DET TRONICS

INSTRUCTIONS
UV Fire Detection System

R7300B C7050B

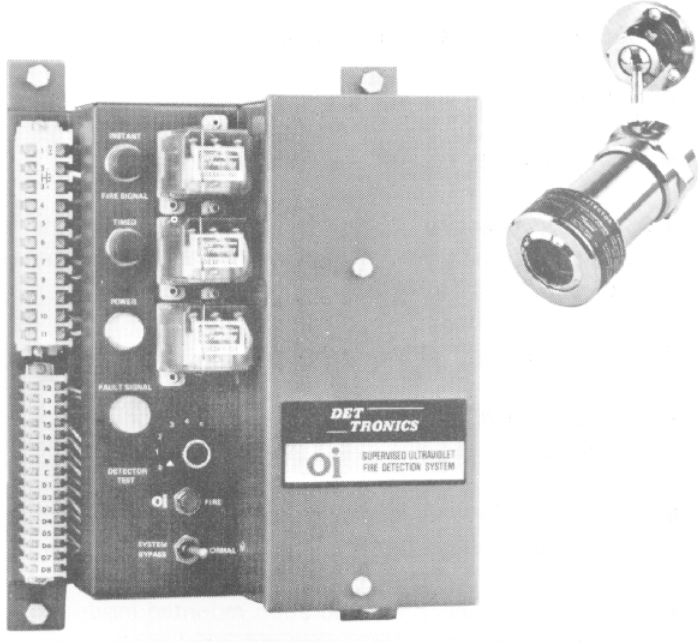

Figure 1—Fire Detection System.

SYSTEM APPLICATION

Designed for use in the protection of hazardous locations, the Detector Electronics R7300B Controller and the C7050B Detector provide a system for instantaneous response to flames and detection of fires generating ultraviolet (UV) radiation. A patented "Oi" feature provides supervision of the lens and critical circuit components.

The R7300B Controller is a surface-mount unit for enclosure inside cabinets or cubicles.

The C7050B Detector, enclosed in an explosion-proof housing, is designed for use in hazardous locations. It may be mounted in direct sunlight because it is designed to be completely solar blind. It will not respond to normal artificial light in indoor applications. Up to eight detectors may be connected to each controller.

Typical applications for the Det-Tronics ultraviolet detection system are:

- —Wherever highly combustible materials are involved.
- —Where there is a need for highly reliable and instantaneous response to flame.
- —Wherever unsupervised areas require automated fire protection.
- —Where there is a large capital investment to be protected.

Examples of actual installations using the Det-Tronics UV detector in automated fire protection systems include:

Petroleum Products
- —Gasoline transport loading terminals
- —Offshore drilling and production platforms
- —Pipeline pumping stations
- —Tank farms
- —Refineries
- —Marine engine rooms
- —Jet engine test cells

Gaseous Fuels
- —Butane and propane loading and storage
- —Pipeline compressor stations
- —Gas gathering facilities
- —Pipelines in highly populated areas
- —LNG and SNG loading, transfer, and storage facilities
- —LNG Marine tankers
- —Methane gas ignitions in coal mines
- —Hydrogen fires in ammonia production and refinery reformers

Solid Materials
- —Munitions productions, illuminating flame material, TNT, black powder, and other propellants
- —Electrostatic powder coating booths
- —Magnesium fires
- —Metal powders

Information on these and a wide variety of potential applications is available from Detector Electronics.

*Oi is Detector Electronics' Trademark for its patented Optical Integrity Systems. U.S. Patent 3,952,196, United Kingdom Patent 1,534,969, Canadian Patent 1,059,598 (1979).

FEATURES

- Monitoring of all circuitry by utilizing the "oi" feature insures proper functioning of critical components.
- Fast response—Typical response to an intense ultraviolet source is less than 25 milliseconds. Systems are available for applications where response times of less than 10 milliseconds are needed. Write for additional information.
- Not sensitive to solar radiation.
- Not sensitive to normal artificial lighting.
- Field adjustable controller sensitivity.
- Two independent relay actions. The first relay responds instantly and the second relay has a field adjustable time delay of 0.2 to 12 seconds.
- Not sensitive to voltage fluctuations.
- Plug-in printed circuit boards and relays for ease of maintenance.
- Detector housing is corrosion resistant nickel-plated brass, 316 stainless steel or anodized aluminum.
- Sensor tube is shock and vibration mounted inside the detector housing to meet rugged industrial applications.
- Fungus-proof treated sensor tube module.
- Connections provided to the trouble relay for external visual and/or audible status indication.
- Connections provided for remote functions, including alarm, extinguish, and trouble signal.
- Wide range of input voltages and frequency options available for worldwide applications.

OPTIONS

The extinguish relay or instant relay circuit may be furnished with zero time delay 120 vac or 24 vdc solid state relays for munitions or other extremely hazardous applications.

Separate load monitoring circuits available where required.

Latching relay circuit (alarm and extinguish relays) available.

GENERAL APPLICATION INFORMATION

In applying any type of sensing device as a fire detector, it is important to know those things that may prevent the device from responding to a fire, and also to know what other sources besides fire will cause the device to respond. An ultraviolet detector is useful in fire protection applications because it will provide very fast response to the presence of ultraviolet radiation from a flame. In addition, it is the only type of sensor that is not affected by wind, rain, snow, extremes of temperature or extremes of pressure. The Det-Tronics UV system is also "solar blind" and is not affected by the ultraviolet component of solar radiation.

Considering the above, it can be seen that there are fire detection applications where only ultraviolet sensors would be suitable. However, success in using an ultraviolet detector is dependent not only on knowing its advantages, but also its limitations. It is important to note that electric arc welding is an intense source of ultraviolet radiation, and care must be taken to ensure that arc welding is not performed in protected areas without securing the detector. In addition, UV detectors should not be positioned so their cone of vision coincides with the horizon; rather, they should be directed down, over the protected hazard.

An important fact regarding radiation detectors of any type is that the radiation must reach the detectors in order for them to respond. Care must be taken to keep physical obstructions out of the line of view, and for an ultraviolet detector, it means that ultraviolet absorbing gases or vapors must not be allowed to accumulate between the detector and the protected hazard. Smoke will absorb ultraviolet radiation, and if accumulations of dense smoke can be expected to precede the presence of flame, then ultraviolet detectors should not be used alone.

It must be noted that malfunctions can occur in any type of equipment, and although the Det-Tronics systems are subjected to rigorous tests before shipment, no way has yet been found to guarantee that every device will be perfect. The highest reliability with regard to response to a fire is achieved when a hazardous area is supervised by more than one detector, and when each detector can independently register an alarm.

SYSTEM DESCRIPTION

The Det-Tronics UV fire detection system consists of a UV detector housed in an explosion-proof, corrosion resistant enclosure, and a remotely mounted controller, which incorporates all required electronic and switching components. The controller is designed for use in non-hazardous areas. See Figure 1.

oi Feature*

The patented Optical Integrity feature, known as oi* was developed by Detector Electronics. It provides a means of assuring that the entire fire detection system is operational and ready to respond to fire or explosion, by checking the detector's optical surfaces as well as the associated electrical circuitry at the controller. It affords early warning of system faults so corrective maintenance may be performed.

UV Detector

The UV detector is a Geiger-Mueller tube that responds to ultraviolet radiation. It is mounted in an explosion-proof housing. When UV strikes the tube, a signal is sent to the comparator circuit of the controller. If the UV sensitivity of the controller is exceeded, an output relay is instantaneously actuated and, after a timed delay, a second relay is actuated.

Controller

The controller contains all electronic circuitry for processing signals from the detector to actuate the relays that control fire alarm and fire protection equipment.

It also contains a bypass switch for temporarily dis-arming the fire protection equipment, while making an oi* check.

System Checkout

oi - The Optical Integrity feature developed by Detector Electronics provides the user with a method for remote system checking of the optical integrity of each detector, and also checks all sensing and alarm circuits to be sure they are operational. See "Checkout Procedure" section for usage.

Dimensions

The controller may be mounted using the four mounting brackets as furnished or the brackets may be reversed. See Figure 2 for mounting dimensions of the detector. See Figure 3 for mounting dimensions of the controller.

Controller Sensitivity

Controller sensitivity is field adjustable for 25, 50, 75 and 100 counts per second response, such that a reference flame [consisting of a gasoline fire generated from a one-square-foot surface (0.09 square meter)] can be detected at distances ranging from less than 15 to greater than 30 feet (4.6 to 9.1 meters). See "Theory of Operation" section for explanation of count rate.

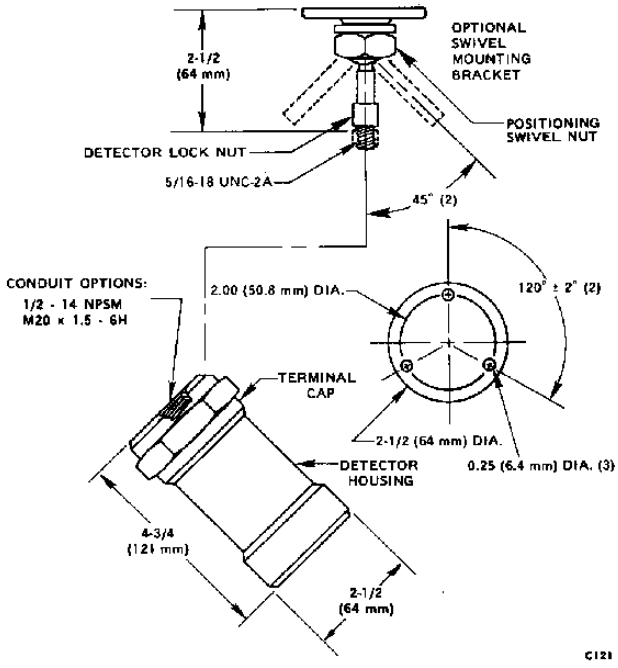

Figure 2—Mounting Dimensions of the Detector in Inches (mm).

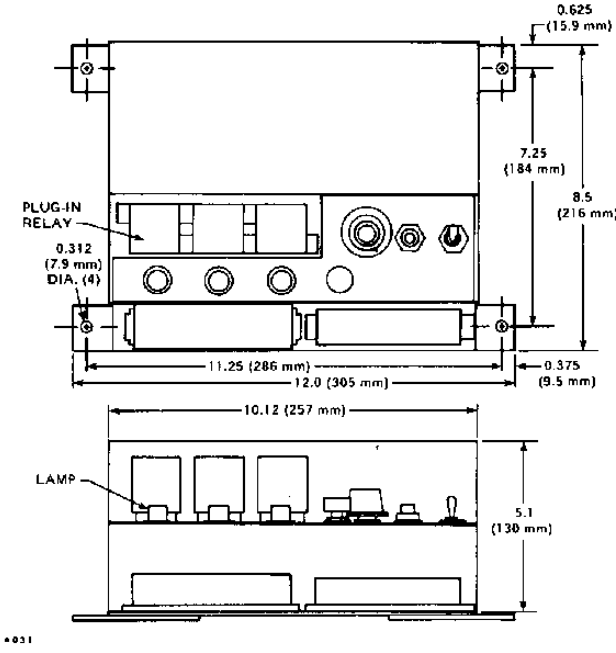

Figure 3—Mounting Dimensions of the Controller in Inches (mm).

Detector Enclosure Rating

Watertight - dust-tight - designed to meet NEMA standards Publication IS 1.1 - 1975 for Type 4 enclosures. CSA certified Enclosure 4.

Hazardous locations - FM approved for Class I, Groups A, B, C and D; Class II, Groups E, F and G. CSA certified for Class I, Groups C and D; Class II, Groups E, F and G. BASEEFA certified for Group IIc (Hydrogen).

Wiring Requirements

A shielded three wire cable plus one more wire, minimum 22 gauge (0.324 square millimeter) 400 volt rating must be used to connect the controller to the detectors. If the cable is installed in conduit to the detectors, it should be used exclusively for the signal cable to avoid noise pulses. The detectors may be located up to 1000 feet (300 meters) from the controller. See "Installation" section and Figure 11 for wiring connections.

We recommend the use of Belden cable 8770 or equivalent.

SPECIFICATIONS

Electrical Ratings

Input Voltage: Standard 120 vac, 50/60 Hz
Optional 220/240 vac, 50/60 Hz
12 vdc
24 vdc

Fluctuations between 85 and 110% of rated a.c. voltage have no effect on detector sensitivity or system operation.

12 vdc models operate over the voltage range of 10.5 to 16.0 vdc.

24 vdc models operate over the voltage range of 18.0 to 38.0 vdc.

(See Theory of Operation, controller section about special instruction for d.c. operation.)

Relay Contact Ratings: Form C (N.O. and N.C.) 10 amperes resistive, 8 amperes inductive.

Solid State Relay Ratings: Optional for use in the time delay circuit. Form A (N.O.). 24 vdc model—1 ampere continuous, 5 amperes intermittent. 120 vac model—7 amperes.

Manual Switch Ratings: 10 amperes resistive, 8 amperes inductive.

Power Consumption: A.C. or D.C., standby condition is typically 12 watts. Maximum power required during actuation is 20 watts.

CONE OF VISION—
The detector has a nominal 80 degree cone of vision, with the highest sensitivity lying along its central axis as shown in Figure 4. This drawing provides a composite view of the cone of vision and relative response for different controller sensitivity settings. These response curves can be directly related to distance as shown in the chart of gasoline reference fire, Figure 12. Note that UV radiation from a fire increases as the fire grows. Thus, a small fire may emit radiation below the detector system's sensitivity setting, but will produce a detector actuation when it grows larger.

SPECTRAL SENSITIVITY RANGE—
The Det-Tronics UV Detector responds to ultraviolet radiation with a wavelength of 1850 to 2450 Angstroms. Detectors are not sensitive to direct or reflected sunlight or to normal artificial light.

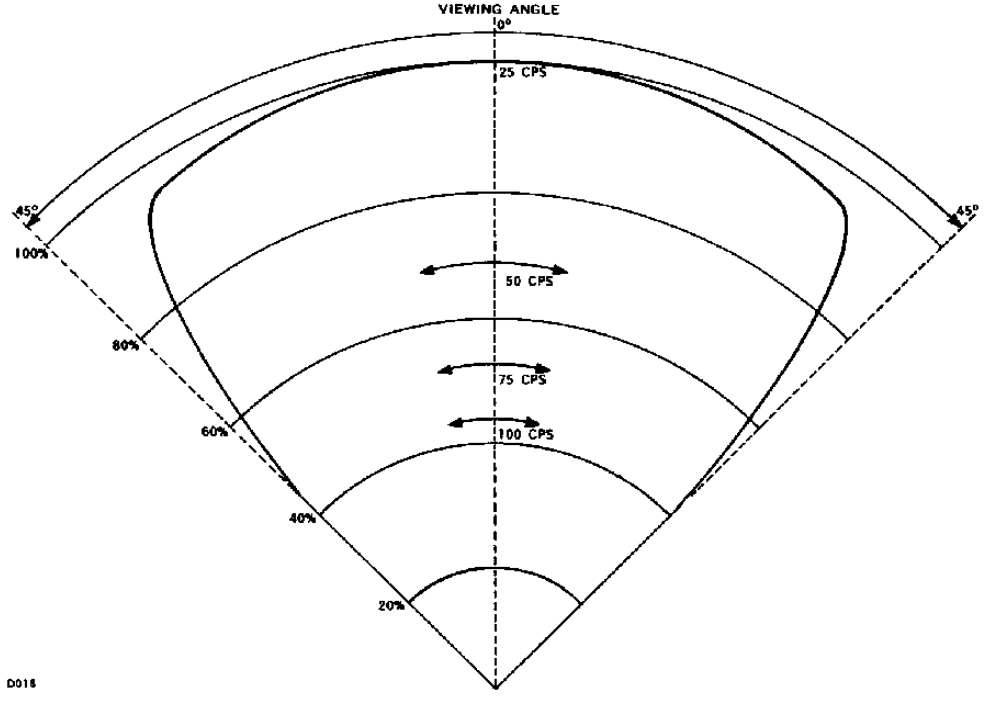

Figure 4—UV Fire Detector Cone of Vision.

NOTE: Intense levels of X-ray and Gamma radiation will cause the system to operate. See "Theory of Operation" section.

Also note that arc welding is an intense UV source, requiring special application techniques to restrict this radiation from the detector's cone of vision.

TEMPERATURE RATING–

Operating: -40 to +170°F (-40 to +77°C).
Storage: -67 to +170°F (-55 to +77°C).

SHIPPING WEIGHT–

	Pounds	Kilograms (Approx.)
R7300B Controller	13	5.85
C7050B Detector (aluminum)	1.25	0.56
(stainless steel or brass)	2.5	1.12

THEORY OF OPERATION

Detector

The Detector Electronics ultraviolet fire detector uses a Geiger-Mueller type detector designed to respond to UV radiation with wavelengths from 1850 to 2450 Angstrom units. (10,000 Angstroms = 1 micron = 0.001 millimeter.)

Figure 5 illustrates the detector's range of sensitivity, and compares this range to other forms of radiation. Note that the UV radiation from the sun reaching the earth does not extend into the detector's region of sensitivity. In addition, radiation from normal artificial lighting, such as fluorescent, mercury-vapor and incandescent lamps also does not extend into the detector's spectral range. As a result, the detector is not sensitive to these forms of radiation. Because of these factors, the detector may be used outdoors in direct sunlight, or it may be used in areas of normal artificial lighting.

Oj Checking Feature

An important consideration with any ultraviolet fire detector is that a gradual buildup of contaminants, e.g., oil, gasoline, dirt - on the window surface will absorb ultraviolet radiation. When the buildup is thick enough, the detector is effectively "blind."

Note that a film layer great enough to completely "blind" the detector can be virtually undetectable to the human eye.

Until now, the only way to detect such a buildup was with a portable ultraviolet "flashlight" that would simulate a fire. This procedure is slow and cumbersome, and requires two men - one with the flashlight, the other at the controller.

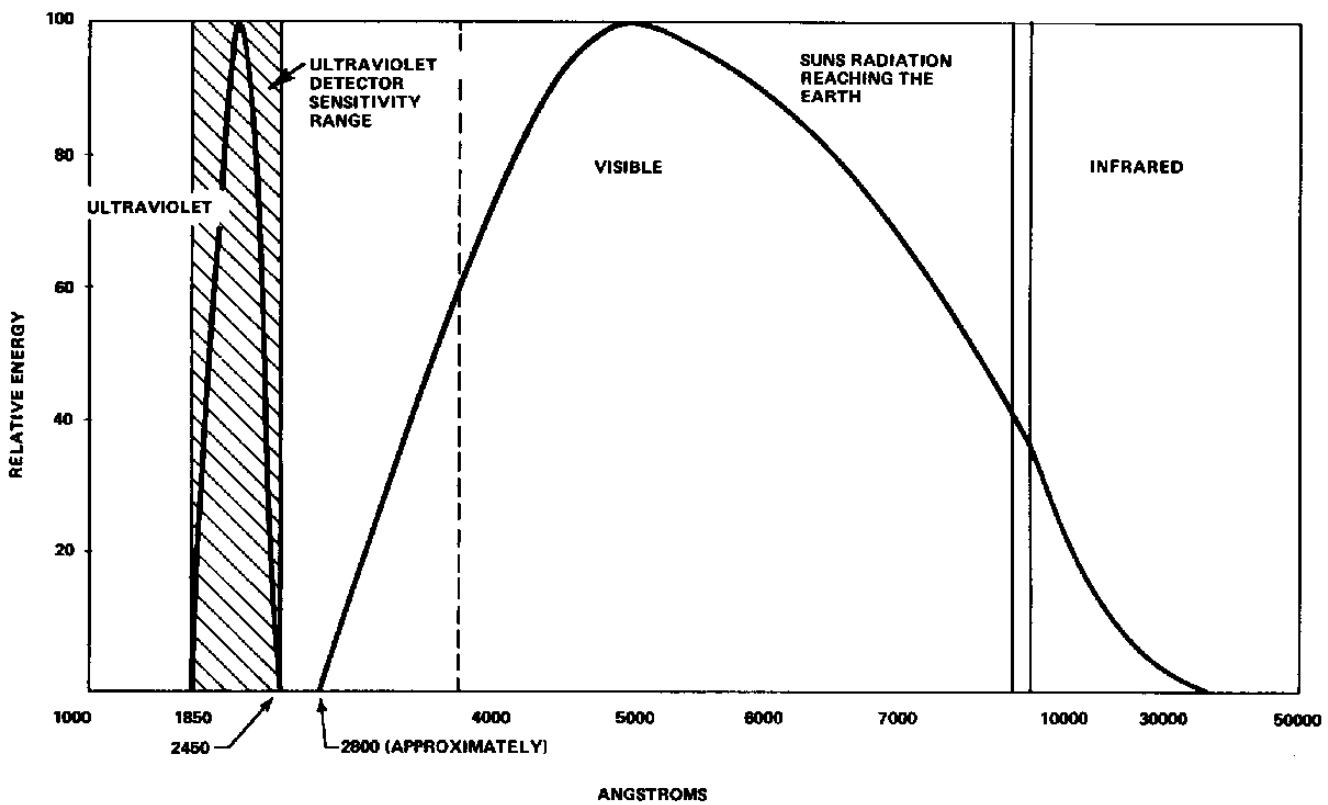

Figure 5–UV Detector's Range of Sensitivity in Reference to Other Forms of Radiation.

A simpler procedure is incorporated in Detector Electronics' "Oi" system. Here the detector itself has a tiny ultraviolet test lamp inside the housing, but screened by a special shield so the sensor cannot see it directly. Ultraviolet radiation from the test lamp goes through the window, reflects off a beveled ring mirror, and goes back through the window to the detector's ultraviolet sensor. See Figure 6 for illustration. Controller response indicates a clean window and that the detector and all electronic circuits are operational. Lack of response indicates that the sensitivity has been reduced due to contamination on the window, or that electronic circuits are not operating properly.

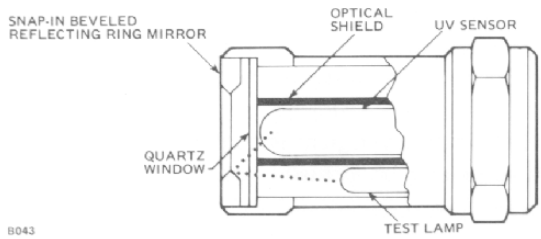

Figure 6—"Oi" Test Lamp in Detector Housing.

Controller

The R7300B Controller contains three independent relays: The first relay (called the Instantaneous relay) is activated immediately when UV radiation received by the C7050B detector exceeds a preset level.

The second relay (called the Time-Delayed relay) is activated if the detector signal is continuous for a preset time. The time delay is field adjustable over the range of 0.2 seconds to 12 seconds. The time delay feature can be used, for example, to assure that a fire of sufficient magnitude exists before an extinguishing system is energized. In many applications the instantaneous relay is used to sound an alarm and to cut off the source of fuel causing the fire, and the time delay relay is used to cause the fire extinguishing agent to be dispensed if the fire continues.

The third relay (called the Fault Relay) is normally energized and monitors for electrical faults within the system that could prevent proper operation in the event of a fire. Some electrical faults are not monitored by the fault relay, requiring a periodic system checkout to be performed for detection of these faults. (See periodic system checkout procedure.)

The fault relay de-energizes if one or more of the following occurs:

—If the Instant, Time Delay or Fault relay coils are "open" or if a relay is removed.
—If any of the four printed circuit boards are removed.
—If a short, ground or open leadwire to the detectors exists.
—If there is a malfunction in one of the circuits being monitored on the printed circuit boards.

The Standard Controller also contains four printed circuit boards.

Relay Drive - Board No. 1

The relay board (shown in Figure 7) provides the following:
—Circuitry to operate the instantaneous relay
—Circuitry for the time delay relay control
—Circuitry to operate the trouble relay
—Time delay adjustment potentiometer

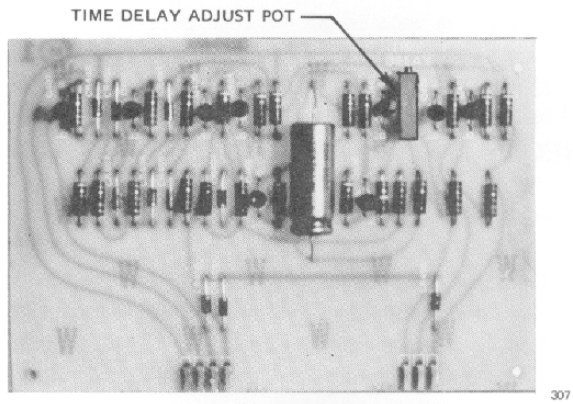

Figure 7—Board No. 1, Relay Drive.

Integrator and Comparator - Board No. 2

This board (shown in Figure 8) provides amplification and integration of the detector signal, and contains the sensitivity adjustment terminal block.

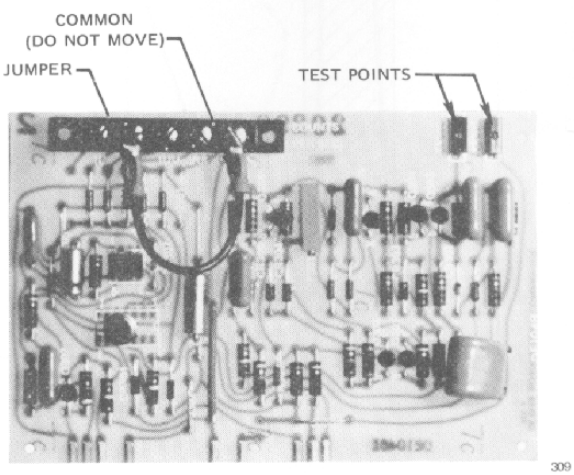

Figure 8—Board No. 2, Integrator and Comparator.

Detector Monitor - Board No. 3

The purpose of the detector monitor board is to continuously check the wiring between the detectors and the controller. (See Figure 9.) If a fault occurs in the detector circuit, the Fault Relay will be de-energized.

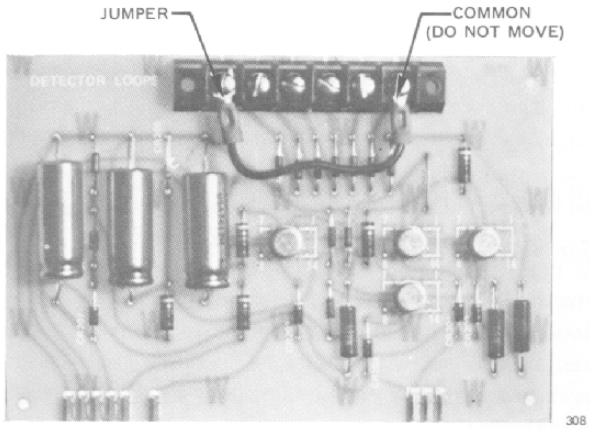

Figure 9—Board No. 3, Detector Monitor.

Power Supply - Board No. 4

The power supply board (shown in Figure 10) provides the regulated d.c. voltage for the amplifiers, the relay drive voltage and 290 volts d.c. for the detectors.

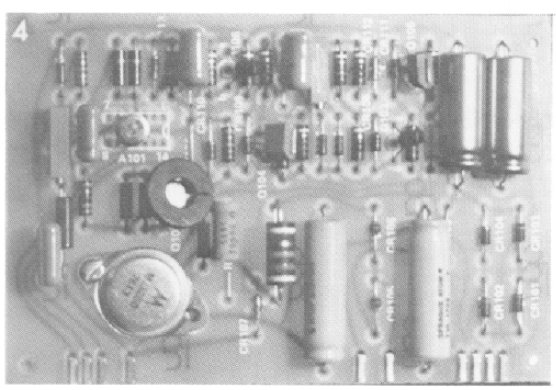

Figure 10—Board No. 4, Power Supply.

Inverter Board

The 12 vdc or 24 vdc controller has one inverter board in addition to the four boards mentioned above.

The inverter board (shown in Figure 11) replaces the line voltage transformer when the 12 vdc or 24 vdc versions of the R7300B are ordered. The controller is not field convertible from a.c. to d.c. power supply.

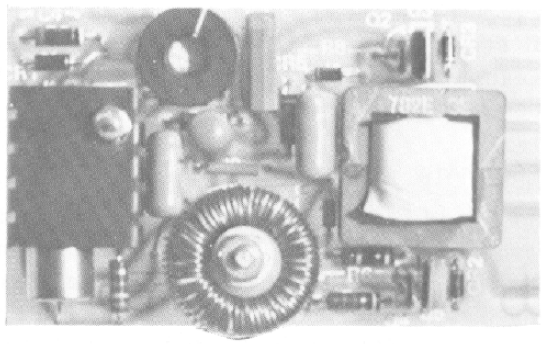

Figure 11—Inverter Board.

The 12 vdc version of the R7300B operates over a range of 10.5 vdc to 16 vdc maximum, including any ripple factor.

The 24 vdc version of the R7300B operates over a range of 18.0 vdc to 38.0 vdc maximum including any ripple factor. If the controller is operated with a power supply or battery having a float charger, the ripple factor must be added to the d.c. voltage so the output voltage supplied to the controller, including the ripple, does not exceed the maximum values given above.

Controller Sensitivity

Selection of controller sensitivity and the time delay to be used in a given application is dependent on the level of hazard present, and the action to be taken in event of a fire. The adjustable sensitivity and time delay features of the R7300B system allow it to meet the requirements of virtually any application. For sensitivity adjustment information, see the "Installation" section of this manual.

As previously stated, all UV detectors are sensitive to welding, and if this type of interference can be expected, it must be controlled through proper application. Successful application techniques include careful positioning or shielding of the detector, and adjusting the controller to a low sensitivity (high count) setting.

Since the UV sensor of this device is a Geiger-Mueller type detector, it will detect any radiation which can penetrate the glass envelope and create ion pairs. The glass envelope absorbs most Alpha or Beta particles, but it permits both

Gamma and X-rays to pass through. If these rays create ion pairs between the electrodes near the cathode, the normal discharge process will then occur and the detector will produce a count. If the X- or Gamma ray flux is sufficient to produce a count rate higher than the system sensitivity setting, a fire alarm will occur.

Data on the sensitivity of the C7050 Detector to various radiation intensities is impossible to relate to a typical detector exposure, due to the many variables which are needed to specify any given exposure. The normal precaution against false actuation due to this radiation is to turn off the detection system when sources of radiation are present. This, however, leaves the area unprotected so caution must be used.

System Sensitivity

The output signal from the UV detector is a voltage pulse, the frequency of which is determined by the size of the flame, the type of fuel that is burning, and the distance from the detector to the fire. The term "counts per second" (cps) is used to designate the number of voltage pulses generated per second by the UV detector. The closer a detector is to the fire, the smaller the flame that is needed to actuate the system. Figure 12 shows the relation between counts per second (cps) and distance. From these curves it can be seen, for example, that if a gasoline fire at 60 feet (18 meters) causes the detector to generate 20 cps, the same fire at 40 feet (12 meters) will generate 50 cps. Another example would be if a fire at 20 feet (6 meters) generated 100 cps, it would generate 8 cps at 70 feet (21 meters). Because of the complexity of the combustion process, the UV tube count rate generated by two different size fires at the same distance is difficult to predict. In general, however, if a fire doubles in size, the count rate is increased by approximately 60%.

INSTALLATION

Mounting

Detector - The detector may be mounted in any position, however, care must be taken so that dirt or other foreign materials will not accumulate on the lens. Each detector may be separated from the controller by a distance of up to 1000 feet (300 meters). See Figure 2 for basic mounting dimensions.

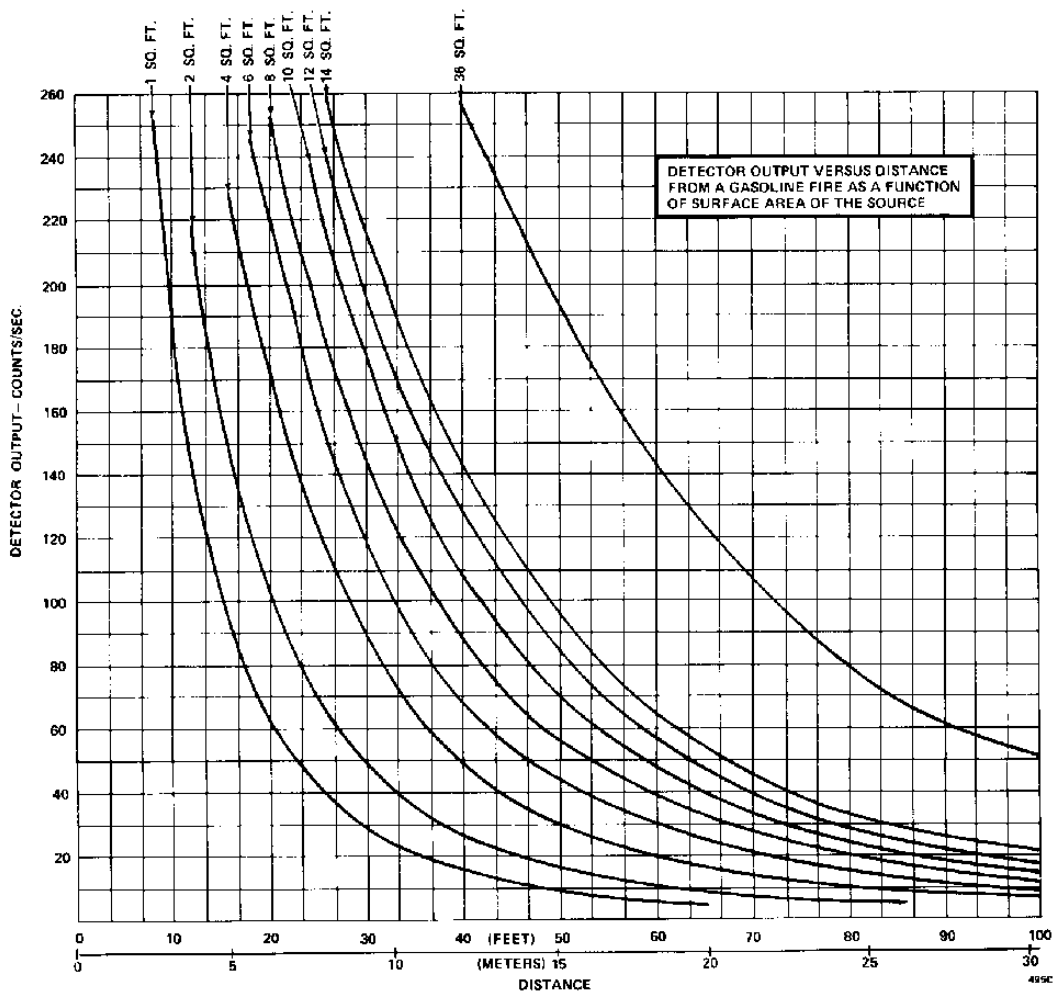

Figure 12–Sensitivity to a Gasoline Reference Fire.

The wiring to each detector should be in a three conductor shielded cable plus one more wire, 22 gauge or larger with at least a 400 volt d.c. rating. The shielded cable is common to all detectors but each detector needs a separate lead from the detector directly to the controller - the "D" lead. The shield is grounded only at the controller. When more than one detector is used the shields are connected together. See Figure 25 for illustration of typical installation. When the cable is run in conduit, it must be in a separate conduit from other electrical wiring.

It is also recommended that conduit sealing compound and conduit breathers be used because in some applications, such as outdoor locations, alternate changes in temperature and barometric pressure causes "breathing," which allows the entry and circulation of air through out the detector and connected conduit. Joints in the conduit system and its components are seldom tight enough to prevent this "breathing." Moisture in the air condenses in the conduit runs and equipment enclosures, and will continue to build up over a period of time. To eliminate this condition, explosion-proof drains and breathers (such as Crouse-Hinds types ECD) should be installed to automatically bleed off the water.

1. Detectors should be positioned for the best view of the area to be protected. A swivel mounting bracket (Q9001 assembly) is available for ease of installation. For outdoor applications the detectors must be directed downward to prevent the cone of vision from scanning the horizon, as the detectors may be affected by long term lightning flashes or arc welding. See Figure 2 for mounting dimensions.

2. Remove the detector housing by turning the housing cover counterclockwise. See Figure 13 for example of detector housing.

3. Install cable or conduit connector and wiring to connections A, B, C and D in terminal block. If the shielded cable is to continue to another detector, tie the shields together and isolate. If not, trim back shield so that it will not touch any connections. The shield is grounded **only** at the controller.

4. Remove tube module from packing and install, locating the correct terminal positions by the index pin.

5. Install four screws and tighten.

6. Replace detector housing.

Detector Positioning and Density

As previously stated, the Det-Tronics detector has a nominal 80° cone of vision. What this means in practical terms can be understood by reference to one typical installation: Consider an enclosure such as a pumping station having a height of 20 feet (6 meters) and assume that it is desired to have complete detector coverage at a level 10 feet (3 meters) above the floor. If a detector was mounted at the ceiling and pointed straight down, the distance from the detector to the designated level would be 10 feet. Because of the 80° cone of vision, the detector would cover a circular area having a diameter of about 17 feet (5.1 meters). A simple layout of the area to be covered will show the number of detectors required to completely supervise the designated area.

In general, detectors should be placed as close as practical to the probable hazard. Det-Tronics systems may be adjusted to various sensitivity levels by programming the controller so it will respond at a pre-determined detector discharge rate. This discharge rate is dependent upon the intensity of ultraviolet radiation reaching the detector,

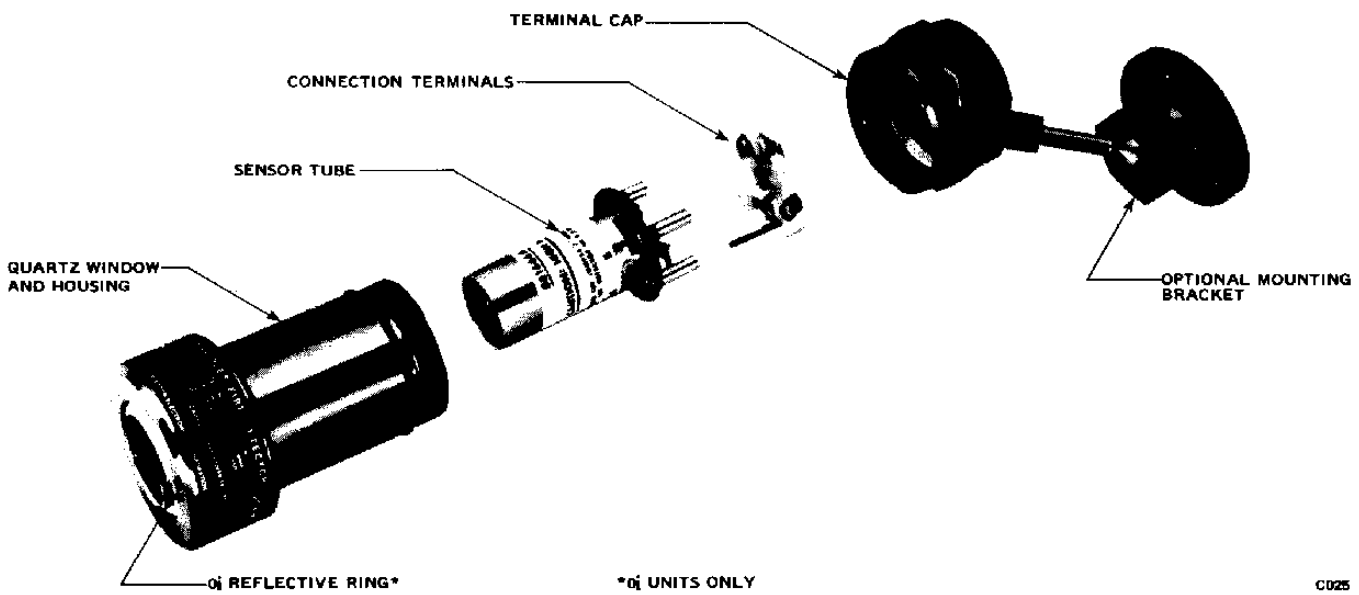

Figure 13--C7050 Detector Assembly.

which is a function of flame size, material burning and distance from the detector. Programming the controller to respond to a low discharge rate ("count rate") results in high system sensitivity. Conversely, programming to a high count rate results in low sensitivity.

Referring to Figure 12 and considering the information described above, the method of determining correct system sensitivity adjustment can be understood. For example, consider a hazard to be at a distance of 20 feet (6 meters) from the detector. Assume that the hazard is gasoline and that it is desired to produce an alarm signal when a "small" fire occurs. Reading on the horizontal "Distance" axis of Figure 12, locate the vertical line marked 20 feet (6 meters). Follow this line until it intersects the "one-square-foot fire" curve. Note that this occurs at about the line marked 60 counts per second on the vertical "Detector Output" axis. Therefore, a controller sensitivity setting of 50 cps would be capable of responding to a gasoline fire of this size with a detector located 20 feet (6 meters) from the flame.

NOTE

Do not mount UV detectors against a flat roof or ceiling where black smoke may accumulate at the onset of a fire. We recommend mounting on side walls a few feet down from the ceiling. Also shorten the delay time for any application where heavy oily smoke may be present before or during a fire.

Controller - The R7300B may be mounted in any position. (See Figure 3 for mounting dimensions.) It should be mounted in a location where it can be easily monitored and checked regularly. If the controller is mounted outdoors, a weather-resistant enclosure must be provided. If it is necessary to mount the controller in a hazardous location, an explosion-proof enclosure must be provided.

Electrical Connections

Controller

Figure 14 shows the standard a.c. terminal configuration of the controller. Figure 14A shows the d.c. terminal configuration. The a.c. terminal configuration is as follows:

Terminal 1 - connects to earth ground as indicated
Terminal 2 - connects to the neutral or negative of the input power line
Terminal 3 - connects to the hot side or positive of the input power line

Terminal 4 - normally closed contacts
Terminal 5 - normally closed contacts
Terminal 6 - normally open contacts
Terminal 7 - normally open contacts
(Instantaneous relay)

Terminal 8 - normally closed contacts
Terminal 9 - normally closed contacts
Terminal 10 - normally open contacts
Terminal 11 - normally open contacts
(Time Delay relay)

Terminal 12 - common
Terminal 13 - normally open
Terminal 14 - normally closed
(Fault Relay)

(These relay contacts are isolated and may be connected to any external power source within the electrical rating of the contacts in the relays.)

Terminal 15 - Remote reset (switch) of the Fault Relay
Terminal 16 - Remote reset (switch) of the Fault Relay

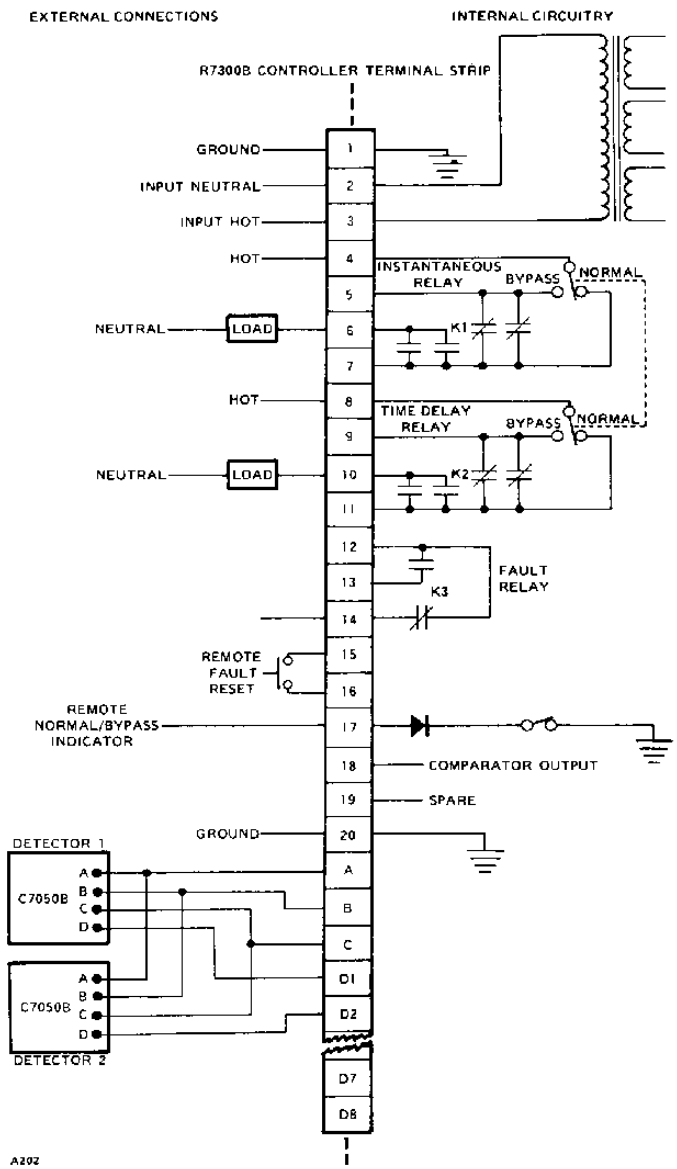

Figure 14—R7300B Controller Terminal Strip, All a.c. Operation.

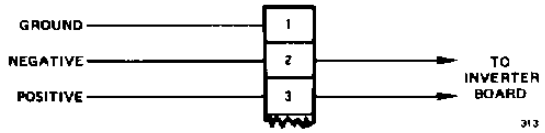

Figure 14A—R7300B Controller Terminal Strip, 12/24 vdc Operation.

Terminal A - connects from the Detector (s)
Terminal B - connects from the Detector (s).
Terminal C - connects from the Detector (s)
Terminal D1 - connects individual wire from Detector 1
Terminal D2 - connects individual wire from Detector 2
Terminal D3 - connects individual wire from Detector 3
Terminal D4 - connects individual wire from Detector 4
Terminal D5 - connects individual wire from Detector 5
Terminal D6 - connects individual wire from Detector 6
Terminal D7 - connects individual wire from Detector 7
Terminal D8 - connects individual wire from Detector 8

The shield on the cable containing leads A, B, and C is connected to Terminal 1.

Figures 15 to 20 show typical wiring diagrams for controllers using standard mechanical relays.

Figures 21 and 22 show typical wiring diagrams for controllers using solid state relays. ***NOTE: Solid state relays have zero time delay.***

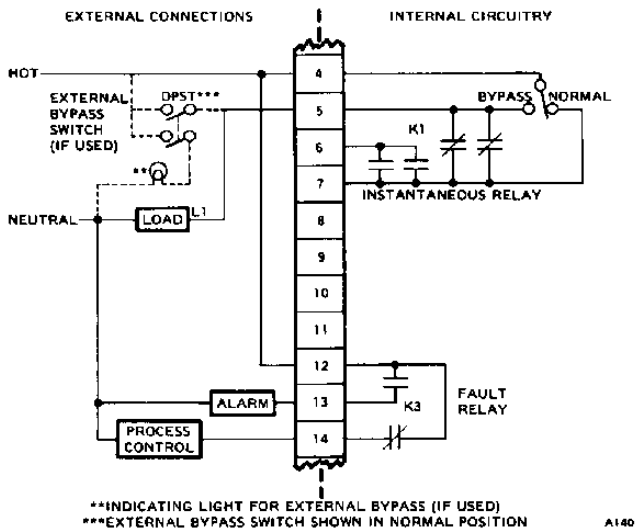

Figure 15—Normally Energized Load Circuit Connected to Instantaneous (Alarm) Relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Power to external load (L1) is removed when Instantaneous relay is in "fire" mode.

The purpose of the bypass switch in this type circuit is to allow checkout of the instantaneous relay without interrupting power to the normally energized external load.

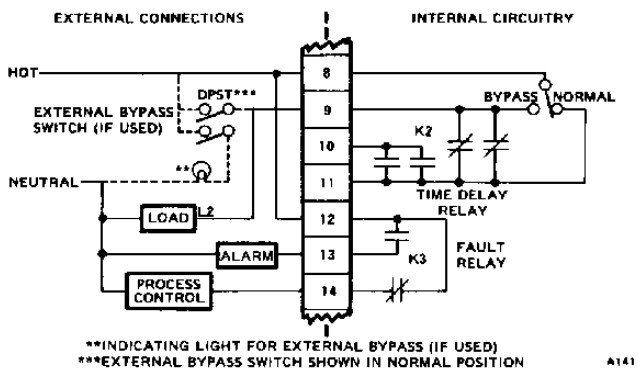

Figure 16—Normally Energized Load Circuit Connected to Time Delayed (Extinguish) Relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Power to external load (L2) is removed when Time Delay relay is in "Extinguish" mode.

Purpose of the bypass switch in this type circuit is to allow checkout of the Time Delay relay without interrupting power to the normally energized external load.

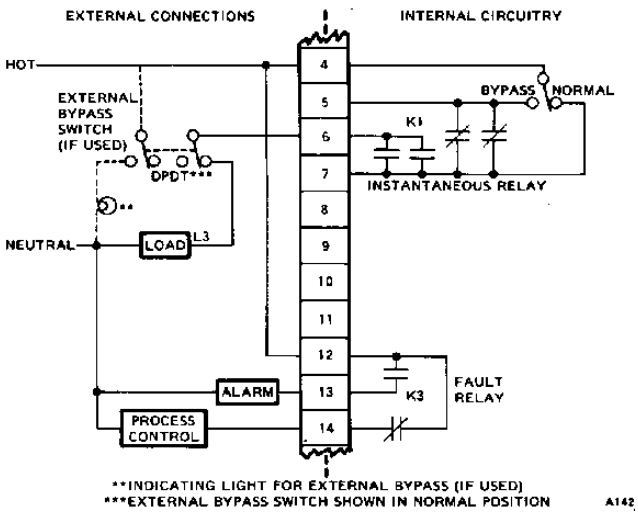

Figure 17—Normally Unenergized Load Circuit Connected to Instantaneous (Alarm) Relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Power is applied to external load (L3) when Instantaneous relay is in "fire" mode.

Bypass switch allows checkout of the instantaneous relay without applying power to the unenergized external load.

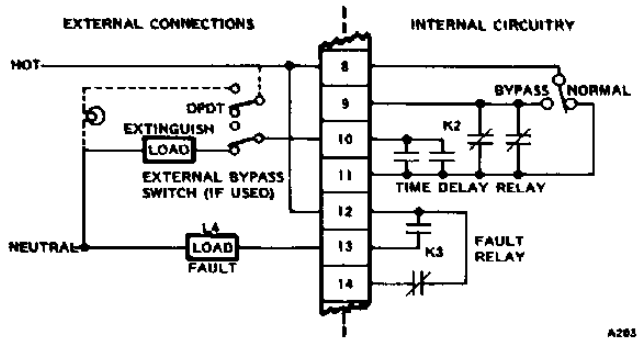

Figure 18–Normally Unenergized Load Circuit Connected to Time Delayed (Extinguish) Relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Power is applied to "trouble load" (L4) when fault occurs in supervised circuitry.

Power is applied to "extinguish load" when time delay relay is energized and both BYPASS switches (external and internal) are in normal positions.

BYPASS switch allows checkout of the time delay relay without applying power to the "extinguish" load.

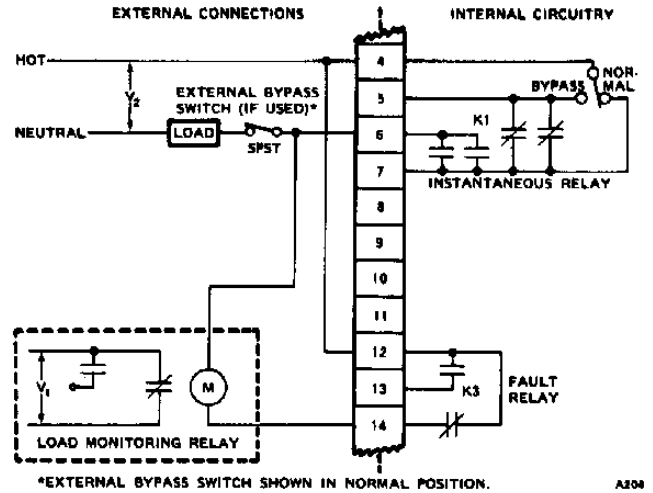

Figure 19– Normally Unenergized Load Circuit Connected to Instantaneous (Alarm) Relay with Load Monitoring Relay External.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Load monitoring external relay will de-energize under the following conditions: (1) a fault in the controller, (2) lead wires to detectors short or open, (3) open circuit in the external load, or (4) leads to the external load open.

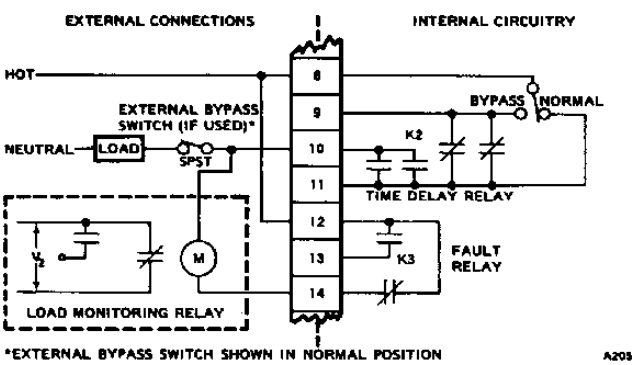

Figure 20–Normally Unenergized Load Connected to Time Delay (Extinguish) Relay with Load Monitoring Relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Load monitoring external relay will de-energize under the following conditions: (1) a fault in the controller, (2) lead wires to detector short or open, (3) open circuit in the external load, or (4) leads to the external load open.

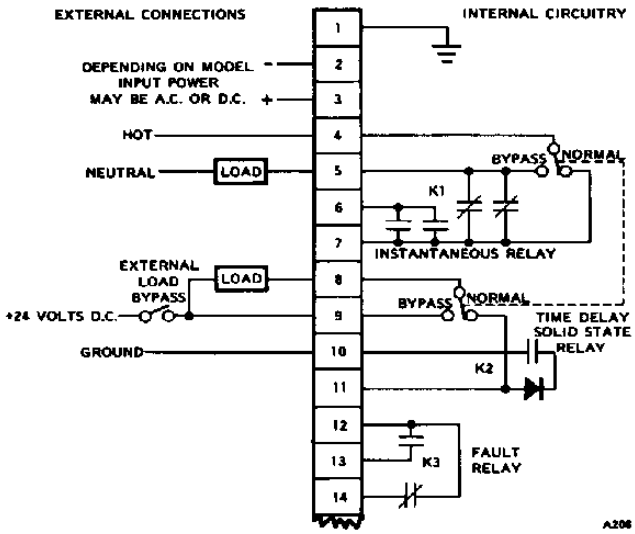

Figure 21—Typical R7300B Wiring Connections Using a 24 vdc Solid State Relay.

Normally unenergized load circuit connected to Time Delay solid state relay and energized load circuit connected to Instant relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Purpose of the bypass switch in this type circuit is to allow checkout of the Instant and the Time Delay relays without interrupting power to the normally energized Instant load, and without applying power to the unenergized load on the Time Delay relay.

The load (10 amperes maximum) on the Instant relay may be either 120 vac or 24 vdc.

The load (1 ampere constant, 5 amperes intermittent) on the Time Delay solid state relay is shown as a 24 vdc load.

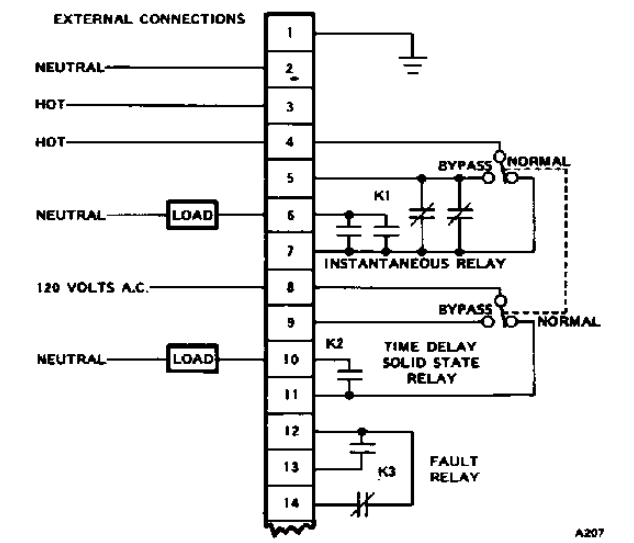

Figure 22—Typical R7300B Wiring Connections Using a 120 vac Solid State Relay.

Normally unenergized load circuit connected to Instant relay.

Normally unenergized load circuit connected to Time Delay solid state relay.

Fault Relay contacts are shown with relay energized (no trouble in circuit).

Power is applied to the external loads when the relays are energized (fire mode).

Purpose of the bypass switch in this type circuit is to allow checkout of the Instant and the Time Delay relays without applying power to the unenergized loads.

The load (10 amperes maximum) on the Instant relay may be either 120 volt A.C. or 24 volt D.C.

The load (7 amperes maximum) on the Time Delay solid state relay is 120 volts A.C.

Self-Latching Relay

When an external self-latching relay is used with the normally closed (N.C.) contacts of either the Instant or Timed relay and the normally open (N.O.) contacts are not used, a jumper must be installed to prevent the external relay from de-latching. For the Instant relay install a jumper from terminal no. 4 to terminal no. 7. For the Timed relay, install a jumper from terminal no. 8 to terminal no. 11.

If both the N.O. and the N.C. contacts on either the Instant or Timed relay are used, with an external self-latching relay connected to the N.C. contacts, a modification is necessary as shown in Figure 23.

NOTE

If the N.O. contacts are used to operate external equipment, DO NOT use the jumper mentioned above. Any external equipment connected to the N.O. contacts WITH THE JUMPER INSTALLED would operate even when the controller is in the BYPASS position.

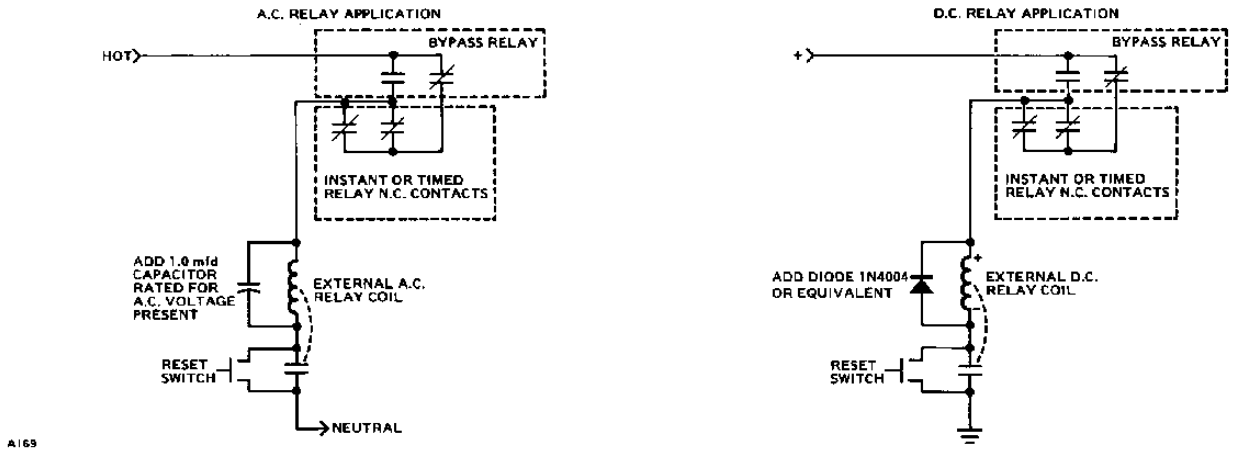

Figure 23–Self-Latching Relay Modification.

Detector

It is possible to connect four detectors directly to the controller and up to eight detectors to the controller with field modification. Terminals A, B and C on the controller terminal panel connect to A, B and C in the detectors. The detectors are wired internally with EOL (end of line) monitoring resistors between terminals A and B and A and C. See Figure 24. Terminal D in **each** detector is connected directly to the individual terminals D1 to D8 on the controller terminal panel. Up to four detectors may be connected to the controller in parallel with their end of line resistors connected. If more than four detectors (up to eight) are used, two or more detectors may be connected together, but this requires a modification of all detectors except the detector at the end of the line. The jumper shown in Figure 24 must be cut in all but the last detector and **in addition** the A, B and C wires from the first detector must be connected directly to the A, B and C connections in each succeeding detector. See Figure 25 for example of wiring. The wires A, B and C from the first detector are then connected to the appropriate terminals on the controller.

Be sure the jumper wire on the detector monitor board, Board No. 3 in the controller, is programmed for the number of EOL resistors in the circuits, up to four. See "Startup Procedure" for further information.

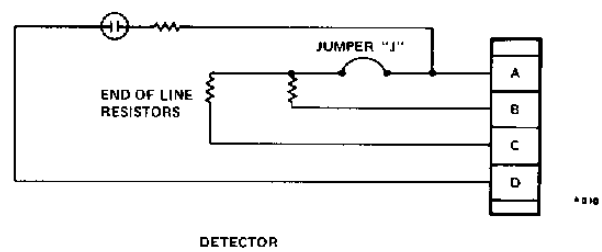

Figure 24–End Of Line Resistors.

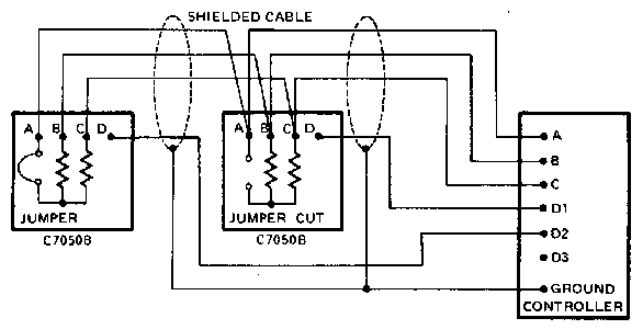

Figure 25–Wiring for Parallel Detectors.

STARTUP PROCEDURE

The following startup procedure should be performed after installation of the equipment has been completed. The NORMAL/BYPASS switch on the controller **must** be in the BYPASS position.

CAUTION: Always remove input power before removing printed circuit boards.

1. Sensitivity Adjustment

The controller is shipped with the sensitivity set at 25 cps. If it is desired to change this setting, remove the printed circuit board No. 2 labeled "Integrator and Comparator." Position the wire on the terminal block to the desired sensitivity by moving the spade lug to the appropriate terminal. The numbers below the terminal block indicate the available sensitivity settings in counts per second, e.g. 25, 50, 75 or 100. Firmly re-insert the printed circuit board. See "System Operation" section and Figure 12 regarding sensitivity levels.

2. Detector Monitor

The detector monitor board is shipped with the number of detectors to be connected set for one. If more than one detector is used, remove printed circuit board No. 3 labeled "Detector Monitor" and move the spade lug of the jumper wire to the appropriate terminal for the number of EOL resistors in the detector circuits. The system can use up to a maximum of eight detectors, but can have only four detectors with EOL resistors connected. To use over four detectors (up to a maximum of eight detectors) it is necessary to modify each detector that is connected in parallel by disconnecting the EOL resistors (cutting jumper "J" in the detector). (See Figure 24.) Then each modified detector is connected in parallel with a detector containing an EOL resistor.

3. Time Delay

The time delay relay is adjusted at the factory for 5 seconds. The total adjustment range is from 0.2 seconds to 12 seconds. If it is desired to change the time delay, put the NORMAL/BYPASS switch on the controller in the BYPASS position and turn on input power.

Pushing the oi switch turns on the INSTANT lamp. Begin timing until the TIMED lamp turns on. It should be approximately 5 seconds. To change the delay time, adjust the potentiometer on the relay drive board (printed circuit board No. 1) to provide the desired time delay. See Figure 7 for location of potentiometer on board. Turning the potentiometer counterclockwise increases the time delay and turning clockwise reduces the delay. Approximately one turn equals one second.

NOTE: If controller is to be mounted in a hazardous area, adjust the time delay to desired setting before installation. Do not apply power to the controller in a hazardous area unless completely enclosed in explosion-proof housing.

Startup Check

After the above adjustments are made, the sensitivity of the system should be checked. This requires two people, the use of a UV source (or optional accessory W866 Test Lamp) and a d.c. voltmeter with at least 20,000 ohm/volt movement. Put the DETECTOR TEST switch on the controller in position No. 1. Push the "oi" button. The INSTANT lamp should light immediately and the TIMED lamp should light when the time delay passes. If the lamps do not light, see "Troubleshooting" section for corrective measures. Proceed to test each position of the DETECTOR TEST switch for each position or number of detectors used in the system as given above.

Next, locate one person in front of Detector No. 1 at the maximum distance to be covered. Turn on the UV source (W866 Test Lamp) and shine into the lens of the first detector. The INSTANT lamp should light almost immediately and the TIMED lamp should light when the time delay passes. If the lamps do not light, move closer to the lens until the INSTANT lamp turns on. This is the "maximum" distance for this detector. The distance should be recorded for future reference when an overall checkup of the system is scheduled. See recommended test form at the end of this manual. Repeat the above procedure for every detector in the system and record data.

Next, attach a voltmeter to the test points provided on Board No. 2, Integration and Comparator board. Set the meter on a scale where 0.2 vdc can be read. See Figure 8 for location of test points. When the detectors are not exposed to UV radiation, the voltage should be 0.05 vdc, pulsing periodically to 0.2 volt not more than once every 5 seconds. If the voltage is above this level, it indicates that one or more detectors are responding to spurious radiation or discharging due to internal fault. Cover the lens of each detector to determine whether the problem is internal or external. If covering the lens removes the signal and the voltage drops to normal, locate the external source of spurious radiation and either shield the detector or remove the source. If no external signal is found, a detector module may be at fault. Successively disconnect each detector until the faulty unit is found. Replace the faulty detector and recheck the voltage to see that it has returned to normal.

Some sources of spurious radiation are the following:

1. Welding operations (detectors may respond to arc welding up to one-half mile (1 kilometer).
2. High inductive load switching nearby or in same conduit.
3. Gamma or X radiation.

The system is now ready to be put into operation by placing the NORMAL/BYPASS switch in the NORMAL position.

Periodic System Checkout Procedure

A periodic system checkout should be scheduled to ensure that the system is always in proper operating condition. Depending on the potential hazard, the frequency of checkout may be once a day, once a week or less frequent. Experience will allow determination of the optimum test frequency. See the "Recommended Test Form" shown at the end of this manual.

The R7300B uses the patented **oi** feature for checkout of the complete system. Put the NORMAL/BYPASS switch at the controller in the BYPASS psoition. This disconnects the controller from the loads, and brings power to the **oi** test switch.

Place the detector TEST switch in position no. 1.

Push and **hold** the **oi** button on the controller until both the INSTANT and TIMED lamps turn on. If the INSTANT lamp does not turn on, clean the window and the reflective ring of the detector with Det-Tronics window cleaner using an oil-free cloth or tissue and repeat above test procedure. If the INSTANT or TIMED lamps do not turn on after cleaning the window, refer to the "Troubleshooting" section.

Repeat the above operation for each detector in the system by rotating the detector test switch to each position used and perform the test. It is recommended that the lens of each detector be cleaned during each checkout of the system. Do not use solvents that will leave a residue since this may absorb significant amounts of UV radiation.

The above procedure should be performed for all detectors in the system to make sure they are all operational. After completing the checkout, return the system to operation by placing the NORMAL/BYPASS switch in the NORMAL position.

In addition, the whole system should be checked with a UV source (such as the W866 Test Lamp) periodically. This is done to make sure that the detectors are not obstructed, that the area "seen" by the detector has not changed and that there is not a fault in the **oi** circuit. Place the NORMAL/BYPASS switch in the BYPASS position. The FAULT lamp comes on to indicate the system is in BYPASS. Move to the distance shown on the Recommended Test Form as recorded during the Startup Procedure. Turn on the test lamp and shine into the detector's quartz window. The INSTANT lamp should turn on. Turn off the test lamp and the lamps turn off. If the lamps do not light, move closer to the detector until the lamps on the controller turn on. Check this distance with the recorded distance for that detector. If there is a significant change in the distance, check the location and angle of the detector to see if it has been changed and that the quartz window on the detector is clean. If not, and the detector does not adequately cover the area, the sensitivity of the UV sensor is reduced and should be replaced. After checking all the detectors and the distances against the original recorded distances, return the system to normal operation by placing the Normal/Bypass switch in the NORMAL position and pressing the Reset switch. The FAULT lamp turns off.

TROUBLESHOOTING

If the "Checkout Procedure" reveals a malfunction in the system, take the following steps to isolate the defective part.

NOTE: Make sure the alarm and extinguish systems are disarmed while performing these tests.

1. Check the input power to the controller by observing the POWER lamp on the R7300B panel. If the lamp is not lighted but there is input power, check the bulb to see if it is burned out.

2. Check the optical integrity of each detector. Put the NORMAL/BYPASS switch in the BYPASS position. The FAULT lamp comes on. Place the DETECTOR TEST switch in position No. 1. Push the **oi** button. The INSTANT lamp should light immediately, and the TIMED lamp after the time delay has passed. Release the **oi** button and the lamps go out. If the lamps did not come on, clean the lens of each detector with Detector Electronics' lens cleaner using a clean, oil-free cloth or tissue and repeat the above steps. If the lamps now light when the **oi** button is pushed, the trouble was a contaminated lens. This indicates the need for a more frequent preventive maintenance cleaning schedule. Repeat the above steps for each detector in the system.

3. If the FAULT lamp is on when the NORMAL/BYPASS switch is in the NORMAL position, reset the lamp by pushing the combination fault signal lamp/reset switch. If the lamp goes out it indicates there was a power interruption. If the lamp does not go out when the switch is reset, it indicates an electrical fault.

   a. Check NORMAL/BYPASS switch to ensure that it is in the NORMAL position.

b. Check for loose connections on A, B or C terminals at the detectors and the controller.

c. Check for 290 vdc between terminals A and GND on the controller.

d. If no 290 vdc is found between terminals A and GND, turn off the input power and replace Board No. 4 - Power Supply Board.

e. Check for 400 millivolts d.c. per detector with load resistors from terminal B to GND. For example, three detectors give a reading of 1200 millivolts. Voltage from terminal C to GND will be 1.2 volts above the terminal B voltage.

4. Check jumper on Board No. 3 to see that it is set for the number of detectors with EOL resistors in the system.

5. If there is 290 vdc between terminals A and GND but the INSTANT and TIMED lamps do not light when the oi button is pushed, attach a voltmeter to test points (plus on red, minus on black) provided on Board No. 2 - Integrator and Comparator Board. The voltage should measure 0.05 vdc pulsing periodically to 0.2 volts not more than once every 5 seconds. Push the oi button and the voltage should rise to over 1.0 volt. If the voltage does not rise, turn off power and replace Board No. 2.

6. If there is 290 vdc between terminals A and GND and the voltage across the test points rises as stated in Step 5, but the lamps do not come on, turn off power and replace Board No. 1 - Relay Drive Board.

7. If there is 290 vdc, the voltage rises as stated in Step 5, and the relays close as expected, again check to see if the FAULT lamp goes out when the NORMAL/BY-PASS switch is placed in the NORMAL position and the Fault Signal/Reset switch is pushed.

   If the FAULT lamp stays on, turn off the input power and replace Board No. 3 - Detector Monitor Board.

8. If the FAULT lamp still stays on, there is a fault in the external leads to the detectors. Turn off input power and check leads A, B and C from the controller to the detectors for "open" and "shorts."

9. If one detector does not respond to Step 2, but all the other detectors in the system respond, check the "D" leads from that detector to the controller.

Failure of Instant or Timed Relay

If the INSTANT lamp does not light but the TIMED lamp lights when performing the checkout procedure, it indicates a defective relay. Replace the relay and repeat the Checkout Procedure. If the INSTANT lamp lights, but **not** the TIMED lamp, there may be three different faults:

1. Turn off input power and replace the TIMED relay. Turn on input power and repeat the Cehckout Procedure. If this does not correct the fault—

2. Turn off input power and replace Board No. 1 - Relay Drive Board. Turn on input power and repeat the Checkout Procedure. If this does not correct the fault—

3. Turn off input power and replace Board No. 4 - Power Supply Board. Turn on input power and repeat the Checkout Procedure.

After correcting and performing the troubleshooting tests, restore the alarm and extinguish system to operation and return the Normal/Bypass switch to the Normal position.

ORDERING INFORMATION

When ordering specify model numbers:

R7300B Controller Unit
C7050B Detector
Q9001B Swivel Positioning Assembly
W866A UV Test Lamp

Order from:

1. Your usual source, or
2. **Detector Electronics Corporation**
   6901 West 110th Street
   Minneapolis, Minnesota 55438 U.S.A.

Phone— 612/941-5665
Telex— 29-0562

DEVICE REPAIR

For devices in need of repair, contact your local source or return transportation prepaid to:

Detector Electronics Corporation
Returned Goods Department
6901 West 110th Street
Minneapolis, Minnesota 55438 U.S.A.

TABLE I

Replacement Parts

Part Number	Description	Used On	Quantity Recommended
001745-01	UV Sensor Tube Module	C7050B	1
**001053-xx	Relay Drive Board No. 1	R7300B	1
**001746-xx	Integrator and Comparator Board No. 2	R7300B	1
001051-01	Detector Monitor Board No. 3	R7300B	1
001050-01	Power Supply Board No. 4	R7300B	1
007402-02	Inverter Board (12 volt d.c.)	R7300B	1
007402-01	Inverter Board (24 volt d.c.)	R7300B	1
101164-01	Plug-in Relay	R7300B	1
101017-04	Lamp, 28 volt	R7300B	1
101211-01	Lamp, 28 volt (Trouble)	R7300B	1
001112-04	Solid State d.c. Relay	R7300B	1
101167-01	Solid State a.c. Relay	R7300B	1
001811-01	oi Reflector Rings	C7050B	1
001680-01	UV Lens Cleaning Kit (6 squeeze bottles)	C7050B	1

**These boards vary according to model. Check board for code letter.