TEMPERATURE RANGE—
–40°F to +167°F (–40°C to +75°C).

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

ENCLOSURE MATERIALS—
Anodized copper-free aluminum or 316 stainless steel.

ENCLOSURE RATINGS—
Water-tight, dust-tight, NEMA 4, IP66.

When wired through a certified 28 volt, 300 ohm barrier: BASEEFA/CENELEC approved intrinsically safe for EEx ia IIC T4 (T_{amb} –40°C to +75°C); BASEEFA Certificate Numbers 90C2107 an 90C2108. Designed to meet FM and CSA intrinsically safe standards for Class I, Groups A, B, C and D; Class II, Groups E, F, and G.

VIBRATION—
Meets MIL-STD-810C for vibration.

SHIPPING WEIGHT—
Aluminum: 4.0 pounds (1.8 kilograms).
Stainless Steel: 8.1 pounds (3.7 kilograms).

RESPONSE CHARACTERISTICS

Response time is dependent on the fuel, the temperature of the fuel, and the time required for the fire to build. As with all fire tests, results must be interpreted according to an individual application.

Typical response distances of the U7698D to five flammable liquids and one flammable solid are listed in Table 1. The fuel used for the fire was approximately one pint of each liquid burned in a 1 foot by 1 foot steel pan or one pound of wood shavings. The detector/controllers were sited to observe the fire at center axis ±10 degrees.

Table 1—U7698 Typical Response Distances

Flammables	Distance from U7698
Acetone	60 feet (18 meters)
Diesel	60 feet (18 meters)
Gasoline	65 feet (20 meters)
Methanol	50 feet (15 meters)
Toluene	50 feet (15 meters)
Fine wood shavings (excelsior)	50 feet (15 meters)

INSTALLATION

POSITIONING AND DENSITY

Complete supervision of an area depends on the level of protection and the distance from the detector/controller to the hazard. The U7698D has a 90 degree cone of vision and covers a somewhat elliptical area when it is angled to cover the probable source of a fire. As the distance increases from the detector/controller to the probable source, so does the response time for a given fire. For outdoor applications, the detector/controller should be aimed downward to prevent the cone of vision from scanning the horizon. This minimizes the response to distant infrared sources outside the protected area.

Even though infrared detector/controllers are less affected by accumulations of smoke, the U7698D should not be placed in an area where rising CO_2 and particulates will obscure its vision. For indoor applications, if dense smoke is expected to accumulate at the onset of a fire, mounting the detector/controller on a side wall a few feet (1 meter) down from the ceiling will normally allow time for the unit to respond before is is affected by rising smoke. All hazardous materials should be fire tested to determine correct detector/controller positioning and coverage.

MOUNTING AND WIRING

The standard U7698D has a single conduit entry on one side of the detector/controller and a stop plug on the other (see Figure 7). A second conduit entry adapter can be added by replacing the stop plug with an adapter. The adapter and plug are also used to tighten the detector/controller to the mounting

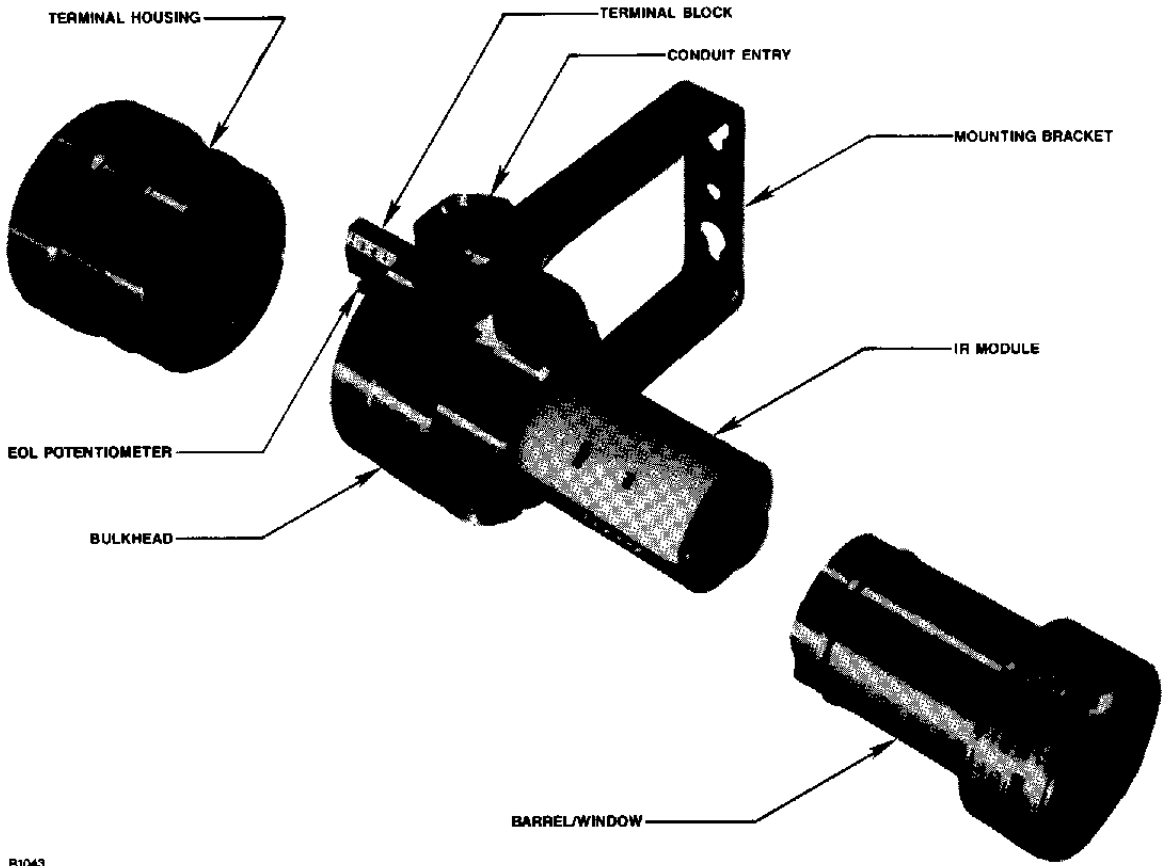


Figure 7—U7698 Detector/Controller Assembly

bracket in a fixed position. See the "Ordering Information" section.

Intrinsically Safe Wiring

For intrinsically safe applications, input power must be connected through a certified 28 volt, 300 ohm barrier located in the safe area (see Figures 8 and 9).

Non-Intrinsically Safe Wiring

For applications that do not require intrinsically safe designs, a 300 ohm, 1 watt resistor must be placed in series with the input power (in place of the 28 volt, 300 ohm barrier) to limit the current to the U7698D (see Figures 8 and 9).

WARNING

Failure to install this resistor can result in damage to the detector.

Moisture-proof Wiring

Certain guidelines must be followed when installing the U7698D to maintain the moisture-proof qualities of its enclosure. When using steel wire armored or mineral-insulated copper-sheathed cables, select an approved gland with a watertight compression stage and an overall gland shroud for outdoor applications. A sealing washer must be fitted between the gland and the conduit entry to ensure IP66 rating.

When the U7698D is wired in conduit and mounted in outdoor locations or locations with high humidity, use seals, drains, and breathers. This type of installation will automatically bleed off water accumulation in the conduit and prevent damage to the equipment.

Rigid metal conduit usage requires water-tight conduit seals to prevent moisture from entering the detector/controller housing. These seals must be installed even if not required by local wiring codes. Seals must be located no further than 18 inches from the U7698D housing. When pouring a seal, use a fiberdam to assure proper formation. Seals should never be poured in below freezing temperatures because the water in the sealing compound will freeze and prevent proper drying. Contamination of the detector will then result when the temperature rises above the freezing point. Cable shielding should be stripped back to permit the seal to form around the individual detector/controller leads, rather than around the outside of the shield, to prevent siphoning action through the inside of the shield.

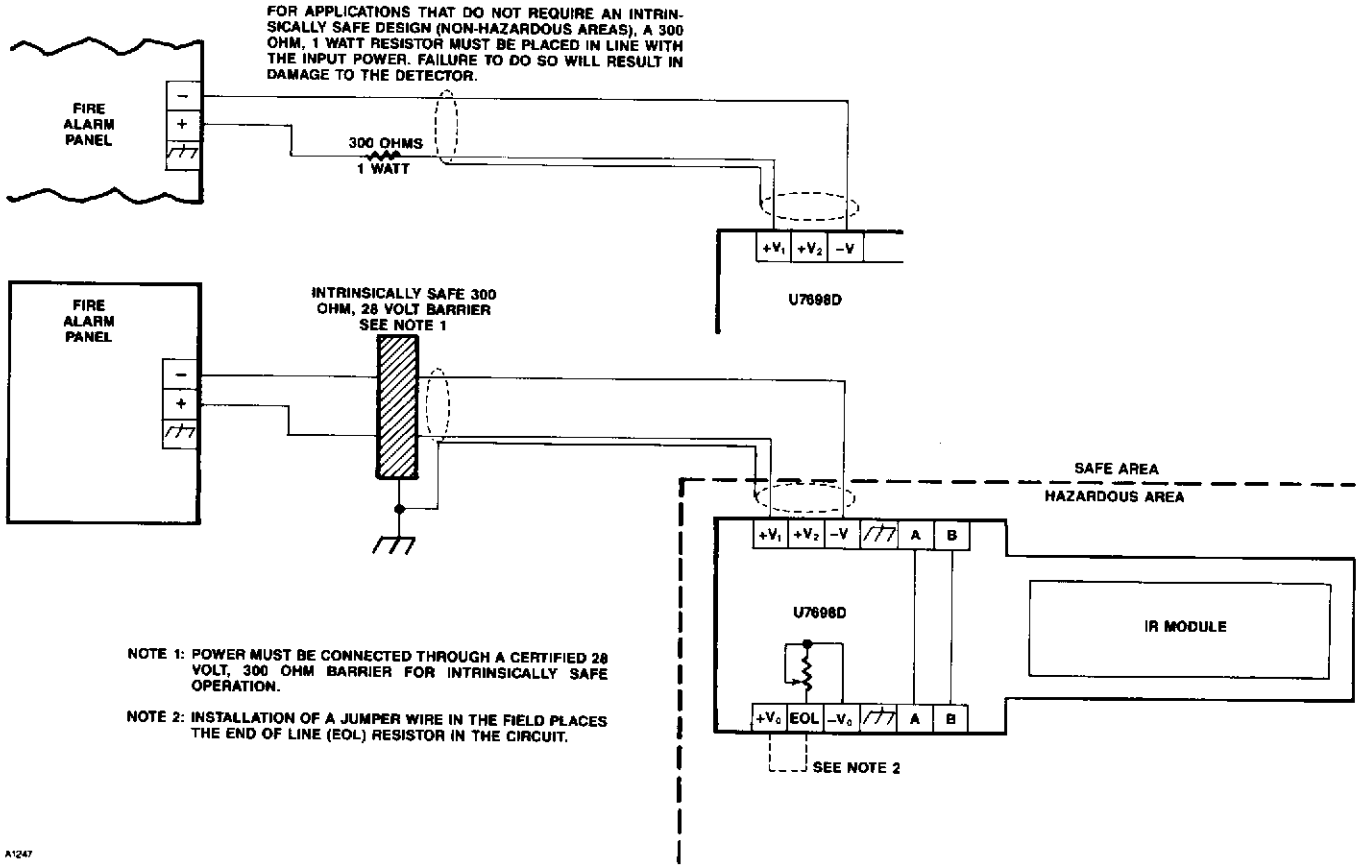


Figure 8—U7698D Typical Wiring Diagram

Wire and Cable Type

Use 16 to 22 gauge (1.5 to 0.5 mm^2) cable to connect the U7698D. Foil-type shielded cable is recommended to protect from electromagnetic interference. The size and length of cable should be taken into account when wiring to ensure the U7698D has a minimum of 16 vdc at the detector/controller. When using cables with shields, it is preferred that the shield be cut back and not connected to the ground of each detector/controller. All wiring must comply with local codes, regulations, and standards.

NOTE

It is important to use cable that is applicable to the installation environment. For example, in applications with high humidity of salt water, use cable made specifically for harsh, salt water environments. In all cases, typical cable insulation resistance should be 100 megohms or more. If resistance drops below 10 megohms, the cable may be deteriorating and should be replaced to avoid shorting out the system. When testing the insulation resistance, disconnect the detector/controller leads before applying a megohmmeter (insulation tester) to the cable.

MOUNTING AND WIRING PROCEDURE

The following procedure should be used for mounting and wiring the detector/controllers. See Figure 7.

1. Detector/controllers should be located to provide the best unobstructed view of the area to be protected. Ensure the detector/controllers are accessible for cleaning. Attention must be paid to false alarm sources such as IR radiation through the rotating blades of a fan or surface vibration of an IR source causing flickering signals within the cone of vision. Dense fog, rain or ice can absorb IR radiation, which can reduce the capability of the detector/controller. For outdoor applications, aim the detector/controllers downward to prevent the cone of vision from scanning the horizon. This minimizes response to distant infrared sources outside the protected area. If the detector/controllers are tilted, position them in such a way that one of the two Fire LEDs is visible.

2. Mount the detector/controller bulkhead and mounting bracket assembly on the wall or ceiling. The surface must be free of vibration and suitable to receive 1/4 inch (M6) screws with a length of at least 1 inch (25 mm).

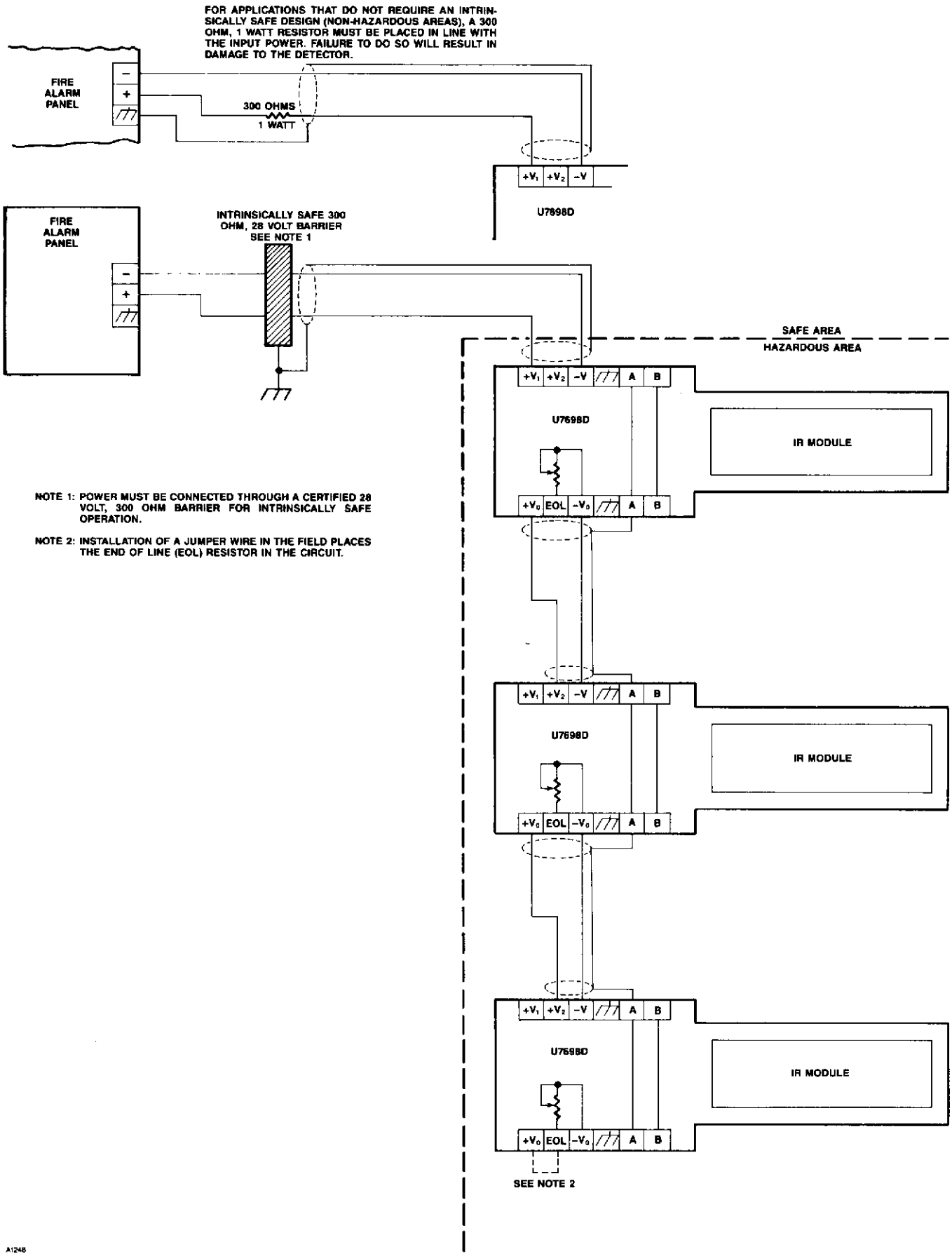


Figure 9—U7698D Wired in a Typical Multiple Unit Configuration

3. Remove the terminal housing and the barrel/window housing by turning them counter-clockwise from the bulkhead.

4. Route the field wiring from the conduit or gland, through the conduit entry. The cable shield should be connected to earth ground only at the power source.

5. Attach the wires to the terminal blocks. See Figures 8 and 9.

6. If wiring detector/controllers in a multiple configuration such as that shown in Figure 9, connect $+V_O$ of the first unit to $+V_2$ of the next unit and $-V_O$ of the first unit to $-V$ of the next unit. If any detector/controller is removed from the loop, all units down the line will be inoperable.

7. For a multiple detector/controller system, an end-of-line (EOL) potentiometer must be placed in the circuit of the last unit.

   Each U7698D has an EOL potentiometer (adjustable from 2.4 kilohms to 12.4 kilohms) installed, but not connected into the system circuit. To place the EOL potentiometer in the system circuit, install a jumper from the "EOL" terminal to the "$+V_O$" terminal of the U7698D (see Figure 9). After installation, adjust the EOL potentiometer to meet the requirements of the system (see Figure 7 for the EOL potentiometer location).

8. Remove the IR module from its shipping package.

9. Thread the wire leads and keyed connector plug through the slotted opening on the IR module, then plug the IR module into the two banana plugs in the bulkhead.

10. Connect the keyed connector plug to the 4-pin connector on the IR module. Tuck wires from the connector into the opening between the printed circuit board and the plastic bracket. Ensure that the wires do not rub on the barrel housing when the housing is screwed on.

11. Replace the terminal housing and the barrel/window housing.

12. Check all field wiring to ensure that the proper connections have been made. If conduit is used, pour the conduit seals and allow them to dry.

NOTE

When handling or disassembling the detector/controller housing, always check the O-rings for breaks, cracks, or dryness. A defective O-ring can cause failure by allowing water to enter the housing. To test an O-ring, remove it and stretch it slightly. If cracks are visible, it should be replaced (see "Recommended Spare Parts"). If the O-ring feels dry to the touch, lubricate it with polyalphaolefin grease being careful not to get grease on the window or the sensor. When re-inserting the ring, make sure it is properly seated in the groove on the housing.

STARTUP PROCEDURE

The startup procedure should be performed after installation of the equipment is complete.

1. Disable any extinguishing system connected to the U7698D or bypass the control unit.

2. Turn on the input power to the U7698D. Allow a 15 second power on delay to stabilize the IR sensor.

3. Hold a flickering IR source such as the Det-Tronics model W867 Test Lamp close to the detector/controller for 5 to 10 seconds.

4. The current flow will increase and the Fire LEDs will light as the device goes into alarm condition.

5. Turn off the IR source. The Fire LEDs and increased current flow will remain on until power is removed.

6. If the unit fails to pass the test, refer to the "Troubleshooting" section of this manual.

7. When all detector/controllers have been tested for normal operation, they should be checked to see that they adequately cover the areas to be protected. See the "Positioning and Density" section.

8. Remove power. There must be 0 volts at the detector/controller for 0.1 second to reset the unit.

9. Turn on the extinguishing system connected to the U7698D or reconnect the control unit.

PERIODIC CHECKOUT PROCEDURE

A periodic system checkout should be scheduled to ensure the system is operating properly. The period

between checkouts depends on the potential hazard and environmental conditions encountered. Frequent checkouts verify the reliability of the system.

When checking the electronics of the detector/controller and the cleanliness of the window, disconnect the extinguishing system to avoid unwanted activation. Check the detector/controllers by pointing a flickering IR source such as the Det-Tronics model W867 Test Lamp at each unit for five to ten seconds. Alarm response indicates that the window is clean and that all electronic circuits are operational. Lack of response may indicate reduced sensitivity due to heavy contamination on the sapphire window, a damaged sensor, or electronic circuit problems. See the "Troubleshooting" section if the unit does not respond.

TROUBLESHOOTING

Perform steps 1 through 8 before disassembling the U7698D.

1. Disable any extinguishing system connected to the U7698D.

2. Inspect the sapphire window for contamination. Infrared devices are relatively insensitive to contamination on the window although deposits of ice, dust or oil will lessen U7698D sensitivity. To clean the window, first remove power to avoid false actuation. Use Det-Tronics window cleaner (part number 001680-001) and a soft cloth or tissue.

3. Check input power and allow a 15 second warm-up period to stabilize the IR sensor.

4. Hold a flickering IR source such as the Det-Tronics model W867 Test Lamp close to the unit for 5 to 10 seconds.

5. Fire LEDs will turn on and latch.

6. Turn off IR source. Fire LEDs will remain on until unit is reset.

7. If the alarm device responded to the IR source, reset the system by interrupting power and proceed to step 10. If the device does not respond, proceed to step 8.

8. Turn off the input power and inspect all wiring for continuity.

9. If the wiring is not at fault, replace the IR Module. See Figure 7.

   a. Remove power to prevent possible false alarm.

   b. Remove barrel/lwindow housing.

   c. Remove connector plug.

   d. Unplug IR module from the bulkhead.

   e. Plug replacement IR module into the bulkhead.

   f. Ensure that the O-rings at the base of the barrel/window housing are positioned correctly and in good condition.

   g. Replace barrel/window housing.

Do not attempt to repair the IR module but return to the factory for repair (see "Device Repair and Return" section).

After troubleshooting the detector/controller, perform the complete "Startup Procedure" before returning the system to normal operation.

DEVICE REPAIR AND RETURN

Prior to returning devices or components, contact the nearest local Detector Electronics office so that an RMI (Return Material Identification) number can be assigned. A written statement describing the malfunction must accompany the returned device or component to expedite finding the cause of the failure, thereby reducing the time and cost of the repair to the customer.

Return all equipment transportation prepaid to the Minneapolis location.

Office Locations

Detector Electronics Corporation
6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Telephone (612) 941-5665
Telex 6879043 DETEL UW
Cable DETRONICS
Facsimile (612) 829-8750

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3000 Wilcrest
Suite 145
Houston, Texas 77042 USA
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Riverside Park, Poyle Road
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Via Carlo D'Adda, 5
I-20143 Milan
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Facsimile 39 2 89407638

Detronics AB
Rochussenstraat 49A
3015 Ec Rotterdam
HOLLAND
Telephone 010-436-2777
Facsimile 010-436-0296

ORDERING INFORMATION

When ordering, specify the enclosure material, conduit options, and if BASEEFA certification is required:

Anodized copper-free aluminum or 316 stainless steel
1/2-14 NPT, 3/4-14 NPT, 20 mm, or 25 mm.

OPTIONAL EQUIPMENT

Q1113 Air Shield Assembly
W867 Test Lamp

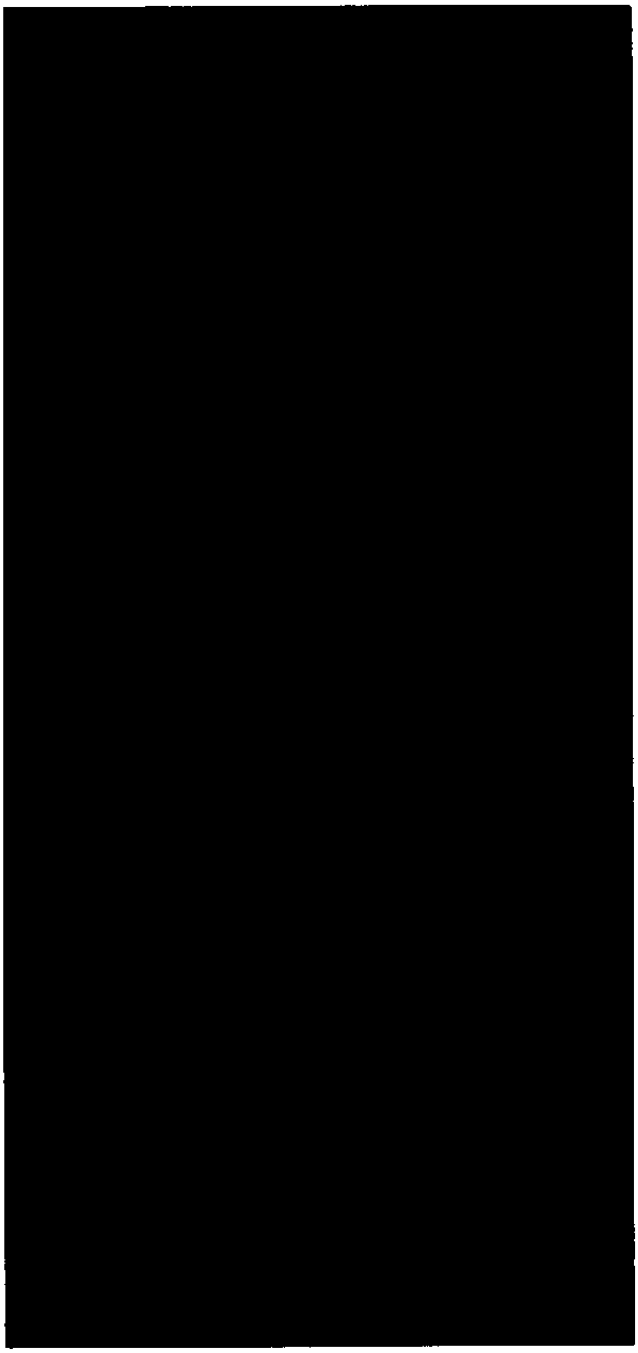
RECOMMENDED SPARE PARTS

Description	Part Number
Barrel/Window Assembly (cap, window, O-ring, and barrel)	
aluminum	003517-004
stainless steel	003517-003
Single Frequency IR Module (electronics)	DE4933-001
O-rings	
small	107427-004
large	107427-007
conduit entry	107427-022
Window Cleaner Kit (six bottles)	011680-001

APPLICATION ASSISTANCE

For assistance in ordering a system to fit your application, please contact:

Detector Electronics Corporation
Field Support Group
6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Telephone (612) 941-5665 or (800) 765-FIRE
Telex 6879043 DETEL UW
Cable Detronics
Facsimile (612) 829-8750



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