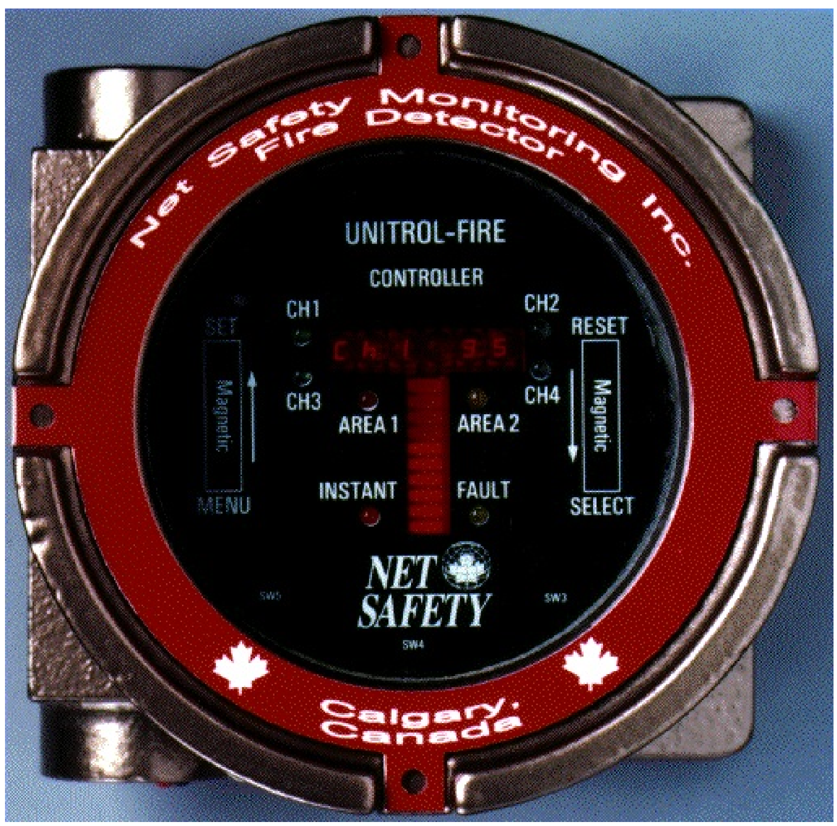
NET SAFETY
MONITORING INC.

MODELS: U1F and U2F-UV/IR
with UVC120 and IRC90H

UV/IR FIRE DETECTION SYSTEM

One and Two-Channel Field-Mount Controller
with the UVC120 and IRC90H Detectors



ISO 9001:2000

QMI REGISTERED

Part Number: MAN-0035-00 Rev. 3

This manual is a guide for the use of a One and Two-Channel Field-Mount Controller and the data and procedures contained within this document have been verified and are believed to be adequate for the intended use of the controller. If the controller or procedures are used for purposes other than as described in the manual without receiving prior confirmation of validity or suitability, Net Safety Monitoring Inc. does not guarantee the results and assumes no obligation or liability.

Net Safety Monitoring Inc. products, are carefully designed and manufactured from high quality components and can be expected to provide many years of trouble free service. Each product is thoroughly tested, inspected and calibrated prior to shipment. Failures can occur which are beyond the control of the manufacturer. Failures can be minimized by adhering to the operating and maintenance instructions herein. Where the absolute greatest of reliability is required, redundancy should be designed into the system.

Net Safety Monitoring Inc., warrants its sensors and detectors against defective parts and workmanship for a period of 24 months from date of purchase and other electronic assemblies for 36 months from date of purchase.

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Unit I GENERAL INFORMATION

DESCRIPTION

The U1F-, U2F-UV/IR model controllers with UVC120 ultraviolet (UV) detector and IRC90H infrared (IR) detector provides fast reliable fire detection in environments where false actuation due to interference can be a problem. Such interference includes x-rays, gamma rays, electric arcs, and hot objects. These interfering agents can make either an infrared or an ultraviolet detection system alone unusable. By combining the two types of fire detection systems, reliable fire detection is possible in these environments without unacceptable false alarms. In order for an alarm condition to be actuated, both the UV and IR detectors must 'see' the fire. The UV and IR detectors monitor different portions of the radiation spectrum and fire is virtually the only source that will affect both types of detectors. This system makes it possible for arc welding and other projects to be performed on the premises without the need to shut down your fire detection system and leave your facility unmonitored. The controller comes with a full array of faceplate indicators, relay and current outputs, automatic and manual Visual Integrity (**vi**) testing.

FEATURES

- Continuous monitoring of 1 or 2 UV/IR detectors
- Non-intrusive testing activated by magnets
- High degree of discrimination against gamma rays, x-rays, and arc welding
- Microprocessor based controller is easily field programmable
- Automatic and manual Visual Integrity (**vi**) testing
- Adjustable sensitivity and time delay
- Automatic fault identification
- Automatic test functions are performed with the system on-line
- Individual channel identification with voting option.
- Latching Area LEDs identify the area(s) responding to fire
- Two digital displays, one bar graph display and high intensity LEDs indicate important system status information
- Output circuits are field programmable for latching or non-latching operation.
- Instant and Area alarm relays are programmable for normally energized or de-energized operation
- Individual IR and UV response can be measured and observed on the display.
- One or Two 4-20mA current outputs to send important system information to other devices

CONTROLLER SPECIFICATIONS

- **Operating Voltage:**
  24 Volts DC. 18 to 32 Volts DC.

- **Power Consumption (controller only):**
  2.4 watts nominal, 4.4 watts maximum.
  100 mA nominal, 180 mA maximum at 24 Volts DC.

  Maximum start-up current is an average of 1.5 Amperes for 10 milliseconds. Power supplies with fold back current limiting should be sized carefully.

- **Maximum Ripple:**
  Ripple should not exceed 5 Volts peak-to-peak. The sum of DC plus ripple must be ≥18 Volts DC and ≤32 Volts DC.

- **Temperature Range:**
  Operating: -40ºC to +85ºC (-40ºF to +185ºF)
  Storage: -55ºC to +150ºC (-65ºF to +302ºF)

- **Relay Contacts:**
  Normally open/normally closed contacts rated for 5 Amperes at 30 Volts DC/ 250 Volts AC

- **Current Output:**
  4-20 mA DC current outputs, with a maximum external loop resistance of 600 Ohms at 18-32 Volts DC

- **Dimensions:**
  Refer to *Figure 1 and 2*

- **Shipping Weight** (approximate)**:**
  2 lbs (0.9 kilograms)

- **Certification:**
  CSA certified for Class 1, Division 1, Groups B, C and D areas.

- **System Sensitivity:**
  Sensitivity is field adjustable using the dip switches on the controller.

- **Response Time:**
  Response to a fire source is typically 10 milliseconds for the channel and alarm outputs and 0.5 seconds for the area outputs when sensitivity is set for greatest sensitivity and time delay is set for 0.5 seconds (minimum settings).

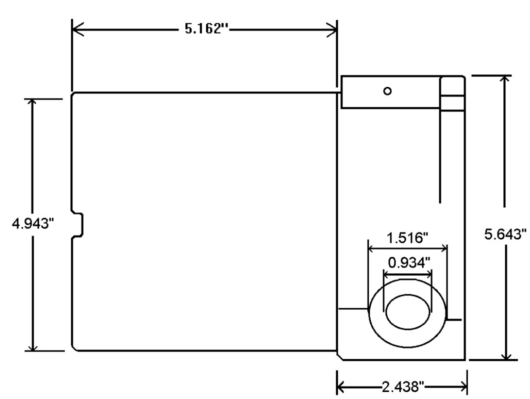


Figure 1 - Controller Dimensions

UV-IR DETECTOR SPECIFICATIONS

- **Operating Voltage:**
  UV-290 Vdc ± 3V (provided from controller)
  IR 24 Vdc ± 3V (provided from controller)

- **Power Consumption** (each detector**)**:
  UV- 0.29 Watts nominal, 0.5 Watts maximum
  1 mA nominal, 1.7 mA maximum

  IR- 1.45 Watts nominal, 2.9 Watts maximum
  60mA nominal, 120 mA maximum

- **Temperature Range:**
  Operating: -40ºC to +125ºC (-40ºF to +257ºF)
  Storage: -55ºC to +150ºC (-65ºF to +302ºF)

- **Dimensions:**
  Refer to *Figure 2*

- **Detector Enclosure Materials:**
  Available in anodized aluminum or optional stainless steel

- **Shipping Weight (approximate):**
  7 lbs (3.0 kilograms)

- **Certification:**
  CSA certified for, Class 1, Division 1, Groups B, C, and D

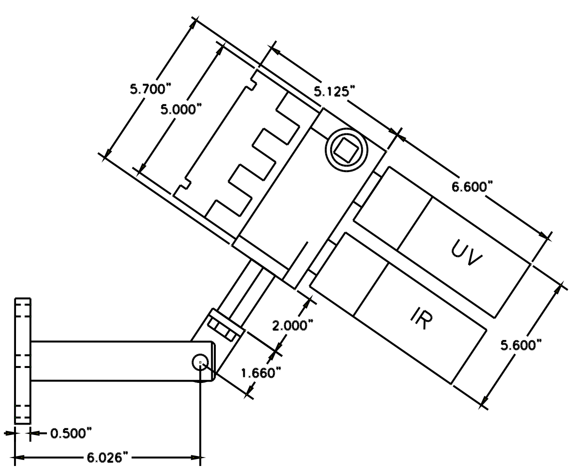


Figure 2 - UV/IR Mounting Assembly

- **Spectral Sensitivity Range:**
  UV radiation over the range of 185 to 260 nanometers (1850 to 2600 angstroms)
  IR infrared radiation centered around 4.4 microns

- **Cone Of Vision:**
  The UV-IR Detector has a nominal 90 degree cone of vision

BASIC OPERATION - CONTROLLER

CONTROLLER FACEPLATE DESCRIPTION

The controller faceplate provides LEDs and two digital displays for identifying status conditions, a bar graph display for indicating an alarm condition, and **MENU/SET** and **SELECT/RESET** reed switches (see Appendix B for instructions on activation) for testing and resetting the system. Refer to *Figure 3.*

- **Digital Displays -** The left digital display is off during normal operation. If a fire alarm or visual integrity fault is detected, it indicates the channel number(s) the alarm or fault is occurring on. The right digital display indicates system status including system error codes, visual integrity (**vi**), system fault, or fire alarm. The right display shows '**nor**' in normal operating mode. If more than one channel is in an alarm or fault condition, the digital displays will cycle through these channels. Since at least one display is always lit, they also function as a power indicator.

- **Bar Graph Display** - This is off when no fire alarm is detected and flashing when a fire alarm is detected in any area.

- **Instant LED** - The instant alarm (no time delay) turns on in response to any signals from a detector pair (one UV and one IR detector make a detector pair) that exceed the sensitivity settings. If the condition goes away, the LED will remain illuminated until the system is reset.

- **Area LEDs -** These two alarms have a programmable time delay. If the selected "voting" criteria has been satisfied in the corresponding area and the time delay has elapsed, the corresponding LED turns on. If the alarm condition goes away (fire is extinguished) the LED will remain illuminated until the system is reset.

- **Fault LED** - flashes upon detection of an overall system fault or **vi** fault and is illuminated during the 15 second power-up time delay as well as when the controller is in the bypass mode.

- **Channel LEDs -** flash in response to the signal from the corresponding detector exceeding the programmed setting. These LEDs remain illuminated (no longer flashing) after an alarm condition has returned to normal and can be extinguished by resetting the system.

- **Menu/set Reed Switch** - is used to enter the main menu, to toggle through menu selections, and in conjunction with the **SELECT/RESET** Reed Switch to enter the special functions menu. This switch is also used to alter the current output calibration, and the forced current output.

- **SELECT/RESET Reed Switch -** is used for a basic system reset, to select menu items, and in conjunction with the **MENU/SET** reed switch to enter the special functions menu. This switch is also used during the **vi** and background test and to alter the CAN address, the current output calibration, and the forced current output.

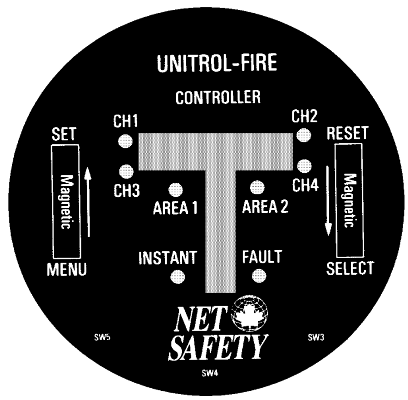


Figure 3 - Controller Face-Plate

OUTPUT

Relay Outputs:
The relay outputs have SPDT, form C, normally open/normally closed contacts rated for 5 Amperes at 30 Volts DC or 250 Volts AC. The four relays include an instant alarm, two time delayed area alarms, and a fault alarm.

RECOMMENDATION

The fault relay output should not be used to activate an automatic shutdown procedure. The fault output indicates a potential problem with the controller, not an alarm condition.

Current Outputs:
4-20 mA DC current outputs transmit system information to other devices. The current outputs can be configured for isolated or non-isolated operation by changing the positions of jumpers as shown in *Figure 4*. Refer to Unit IV, System Operation for a description of the current output signal levels.

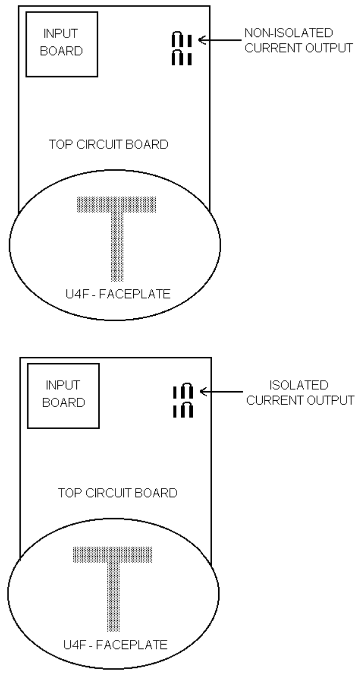


Figure 4 - Jumper Selection for Isolated or Non-Isolated Current Outputs

PROGRAMMING OPTIONS

A set of dip-switches, located on the circuit board are used to “program” various options including:

- channel selection
- system sensitivity
- fire area voting logic
- time delay for area alarms
- relay latching/non-latching selection
- relay energized/de-energized selection

NOTE

Whenever dip switch settings are altered, the power to the controller must be recycled to make the changes take effect.

The instant and area alarm outputs are programmable for either normally energized or normally de-energized operation (programmable as a group only, not individually). The fault output is normally energized. The instant and area alarm relay contacts are programmable as a group for either latching or non-latching operation.
The relays are also selectable with jumpers for normally open or normally closed operation.

Refer to the following Table *(Table 1)* for a summary of the programming options.

Table 1 - Selectable Output Options

OUTPUT	Selectable Normally Open/Closed	Selectable Normally Energized/De-Energized	Selectable Latching/Non-latching
AREA[1]	Y	Y	Y
INSTANT	Y	Y	Y
FAULT	Y	N[2]	N[3]

[1] Area alarms are programmed together, not individually.
[2] Fault relay is normally energized.
[3] Fault relay is non-latching.

EXTERNAL RESET

A normally open, momentary closure switch can be connected between the external reset terminal and the negative power terminal to provide remote reset capabilities.

AUTOMATIC DIAGNOSTICS AND FAULT IDENTIFICATION

The microprocessor-based controller features self-testing circuitry that continuously checks for problems that could prevent proper system response. When power is applied, the microprocessor automatically tests memory. In the Normal Operating Mode it continuously monitors the system to ensure proper functioning. A "watchdog" timer is maintained to ensure that the program is running correctly.

The main loop of the operating program continuously cycles through the Automatic Visual Integrity test, checking each detector and its wiring. The microprocessor can be interrupted by any one of several status changes such as a fault or a "fire" signal from one of the detection areas to take appropriate action.

If a system or **vi** fault is detected the Fault LED flashes, digital displays and current outputs identify the nature of the fault and the fault relay is de-energized.

VOTING LOGIC

The two channel controller (U2F-UV/IR) can be dip-switch configured for one or two monitoring areas. For a one area configuration, all four channels (2 UV/IR heads) are considered as being in Area 1 and the Area 1 and 2 relays are activated together. The dip switches can be set so that only one detector pair need be in an alarm state to activate the area alarms, or so that both detector pairs must ‘vote’ (see a fire at the same time) to activate the area alarms. The instant alarm will be activated when either pair sees a fire, no matter what voting option is being used.

Unit II UV/IR FIRE DETECTION

SYSTEM APPLICATION

The UVC120 detector responds instantly to the ultraviolet radiation from 185 to 260 nanometers that is emitted by a flame. Once the UVC120 is activated, the controller will check the IRC90H, which reacts to infrared radiation in the area of 4.4 microns. Fire produces a high degree of radiation at 4.4 microns. Figures 5 and 6 show the relative radiation emitted by fire and the sun in relation to the detector monitoring ranges. The controller will not check the infrared detectors until the ultraviolet detectors have seen UV radiation, since IR detectors are more liable to be triggered by radiation from sources other than fire. The UV/IR detection system is designed for use in indoor or outdoor hazardous locations where ultraviolet detectors are not used alone due to possible interference from other sources of UV radiation (i.e. arc welding).

Typical applications for UV/IR detection systems are:

- around highly combustible materials,
- if instantaneous response to flame is needed
- where automated fire protection is required
- to protect large capital investments.
- wherever false alarms cannot be tolerated

Radiation below the intensity of that produced by an actual fire in the controlled area is referred to as “background radiation.” An example of a high level of background radiation could be the UV radiation produced by a flare stack situated outside of a building. The UV radiation produced by this flare may be detected when a door to the building is opened. Windows or reflective surfaces may also result in unusually high levels of UV radiation entering the building from the flare. With the UV/IR detectors, these situations usually do not cause a problem. If high levels of both UV and IR radiation are in the monitored area, the system sensitivities must be carefully set and monitored.

The normal precaution against false actuation due to high levels of background radiation is to turn off the detection system when sources of high level radiation in both the UV and IR spectrum are being used in the immediate area. Caution must be exercised if the detection system is turned off, since the hazardous area will not be protected.

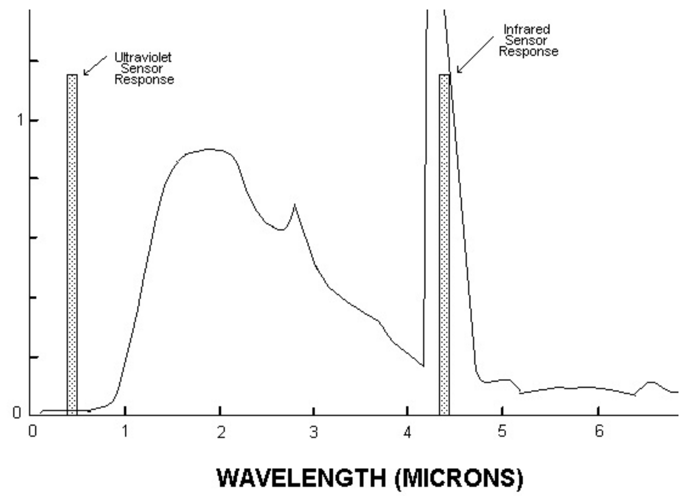


Figure 5 - Hydrocarbon Fire Radiation

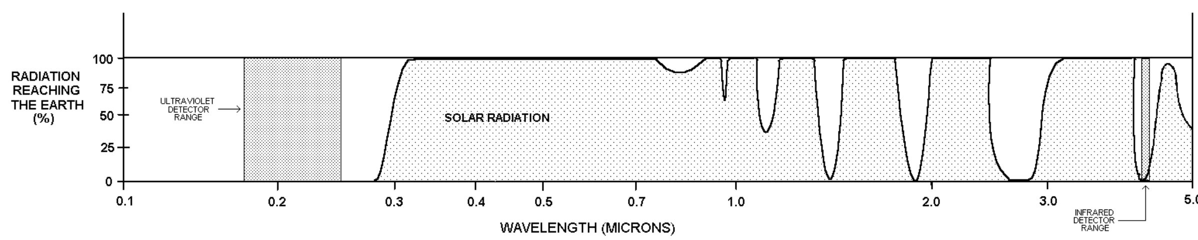


Figure 6 - Solar Radiation Spectrum

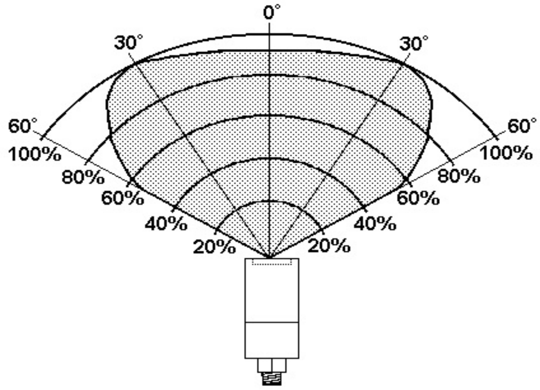


Figure 7 - UV Detector Cone of Vision

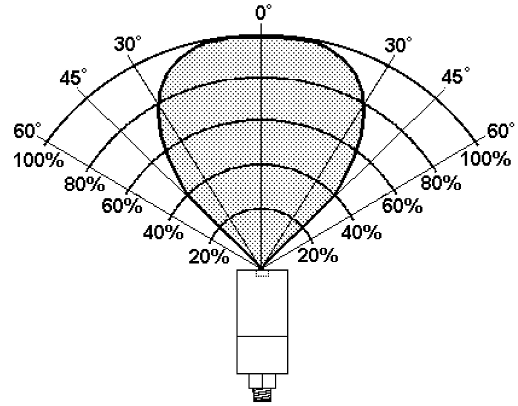


Figure 8 - IR Detector Cone of Vision

OPTICAL SENSITIVITY RANGE (Cone of Vision)

The UV detector has a 120 degree cone of vision. *Figure 7* shows a composite view of the cone of vision and the detector response to a constant UV source at various relative distances.

The infrared detector has a nominal cone of vision of 90 degrees, with its greatest sensitivity along its central axis. *Figure 8* shows a composite view of the cone of vision and the detector response to a constant IR source at various relative distances. Depending upon the intensity of the radiation source, the detector pair can be considered to have a practical cone of vision of 90 degrees and an application distance of up to about 50 feet (15 meters). The distance is directly related to the intensity of the radiation source. Since physical obstructions, can prevent radiation from reaching the detectors, they should be mounted as close as practical to the probable hazard. Under certain controlled conditions, detectors can be used at greater distances.

SYSTEM SENSITIVITY CONSIDERATIONS

Selection of 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 fire. The adjustable sensitivity and time delay of the controller allows it to meet the requirements of virtually any application.

The system can be adjusted to various sensitivity levels by programming the controller to respond to a pre-determined radiation intensity received by the detectors. This radiation is dependent upon the type of fuel, flame size, distance from the detector, and the amount of UV absorbing vapors that may be present. If there is too much UV absorbing vapor (see Appendix D) between the detectors and the source of the fire, the UV detector may not receive enough radiation to trigger an alarm. If the UV detector cannot detect the radiation from the fire, the controller will not check the IR detector to see if it is seeing any radiation.

Unit III SYSTEM INSTALLATION

INSTALLATION

GENERAL WIRING REQUIREMENTS

NOTE

> *The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. Because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with applicable regulations that relate to the installation of electrical equipment in a hazardous area. If in doubt, consult a qualified official before wiring the system.*

Shielded cable is highly recommended for power input and signal wires to protect against interference caused by extraneous electrical 'noise'. Relay outputs do not require shielded cable. Recommended detector cable is four conductor, shielded cable, 18 AWG, rated 300V. If the wiring cable is installed in conduit, the conduit **must not** be used for wiring to other electrical equipment. Detectors can be located up to 2000 feet (600 metres) from the controller.

Water will damage electronic devices. Moisture in the air can condense within electrical conduit and drain into the enclosure, therefore, water-proof and explosion-proof conduit seals are recommended to prevent water accumulation within the enclosure. Seals should be located as close to the device as possible and not more than 18 inches (46 cm)away. Explosion-proof installations may require an additional seal where conduit enters a non-hazardous area. Conform to local wiring codes.

When pouring a seal, use a fibre dam to assure proper formation of the seal. The seals should never be poured at temperatures below freezing.

The jacket and shielding of the cable should be stripped back to permit the seal to form around the individual wires. This will prevent air, gas and water leakage through the inside of the shield and into the enclosure.

It is recommended that explosion-proof drains and conduit breathers be used. In some applications, alternate changes in temperature and barometric pressure can cause 'breathing' which allows moist air to enter and circulate inside the conduit. Joints in the conduit system are seldom tight enough to prevent this 'breathing'.

CONTROLLER WIRING

NOTE

The controller contains semiconductor devices that are susceptible to damage by electrostatic discharge. An electrostatic charge can build up on the skin and discharge when an object is touched. Therefore, use caution when handling, taking care not to touch the terminals or electronic components. For more information on proper handling, refer to the Appendix.

The controller is furnished with field wiring terminals for connecting the external wiring. Refer to *Figure 9* for the terminal configurations of the U2F-UV/IR and the termination box for the UV/IR detector pair. *Figures 10a, 10b, 11a, and 11b* show the proper wiring of the system for isolated and

non-isolated current outputs (refer to *Figure 4* for the correct positioning of jumpers ‘J12' and ‘J18' for isolated or non-isolated current outputs).

NOTE

If local wiring codes permit, and if a ground fault monitoring system is not being used, the minus side of the DC power source can be connected to chassis (earth) ground. Alternatively, a 0.47 microfarad, 100 Volt capacitor can be installed for extra immunity against electromagnetic interference.

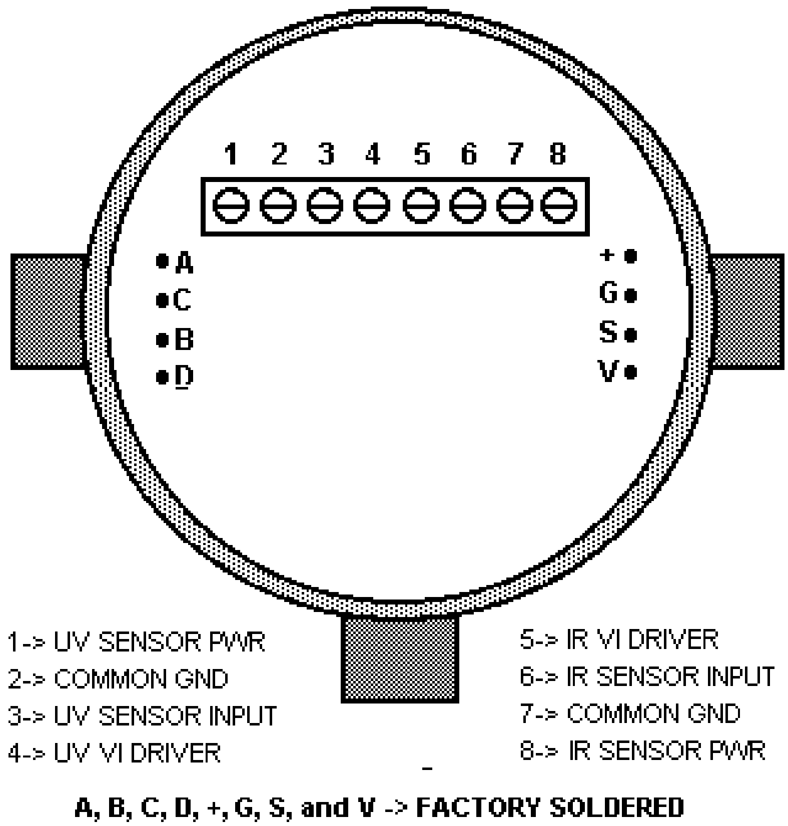
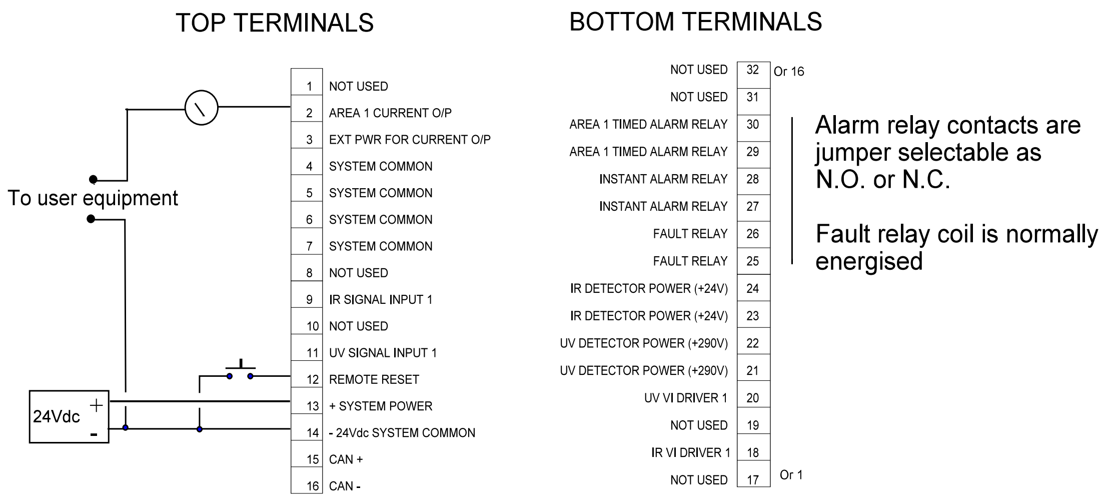


Figure 9 - UV/IR Termination Box Configuration

U1F- UV/IR CONTROLLER
NON-ISOLATED CURRENT OUTPUT



Note: *Terminals shown as 17 thru 32 above may be labeled 1 thru 16 on unit*

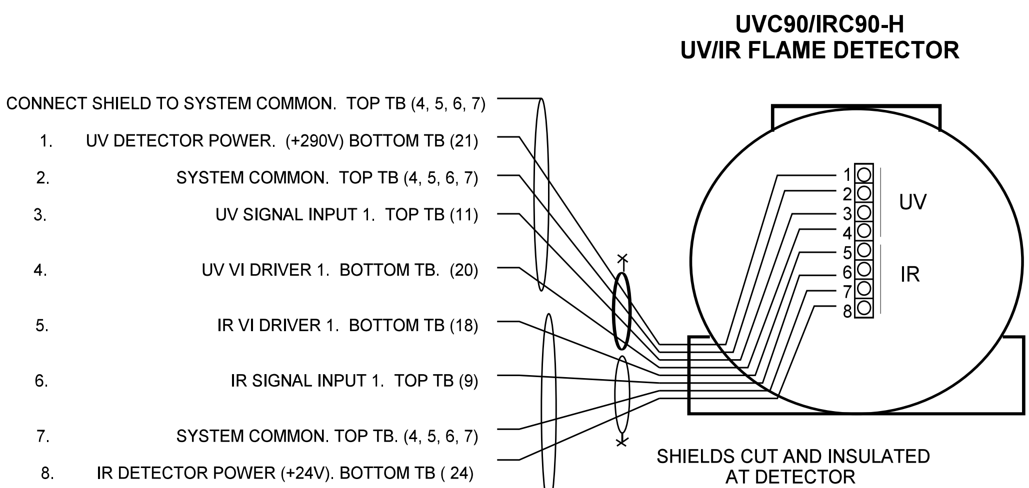
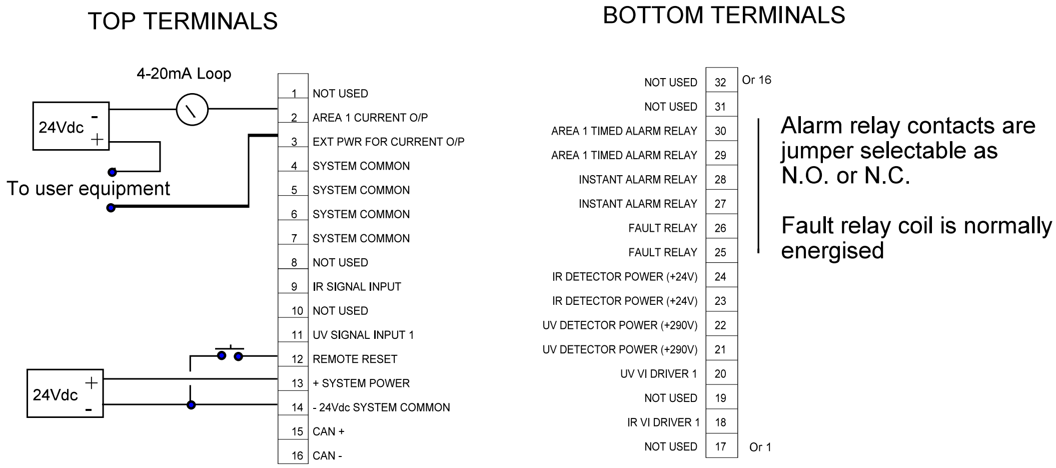


Figure 10a - Wiring for U1F-UV/IR with Non-Isolated Current Output

U1F-UV/IR CONTROLLER
ISOLATED CURRENT OUTPUT



Note: *Terminals shown as 17 thru 32 above may be labeled 1 thru 16 on unit*

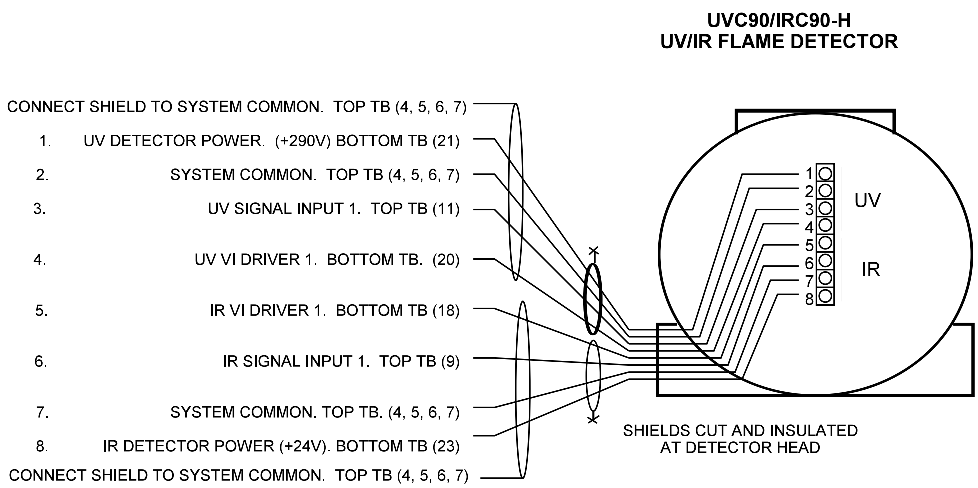
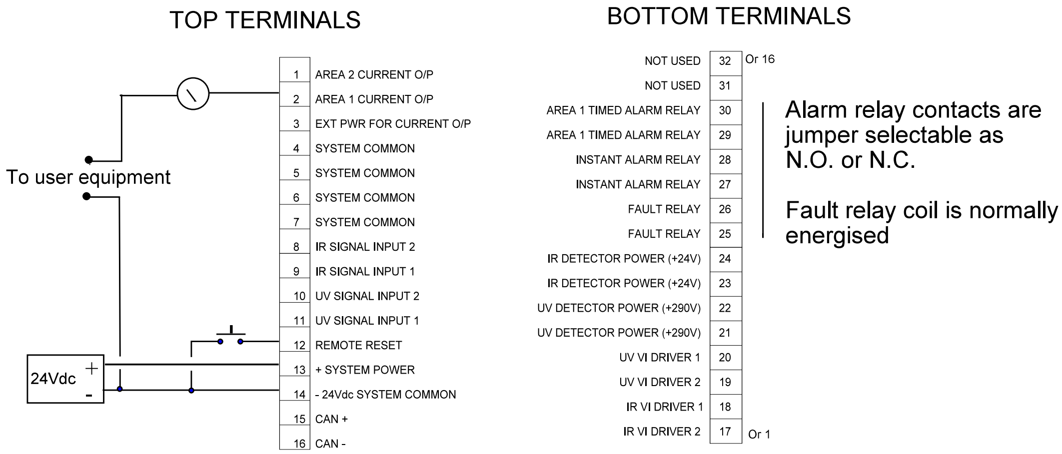


Figure 10b - Wiring for U1F/IR with Isolated Current Output

U2F- UV/IR CONTROLLER
NON-ISOLATED CURRENT OUTPUT



Note: *Terminals shown as 17 thru 32 above may be labeled 1 thru 16 on unit*

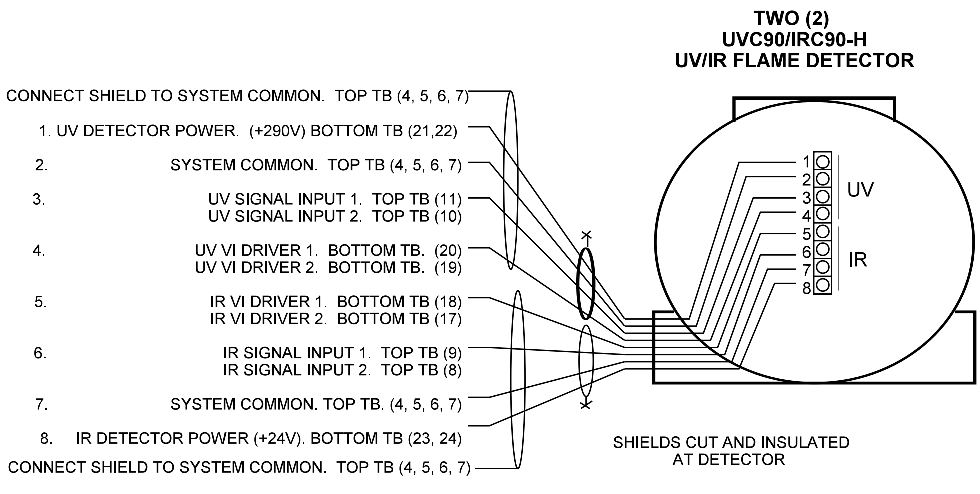


Figure 11a - Wiring for U2F-UV/IR with Non-Isolated Current Output

U2F-UV/IR CONTROLLER
ISOLATED CURRENT OUTPUT

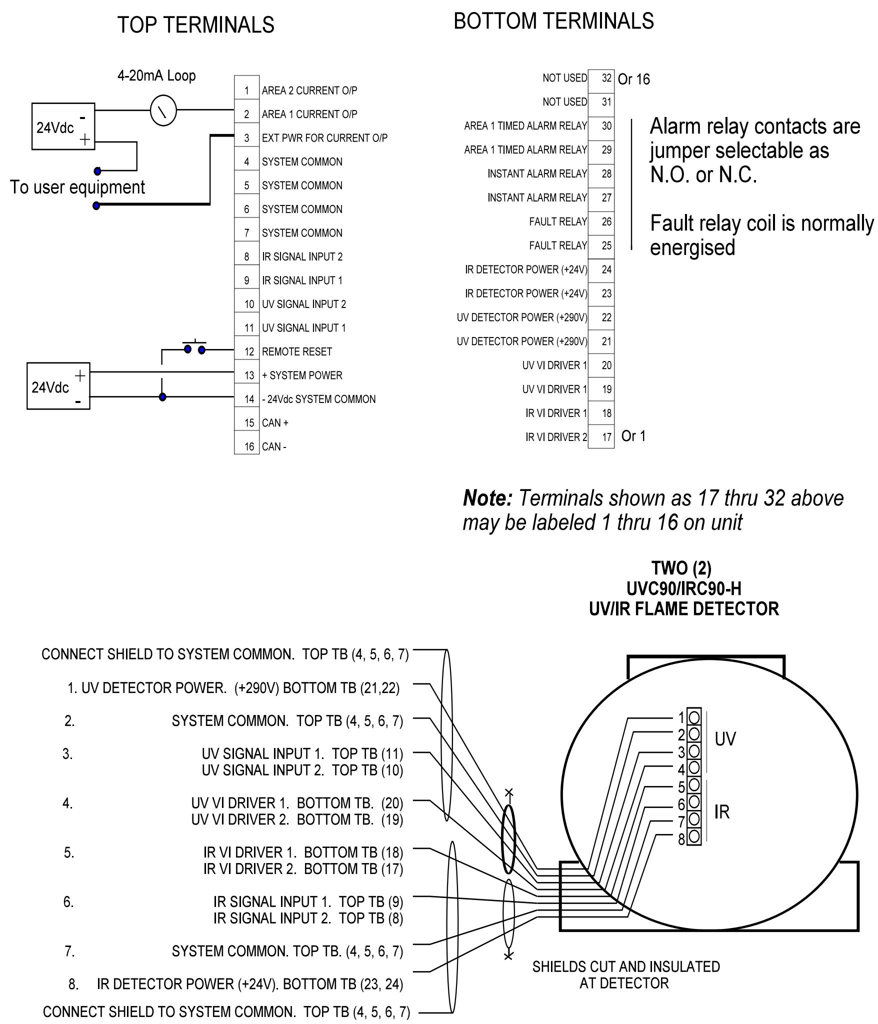


Figure 11b - Wiring for U2F-UV/IR with Isolated Current Output

POSITION AND DENSITY OF DETECTORS

The detector has a nominal 90º cone of vision. In an application such as a loading rack with a ceiling height of 25 feet (7.5 meters) where it is desired to have complete detector coverage at floor level and a detector is mounted 2 feet (0.6 meter) from the ceiling and pointed straight down, the distance from the detector to the designated level would be 23 feet (7 meters) and because of its 90º cone of vision the detector would cover a circular area 46 feet (14 meters) in diameter at floor level. A sketch of the area to be covered will indicate the number of detectors required to monitor the area. Detectors should be placed as close as practical to the expected fire hazard.

NOTE

Do not mount detectors close to the ceiling in en areas if dense smoke can be expected to accumulate at the onset of a fire. Mounting the detectors 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 any time delay settings for applications where smoke may accumulate during a fire.

MOUNTING THE DETECTORS

Locate detectors to ensure an unobstructed view of the area to be monitored and where accessible for cleaning the detector window and **vi** reflecting surface. Take care so dirt will and dust not accumulate and obscure the detector viewing window. Detectors mounted outdoors should be pointed downward to prevent the cone of vision from scanning the horizon where long duration lightning flashes or far-off arc welding may activate the detector. To minimize dirt accumulation around the **vi** surfaces, mount the detectors so that the internal **vi** tube is on top. The silver external reflector should be placed directly over the **vi** tube. Refer to *Figures 1 and 2* for the detector and swivel mounting assembly dimensions. Refer to *Figure 7* for a diagram of the assembled detector

DIP SWITCH SETTINGS

NOTE

Whenever dip switch settings are altered, the power to the controller must be recycled to make the changes take effect.

It is essential that the controller be properly programmed before applying power to the system. There are three banks of dip switches located in the controller. Each switch bank has eight switches, which are ed or to select area and detector combinations, controller sensitivity, fire logic, output latching and time delay.

NOTE

The dip-switches are easily visible on the controller circuit board. Refer to Figure 14a for the location. The switches are numbered from bottom to top as SW3, SW4, and SW5. Individual switches are referenced as "SWX.Y" where "X" refers to the switch bank number and "Y" refers to the switch number on "X" bank. Switches are set as either '' OFF or '' ON. Refer to Figure 14b for an illustration.

CHANNEL SELECTION

Switches 3.1 through 3.4 enable the detectors connected to the controller. The appropriate switch must be set to the OFF position for each detector connected. Care must be taken when setting these switches. If a switch is set '', but no detector is connected in that location, the controller will go into a fault condition. If a switch is set ON, but a detector is connected, the controller will appear to be operating incorrectly. However, that detector will be eliminated from the Automatic **vi** test sequence, and any faults occurring in its circuit will not be annunciated.

- SW3.1: OFF: detector 1 (UV Area 1) connected
  ON: detector 1 (UV Area 1) not connected
- SW3.2: OFF: detector 2 (UV Area 2) connected
  ON: detector 2 (UV Area 2) not connected
- SW3.3: OFF: detector 3 (IR Area 1) connected
  ON: detector 3 (IR Area 1) not connected
- SW3.4: OFF: detector 4 (IR Area 2) connected
  ON: detector 4 (IR Area 2) not connected

NOTE

If only one detector pair (one UV and one IR) are being used, channel s 1 and 3 should be used. Channel 1 is for the Area 1 UV detector which is used in conjunction with Channel 3, the Area 1 IR detector. Channel 2 is the Area 2 UV detector and Channel 4 is the Area 2 IR detector.

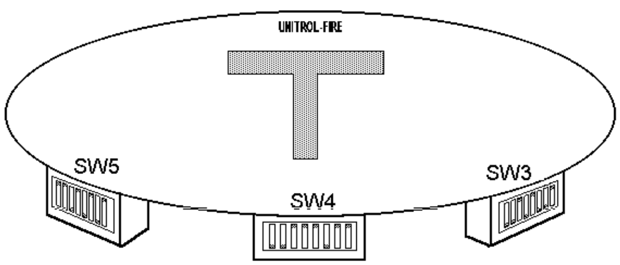


Figure 12a - Dip Switch Position

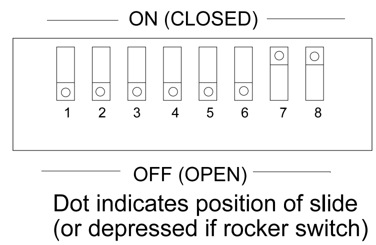


Figure 12b - Dip Switch

CONTROLLER SENSITIVITY ADJUSTMENT FOR IR

Switched 3.5 through 3.8 are used to set (program) the controller sensitivity for the infrared detectors from 50 to 80 units in 2 unit increments.

- SW3.5: ON: 2 units
- SW3.6: ON: 4 units
- SW3.7: ON: 8 units
- SW3.8: ON: 16 units

The switches used in combination are added together and added to a base value of 50 units. If no switches are ON, the default setting is 50 units. These switches are factory set to give a sensitivity setting of 66 units as shown in the example.

Example: SW3.5 OFF
SW3.6 OFF *sensitivity*
SW3.7 OFF *= 66 units*
SW3.8 ON

CONTROLLER SENSITIVITY ADJUSTMENT FOR UV

Switches 4.1 through 4.4 are used to set (program) controller sensitivity for the ultraviolet detectors in 8 cps (counts per second) increments.

- SW4.1: ON: 8 cps
- SW4.2: ON: 16 cps
- SW4.3: ON: 32 cps
- SW4.4: ON: 64 cps

The switches used in combination are added together. If no switches are ON, the default sensitivity is 8 cps. These switches are factory set for a sensitivity setting of 24 cps, as shown in the example.

Example:

SW4.1	ON	
SW4.2	ON	*sensitivity*
SW4.3	OFF	*= 24 cps*
SW4.4	OFF	

FIRE AREA VOTING SEQUENCE (for U2F UV-IR only)

Switches 4.5 and 4.8 select voting sequence **(SW4.6 and SW4.7 are not used)**, which can be Fire Area 1 only (both detector pairs in Area 1) or Fire Area 1 (one detector pair) separate from fire Area 2 (one detector pair). When two areas are used, detectors 1 (UV) and 3 (IR) make up the detector pair for Area 1 and detectors 2 (UV) and 4 (IR) make up the detector pair for Area 2.

Switch 4.8 is used to determine whether one or two Areas are used and switch 4.5 is used to set the voting criteria. If SW4.8 is OFF, both detector pairs are in Area 1 and SW4.5 is used to set the voting criteria. If SW4.5 is OFF, only one detector pair needs to 'see' a fire condition to activate the Area 1 alarm. If SW4.5 is ON, both detectors must vote (see the fire condition at the same time) to activate the Area 1 alarm. These switches are factory set to have two fire areas and no voting.

When SW4.8 is ON, two separate fire areas are used. Since this configuration allows for one detector pair in each area, voting can not be accomplished and SW4.5 does not affect the settings.

NOTE

If only one detector pair is connected set SW4.5 OFF and SW4.8 OFF.

Area 1 only configuration:

- SW4.8 OFF
- SW4.5 OFF: no voting required.
  ON: both detector pairs must vote on a fire condition

Area 1 and 2 configuration:

- SW4.8 ON
- SW4.5 OFF or ON

NOTE

SW4.6 and SW4.7 are not used.

RELAY OUTPUTS LATCHING/NON-LATCHING

The alarm relays are programmed together for latching or non-latching operation (the fault relay is non-latching). This switch is factor set to the ON position.

- SW5.1: ON: non-latching operation
  OFF: latching operation

NOTE

The outputs are unlatched by activating the RESET switch.

RELAY OUTPUTS ENERGIZED/DE-ENERGIZED

The area and instant alarm relays can be programmed for normally energized or de-energized operation; the fault relay is always normally energized. This switch is factory set to the ON position.

- SW5.2: OFF: normally energized
  ON: normally de-energized

TIME DELAY FOR AREA ALARMS

NOTE

Time delay affects the Area alarms only; the instant Alarm operates as soon as a fire is detected.

- SW5.3-7: OFF: 0.5 sec. time delay
- SW5.3: ON: 0.5 sec. time delay
- SW5.4: ON: 1 sec. time delay
- SW5.5: ON: 2 sec. time delay
- SW5.6: ON: 4 sec. time delay
- SW5.7: ON: 8 sec. time delay

If switch 5.8 is "OFF" then in Bypass mode:
- the current output is 4 mA
- the Fault Relay state remains unchanged (if it was energized, it remains energized; if it was de-energized, it remains de-energized)

If switch 5.8 is "ON" then in Bypass mode:
- the current output is 3 mA
- the Fault Relay is de-energized

The total time delay is the added value of the switches ON. Switches can be ON in any combination for a time delay from 0.5 to 15.5 seconds in half second increments. These switches are factory set to give a three second time delay, as shown in the example. **Switch 5.8 is not used.**

Example:			
	SW5.3	OFF	
	SW5.4	ON	*time delay*
	SW5.5	ON	*= 3.0 sec.*
	SW5.6	OFF	
	SW5.7	OFF	

RELAY SETTINGS

There are four relays on the controller circuit board that can be set up for normally or normally operation by moving the jumpers which are located next to the relays. See *Figure 14a* for the location of the relays on the board and *Figure 14c* for the settings.

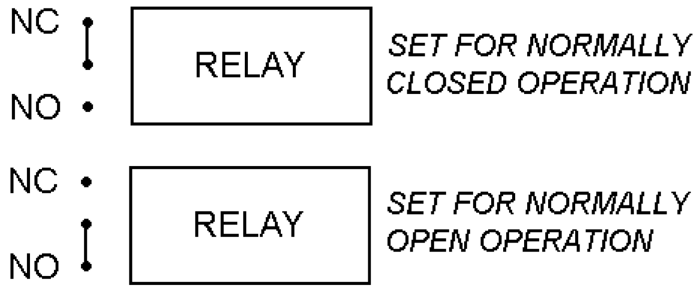


Figure 12c - Relay Settings

Unit IV SYSTEM OPERATION

STARTUP PROCEDURE

CAUTION

Placing the controller in the Bypass mode inhibits its outputs, rendering the system incapable of actuating any extinguishing or alarm circuits that are connected to it. For maximum safety, however, secure output loads (remove power from any devices that would normally be actuated by the system) before manually testing the system. Remember to place this same equipment back into service when the test is complete.

1. After setting the selection switches and making all electrical connections, plug the electronics module into the terminal strips located in the Class 1, Division 1, Explosion proof housing.

2. Turn on power and perform the Checkout Procedure

3. If the controller appears to be operating normally, remove mechanical blocking devices and restore power to the response devices

NOTE

Be sure that the detectors are correctly aimed at the potential hazard and that no obstructions interfere with their line of vision. In addition, UV absorbing gases should not exist between the detector and the potential hazard.

CHECKOUT PROCEDURE

CAUTION

When testing the system, be sure to secure all output devices to prevent unwanted activation of this equipment, and remember to place these same devices back into service when the check-out is complete.

MANUAL vi CHECK/COUNT TEST

The Automatic **vi** (visual integrity) feature checks the detectors for correct response.
The visual integrity test and the count test are performed at the same time.

1. Place the controller in the bypass mode (all output inhibited). This is accomplished by using the **MENU/SET** magnetic reed switch until '**bPS**' is shown on the left display, then activate the

SELECT/RESET reed switch. The left digital display will show '**Chn**' and the right digital display will show "**bPS**".

2. Activate the **MENU/SET** reed switch again to toggle through the available channels. When the desired channel is shown on the left display, activate the **SELECT/RESET** reed switch.

3. While in the bypass mode, the right display will show the radiation being detected by the selected detector. Activating the SELECT/RESET reed switch will perform the manual vi test, a significant increase in the radiation displayed, should be observed. For the UV signal the value should be between 150 and 400. The IR signal should be between 55 and 120. If the counts read are not with in these ranges the lens and reflector need cleaning or the vi adjustment allen screw on the sensor on module needs to be repositioned (only available on tube modules with aluminum shroud.)

4. To exit the bypass mode, activate the **MENU/SET** reed switch repeatedly until 'tSt' is shown on the left display. Now activate the **SELECT/RESET** reed switch.

NOTE

The Automatic **vi** *system continuously monitors the operation of the detector but* ***does not*** *monitor external relays or equipment that may be operated from the fire signal output, 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 a UV/IR Test Lamp to simulate a fire.*

MANUAL CHECK PROCEDURE

The whole system should be checked periodically with a UV/IR test lamp to make sure that the detectors are not obstructed, that the area "seen" by the detectors has not changed, and that there is no fault in the **vi** circuit.

CAUTION

Secure all output loads connected to the controller outputs to prevent unwanted activation.

1. Place the channel to be tested in bypass using the procedure described in the 'MANUAL vi/COUNT TEST' section of this manual.

2. Shine the test light into a detector viewing window. The counts per second (cps) displayed on the right display should increase to an alarm level.

3. Turn off the test light.

4. Repeat the test for all detectors in the system.

5. After all detectors have been checked, return the system to the normal operating mode.

6. Restore power to output loads or remove any mechanical blocking devices.

ALTERNATE TEST PROCEDURE

When the bypass mode is selected from the main menu, after each channel is offered for selection a final '**tSt bPS'** selection is offered. Activate the **SELECT/RESET** reed switch to choose this selection. All channels are now in the test bypass mode. In this mode the radiation levels, normally seen when a channel is in bypass, are not seen. In this mode the channel, instant, and area LEDs will operate as they would in the normal operating mode (i.e. flash when a fire condition exists), but the relay outputs are inhibited. It should be noted that if the UV detector in a detector pair is not 'seeing' an alarm level of UV radiation, the signal from the IR detector in that pair will not be checked. This is an excellent way to test sensor sensitivity settings, and be sure that if a fire exists the controller will take the appropriate action.

NORMAL OPERATION

FIRE RESPONSE

When the controller receives a "fire" signal from a UV detector in the system, it is compared to the stored information of the program. If the signal received is greater than the programmed sensitivity setting, the controller will check the signal from the IR detector in the same detector pair. If the IR detector is also signaling an alarm condition:

1. The instant relay alarm output changes status. The instant alarm output is activated when any detector pair detects a fire.

2. The left display cycles through all detectors responding to the fire (CH1, CH2, CH3, or CH4).

3. The right digital display indicates a fire (“**Fir**”).

4. Two or more channel LEDs turn on (blinking), indicating the channel(s) detecting fire level radiation (if only the UV detector sees fire level radiation, no alarms are activated, but the channel LED for that channel will flash).If the detector pair receives fire level radiation for a period greater than the preset time delay:

If the selected "voting" criteria has been satisfied, the appropriate Area output changes status, and the corresponding Area LED is on. The bar graph display is also flashing.

NOTE: *When a fire signal is no longer present, the channel LED(s) and the display indication will latch until manually reset (channel LED emits steady light).*

Current Outputs

Two 4-20 mA DC current outputs for transmitting system information to other devices are also included. *Table 2* shows the current outputs for various situations.

Table 2 - Current Outputs

Current Output	Situation
0 mA	Shorted signal output, or loss of power
1 mA	Fault
2 mA	Power Fault
4 mA	Normal
5 mA	VI fault channel 1 (UV)
6 mA	VI fault channel 2 (UV)
7 mA	VI fault channel 1 (IR)
8 mA	VI fault channel 2 (IR)
9 mA	VI fault more than one channel
15 mA	Instant alarm channel 1

Current Output	Situation
16 mA	Instant alarm channel 2
17 mA	Instant alarm channel 3
18 mA	Instant alarm channel 4
19 mA	Instant alarm more than one channel
19.5 mA	Fire (Area alarm)

AUTOMATIC DIAGNOSTICS AND FAULT IDENTIFICATION

If a fault is detected:

- the Fault LED flashes,
- the digital displays identify that a fault has occurred,
- the fault relay output becomes de-energized, and
- if a problem specific to a single detector is detected (example, wiring problems), the corresponding channel LED will be on.

Refer to *Table 3* to identify the error messages. If more than one error is occurring, the message will continuously cycle through all the errors, changing every few seconds.
If a fault has occurred, but no longer exists, the fault LED will remain illuminated and the displays will alternate between '**nor**' and '**Err Fnd**'. To review the fault, enter the error check mode. This is accomplished by activating the **MENU/SET** reed switch until '**Chc Err**' is displayed, then activating the **SELECT/RESET** reed switch. The display should now show '**dSP Err**'. To see the error codes, activate the **SELECT/RESET** reed switch and the faults are sequentially displayed. Once all faults have been displayed, '**Clr Err**' is displayed. To clear the fault codes, activate the **SELECT/RESET** reed switch.

SPECIAL FUNCTION MENU

To enter the special function menu, activate and hold both magnetic reed switches for 20 seconds, until '**FoP**' is shown on the bottom display. This menu is a little harder to enter because it is not intended for general use. The items in this menu are used for system maintenance and calibration of equipment.

FORCED CURRENT OUTPUT MODE

The forced current output mode is used to check the current output calibration and the operation of any devices connected to the current outputs. To enter the forced current output mode, enter the special function menu. When '**FoP**' is shown on the right display activate the **SELECT/RESET** reed switch. Upon successful entry into this mode the left display will flash '**GPn**'. Activate the **MENU/SET** reed switch until the desired area output is reached ('GPA' = Area 1 and 'GPb' = Area 2), then activate the **SELECT/RESET** reed switch.

When an area has been chosen for forced current output, the left display will alternate between '**GPn**' and '**FoP**' and the bottom display will show what type of current output is being placed on the current output line:

FLt -> Fault (1mA)
POE -> Power Error (2mA)
Nor -> Normal (4mA)
OP1 -> Visual Integrity Error Channel 1 (5mA)
OP2 -> Visual Integrity Error Channel 2 (6mA)
OP3 -> Visual Integrity Error Channel 3 (7mA)

OP4 -> Visual Integrity Error Channel 4 (8mA)
OPA -> Visual Integrity Error on more than one channel (9mA)
in1 -> Instant Alarm Channel 1 (15mA)
in2 -> Instant Alarm Channel 2 (16mA)
in3 -> Instant Alarm Channel 3 (17mA)
in4 -> Instant Alarm Channel 4 (18mA)
inA -> Instant Alarm on more than one channel (19mA)
Fir -> Area Alarm (19.5mA)

The controller will start with the Fault output and the magnetic reed switches are used to scroll up and down through the different outputs. To exit this mode, scroll down past the Fault output selection until '**rtn**' is displayed then wait 10 seconds. The controller will return to the normal operating mode.

Table 3 - Error Codes

Left Display	Right Display	ERROR
290	**gnd**	Grounding problem with detector 290 Vdc supply
290	**OLo**	Detector 290 Vdc supply too low
290	**OHi**	Detector 290 Vdc supply too high
12	**OUT**	Internal 12 Vdc supply out of operating range[1]
5	**OUT**	Internal 5 Vdc supply out of operating range[1]
24H	**OUT**	Controller supply is greater than 32Vdc
24L	**OUT**	Controller 24 Vdc supply is less than 18Vdc
chx[2]	**OiH**	Visual imparity error (Signal received is too high); "x" indicates detector #
chx[2]	**OiL**	Visual imparity error (Signal received is too low); "x" indicates detector #
Ert	**Err**	external reset switch short error
CFg	**Err**	configuration error; incorrect dip switch settings
E91	**Err**	system RAM error
E92	**Err**	power is not stable
E94	**Err**	EEPROM data not correct
E97	**Err**	EEPROM reading, or writing not correct
E98	**COE**	Duplicate CAN address detected.
E99	**COE**	Lost communication.

Note
[1] If an internal power supply problem occurs, recycle the power supply. If the problem persists, contact supplier.
[2] If more than one channel has a **vi** error, the left display will sequentially show each channel number.

CURRENT CALIBRATION MODE

The next selection in the special function menu is the current calibration mode. This mode is selected to calibrate the current outputs. The Area output to calibrate is chosen as in the Forced Current Output Mode. Once an area has been selected, the left display will alternate between 'CuC' and the area that is being calibrated. The right display will show a constant which will rise and fall as the current is adjusted (does not show the current on the outputs). Place a milliamp meter between the Area current output and common ground. Use the magnetic reed switches to raise and right the current. Once the current measured is as close to 4mA as possible, do not activate any reed switches for 10 seconds and the controller will return to the normal operating mode.

ADDRESS SET MODE (do not use)

Do not use the final selection which is Address Set Mode.

Unit V MAINTENANCE

ROUTINE MAINTENANCE

The detector requires no periodic calibration. To maintain maximum sensitivity, the viewing windows and reflectors should be cleaned on a routine basis depending on the type and amount of contaminants in the area.

The rubber O-rings on the detector housing are used to ensure it is watertight. The housings should be ed periodically and the O-rings inspected for breaks, cracks or dryness. To test them, remove the O-rings from the detector housing and stretch them slightly. If cracks are visible, the O-ring should be replaced. If they feel dry to the touch, a thin coating of lubricant should be applied. When re-installing the O-rings, be sure that they are properly seated in the groove on the housing.

These O-rings must be properly installed and in good condition to prevent water from entering the detector and causing failure. The life expectancy of rubber O-rings varies, depending on the type and amount of contaminants present in the area. The person who maintains the system must rely on experience and common sense to determine how frequently the rings should be inspected. A coating of lubricant should also be applied to the enclosure threads before reassembling the detector to help prevent moisture from entering.

CAUTION

> *The O-ring should be lubricated with polyalphaolefin grease, such as GRS-450 made by CPI Engineering. Silicone based lubricants should never be used if catalytic type combustible gas sensors are being used in conjunction with the detectors, since inadvertent use of a silicone lubricant on or near the combustible gas sensor will cause irreversible damage to the sensing element.*

TROUBLESHOOTING

The Automatic **vi** (visual imparity) feature continuously checks the detectors for correct response. If a problem is detected, the FAULT LED will turn on, the left digital display will indicate which channel has the problem, and the right digital display will show "**vi**." The fault relay will be de-energized.

If a fault is in the detector or wiring, the left displays will indicate which detector is affected. The right display will indicated by code number the type of fault. If the fault is in the microprocessor circuitry, the FAULT LED will turn on, but the left digital display will remain blank. Refer to *Table 3* for a detailed explanation of the status/fault code numbers on the digital displays.

DEVICE REPAIR AND RETURN

The detector and controller are not designed to be repaired by the customer in the field. If a problem should develop, first carefully check for proper wiring and programming. If it is determined that the problem is caused by an electrical malfunction, the unit must be returned to the factory for repair.

Net Safety Monitoring Inc. encourages its distributors to make advance replacement units available to the user during the warranty period. This allows Net Safety Monitoring Inc. to take time to repair the unit completely while users keep their operations running with the advance replacement unit.

Prior to returning items, contact the nearest distribution office so that an RMI (Return Material Identification) number can be assigned. A written statement describing the malfunction must accompany the returned item to simplify finding the cause of the failure and reduce the time and cost of the repair. Pack the item to protect it from damage and use an anti-static bag or aluminum-backed cardboard as protection from electrostatic discharge.

Appendix A Net Safety Monitoring Inc. Electrostatic Sensitive Device Handling Procedure

With the trend toward increasingly widespread use of microprocessors and a wide variety of other electrostatic sensitive semiconductor devices, the need for careful handling of equipment containing these devices deserves more attention than it has received in the past.

Electrostatic damage can occur in several ways. The most familiar is by physical contact. Touching an object causes a discharge of electrostatic energy that has built up on the skin. If the charge is of sufficient magnitude, a spark will also be visible. This voltage is often more than enough to damage some electronic components. Some devices can be damaged without any physical contact. Exposure to an electric field can cause damage if the electric field exceeds the dielectric breakdown voltage of the capacitive elements within the device.

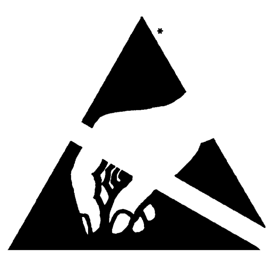
In some cases, permanent damage is instantaneous and an immediate malfunction is realized. Often, however, the symptoms are not immediately observed. Performance may be marginal or even seemingly normal for an indefinite period of time, followed by a sudden and mysterious failure.

Damage caused by electrostatic discharge can be virtually eliminated if the equipment is handled only in a static safeguarded work area and if it is transported in a package or container that will render the necessary protection against static electricity. Net Safety Monitoring Inc. modules that might be damaged by static electricity are carefully wrapped in a static protective material before being packaged. Foam packaging blocks are also treated with an anti-static agent. If it should ever become necessary to return the module, it is highly recommended that it be carefully packaged in the original carton and static protective wrapping.

Since a static safeguarded work area is usually impractical in most field installations, caution should be exercised to handle the module by its metal shields, taking care not to touch electronic components or terminals.

In general, always exercise all of the accepted and proven precautions that are normally observed when handling electrostatic sensitive devices.

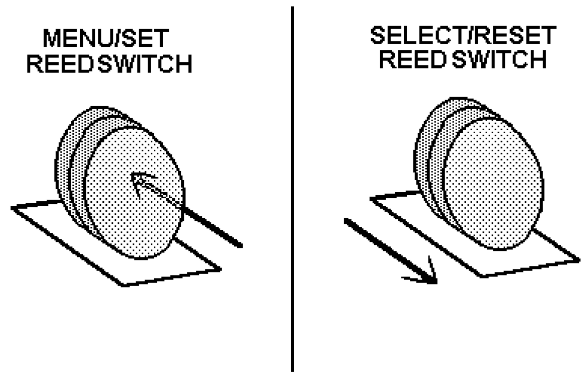
A warning label is placed on the packaging, identifying those units that use electrostatic sensitive semiconductor devices.



*Published in Accordance with E1A standard 471

Appendix B Procedure For Activating Reed Switches

When activating the **MENU/SET** and **SELECT/RESET** reed switches, it is important to orient the magnets provided with the device in the proper direction. They are to be positioned on the faceplate with the curved edge facing the glass. Do not place the flat surface of the magnet against the faceplate. Refer to the diagrams below.



Appendix C

Record Of Dip Switch Settings

DIP SWITCH	ON	OFF
SW3.1		
SW3.2		
SW3.3		
SW3.4		
SW3.5		
SW3.6		
SW3.7		
SW3.8		
SW4.1		
SW4.2		
SW4.3		
SW4.4		
SW4.5		
SW4.6		
SW4.7		
SW4.8		
SW5.1		
SW5.2		
SW5.3		
SW5.4		
SW5.5		
SW5.6		
SW5.7		
SW5.8		

Appendix D Common Ultra-Violet Absorbing Gases

Since the UVC120 fire detector is designed to detect fires by responding to the ultra-violet (UV) radiation they emit, it is very important to be aware of UV absorbing gases that may be present between the detector and the sources of potential fires. Small concentrations of these types of gases may not absorb enough UV radiation to cause a problem, but when higher concentrations of these gases are present the detectors may become blind as not enough ultra-violet radiation can reach them to activate an alarm. Moving detectors closer to the probable source of fire and increasing the sensitivity of the detector can help to overcome this problem in some cases. Following is a list of common UV absorbing gases:

Acetaldehyde
Acetone
Acrylonitrile
Ethyl Acrylate
Methyl Acrylate
Ethanol
Ammonia
Aniline
Benzene
1,3 Butadiene
2-Butanone
Butylamine
Chlorobenzene
1-Chloro-1-Nitropropane
Chloroprene
Cumene
Cycltadiene
O-Dichlorobenzene
P-Dichlorobenzene
Methyl Methacrylate
Alpha-Methylstyrene
Naphthalene
Nitroethane
Nitrobenzene
Nitromethane
1-Nitropropane
2-Nitropropane
2-Pentanone
Phenol
Phenyl Clycide Ether
Pyridine
Hydrogen Sulfide
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Toluene
Xylene

Appendix E Wire Resistance In Ohms

Distance (Feet)	AWG #20	AWG #18	AWG #16	AWG #14	AWG #12	AWG #10	AWG #8
100	1.02	0.64	0.40	0.25	0.16	0.10	0.06
200	2.03	1.28	0.80	0.51	0.32	0.20	0.13
300	3.05	1.92	1.20	0.76	0.48	0.30	0.19
400	4.06	2.55	1.61	1.01	0.64	0.40	0.25
500	5.08	3.20	2.01	1.26	0.79	0.50	0.31
600	6.09	3.83	2.41	1.52	0.95	0.60	0.38
700	7.11	4.47	2.81	1.77	1.11	0.70	0.44
800	8.12	5.11	3.21	2.02	1.27	0.80	0.50
900	9.14	5.75	3.61	2.27	1.43	0.90	0.57
1000	10.20	6.39	4.02	2.53	1.59	1.09	0.63
1250	12.70	7.99	5.03	3.16	1.99	1.25	0.79
1500	15.20	9.58	6.02	3.79	2.38	1.50	0.94
1750	17.80	11.20	7.03	4.42	2.78	1.75	1.10
2000	20.30	12.80	8.03	5.05	3.18	2.00	1.26
2250	22.80	14.40	9.03	5.68	3.57	2.25	1.41
2500	25.40	16.00	10.00	6.31	3.97	2.50	1.57
3000	30.50	19.20	12.00	7.58	4.76	3.00	1.88
3500	35.50	22.40	14.10	8.84	5.56	3.50	2.21
4000	40.60	25.50	16.10	10.00	6.35	4.00	2.51
4500	45.70	28.70	18.10	11.40	7.15	4.50	2.82
5000	50.10	32.00	20.10	12.60	7.94	5.00	3.14
5500	55.80	35.10	22.10	13.91	8.73	5.50	3.46
6000	61.00	38.30	24.10	15.20	9.53	6.00	3.77
6500	66.00	41.50	26.10	16.40	10.30	6.50	4.08
7000	71.10	44.70	28.10	17.70	11.10	7.00	4.40
7500	76.10	47.90	30.10	19.00	12.00	7.49	4.71
8000	81.20	51.10	23.10	20.20	12.70	7.99	5.03
9000	91.40	57.50	36.10	22.70	14.30	8.99	5.65
10 000	102.00	63.90	40.20	25.30	15.90	9.99	6.28

NOTE: RESISTANCE SHOWN IS ONE WAY. THIS FIGURE SHOULD BE DOUBLED WHEN DETERMINING LOOP RESISTANCE.

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