



Instructions

95-8256-02

Ultraviolet Fire Detection System
with Nuclear Surveillance
R7404 Controller/C7051 Detector



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AUTOMATIC **oi***

SYSTEM APPLICATION

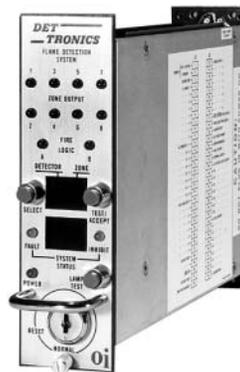
The R7404 Controller is a significant advance in the Det-Tronics line of ultraviolet (UV) fire detection equipment, and broadens the range of capabilities available for fire protection systems. Incorporating microprocessor-based circuitry, the R7404 increases operational flexibility and at the same time retains important features developed through successive design innovations in several generations of Det-Tronics equipment. These include the Automatic Optical Integrity (**oi**) feature, which provides a continuous check of the optical surfaces, detector sensitivity and electronic circuitry of the detector/controller system. Also included is automatic fault identification, which monitors optical integrity, detector supply voltage, controller operation mode and incoming "fire" signals, and provides a digital display of system status in numerical code. Other features retained from previous generations of Det-Tronics equipment include individual zone identification and "voting" capability, as well as manual **oi** testing.

The operational flexibility of the R7404 has led to the development of the Det-Tronics nuclear surveillance (count subtraction) fire detection system, which automatically compensates for x-rays or gamma radiation that might otherwise cause false actuation of the system. The detector consists of a UV detector module mounted next to a similar detector module that is blinded to UV. The sensor tubes within the detector module pair are electronically matched for identical response to external radiation. The blinded detector module can only respond to x-rays and gamma radiation, while the fire detector module can respond to UV as well as x-rays and gamma radiation. The controller subtracts the blinded detector's signal from the fire detector's signal. The remainder represents only the UV radiation, if present.

The C7051 Detector is sensitive to the UV radiation that is emitted by a flame, and is designed for hazardous locations. It is particularly suitable for use in outdoor applications because it is not affected by wind or rain and is insensitive to solar radiation. In addition, the detector does not respond to normal artificial light.

***oi** is Detector Electronics' Trademark for its patented Optical Integrity Systems. U.S. Patent 3,952,196, United Kingdom Patent 1,534,969, Canada Patent 1,059,598.

Ultraviolet Fire Detection System with Nuclear Surveillance R7404 Controller C7051 Detector



Typical applications for Det-Tronics UV detection systems are:

- Wherever highly combustible materials are involved
- Where there is a need for fast response (0.5 second) to flame
- 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:

Solid Materials

- Munitions production such as illuminating flare material, TNT, black powder and other propellants

Other Processes

- Chemical and petrochemical production

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

FEATURES

- Automatically compensates for nuclear radiation.
- Detectors operate under adverse weather conditions such as wind, rain, snow, high humidity, and extremes of temperature or pressure.
- Automatic Optical Integrity.
- All automatic test functions performed with the system on line.
- Manual **oi** test capability (in addition to Automatic **oi** capability).
- Automatic fault identification.
- Individual zone identification.
- Microprocessor control.
- Both fire and fault outputs have redundant indication, i.e. digital readout and separate LED.

- Output circuits can be made latching or non-latching through field adjustment.
- Keylock switch for setting the controller mode to NORMAL, RESET or TEST.
- Power supply will accommodate high direct current transients such as those associated with battery charging.
- TEST/ACCEPT button for silencing external audible signaling devices.
- LAMP TEST button for checking all panel LEDs and digital display segments while the system is on line.
- Individual detector count rates can be measured and observed on the digital display.
- Digital display signal output available at field wiring terminals for coupling to computers or other equipment.

GENERAL APPLICATION INFORMATION

In applying any type of sensing device as a fire detector, it is important to know of any conditions 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. A UV detector is useful in fire protection applications because it will provide very fast response to the presence of ultraviolet radiation emitted by a flame. In addition, it is the only type of sensor that is not affected by environmental conditions such as wind, rain, or extremes of temperature and pressure. The Det-Tronics UV system is also insensitive to the ultraviolet component of solar radiation.

Considering the above, it can be seen that there are fire detection applications where only ultraviolet sensors are suitable. However, success in using an ultraviolet detector is dependent not only on knowing its advantages, but also its limitations. High atmospheric electrostatic potential can cause false actuation of an ultraviolet detection system if its detectors are not correctly grounded. Electric arc welding is a source of intense 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 that their cone of vision can scan the horizon. Rather, they should be directed down over the designated hazardous area to reduce the likelihood of picking up UV radiation from distant sources.

Nuclear radiation is also a potential cause of false actuation of the detection system. X-rays and gamma radiation easily penetrate the metal housing of the detectors, causing the UV sensor tubes to react in the same way as they would to UV radiation. While the nuclear surveillance system compensates for x-rays and gamma radiation present in the protected area, care must be taken that the C7051 Detectors are aligned in such a way that the blinded detector sections are between the nuclear radiation source and the UV detector sections. If the blinded detector section intercepts less nuclear radiation than the fire detector section, false system actuation can result. Consult "Installation" section for further details.

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

It must be noted that malfunctions can occur in any type of equipment, and although Det-Tronics systems are subjected to rigorous tests before shipment, no way has yet been found to guarantee that every device will always operate perfectly. 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 nuclear surveillance system consists of one to four R7404 Controllers that are wired and programmed to monitor up to sixteen C7051 UV/nuclear radiation detectors.

Each controller can accommodate up to four C7051 Detectors. Figure 1 is a simplified diagram of a nuclear surveillance system.

C7051 DETECTOR

The C7051 Detector (Figure 2) incorporates two Det-Tronics C7050 type UV detector modules. Each module holds a Geiger-Muller type sensor tube, circuitry to process and transmit an output signal, and a UV test lamp ("source tube") which is used to test the sensor tube. The two sensor tubes are sent from the factory as a matched pair; both are selected for their identical response to UV and nuclear radiation. One detector module is blinded to UV; both are responsive to x-ray and gamma radiation. When UV or nuclear radiation strikes the cathode of the sensor tube, a series of voltage pulses is sent to the controller. The frequency of the pulses is proportional to the intensity of the UV or nuclear radiation. Each detector module is connected to the controller by three wires (see "Installation"). The wires are referred to as A-, B-, and D- leads.

1. The A- lead is connected to the +290 vdc supply.
2. The B- lead is the "signal" line (sensor tube to controller).
3. The D- lead is the test lamp control line.

Each module is housed in an explosion-proof enclosure designed to meet most national and international standards.

NOTE

It is required that the C7051 Detector housing be connected to earth ground to avoid the possibility of false detector actuation in areas with high electrostatic potential. A grounding lug is provided for this purpose at the junction box.

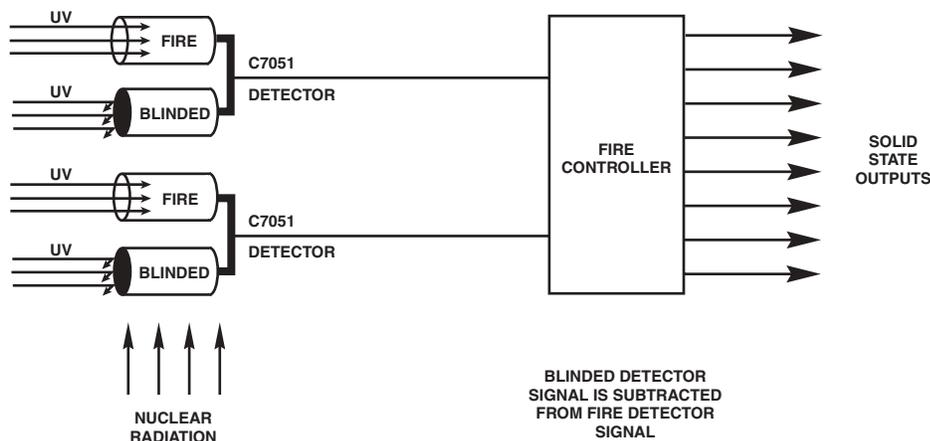


Figure 1—Simplified Block Diagram - Nuclear Surveillance System

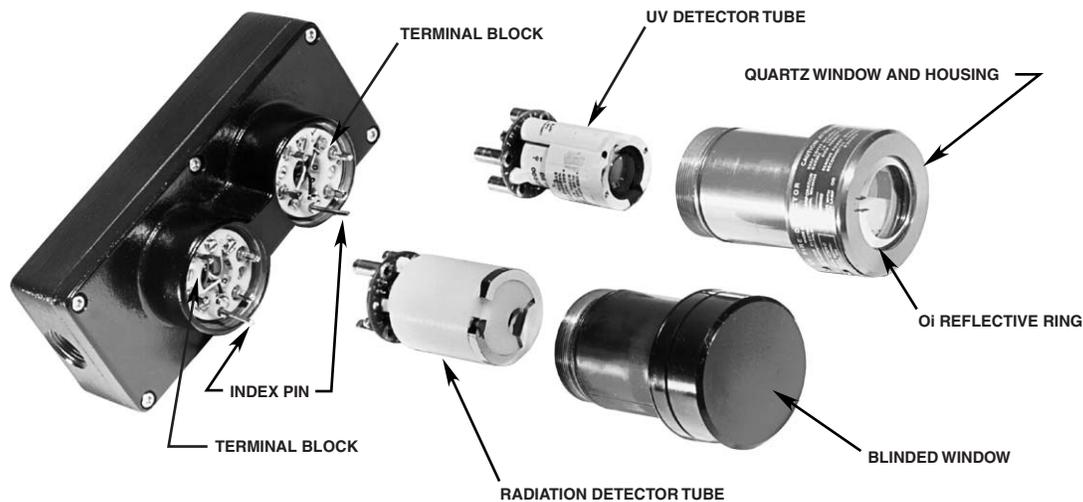


Figure 2—C7051 Detector Assembly

R7404 CONTROLLER

Microprocessor technology has made possible a degree of programming flexibility that could not be achieved in previous generations of Det-Tronics systems. The R7404 Controller incorporates a microprocessor and a programmable memory to store and implement the permanent program for operating the system. The operating program continuously cycles through the Automatic Optical Integrity test, checking each detector and its wiring. The microprocessor can be interrupted by any one of several status changes, such as a fault, a UV signal from one of the C7051 Detectors, or a change in the setting of the keylock switch. In the event of a status change, the microprocessor will react to the change.

The output of the controller is interpreted by other surveillance/fire detection controllers in the system for voting purposes. The controller provides solid state outputs that are activated in response to fire signals from the C7051 Detectors, and to status occurrences such as system faults.

In the nuclear surveillance system, fire detection and surveillance functions are controlled by the same R7404 Controller. The operating program of each R7404 determines its wiring and switch setting configuration as well as its mode of operation.

Front Panel

The front panel of the R7404 Controller (Figure 3) provides switches and indicators to enable manual **oi** and data bus tests (see "Checkout Procedure") and to identify output actuation and status occurrences.

1. The green POWER LED is illuminated whenever power is applied to the controller.
2. The amber FAULT LED is illuminated in the event of a system malfunction or an undesirable status occurrence (see "Theory of Operation - Fault Identification").
3. The amber INHIBIT LED is illuminated when the controller is reset or placed in the test mode. It indicates that all solid state outputs are disabled. (See "Theory of Operation" and "Installation" sections.)
4. The red FIRE LOGIC A and B LEDs are illuminated when the solid state fire logic outputs are actuated. (See "Theory of Operation".)
5. The eight ZONE OUTPUT LEDs correspond to the eight detector inputs. See "Theory of Operation" for details. The ZONE OUTPUT LEDs are red for the fire protection zones and green for the remote surveillance zones.
6. The upper digital display on the front panel identifies the number of the zone involved in any system status occurrence on the ZONE display. Since the nuclear surveillance system is restricted to one detector per zone, the DETECTOR display will show a "0" whenever it is activated. (See "Theory of Operation.")
7. The lower digital display identifies by code number system status occurrences such as fire or fault conditions. Table 1 is a list of the status codes and their interpretations.

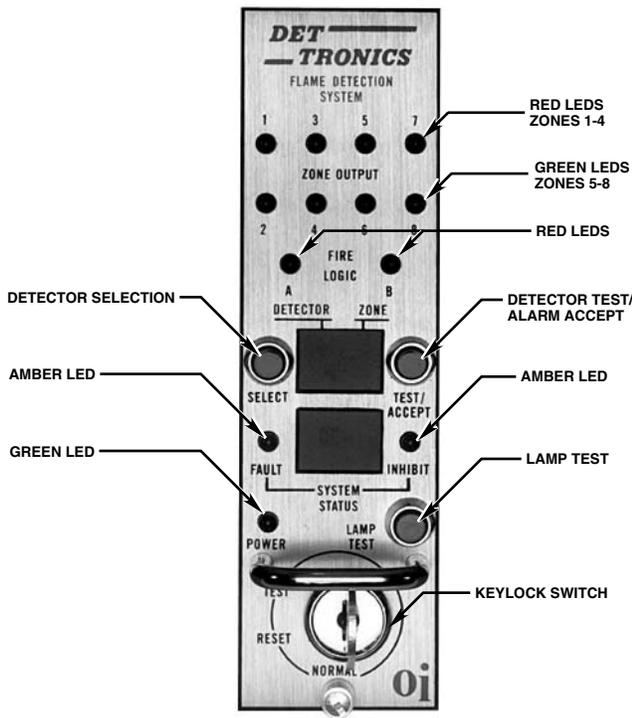


Figure 3—Front Panel - Nuclear Surveillance Controller

8. The SELECT and TEST/ACCEPT buttons are used to manually test each detector (see “Checkout Procedure” section). The SELECT button is used to sequentially select each detector for test. The TEST/ACCEPT button is used to activate the manual **oi** test in each detector when the controller is in the bypass mode. When the controller is in the normal mode, the TEST/ACCEPT button performs an alarm accept function that can be used to de-activate an alarm circuit without interrupting zone and fire logic outputs. (See “Theory of Operation” for details.)
9. The LAMP TEST button is used to illuminate all LEDs and digital display segments in order to verify that they are operational. The lamp test can be performed in the normal mode, since it has no effect on the system’s operation.
10. The keylock switch is used to select normal and test modes and to reset the controller. (See “Theory of Operation” section.)

Field Wiring Connectors

The R7404 Controller is furnished with a field wiring connector that incorporates pressure type screw terminals for attaching wires and circuit board edge connectors for plugging the controller in. Each terminal will accept two, 22 gauge wires. Refer to the “Installation” section for a detailed description of terminal configurations.

Programming Switches

The R7404 is furnished with four rocker switch assemblies that are used to select options such as detectors connected, time delay, fire logic, controller sensitivity, master/slave position and latching/non-latching. Refer to the “Theory of Operation” and “Installation” sections for a detailed explanation of the programming options. It is essential that the controller be properly programmed before applying power to the system.

THEORY OF OPERATION

FIRE DETECTION

When a detector senses ultraviolet (UV) radiation, it generates a series of voltage pulses and transmits them to the controller. A counter circuit in the controller samples the incoming signals (or count rate). In the nuclear surveillance system, two factors are weighed against the count rate of the detector signals. First, the count rate of the blinded detector modules must be subtracted from the incoming count rate of the fire detector modules. After the nuclear surveillance data value has been subtracted, the new adjusted count rate is compared to a pre-programmed sensitivity setting. (See “Installation - Switch Setting Procedure.”) If the adjusted count rate exceeds the sensitivity setting for a pre-programmed timer interval, the fire controller’s microprocessor will generate the following response:

1. The appropriate zone output(s) is energized (solid state - open collector) and the corresponding ZONE OUTPUT LED blinks. Each of the four detector pairs is matched with its own zone output and ZONE OUTPUT LED.

Table 1—System Status Codes

0	— Keylock switch in RESET position, or external Inhibit/Reset is activated.
1	— Keylock switch in TEST position.
2	— Reduced detector sensitivity (oi fault), or faulty wiring.
3	— Spurious detector operation, or high background radiation.
4	— Low +290 vdc (+290 volt detector supply wire may be shorted).
5	— High +290 vdc (voltage regulation failure in the 290 volt supply).
6	— Fire (Zones 1-4 only).
7	— Count subtraction lockout.
8	— Controller in count test mode.
9	— Data Link Failure (faulty data transfer).

2. The alarm output is energized (solid state - open collector). The alarm is activated when any zone detects a fire.
3. The ZONE display shows the number of the first responding zone. The DETECTOR display is blank.
4. The SYSTEM STATUS display shows a "6", indicating fire.
5. If the voting criteria (see below) have been satisfied, the fire logic output is energized and the fire logic LEDs are illuminated.

NOTE

When the UV signal (count rate) falls below the sensitivity threshold, the zone and fire logic outputs are de-activated and their corresponding LEDs are turned on (steady state). If the latching option (see below) has been selected, the outputs will remain activated and their corresponding LEDs will continue to blink. The alarm output is a latching output and will remain activated after the UV signal has been removed.

CONTROLLER SENSITIVITY AND TIME DELAY

The R7404 Controller can be programmed to respond only when a specific level of UV radiation has been exceeded, and to require that the duration of the radiation is greater than a desired time period (see also: "Installation" section). 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 the event of a fire. The programmable sensitivity and time delay of the R7404 system allow it to meet the requirements of virtually any application.

Sensitivity is field programmable (in increments of 8 cps) over a range of 8 through 120 counts per second. The maximum response distance (highest sensitivity) is achieved at an eight cps sensitivity setting. For applications involving high background UV radiation potential, the system can be desensitized by increasing the count rate required to actuate it. The 120 cps setting (minimum sensitivity) results in the minimum response distance. The fire response output signals can be delayed (in quarter second intervals) over a range of 0.5 to 8.25 seconds.

Although there is one delay setting for the entire controller, the response of each zone output is affected by the time delay individually. For example: If zone one

detects a fire, the zone one output will be activated provided UV radiation is continuously detected for the pre-selected time delay. If zone three detects a fire at a later time, the microprocessor will again require that UV is detected continuously for the time delay period before activating the zone three output.

NOTE

Setting the controller at maximum sensitivity and minimum delay may increase the possibility of false system actuation. Consult Detector Electronics' Customer Service Department if such a setting is desired.

CONTROLLER - FIRE LOGIC "VOTING"

"Fire Logic" is activated when a preset number of zones sense UV radiation (see "Installation" section). Up to four zones can "vote" together. Specifically, the controller can be programmed so that one, two, three or four of zones 1 to 4 detect fire before activating the fire logic output. Unless the controller is programmed for latching outputs (see below), voting criteria can be satisfied only by simultaneously activated zones. Figure 4 is a brief flow chart of fire logic selection and voting.

The external data bus is used to connect up to four controllers so that up to 16 detectors can vote together.

The Det-Tronics "voting" principle allows combinations of detectors to fulfill voting requirements and represents the best balance between reliability of fire detection and freedom from false actuation due to individual detector malfunction.

CONTROLLER - LATCHING OUTPUTS

The controller can be field-programmed to have latching or non-latching outputs (see "Installation" section). If the controller is programmed for latching outputs, all responding zone and fire logic outputs will remain activated (6-status) until manually reset. If the controller is programmed for non-latching outputs, all activated zones and fire logic outputs will be deactivated and their respective LEDs will be illuminated (steady state) after UV radiation has been removed. The alarm output is latching and, once activated, will remain so until manually reset (via the TEST/ACCEPT button or the External Accept input). When the controller is programmed for latching outputs, the fire logic (voting) criteria can be satisfied by detector zones that are latched on. In this case, simultaneous detection of fire is not required to satisfy voting criteria.

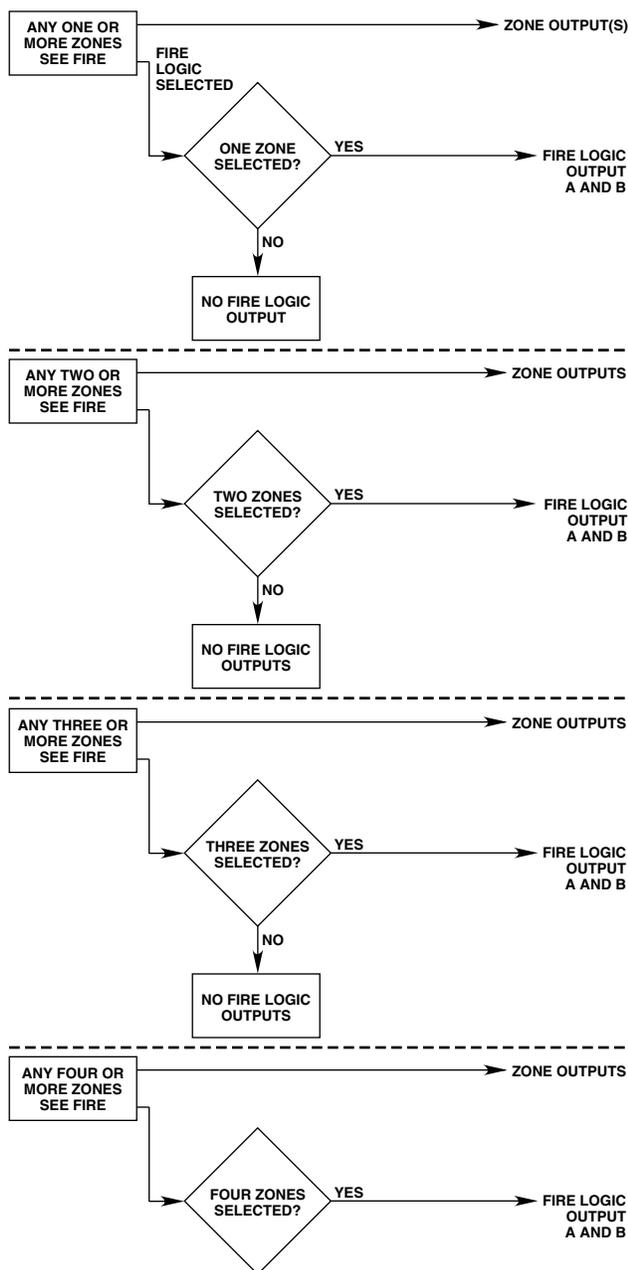


Figure 4—Fire Logic Selection and Voting Sequence

NUCLEAR SURVEILLANCE OPERATION

The C7051 Detector includes two sensor modules mounted on one base. The sensors are paired at the factory for identical response to x-rays and gamma radiation. One detector module is blinded to UV radiation but detects nuclear radiation. The other detects both UV and nuclear radiation. Both modules view the same area. The blinded detector module is placed closer to the radiation source than the fire detector, so that it

absorbs as much or more nuclear radiation as the fire detector. Up to four C7051 assemblies can be used with one R7404.

The count rate of the blinded detector module corresponds to the intensity of nuclear radiation in the area to be protected. The count rate of the fire detector module corresponds to the intensity of the nuclear radiation plus the UV radiation present in the protected area. The blinded detector module's count rate is subtracted from the fire detector module's count rate. The remainder corresponds to the UV radiation intensity in the protected area. On the controller, zones one through four correspond to fire detector modules and zones five through eight correspond to surveillance detector modules. The output of detector 5 is subtracted from detector 1, detector 6 from detector 2, and so on. Though the 5 - 1, 6 - 2, 7 - 3, and 8 - 4 pairs correspond to different detectors on the controller, each pair corresponds to a single C7051 Detector. (See also the "System Sensitivity Considerations" and "Switch Setting Procedure" sections.)

AUTOMATIC OPTICAL INTEGRITY

An important consideration with any UV fire detector is that an accumulation of contaminants (oil, gasoline, dirt) on the quartz window will absorb or block UV radiation. Contamination on the window great enough to completely obscure UV from the detector can be virtually undetectable to the human eye.

To ensure that the detectors are operational, the Automatic **oi** program continuously cycles through a test of each detector module and its wiring. Both the blinded and the unblinded modules of the C7051 Detector incorporate a UV sensor tube and an optically isolated UV test lamp.

In the unblinded module, actuation of the test lamp causes UV radiation to travel out through the quartz window, where it encounters a reflective **oi** ring and is directed back through the window to the sensor tube. If the window is clean, the sensor tube detects the UV from the lamp and sends a signal back to the controller to verify that the detector module and its wires are functioning properly. See Figure 5.

The blinded detector module is tested the same way, except that only the sensor tube is tested, since there is no quartz window to check.

The R7404 tests its detectors at the rate of approximately one per second, so that if a fault occurs, it is almost instantly detected.

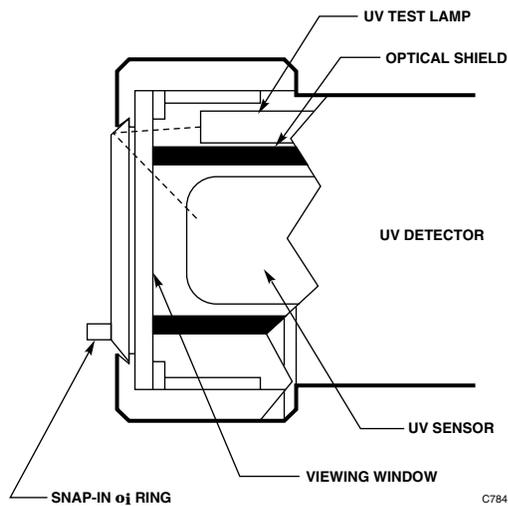


Figure 5—Fire Detector Module with Oi

The basic operation of the Automatic **Oi** program involves selecting and illuminating a UV test lamp, sensing a return signal from the detector, turning off the UV test lamp, sensing the termination of the return signal, and selecting and illuminating the next UV test lamp. In the R7404 nuclear surveillance system, all detector modules (both surveillance and fire protection) are continually checked by the microprocessor programs of the controller.

AUTOMATIC FAULT IDENTIFICATION

In the event of a system malfunction, the microprocessor branches to an automatic fault identification program. This feature operates much the same as on previous generations of Det-Tronics equipment. When a fault occurs, the (normally energized) solid state fault output is de-energized, the FAULT LED is illuminated and the STATUS and ZONE displays are activated to identify the fault code and (when applicable) the number of the affected zone. Because there is only one detector module per zone, the DETECTOR display will show "0" whenever a status change is identified. When a non-fault status indication such as "fire" (6-status) occurs, the fault output remains energized, and the FAULT LED is not turned on, but the STATUS and ZONE displays are activated to indicate the status code and number of the affected zone.

Depending on the zone affected, the 3-status can have one of two meanings. If the STATUS display shows "3" and the ZONE display indicates zones 1 to 4, the count rate of the sensor tube affected has exceeded 50 percent of the controller's sensitivity setting. If this occurs, a separate "LOW LEVEL ALARM" output is activated (terminal 39), but the FAULT output is not activated.

If the STATUS display shows "3" and the ZONE display indicates zones 5 to 8, the blinded surveillance detector indicated may be in a "runaway" state, uncontrollably generating counts. This can be checked by using the count mode test of the controller as described in the "Checkout" section. If the sensor tube in the blinded detector module is in a "runaway" state, it and its counterpart in the fire detector module must be replaced. Tables 1 and 5 provide an explanation of the STATUS codes of the nuclear surveillance controller.

TEST MODE

Although the automatic optical integrity and fault identification features provide continuous monitoring of most of the system circuitry, a microprocessor controlled test mode provides a means to positively determine that the system is operational. The controller is placed in the test mode by turning the keylock switch to the TEST position.

When the controller is placed in the test mode, the following occurs:

1. Fault output is de-energized and the FAULT LED is illuminated.
2. Outputs inhibited output (see "Installation" section) is energized and the INHIBIT LED is illuminated, indicating that all other outputs are disabled.
3. SYSTEM STATUS display shows a "1".
4. DETECTOR display shows a "0".
5. ZONE display indicates the number of the highest numbered zone.

In the test mode, the SELECT and TEST buttons are enabled. Pressing the SELECT button causes the microprocessor to step to the next lower zone, allowing another detector to be selected for testing. When the TEST button is depressed, the UV test lamp of the detector under test is turned on. After the pre-selected time delay, the ZONE LED that corresponds to the detector under test will blink. Because the controller outputs are inhibited, the data bus or corresponding zone output will not be energized.

COUNT TEST MODE

The count test is a means of determining the response of each detector in the system. To enter the count test mode:

1. Place the keylock switch in the TEST position.

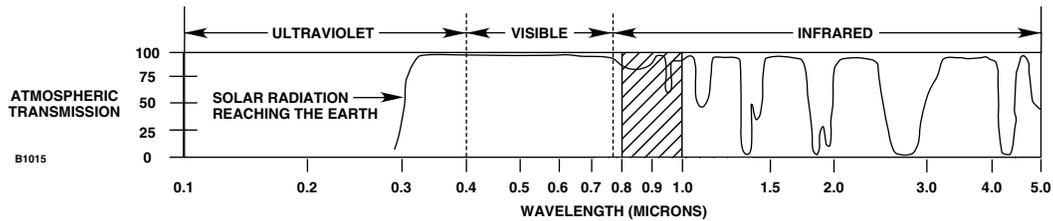


Figure 6—UV Detector's Range of Sensitivity

2. Depress the TEST and SELECT buttons simultaneously and then release.
3. The STATUS display will show an "8" and the DETECTOR and ZONE displays will show a "0" and the number of the zone under test respectively.

The SELECT button serves the same function as in the test mode described above. When the TEST button is pressed, the UV test lamp in the selected detector is illuminated and the sensor sends a response back to the controller. The DETECTOR and ZONE displays indicate the response of the UV sensor under test (in cps). If the FIRE LOGIC LEDs turn on, multiply the displayed count by ten. **The count rate should be between 50 and 300.**

SPECIFICATIONS

SPECTRAL SENSITIVITY RANGE—

Det-Tronics ultraviolet fire detectors respond to radiation over the range of 1850 to 2450 Angstroms (see Figure 6). Detectors are insensitive to direct or reflected sunlight and to normal artificial lighting.

NOTE

High electrostatic forces will affect the detectors if exposed directly at the window. Arc welding is an intense UV source, and special application techniques are required to restrict this radiation from the detector's cone of vision.

OPTICAL SENSITIVITY RANGE (CONE OF VISION)—

The fire detector module of the C7051 Detector has a nominal 90 degree cone of vision with the highest sensitivity lying along its central axis. Figure 7 shows a composite view of the cone of vision and the detector response to a constant UV source at various relative distances. Depending upon the intensity of the UV radiation source, the C7051 can be considered to have a practical application distance of up to about 50 feet (15 meters) when set to 24 cps. Since physical obstructions, smoke accumulation or UV absorbing chemical vapors will prevent UV from reaching the detectors, they should

be mounted as close as practical to the probable hazard. Under certain controlled conditions, detectors may be used at greater distances.

SYSTEM SENSITIVITY—

Sensitivity for R7404 Controllers is field adjustable over a range of 8 through 120 counts per second (cps) in increments of 8 cps. The system should be set at no higher a sensitivity than the minimum required for adequate response to flame or explosion. The maximum response distance (maximum sensitivity) is achieved at an 8 cps sensitivity setting. For applications involving high background radiation potential, the system can be desensitized by increasing the count rate required to actuate it. The 120 cps setting (minimum sensitivity) results in the minimum response distance.

NOTE

Setting the controller at maximum sensitivity and minimum delay may increase the possibility of false system actuation. Consult Detector Electronics' Customer Service department if such a setting is desired.

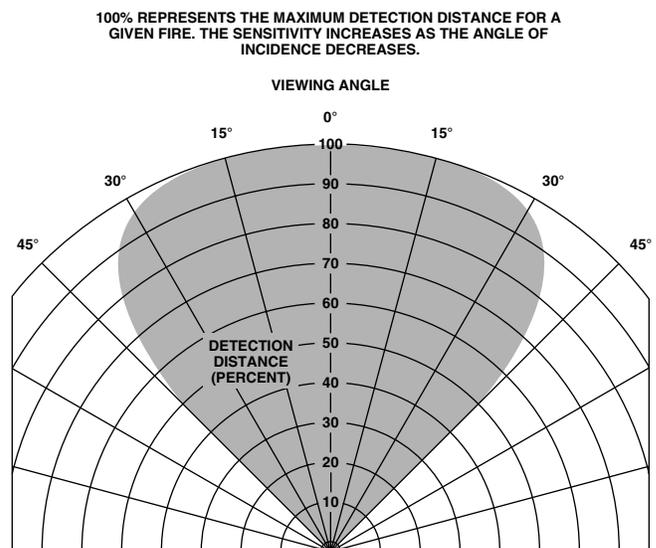


Figure 7—Detector Cone of Vision

INPUT VOLTAGE—

The R7404 is designed to operate from any voltage in the range of 10 to 38 volts dc. For ac line (mains) voltage operation, an optional voltage converter (model W4220) is available from Det-Tronics.

TEMPERATURE RATING—

Operating: Detector: -40°F to +167°F
 (-40°C to +75°C).
 Controller: -40°F to +158°F
 (-40°C to +70°C).
 Storage: -67°F to +170°F (-55°C to +77°C) for the system.

R7404 OUTPUT CIRCUIT RATINGS—

Open collector solid state output is rated 100 milliamperes dc and is transient protected by an “inherent” zener diode. Lead monitoring is provided by an internal 100 kilohm resistor from output to ground. The output transistors are rated at 60 vdc. External equipment that may generate transients when switching (such as relays) should have a transient suppression device connected across the coil at the time of installation. This will safeguard the output transistors in the R7404.

POWER CONSUMPTION—

Standby condition: 1.5 watts typical, 1.7 watts maximum.
 Fire condition (all detectors responding): 15 watts typical, 16.5 watts maximum.

WIRING REQUIREMENT—

A shielded wire is required for the B-lead from each zone to the controller, 22 gauge, 300 volt rms rating minimum. Each detector also requires an individual wire (D-lead) for actuation of the UV test lamp (shielded wire is recommended). Use a common wire for all detectors for the +290 volt dc supply (A-lead). The detectors may be located up to 2000 feet (600 meters) from the controller.

An 18 gauge wire from each detector housing to earth ground is required for prevention of false detector actuation due to high electrostatic charges.

Characteristics of 22 Gauge Copper Wire

	Metric	U.S. Customary
Diameter	0.6439 mm	0.02535
Cross Section	0.3255 mm ²	0.0005 in ²
Resistance	33.3 ohm/km	10.15 ohm/1000 ft

SHIPPING WEIGHT (APPROXIMATE)—

	Pounds	Kilograms
R7404 Controller	2.5	1.1
C7051 Detector (aluminum)	6.0	2.7

DIMENSIONS—

The dimensions given for the R7404 Controller in Figure 8 are for the unit only. If the optional Q4004 Mounting Cage is used, the dimensions given in Figure 9 apply. See Figure 10 for mounting dimensions of the C7051 Detector.

DETECTOR ENCLOSURE RATINGS—

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

Hazardous locations: Designed for Class I, Groups 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.

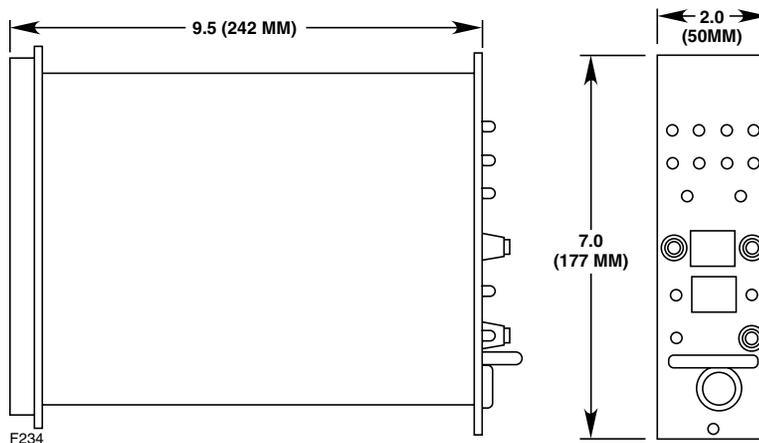
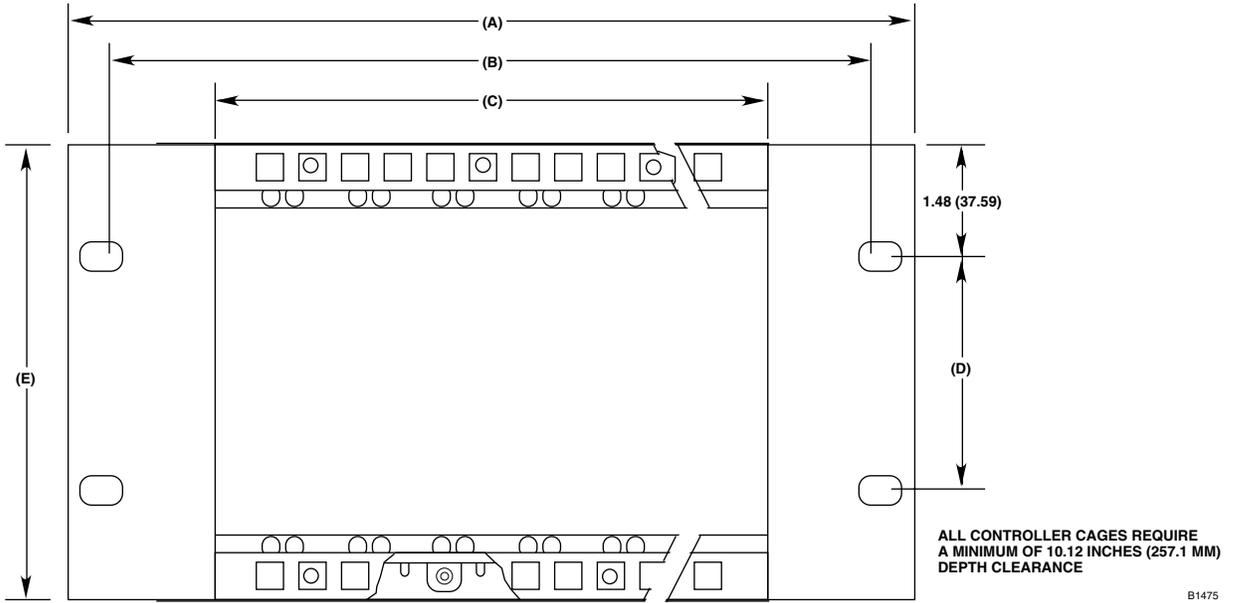


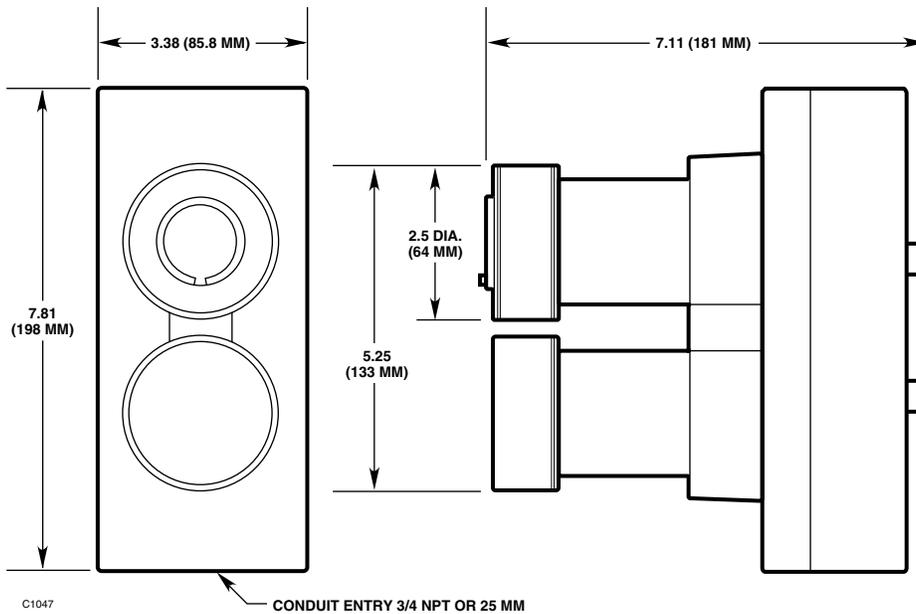
Figure 8—Dimensions of R7404 Controller in Millimeters (Inches)

RACK TYPE	PART NUMBER 005269-XXX	CONTROLLER POSITIONS FOR:		HT:	DIM. (A)		DIM. (B)		DIM. (C)		DIM. (D)		DIM. (E)		WEIGHT	
		FIRE	GAS		INCH	MM	LB	KG								
4U	-001	8	16	4U	19.00	482.6	18.30	464.8	17.36	440.9	4.00	101.6	6.97	177.1	9.3	4.2
4U	-002	6	12	4U	15.06	382.6	14.36	364.7	13.42	340.9					7.6	3.5
4U	-003	4	8	4U	11.13	282.6	10.43	264.9	9.49	241.1					5.9	2.7
4U	-004	3	6	4U	9.16	232.7	8.46	214.9	7.52	191.0					5.1	2.3
4U	-005	2	4	4U	7.19	182.7	6.49	164.9	5.55	141.0					4.2	1.9
4U	-006	1	2	4U	5.22	132.6	4.52	114.8	3.58	90.9					3.1	1.4



B1475

Figure 9—Dimensions of Q4004 Mounting Cage in Inches (Millimeters)



C1047

Figure 10—Dimensions of C7051 Detector in Inches (Millimeters)

OPTIONS AVAILABLE

- R6006 Relay Output Module to be used in conjunction with the R7404 when relay switching contacts are required. Four models are available. The R6006A has six fire relays, one fault relay, and one alarm relay. The R6006B has eight fire relays. The R6006C and D are functionally identical to the R6006A and B respectively, with the addition of an output load monitoring feature. The relays in the R6006 have form C (normally open/normally closed) contacts that are capable of operating fire alarm devices requiring up to 3 amperes at 30 vdc or 250 vac. Refer to form 90-1016 for more information.
- W4220 Voltage Converter for operating the R7404 from line (mains) voltage. The W4220 Voltage Converter is designed to furnish operating power for up to eight modules of the Det-Tronics Fire Detection System. It is available with either two or four channels, each separately fused and completely separate. Should a fault occur in one channel, the others are unaffected. It is styled and sized to be compatible with other modules when mounted with them in the Det-Tronics Q4004 Mounting Cage. Refer to form 95-8243 for more information.
- Q4004 Mounting Cage (Figure 9) designed for holding up to 8 modules in a standard 19 inch instrument rack. The Q4004 is recommended for ease of installation and service.

DETECTOR SENSITIVITY

The Detector Electronics ultraviolet fire detector uses a Geiger-Muller type detector designed to respond to radiation over a wavelength of 1850 to 2450 Angstrom units (10,000 Angstroms = 1000 nanometers = 1 micron = 0.001 millimeter). Figure 6 illustrates the sensor tube's range of sensitivity, and compares this range to other forms of radiation. Note the UV radiation reaching the earth from the sun does not extend into the detector's range of sensitivity. In addition, radiation from normal (properly screened) artificial lighting (fluorescent, mercury-vapor and incandescent lamps) does not extend into the detector's spectral range. As a result, the detector is insensitive to these forms of radiation and may be used outdoors or indoors. Some mercury-vapor lamps can operate for extended periods with cracked or otherwise damaged envelopes, and will then emit UV radiation in the frequency response range of the Det-Tronics detector. Defective mercury-vapor lamps can cause eye irritation and should be immediately removed from service.

The UV sensor responds to any radiation which can penetrate its 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 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, an undesired actuation of the system may occur.

By automatically compensating for the extra counts produced by radioactivity, the C7051 Detector assembly keeps the UV detection system functional in locations where radioactivity is present.

SYSTEM SENSITIVITY CONSIDERATIONS

Because of the complexity of the combustion process, the UV detector count rate generated by different size fires viewed from the same distance is difficult to predict with a high degree of precision. In general, however, if a fire doubles in size, the detector count rate is increased by approximately 60 percent.

Selection of the controller sensitivity and time delay to be used in a given application is dependent on the level of hazard present and the action to be taken in the event of a fire. The adjustable sensitivity and time delay of the R7404 system allows it to meet the requirements of virtually any application. For sensitivity and time delay adjustment information, see the "Installation" section.

INSTALLATION

DETECTOR POSITIONING AND DENSITY

As previously stated, the Det-Tronics detector has a nominal 90 degree cone of vision. What this means in practical terms can be understood by reference to a typical installation. Consider an application with a ceiling height of 25 feet (7.5 meters) and assume it is desired to have complete detector coverage at floor level. If a detector is mounted 2 feet from the ceiling and pointed straight down, the distance from the detector to the designated level is 23 feet (7 meters). Because of its 90 degree cone of vision, the detector covers a circular area with a diameter of 39 feet (12 meters). A simple layout of the area to be covered will easily reveal the number of detectors required to completely supervise the designated area.

In general, fire detectors should be placed as close as practical to the probable hazard. The (blinded) nuclear surveillance module of the C7051 Detector must be positioned at least as close, if not closer, to the source of radioactive interference as the fire detector module. See Figure 1.

Det-Tronics systems may be adjusted to various sensitivity levels by programming the controller to respond at a pre-determined detector count rate. This count rate is dependent upon the intensity of ultraviolet radiation reaching the detector, which is a function of fuel, flame size, distance from the detector and the amount of UV absorbing vapors present. Programming the controller to respond to a low count rate results in high system sensitivity. Conversely, programming the controller to require a high count rate results in low system sensitivity.

The possible presence of UV absorbing vapors must be examined closely. Some chemical and petrochemical vapors have very strong UV absorption characteristics. For a listing of UV-absorbing vapors, contact Detector Electronics Corporation, Customer Service.

NOTE

Do not mount UV detectors close to the ceiling in enclosed areas if dense smoke may be expected to accumulate at the onset of a fire. Mounting the detector on side walls a few feet (or about 1 meter) down from the ceiling will normally allow time for the detectors to respond before they are affected by smoke rising to the ceiling. It is also advisable to shorten the time delay settings for applications where smoke may accumulate during a fire. A smoke/fire detector is available for use in applications where dense smoke might accumulate prior to the presence of flame (as in an electrical fire). Consult Detector Electronics' Customer Service department for details.

MOUNTING AND WIRING THE DETECTOR

The wiring to each detector must be 22 gauge (0.643 mm diameter) minimum, with at least a 600 volt rms rating. The B-leads from each detector must be individually shielded. If the B-leads are run in conduit, the conduit must not be used for wiring from other electrical equipment. Shielded wiring is recommended for the A-leads and the D-leads. The A-lead can be common to all detectors connected to one controller, but each detector must have a separate D-lead to the controller to operate the **oi** system. Each detector may be located at a distance of up to 2000 feet (600 meters) from the controller.

A grounding screw is provided inside the housing for connecting the C7051 to earth ground. It is recommended that a conduit seal, drains and breathers be used. Seals should be installed immediately behind the detector module to provide a watertight enclosure. In some applications, alternate changes in temperature and barometric pressure cause "breathing," which allows the entry and circulation of moist air throughout 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 at the base of vertical conduit runs and equipment enclosures, and will build up over a period of time. This can be detrimental to electronic devices. To eliminate this condition, explosion-proof seals, drains and breathers (such as Crouse-Hinds type ECD) should be installed to automatically bleed off accumulated water.

The following steps should be used for mounting and wiring the detectors:

1. Detectors should be located for the best unobstructed view of the area to be protected. Detectors must be accessible for cleaning the window and reflector rings.

The blinded detector module should be mounted as close as or closer than the fire detector module to the source of radioactivity. For outdoor applications, fire detectors should be aimed downward to prevent the cone of vision from scanning the horizon, because the detectors could respond to long duration lightning flashes. If the detectors are not pointed straight down, they should be mounted with the UV test lamp of the fire detector module at the module's highest point, if feasible. Otherwise, dirt accumulation between the window and the reflector ring might interfere with the Automatic **oi** function. See Figure 10 for mounting dimensions.

2. Disassemble the detector enclosures by turning the housing covers counterclockwise. See Figure 2 for an example of the detector assemblies.
3. Connect the terminal cap to the conduit or the optional swivel mounting bracket so that the wires from the controller can be installed and trimmed.
4. Connect A-, B-, and D-leads to connections in terminal block.

Connect the B-lead shields to connector C in the terminal block. All A-leads go to the A-lead connection in the terminal block. If one C7051 is used, its fire detector module is connected to zone 1 B-lead and D-lead inputs, and its blinded detector module is connected to zone 5 B-lead and D-lead inputs. A second C7051's fire and blinded detector module would be connected to zones 2 and 6 respectively. Zones 1 to 4 on the backplate connect to fire detector modules. Zones 5 to 8 connect to blinded surveillance detector modules. Up to four C7051s can be connected to one R7404.

NOTE

If the wires from individual detectors are connected to the R7404 Controller in a multiple conductor cable, it is necessary to arrange them as shown in Figure 11 to prevent "cross-talk." The individual B-leads should be arranged around the outside of the cable with a ground lead between. The inner layer of conductors should be the D-leads with the common A-lead in the center. These instructions apply for installations using from two to four detectors.

- Remove matched UV sensor tube modules from shipping package and place into position on blinded and fire detector terminal blocks, locating the correct terminal position by observing the index pin. Avoid touching the exposed glass envelopes of the tubes, since oil from fingerprints can absorb UV and reduce the tube's sensitivity.

NOTE

Use only specially matched pairs of DE1888G2 tube modules in R7404/C7051 systems.

- Install four screws on each detector and tighten.

- On blinded detector module, slide **o**i reflector cap over barrel of sensor tube module until firmly seated. Make certain semicircular opening is centered exactly over source tube on sensor tube module.
- Replace detector housings. Black anodized barrel is screwed onto blinded detector module. Red barrel is screwed onto fire detector module.
- Thoroughly clean the fire detector window and the reflective ring. Det-Tronics window cleaner solution is specially designed for this application. Many of the commercial cleaners leave a residue on the surface that absorbs UV radiation. Clean the window out to the edge. After cleaning, re-install the ring so the split is 180 degrees from the **o**i test lamp (opening down to prevent water buildup). Hold the ring by the tabs, being careful not to leave fingerprints on the reflective surface.

NOTE

Use a clean cloth for cleaning. DO NOT use commercial glass cleaning tissues since many of these contain a silicone substance, which remains on the cleaned surface and will absorb UV radiation.

SWITCH SETTING PROCEDURE

It is essential that the controllers are properly programmed at the time of installation. There are three rocker switch assemblies on the left side of each controller that are used to select detectors, controller sensitivity, fire logic (voting), output latching and time delay.

Figure 12 illustrates the left side of the R7404 Controller and contains a short explanation of rocker switch usage.

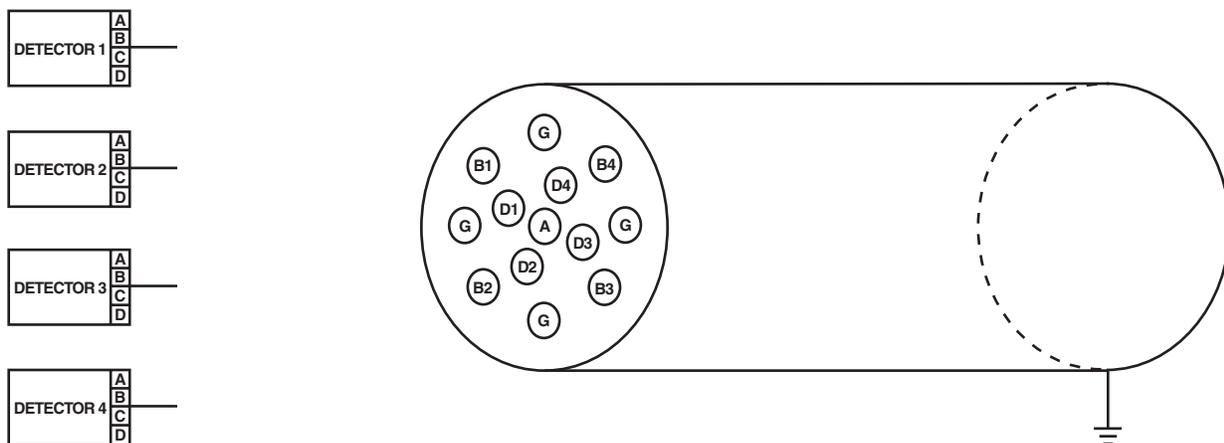


Figure 11—Wire Arrangement in a Multiple Conductor Cable

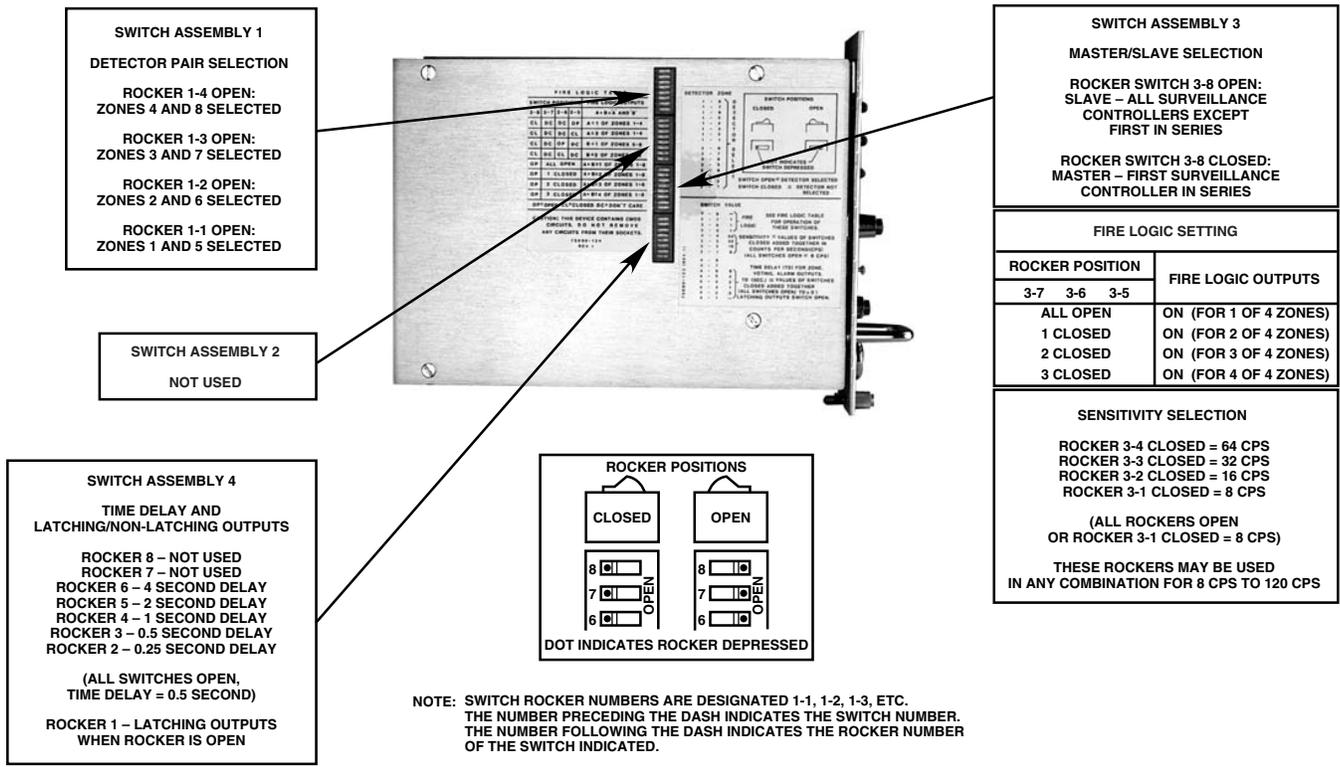


Figure 12—Controller Rocker Switches

1. Detectors Connected — Switch Assembly Rockers 1-1 to 1-4. Each zone can have one detector for a maximum of four detectors in four zones connected to one controller. (The word “detector” denotes the C7051, which comprises two detector modules, in this context.) Switch assembly rockers 1-1 through 1-4 are used to enable the detector of each zone. The appropriate rocker must be set to the “Open” position for each detector connected.

Care must be taken when setting these rockers. If a rocker is set open, but no detector is connected in that location, the controller will show a “2-fault” on the lower digital display and the ZONE display will show which zone is set incorrectly. If a rocker is set closed, but a detector is connected, the controller performs normally, but that detector is eliminated from the Automatic **oi** test sequence, and any faults that may occur in its circuit would not be automatically identified. This condition can be found only when performing the manual **oi** test procedure. See the “Troubleshooting” section. Figure 13 is an example of switch settings for a controller using three detectors.

2. Switch Assembly Rockers 2-1 to 2-8 are not used.

3. Controller Sensitivity Adjustment — Switch Assembly Rockers 3-1 to 3-4 are used to set (program) controller sensitivity in 8 cps increments.

- 3-1 closed - 8 cps
- 3-2 closed - 16 cps
- 3-3 closed - 32 cps
- 3-4 closed - 64 cps

Sensitivity = cumulative value of rockers set closed

These rockers may be set in any combination to give the sensitivity setting selected for the application, up to 120 cps.

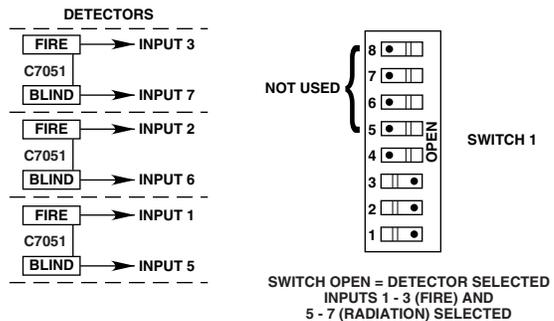


Figure 13—Detector Selection

NOTE

If no rockers are closed, or if only rocker 3-1 is closed, the controller responds to an 8 cps signal from the detector.

Figure 14 is an example of a 24 cps setting.



Figure 14—Controller Sensitivity Selection

4. Fire Logic Voting Criteria — Switch Assembly Rockers 3-5 to 3-7, Rockers 3-5, 3-6 and 3-7 select the voting requirements, which are Fire Logic A and B common (4 zones voting).

NOTE

When the outputs are set for non-latching operation, the voting process will actuate the Fire Logic outputs only if the preselected number of voting zones “see” fire at the same time. When the outputs are set for latching operation, the voting process will actuate the Fire Logic outputs when voting criteria have been met, even if fire is not being seen by each voting zone at the same time. Zones 5 through 8 do not latch.

- Rockers 3-5, 3-6 and 3-7 open - one of four zones is required for actuation.
- Rocker 3-5 closed, rockers 3-6 and 3-7 open - two of four zones are required for actuation.
- Rockers 3-5 and 3-6 closed, rocker 3-7 open - three of four zones are required for actuation.
- Rockers 3-5, 3-6 and 3-7 closed - four of four zones are required for actuation.

In the example illustrated in Figure 15 the setting is for three of four zones voting.

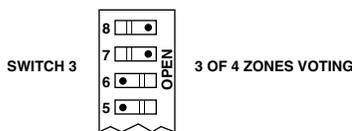


Figure 15—Fire Logic Voting Selection

Switch 3-8 selects master or slave operation for the controller.

Closed = master, Open = slave.

5. Outputs Latching/Non-Latching - Switch Assembly Rocker 4-1.

Closed = Non-Latching

Open = Latching

NOTE

The zone and fire logic outputs will latch when turned on if rocker 4-1 is set open.

The outputs are de-latched by placing keylock switch in RESET position or by actuating the External Inhibit input. Figure 16 shows the setting for selecting latching outputs.



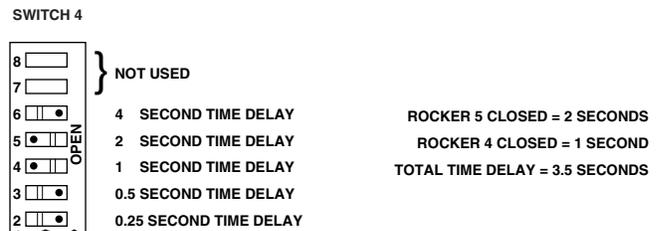
Figure 16—Latching/Non-Latching Output Selection

6. Time Delay — Switch Assembly Rockers 4-2, 4-3, 4-4, 4-5 and 4-6. The time delay switches have the following values.

Rocker 4-2	0.25 second
Rocker 4-3	0.5 second
Rocker 4-4	1.0 second
Rocker 4-5	2.0 seconds
Rocker 4-6	4.0 seconds

The total time delay is the added value of the rockers in the closed position plus 0.5 second. Rockers can be closed in any arrangement for a time delay of 0.5 to 8.25 seconds in 0.25 second intervals.

Figure 17 shows the switch setting for a time delay of 3.5 seconds.



NOTE: THE VALUE OF ROCKERS SET IN THE CLOSED POSITION ARE ADDITIVE.

Figure 17—Time Delay Selection

It is inadvisable to use the minimum time delay (0.5 second) with the maximum detector sensitivity (8 cps), as this setting increases the possibility of false system actuation.

CONTROLLER ELECTRICAL CONNECTIONS

All electrical connections are made to the plug-in field wiring connector that is furnished with the controller. Figure 18 shows its terminal configuration. Table 2 lists the terminal connections and a brief description of their usage.

Up to four detectors in four separate zones can be connected to the controller. Terminals A, B and D on the detectors must be connected to the appropriate A, B and D terminals at the R7404 Controller. Connect the shield of the B-lead to terminal C in the detector and the other end to circuit ground (terminal 2) at the controller (see Figures 18 and 19). Terminal D in each detector connects directly to individual terminals 12 through 19 on the controller.

J1	R7404	J2
1	+ } 10 TO 38 VDC	ZONE OUTPUT 1
2		ZONE OUTPUT 2
3	(A) +290 VDC	ZONE OUTPUT 3
4	B - INPUT 1	ZONE OUTPUT 4
5	B - INPUT 2	NOT USED
6	B - INPUT 3	NOT USED
7	B - INPUT 4	LOW LEVEL ALARM
8	B - INPUT 5	LOCKOUT OUTPUT
9	B - INPUT 6	FIRE LOGIC
10	B - INPUT 7	DATA SYNC
11	B - INPUT 8	ALARM OUTPUT
12	D1-1 oi DRIVER	EXTERNAL INHIBIT
13	D1-2 oi DRIVER	OUTPUTS INHIBITED
14	D1-3 oi DRIVER	FAULT OUTPUT
15	D1-4 oi DRIVER	EXTERNAL ACCEPT
16	D1-5 oi DRIVER	STATUS & DET. OUTPUT S1
17	D1-6 oi DRIVER	STATUS & DET. OUTPUT S2
18	D1-7 oi DRIVER	STATUS & DET. OUTPUT S3
19	D1-8 oi DRIVER	STATUS & DET. OUTPUT S4
20	DATA OUTPUT 0	STATUS & DET. OUTPUT S5
21	DATA OUTPUT 1	STATUS & DET. OUTPUT S6
22	DATA OUTPUT 2	STATUS & DET. OUTPUT S7
23	DATA OUTPUT 3	STATUS & DET. OUTPUT S8
24	DATA OUTPUT 4	DATA BUS 0
25	DATA OUTPUT 5	DATA BUS 1
26	DATA OUTPUT 6	DATA BUS 2
27	DATA OUTPUT 7	DATA BUS 3
28	DMA OUT AVAILABLE	DATA BUS 4
29	DMA OUT	DATA BUS 5
30	DMA IN	DATA BUS 6
31	DATA STROBE	DATA BUS 7
32	DMA IN AVAILABLE	CHASSIS (EARTH) GND

Figure 18—R7404 Nuclear Surveillance Controller Terminal Configuration

Table 2—Nuclear Surveillance Controller Terminal Connections

Electrical Terminals	Description
1 and 2	Input power: +10 to +38 vdc (1 to positive, 2 to circuit ground).
3	A-lead: (+290 vdc) connected to all detectors.
4 through 11	B-lead: input from each detector.
12 through 19	D- lead: oi driver to each detector.
20 through 27	Data Bus terminals - data transfer outputs, connected to the data input bus of the (next) surveillance controller in the series.
28 through 32	DMA (direct memory access) and data strobe terminals. DMA IN (terminal 30) is connected to the data sync output of the last surveillance controller in the series.
33 through 36	Solid State Zone Outputs: correspond to four fire zones (reference to ground - terminal 2). <i>NOTE: All R7404 solid state outputs are rated 100 ma at 0.5 volt when "on" (low state). The outputs are high impedance (open collector, 100K ohm) when "off" (high state). Only the Fault output is normally "on."</i>
37, 38	Not used.
39	Low level alarm output – count rate has exceeded 50% of sensitivity setting.
40	Solid state "lockout" output – activated by controller to indicate saturation lockout condition.
41	Solid State Fire Logic output – see "Theory of Operation."
42	Data Sync output – connects to DMA IN of slave controller.
43	Solid State Alarm output – activated whenever any zone output is activated. It is a latching output and can be deactivated by depressing the TEST/ACCEPT button or by activating the external accept input (see below).
44	External Inhibit (input) – when activated, resets the controller and disables fire response outputs. Input is activated when shorted to ground (-V, terminal 2).
45	Solid State Outputs Inhibited (output) – is activated when fire response outputs are disabled.
46	Solid State Fault output – Normally "on" (low voltage - logic 1), turned off by controller to indicate a fault status.
47	External Accept (input) provides a means to deactivate the alarm output. Input is activated when shorted to ground.
48 through 55	Solid State Status and Detector outputs – provide binary representations of the front panel digital displays for zone and status identification. Tables 3 and 4 list the identification codes and the logic states of the "Fault" and "Outputs Inhibited" bits for the various status conditions.
56 through 63	Data Bus terminals – data transfer inputs, connected to the data output bus of the last surveillance controller in the series.
64	Chassis (earth) ground – should be connected to circuit ground (terminal 2) through a 0.47 µF 400 Volt non-polarized capacitor (not supplied).

Table 3—Relationship of ZONE Display to the Status Outputs

Zone	Status Outputs			
	S1	S2	S3	S4
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1

TYPICAL SYSTEM APPLICATION

The following application is an example only. For assistance in adapting a system to your individual requirements, contact Application Engineering at Detector Electronics.

The system illustrated in Figure 19 incorporates two controllers that monitor eight detectors.

STARTUP PROCEDURE

CAUTION

Secure output loads before startup as described in the “Manual Check in Normal Mode” subsection of the “Checkout Procedure.”

1. After setting the selection switches and making all electrical connections, make sure that power is off and plug controllers into connectors.
2. Turn on power and go through checkout procedures.
3. If the controllers appear to be operating normally, remove mechanical blocking devices and restore power to the extinguishing loads.

CHECKOUT PROCEDURE

MANUAL CHECK OF OPTICAL INTEGRITY

1. Place keylock switch in TEST position.
2. FAULT LED turns on.

Table 4—Relationship of SYSTEM STATUS Display to Status Outputs

Front Panel Display	Status Outputs					
System Status	S5	S6	S7	S8	Fault	Outputs Inhibited
0	0	0	0	0	0	1
1	0	1	0	0	0	1
2	0	0	1	0	0	0
3	0	1	1	0	x***	0
4	0	0	0	1	0	0
5	0	1	0	1	0	0
6*	0	0	1	1	1	0
7**	0	1	1	1	1	0
8	0 or 1	0	0	0	0	1
9	1	1	0	0	0	1
Status Outputs S1 – S8, Fault Outputs Inhibited	Logic 0 = 100k ohms to ground (0 volts) Logic 1 = Less than 25 ohms to ground (0 volts)					

* Fire Zones only

** Surveillance Zones only

*** 1 on Fire Zones, 0 on Surveillance Zones

3. INHIBIT LED turns on.
4. ZONE display indicates the zone selected. DETECTOR display shows a “0”.
5. STATUS display indicates a “1”. (If any other number appears, see “Troubleshooting” section.)
6. Push and hold TEST/ACCEPT button. If the lens is clean, a ZONE OUTPUT LED flashes to indicate the zone of the detector being tested (after time delay).
7. Appropriate FIRE LOGIC LEDs are turned on if voting requirements are met.

(Surveillance zones 5-8 are not voted on and will not turn on FIRE LOGIC LEDs).
8. Release TEST/ACCEPT button, ZONE OUTPUT LED remains on steady.
9. Push SELECT button. Controller sequences to the next lower numbered zone.
10. Repeat steps 6 through 10 until all detectors have been checked.

TESTING OF DETECTOR MODULE RESPONSE TO UV RADIATION (COUNT MODE TEST)

1. Place keylock switch in TEST position.
2. SYSTEM STATUS displays the number "1".
3. ZONE display shows the zone that is electrically positioned for testing.
4. Press and release SELECT and TEST/ACCEPT buttons simultaneously.
5. SYSTEM STATUS display changes to an "8".
6. Press and hold TEST/ACCEPT button.
7. UV source tube (in detector housing of the module under test) turns on.
8. Upper displays indicate the discharge rate of the sensor under test (in cps). If FIRE LOGIC LEDs turn on, multiply displayed count by 10. **Count rate should be between 50 and 300 cps.** If not, **clean the window** (fire detector module) and the metal **o_i** reflector ring. If count rate does **not fall within the 50 to 300 cps range after cleaning, and the o_i ring shows no signs of deterioration, replace the sensor tube module.** Record count reading in the Recommended Test Form (inside back cover).
9. Release TEST/ACCEPT button.
10. Upper displays now indicate quiescent state of detector tube. Count should be between 00 and 05. If higher, place an obstruction over the detector window. If the count rate returns to the 00 to 05 range, the detector has been responding to external radiation. Check area for external source of UV radiation, and either remove it or shield the detector from it. If none can be found, use cardboard to cover the windows of the detectors in the zone being tested. If the high count rate continues after the detector window is covered, this indicates a faulty module, and it must be replaced. If other detectors in the vicinity exhibit similar symptoms, the presence of x-rays or gamma radiation is indicated.
11. To test the next detector, press and release the SELECT button.
12. ZONE display shows zone just tested.
13. Press and release the SELECT button again.
14. Controller cycles to next lower zone pair (controller cycles through the detectors selected on rocker switches 1-1 to 1-4). (See "Theory of Operation.")
15. Repeat steps 6 through 14 until all detectors have been checked. At the completion of the sequence, each detector will have been tested for the following conditions:
 - A. Influence of background radiation, if any.
 - B. UV transmission capability of all optical surfaces (where applicable).
 - C. Calibration of UV source/UV detector (these elements are factory adjusted, but are subject to influences that may affect the calibration).
 - D. If the system is to be tested for response to an actual fire, the exact response of each detector can be measured. If any improvements in system layout are needed, they will be revealed in this way.
16. After completion of all tests, return keylock switch to NORMAL position. System resets and both digital displays should become blank.

NOTE

The Automatic o_i system continuously monitors the operation of the R7404 but does not monitor external relays or equipment that may be operated from the fire signal outputs, the alarm signal output or the fault signal output. It is important that the system be manually checked using the Normal Mode Checkout Procedure on a regular basis. The whole system (including external equipment) should be checked periodically using the W8066 UV Test Lamp or an equivalent UV source to simulate a fire.

MANUAL CHECK IN NORMAL MODE

The whole system should be periodically checked with the W8066 UV Test Lamp or an equivalent UV source to make sure that the detectors are not obstructed, that the area "seen" by the detector has not changed, and that there is no fault in the o_i circuit.

CAUTION

Secure output loads (remove power from valves, relays, igniters or other devices which would normally be actuated by the UV system) before performing the following test.

1. Place the keylock switch in the NORMAL position.
2. Turn on W8066 UV Test Lamp or an equivalent UV source and shine into any fire detector.
3. If system works correctly, the appropriate ZONE OUTPUT LED turns on and flashes, indicating the zone in which the detector is located. ZONE display shows first zone activated. STATUS display shows a "6".
4. The FIRE LOGIC LEDs turn on if voting requirements are met.
5. Turn off the UV source.
6. FIRE LOGIC LEDs stay on if turned on in step 4.
7. The ZONE OUTPUT LED stays on but stops flashing. The numeral indicating the first zone that responded to the UV signal is held in the ZONE display, and the numeral "6" remains in the STATUS display.
8. Repeat steps 2 through 5 for each detector in the system.
9. After all detectors have been checked, reset the system by turning the keylock switch to the RESET position. Then turn it to the NORMAL position. Display turns off. INHIBIT LED turns off. FAULT LED turns off.
10. Restore power to output loads or remove any mechanical blocking devices.

TROUBLESHOOTING

The Automatic Fault Identification circuitry, in conjunction with the Automatic **oi** feature, continuously monitors the status of the controller and all detectors. In the event of a system malfunction, the microprocessor immediately branches to an automatic fault identification program. If a fault occurs, the FAULT LED will turn on. If the fault is in the detector or wiring, the ZONE display will indicate which zone has the fault. The STATUS display will indicate by code number the type of fault. If the fault is in the microprocessor circuitry, the displays will remain blank but the FAULT LED will turn on. See Table 5 for a detailed explanation of the status/fault code numbers on the lower digital display and the corresponding identification numbers on the upper digital display.

NOTE

Record all faults on the Fault Record Sheet at the back of this manual.

VOLTAGES AND WAVEFORMS TO AID IN TROUBLESHOOTING

A-lead (terminal 3) to circuit ground: +290 vdc.

D-lead (terminals 12 through 19) to A-lead: less than 1 volt.

Do not check in normal mode. System must be in test mode to prevent false actuation. In the test mode, manual **oi** operation can be verified by observing the voltage between the D-lead and circuit ground.

Due to the meter "loading" factor, the voltage from the D-lead to ground measures approximately +260 vdc. When the test button is depressed (in test mode) the voltage on the D-lead of the detector under test drops to 0.5 vdc or less (see Figure 20).

B-lead (terminals 4 through 11): The manual **oi** test causes the detector to send a series of voltage pulses to the controller. The waveform on the B-lead of the detector under test is illustrated in Figure 21.

SOLID STATE INPUT AND OUTPUT CIRCUITRY

Figures 22 and 23 illustrate the input and output drive circuitry of the R7404 Controller.

ORDERING INFORMATION

When ordering specify:

Model R7404 Fire Protection and Nuclear Surveillance Controller

Model C7051 Detector

Number of C7051 Detectors and R7404 Controllers

ACCESSORIES

— Q4004 Mounting Cage. Cage accommodates up to eight modules. It is designed to fit a standard 19 inch instrument rack. See form 95-8241 for details.

— Filler panels (part number 002188-001). For empty positions in the Q4004 Cage.

— W8066 Explosion-proof, portable UV Test Lamp. See form 95-8345 for details.

— Matched pair, DE1888G2 sensor tubes (part number 003240-207), for replacement into C7051 Detector.

DEVICE REPAIR

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

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

Table 5—Status Codes - Nuclear Surveillance Controller

Upper Displays		Lower Display	Description
Detector	Zone	Status	
0	0	0	Keylock switch is in RESET position, or the external inhibit is activated. (Outputs inhibited, except Status outputs.)
0	1 - 8	1	Keylock switch is in TEST position. (Outputs inhibited, except Status outputs.)
0	1 - 8	2	oi fault - the oi ring and/or the window of the detector indicated in the upper ZONE display is dirty, or the detector module has lost sensitivity, or there is an open wire between the detector and the controller.
0	1 - 8	3	Zones 1-4: Count rate has exceeded 50% of sensitivity setting. A separate output is activated, and no fault output is activated. Zones 5-8: Runaway detector – fault output activated. (This can be checked by using the count mode test of the controller as described in the “Checkout” section.)
0	0	4	Low +290 vdc caused by a shorted A-lead or controller malfunction.
0	0	5	High +290 vdc caused by a failure in the regulating network in the controller.
0	1 - 4	6	Fire Output signal - blinking ZONE OUTPUT LED indicates fire location. Steady ZONE OUTPUT LED indicates that the detectors in that zone have responded to a UV signal, but are no longer responding. This is not a fault condition.
0	1 - 8	7	Count Subtraction Lockout. Surveillance detector module or modules are discharging at their maximum rate and the controller is subtracting the maximum signal from the fire detector module’s signal. The system is thus “saturated,” and effectively “locked-out,” i.e. there will be no false actuation of the system due to interference signals, but the system is incapable of responding if a fire should occur at this time. A separate output is activated when the system enters “lock-out.”
0	1 - 8	8	Controller has been placed in “count” mode (see “Checkout” section). Pushing and releasing both SELECT and TEST/ACCEPT buttons at the same time while the keylock switch is in the TEST position changes the lower display to a numeral “8” - the count mode for checking the count rate of each zone.
Blank	Blank	9	Data Link Failure – slave controller is not receiving data, or is receiving incorrect data from the master controller.
Blank	Blank	Blank	FAULT LED on. There is a problem in the R7404 microprocessor circuitry. Place keylock switch in RESET, push and release LAMP TEST pushbutton and return the keylock switch to NORMAL. If operation does not return to normal, replace the entire unit. Make sure the new R7404 is programmed the same as the one being replaced.
Blank	Blank	Blank	No LEDs on or displays on. Check input power to controller or blown fuse in controller.

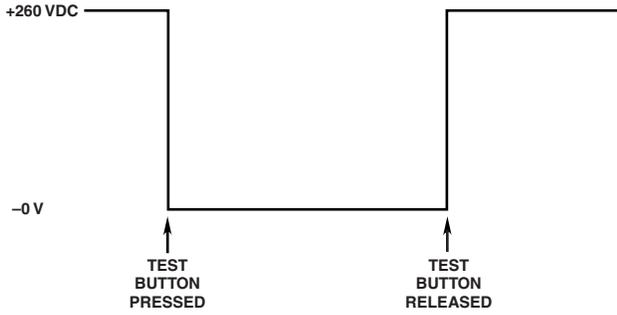


Figure 20—Detector D-lead Voltage - Manual Test

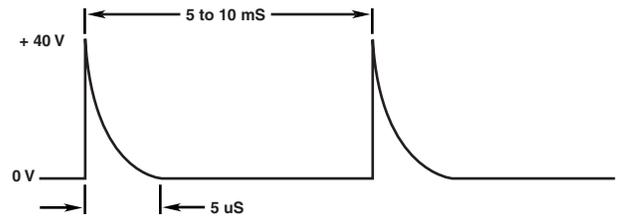


Figure 21—Detector B-lead Waveform

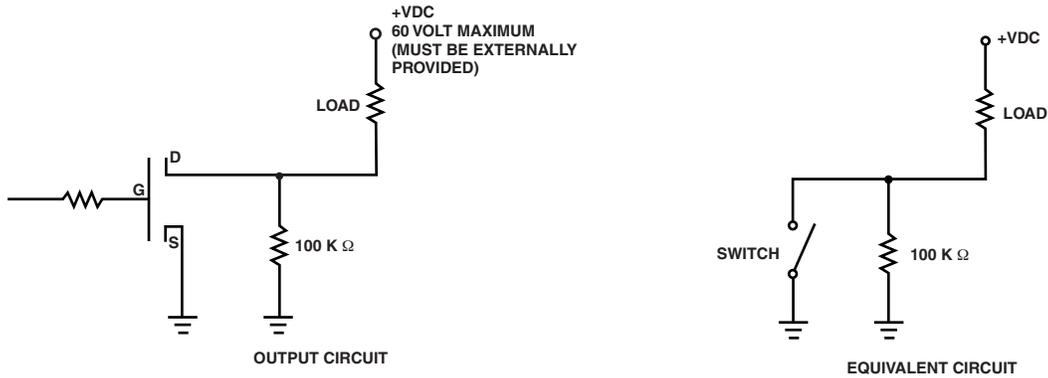


Figure 22—R7404 Solid State Output Circuit

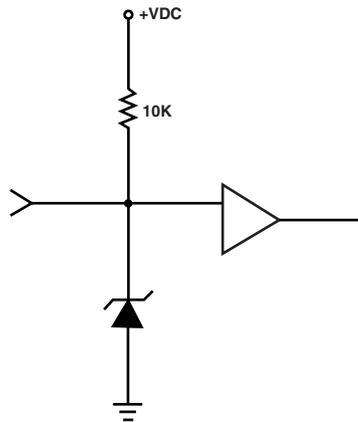


Figure 23—Solid State Input

Detector Electronics Corporation
 6901 West 110th Street • Minneapolis, Minnesota 55438 • Fax (612) 829-8750
 Telephone (612) 941-5665 or (800) 765-FIRE • www.detronics.com • email: detronics@detronics.com

Recommended Test Form

Date Installed	Date Checked	Date Lens Cleaned	Sensitivity Readings Count Test Mode	Remarks