

DET _____
TRONICS



INSTRUCTIONS

Dual Frequency Infrared
Detector/Controller

U7099



APPLICATION

The Det-Tronics U7099 Unitized Dual Frequency Infrared (IR) Detector/Controller features two sensors, each looking at different wavelengths in the infrared spectrum. The signals from the sensors are used to detect particular spectral characteristics of burning hydrocarbon fires, and are processed so that false alarms from "blackbody" sources are reduced. Since electric arcs do not emit significant radiation at the response frequencies of the U7099, false actuations from arc welding will not occur. Thus the U7099 responds primarily to a true fire condition. Its performance is relatively unaffected by smoke, and contamination of optical surfaces by such things as oil and grease has only moderate effect.

The standard U7099 Dual Frequency Infrared Detector/Controller has a Fire and a Fault relay. A model that includes an additional Auxiliary Fire relay is available to provide expanded output options.

Typical applications for the Det-Tronics IR fire detection system are:

- aircraft maintenance hangars
- ship engine compartments
- hazardous locations where smoke can be expected to precede a fire
- hazardous locations where arc welding is conducted
- automobile paint spray booths
- turbine enclosures.

FEATURES

- Quick response to hydrocarbon fires - typical reaction time to a one square foot gasoline pan fire at 25 feet (7.5 meters) is less than 5 seconds.
- Not adversely affected by arc welding, strobe lights, lightning flashes, flashbulbs or radioactive sources (x-rays).
- Adjustable mounting swivel for ease of installation and positioning.
- Factory Mutual (FM) approved and Canadian Standards Association (CSA) certified.



SPECIFICATIONS

INPUT VOLTAGE—

20 to 32 vdc with a maximum ripple of 5 volts peak to peak.

ENCLOSURE MATERIALS—

Anodized copper-free aluminum.

ENCLOSURE RATINGS—

Explosion-proof housing designed for indoor use. FM approved and CSA certified for Class I, Groups C and D; Class II, Groups E, F and G. CSFM listed.

SENSITIVITY—

The IR sensing elements are adjusted for response to a one square foot gasoline pan fire at a distance of 25 feet (7.5 meters) on the primary axis in less than 5 seconds. Figure 1 gives response of the detector to fire at varying distances. Figure 2 is a diagram of the cone of vision.

POWER CONSUMPTION—

1.5 watts, typical, 2.5 watts, maximum.

TEMPERATURE RATING—

Operating: -13°F to +185°F (-25°C to +85°C).
Storage: -67°F to +185°F (-55°C to +85°C).

DIMENSIONS—

See Figure 3.

RELAY CONTACT RATING (Maximum)—

Resistive: 2 amperes at 28 vdc, 0.1 ampere at 115 vac.
Inductive: 0.5 ampere at 28 vdc.

RELAY OPERATION—

Fire (standard) and Auxiliary Fire (optional) Relays: These two relays are de-energized with no fire present, as shown in Figures 4 and 5. They energize when a fire is present that meets all criteria, and remain energized until 5 to 15 seconds after the fire is no longer detected. Fire relay is standard, additional Auxiliary Fire relay is available.

Fault Relay: This relay is energized with no fault present, as shown in Figures 4 and 5. The Fault relay energizes after an initial startup delay of 45 to 60 seconds when power is first applied. In the event of a power failure or when power is removed, the Fault relay will de-energize.

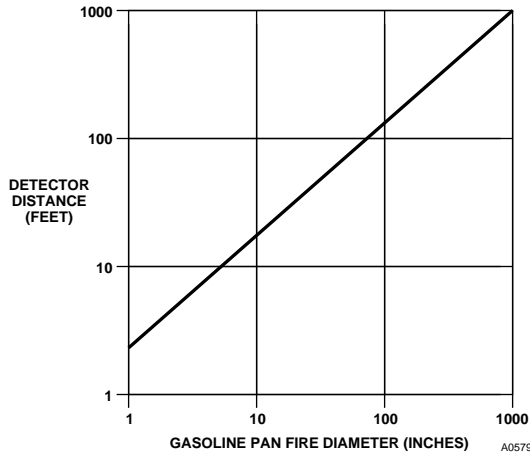
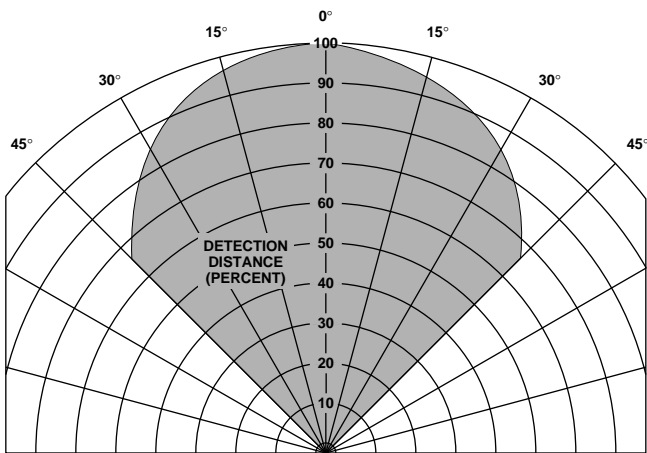


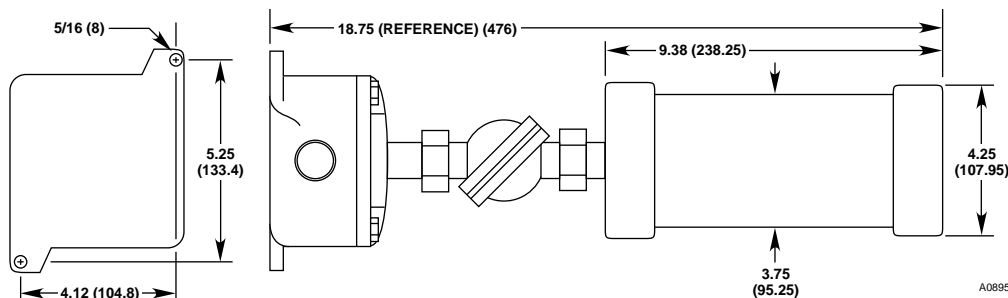
Figure 1—Response of the Detector to Fire at Varying Distances

100% REPRESENTS THE MAXIMUM DETECTION DISTANCE FOR A GIVEN FIRE. THE SENSITIVITY INCREASES AS THE ANGLE OF INCIDENCE DECREASES.



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Figure 2—U7099 Cone of Vision



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Figure 3—Dimensions in Inches (MM)

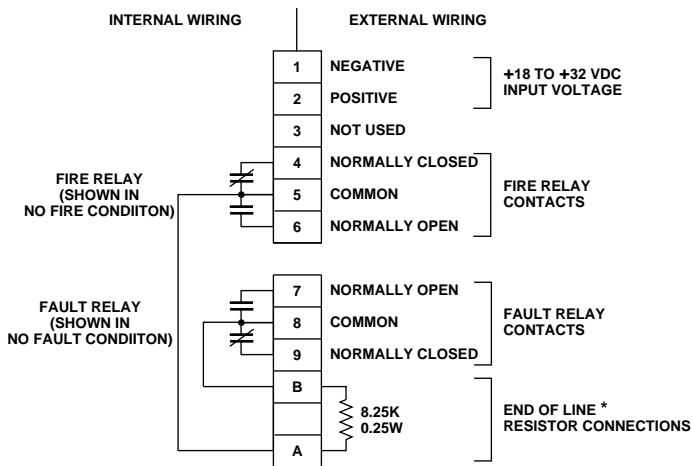
SYSTEM DESCRIPTION

The U7099 Unitized IR Detector/Controller is a dual frequency device that contains all electronic, sensing and switching components in the same explosion-proof enclosure. The device requires no external controller and provides one Fire relay output (NO/NC contacts) and one Fault relay output (NO/NC contacts). An optional model that includes the standard Fire and Fault relays (as described above) plus an additional Auxiliary Fire relay (NO/NC contacts) is also available. The Fault relay is normally energized with power applied and no faults present and deactivates in the event of an internal malfunction or power failure.

The Det-Tronics U7099 Unitized Dual Frequency Infrared (IR) Detector/Controller features two sensors, each looking at different wavelengths in the infrared spectrum. The signals from the sensors are used to detect particular spectral characteristics of burning hydrocarbon fires, and are processed so that false alarms from "blackbody sources" are reduced. Since electric arcs do not emit significant radiation at the response frequencies of the U7099, false actuations from arc welding will not occur. Its performance is relatively unaffected by smoke, and contamination of optical surfaces by such things as oil and grease have only moderate effect. Figure 6 illustrates the typical emission spectrum of hydrocarbon fires at sea level. The response range of the two sensors used in the U7099 is represented by the cross-hatched areas. Note that the fire emission intensity at the sensor 2 channel is greater than that at the sensor 1 channel. Before producing a fire indication, the U7099 IR Detector/Controller performs the following verification processes:

1. Measurement of signals from the two sensor channels.
2. Determination of the signal ratio between the two channels.
3. Detection of a signal on the 4.03 micron channel that is greater than a predetermined reference level.
4. Determination that the 4.45 and 4.03 micron radiation is synchronous.

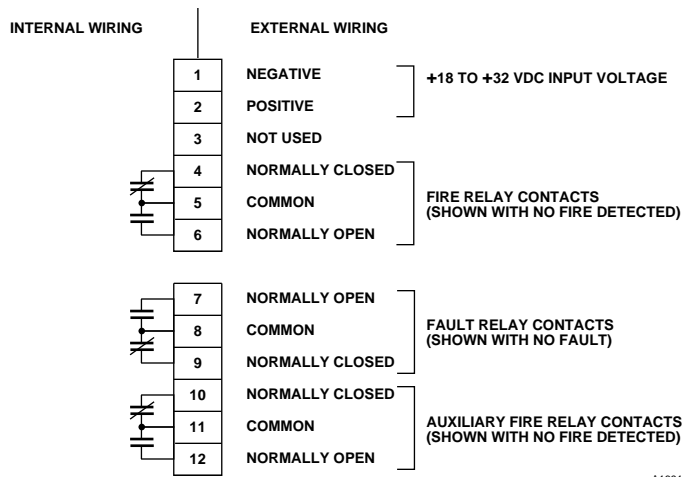
Potential false alarm sources such as welding arcs and lightning will not satisfy the above requirements, and are therefore ignored by the Detector/Controller.



* 8.25 KILOHM END OF LINE RESISTOR IS INSTALLED FOR USE IF REQUIRED. IF NOT REQUIRED, REMOVE THE END OF LINE RESISTOR FROM THE TERMINAL BLOCK (SEE FIGURE 9). WITH THE END OF LINE RESISTOR INSTALLED, THERE WILL BE CONTINUITY BETWEEN FIRE RELAY COMMON (TERMINAL 5) AND FAULT RELAY COMMON (TERMINAL 8). IF A DIFFERENT VALUE END OF LINE RESISTOR IS REQUIRED, REMOVE THIS RESISTOR AND REPLACE WITH ONE OF REQUIRED VALUE.

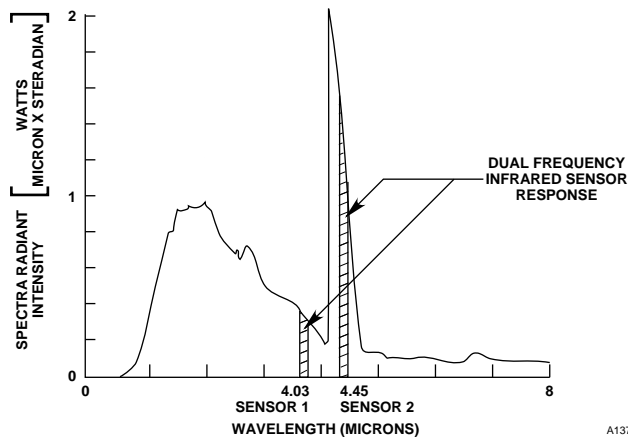
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Figure 4—U7099 Wiring Diagram



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Figure 5—U7099 Wiring Diagram with Optional Auxiliary Fire Relay



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Figure 6—Emission Spectrum of Hydrocarbon Fires at Sea Level

THEORY OF OPERATION

DETECTION

The detector of the U7099 consists of two thermopile sensors. These devices are sensitive to a broad band of infrared radiation, but are equipped with sapphire optical filters that only permit certain wavelengths of radiation to reach the sensor. One sensor is sensitive to IR radiation at 4.03 microns and the other at 4.45 microns.

SIGNAL PROCESSING

Figure 7 is a block diagram that illustrates the major components of the signal processing circuitry. The IR radiation to each sensor channel is transmitted through bandpass filters, and the output signal from each sensor channel is amplified. The gain control is automatically varied, depending on the input level. This gain control operates on both channels simultaneously to preserve and provide accurate signal information for ratio comparison. The signals are then checked to ensure that both channels are operating synchronously to prevent a single sensor from activating the system. Signals from the synchronous detector are introduced to the ratio comparator, which compares the level of the two sensor signals. The threshold detector compares the intensity of the sensor 1 channel signal to a preset reference. The startup delay inhibits the alarm output(s) after initial power-up, allowing approximately 60 seconds for the sensors to stabilize.

If the startup delay is over, the ratio of the two sensor signals is a fire signal. If the intensity of the sensor 1 signal exceeds the threshold level and the two signals are synchronous, the "and" gate activates an alarm signal that causes the Fire and (if applicable) Auxiliary Fire relays to energize. These relays remain energized until 5 to 15 seconds after the fire is no longer detected. If one or more of the four criteria is not met, the alarm signal is inhibited and the Fire relays remain de-energized.

The startup delay also inhibits the fault output for approximately 60 seconds after initial power-up, allowing the sensors to stabilize and the Fault relay to energize. In the event of a power failure or when power is removed, the Fault relay will de-energize, indicating a fault condition.

INSTALLATION

The U7099 has a nominal 90 degree cone of vision. Consider an installation having a height of 20 feet (6 meters) and assume it is desired to have complete detector coverage at a level 10 feet (3 meters) above ground. If a detector is mounted at the top and pointed

down, the distance from the detector to the designated level would be 10 feet (3 meters). Because of the nominal 90 degree cone of vision, the detector covers a circular area having a diameter of approximately 20 feet (6 meters). A simple layout of the area to be covered will show the number of detectors required to completely supervise the designated area.

DETECTOR MOUNTING AND WIRING

All wiring must comply with local codes, regulations, and ordinances.

1. Refer to Figure 8. While holding the detector barrel, remove the four hex screws from the top of the junction box. Carefully lift the detector barrel and unplug P1 from the terminal block board receptacle. Set the detector barrel aside.

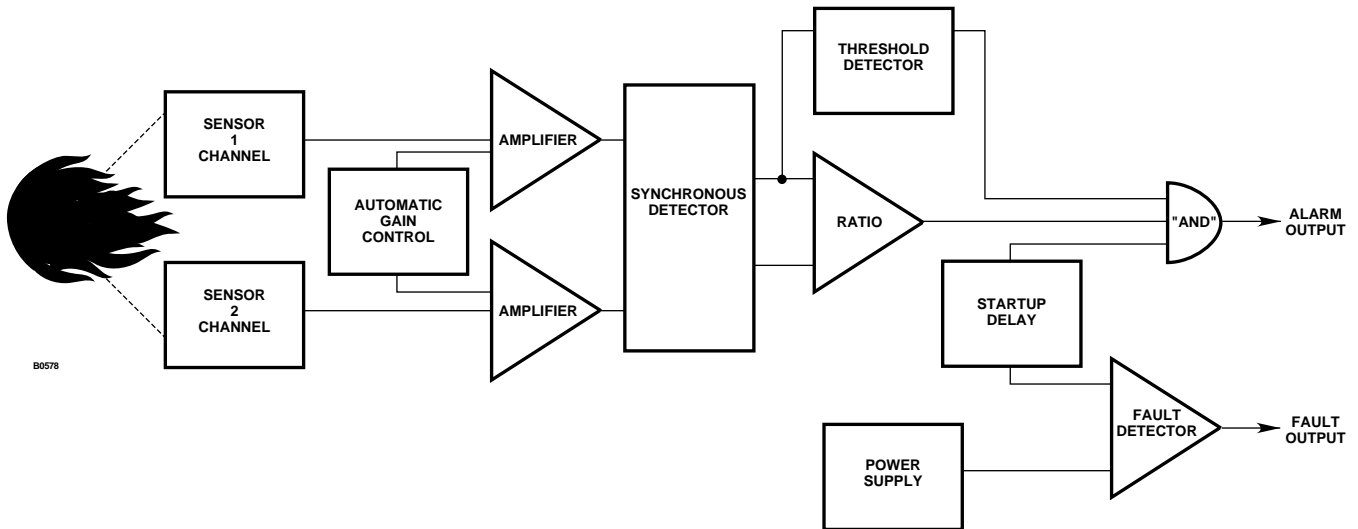


Figure 7—Block Diagram of U7099 Signal Processing Sequence

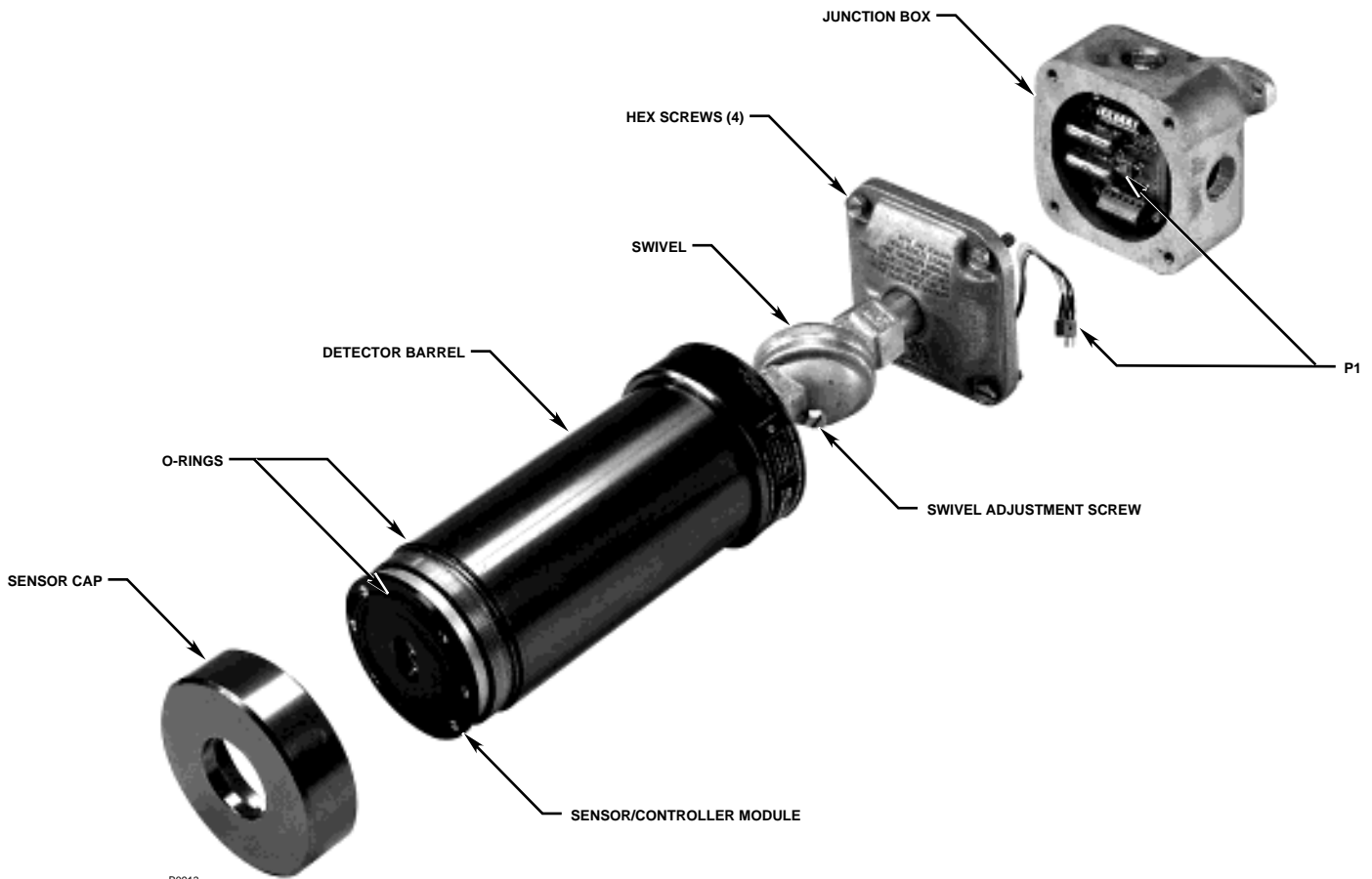


Figure 8—U7099 Assembly

- Mount the junction box in the desired location. See Figure 3 for mounting dimensions.
- Connect the input power and relay contact leads through the conduit to the terminal blocks. Figures 4 and 5 show the wiring diagrams for the standard U7099 and the U7099 with an Auxiliary Fire relay, respectively. Figure 9 shows the terminal block and end of line resistor locations. Figure 10 shows typical system wiring using two standard U7099 Detector/Controllers with an end of line resistor installed.
- Plug P1 from the detector barrel assembly into the terminal block board receptacle.
- Replace the four hex screws attaching the detector barrel to the junction box.
- Loosen the swivel adjustment screw to position the detector. Tighten screw when desired position is obtained.

IMPORTANT

An 8.25 kilohm end of line resistor is installed between terminals A and B on standard U7099 Detector/Controllers for use if required (see Figure 4). If an end of line resistor is not required, remove the resistor from the terminal block (see Figure 9 for location). With the end of line resistor installed, there will be continuity between the Fire relay common (terminal 5) and the Fault relay common (terminal 8).

- 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.

CAUTION
Do not rotate swivel more than 360 degrees. Swivel contains internal wires that can be damaged if rotated more than 360 degrees.

- Perform the "Startup Procedure."

STARTUP PROCEDURE

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

- Disable any extinguishing system connected to the unit. Connect external annunciation equipment to the U7099 relay contacts.
- Turn on the input power to the U7099 (allow one minute warmup).
- Hold the Det-Tronics Model W868 Test Lamp against the viewing window of the detector for 5 to 10 seconds.
- The alarm relay in the U7099 energizes the external annunciation equipment.
- Turn off the IR source.
- If the U7099 fails to pass the test, refer to the "Troubleshooting" section of this manual.
- When all detectors have been checked for normal operation, they should be checked to see if they adequately cover the protected areas for complete fire protection.

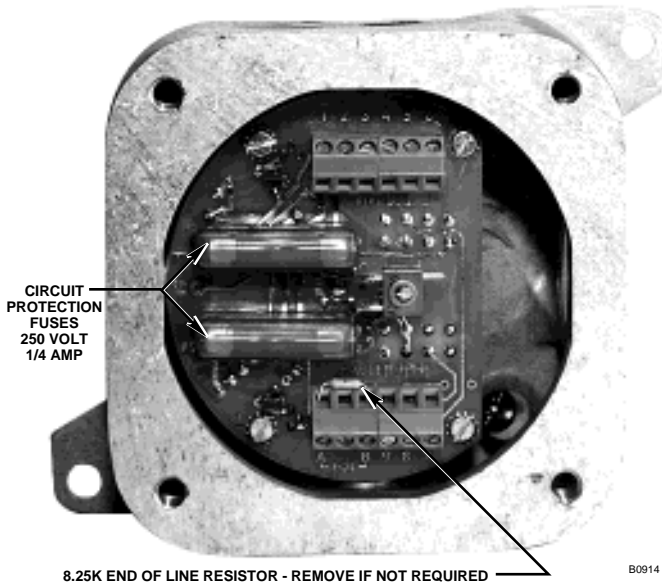


Figure 9—Terminal Block

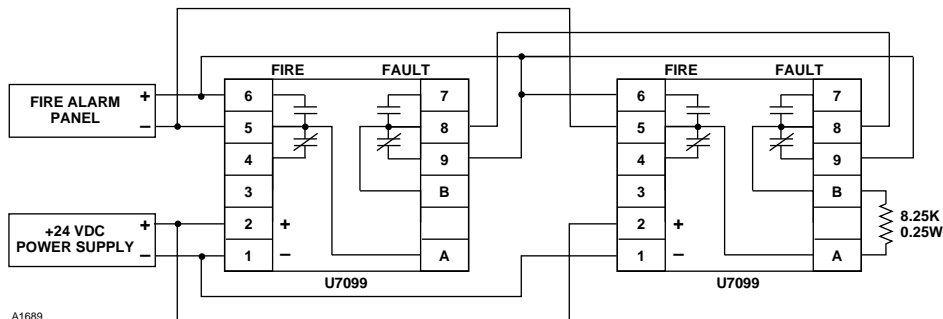


Figure 10—Typical U7099 System Wiring Using End of Line Resistor

8. Activate the extinguishing system at the completion of the Startup/Test Procedure.

PERIODIC CHECKOUT PROCEDURE

A periodic system checkout should be scheduled to ensure that the system is operating properly. The period between checkouts depends on the potential hazard and environmental conditions encountered. Frequent checkouts increase the dependability of the system.

When checking the electronics of the controller and the cleanliness of the detector window, the extinguishing equipment must be disabled. The simplest method is a remote key switch that disconnects or inhibits the extinguishing equipment.

To check the detectors, hold a dual intensity, flickering IR source such as the Det-Tronics Model W868 Test Lamp against the detector for 5 to 10 seconds. Controller response (Fire relay energizes) indicates a clean window and sensors, and that all electronic circuits are operational. Lack of response indicates sensitivity is reduced due to heavy contamination on the windows, defective sensor or electronic circuit problems. See the "Troubleshooting" section if the controller does not respond correctly.

TROUBLESHOOTING

Proceed through steps 1 through 7 before disassembling the unit.

1. Disable any extinguishing system connected to the unit.
2. Inspect the window for contamination that could prevent infrared radiation from reaching the sensor. To clean the window, use Det-Tronics window cleaner solution and a soft cloth or tissue.
3. Check input power to the detector and ensure that the warmup period is complete. Check circuit protection fuses (250 volt, 1/4 ampere) mounted on terminal block. See Figure 9.
4. Hold the IR source close to the unit for 5 to 10 seconds.
5. Alarm device (if connected) will activate.
6. Extinguish the IR source.
7. If the alarm device activated in response to the IR source, reset the system and proceed to step 10. If the device does not respond, proceed to step 8.
8. Turn off input power.

9. Replace the sensor/controller module (refer to Figure 8).
 - a. Remove sensor cap.
 - b. Slide sensor/controller module out of housing.
 - c. Slide replacement sensor/controller module into the housing. Ensure the the replacement module is properly aligned with the index pin inside the housing before pressing it firmly into place.

NOTE

The housing base is spring loaded. To ensure the proper seating of the module, press firmly downward on the module top. The module should contact the detector barrel. If not, remove the module and check alignment before re-installing.

- d. Ensure that the O-rings on top of the module and at the top of the barrel are positioned correctly (see Figure 8) and in good repair (no cracks or breaks).
 - e. Replace sensor cap.
10. Repeat the "Startup Procedure" before returning the system to normal operation. Do not attempt to repair the IR sensor/controller module. Return all faulty components to the factory for repair.

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.

Pack the unit properly. Use sufficient packing material in addition to an antistatic bag or aluminum-backed cardboard as protection from electrostatic discharge.

Return all equipment transportation prepaid to the Minneapolis location.

OFFICE LOCATIONS

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Telephone (612) 941-5665 or (800) 765-FIRE
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Facsimile 58-61-926525

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Rio de Janeiro 22740-011
BRAZIL
Telephone (55) 21 392 9633
Facsimile (55) 21 392 5568

ORDERING INFORMATION

When ordering, specify the U7099 Dual Frequency
Unitized Infrared Detector/Controller.

RECOMMENDED SPARE PARTS

Description	Part Number
Sensor/Controller Module (plug-in electronic package)	SP003939-002
O-Rings (small)	107427-007
O-Rings (large)	107427-026
Window Cleaner	001680-001

ACCESSORIES

W868 Portable Dual Frequency IR Test Lamp
Q1114A Dual Frequency IR Air Shield Assembly

For assistance in ordering a system to fit your applica-
tion, please contact:

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