



**UVU-140A AND UVU-140-AR
UNITIZED ULTRAVIOLET FIRE
DETECTOR
USER MANUAL**



ISO 9001:2000



Part Number: MAN-0002-00 Rev. 1

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This manual is a guide for the use of a Unitized UV Fire Detector and the data and procedures contained within this document have been verified and are believed to be adequate for the intended use of the detector. If the detector 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.

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CHAPTER 1 TECHNICAL INFORMATION

Introduction

The UVU-140-A & UVU-140-AR fire detectors provide fast, reliable flame detection in a wide variety of applications. The automatic visual integrity (vi) feature allows for a continuous check of optical surfaces, sensitivity and electronic circuitry of the unitized fire detector. Fire and fault identification are accomplished by the use of specific current output levels and relay contacts (UVU-140-AR only). The fire detectors are housed in explosion-proof enclosures that are designed to meet most national and international standards. They are available in anodized aluminum or optional stainless steel. The UVU-140-A & UVU-140-AR fire detectors are typically mounted with a swivel mounting assembly (see Figure 3).

The UVU-140-AR unitized fire detector connects to a JBR-T-ASSY which consists of a junction box, two relays and a terminal connector board. The JBR-T-ASSY has large, easy access, spring tension terminals and a user selectable dip switch which allows the operator to select relay and coil status conditions (see Table 3).

Features

- ▶ Instantaneous response to ultraviolet radiation
- ▶ Automatic and manual visual integrity (vi) testing
- ▶ Adjustable sensitivity and time delay
- ▶ All automatic test functions are performed with the system on-line
- ▶ Alarm and automatic fault identification indicated by a 4 to 20mA output
- ▶ Relay outputs for fire and fault identification (UVU-140-AR only)
- ▶ The fault relay is normally energized and non-latching (UVU-140-AR only)

Spectral Sensitivity Range

The UVU-140-A & UVU-140-AR fire detectors respond to radiation wavelengths of 185 to 260 nanometres (1850 to 2600 angstroms). Figure 1 illustrates the range of sensitivity and compares this range to other forms of radiation. Note that UV radiation reaching the earth from the sun does not extend into the sensitivity range of the detector. Nor does radiation from normal artificial lighting, such as fluorescent, mercury vapour and incandescent lamps.

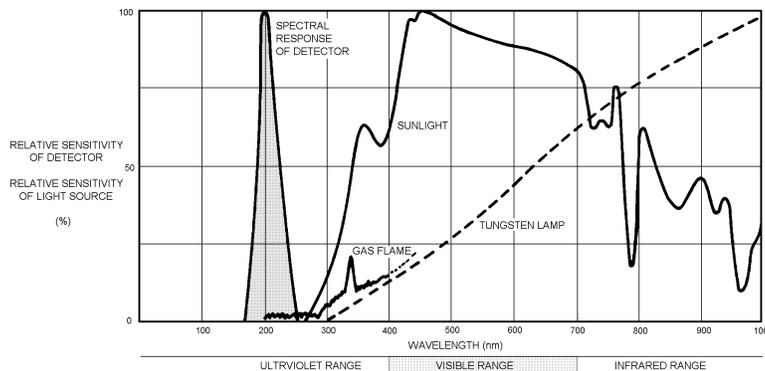


Figure 1 - Various Spectral Distributions

Specifications

- ▶ **Operating Voltage Range:**
24Vdc nominal: 10.5 to 32Vdc
If a fuse is rated in line with the main power supply, it should be a 1A slow-blow type. If a power supply with current limiting is used it should have a rating appropriate for the inrush current required by the product.
- ▶ **Power Consumption (UVU-140-A):**
1.92 Watts nominal 2.4 Watts maximum @ 24Vdc
80mA nominal 100mA maximum @ 24Vdc
Inrush Current 250 mA for 2.5 ms
- ▶ **Power Consumption (UVU-140-AR):**
2.4 Watts nominal (fault relay energized) @ 24Vdc
2.9 Watts maximum (fire & fault relays energized) @ 24Vdc
100mA nominal @ 24Vdc 120mA maximum @ 24Vdc
Inrush Current 380 mA for 2.5 ms
- ▶ **Temperature Range:**
Operating: -40°C to +85°C (-40°F to +185°F)
Storage: -55°C to +125°C (-67°F to +257°F)
- ▶ **Dimensions:**
Refer to *Figures 4, 5, 6 and 7*
- ▶ **Detector Enclosure Materials:**
NEMA 4X anodized copper-free aluminum or stainless steel (optional)
- ▶ **Shipping Weight (approximate):**
2 lbs (0.9 kilograms) aluminum
- ▶ **Certification:**
CSA, NRTL/C, NEMA 4X certified for hazardous locations
Class 1, Division 1, Groups B, C and D
IEC approval Ex d IIB+H2 T5 (Class 1, Zone 1, Groups IIB+H2 T5)
- ▶ **Spectral Sensitivity Range:**
The detectors respond to UV radiation over the range of 185 to 260 nanometres
(1850 to 2600 angstroms)
- ▶ **Cone of Vision:**
120 degree cone of vision when measured in accordance with NFPA 72 guidelines
- ▶ **Current Outputs:**
4-20mA DC into a maximum external loop resistance of 600 Ohms at 10.5 to 32Vdc
- ▶ **Relay Contacts: (Available on UVU-140-AR only)**

1A @ 30Vdc 0.5A @ 125Vac

- ▶ **Response Time:**
Response to a saturating (high intensity) UV source is typically 10 milliseconds
Alarm response time is programmable
- ▶ **Time Delay Settings:**
DIP switch selectable 3, 4, 5 or 7 seconds
- ▶ **Sensitivity Settings:**
DIP switch selectable 8, 16, 24 or 32 counts per second
- ▶ **Humidity Range:**
0 to 100% relative humidity

Applications

The UVU-140-A & UVU-140-AR fire detectors respond instantly to ultraviolet radiation emitted by a flame. These devices are designed for use in hazardous locations and are suitable for use in outdoor applications.

Typical applications for UV detection systems

- ▶ around highly combustible materials
- ▶ when instantaneous response to flame is needed or where automated fire protection is required
- ▶ protection of large capital investments

Petroleum Products Handling

- ▶ petroleum loading terminals
- ▶ offshore platforms
- ▶ pipeline stations
- ▶ tank farms
- ▶ refineries
- ▶ engine rooms

Gaseous Fuel Handling

- ▶ butane and propane loading and storage
- ▶ pipeline compressor stations
- ▶ gas gathering facilities
- ▶ LNG loading, transfer and storage
- ▶ hydrogen
- ▶ gas turbines

Other Processes

- ▶ paint spray booths
- ▶ chemical and petrochemical production
- ▶ powder coating booths

Automated fire protection systems also have applications in any manufacturing or research facility where the potential of fire may be low to moderate, but the losses due to a fire would be high.

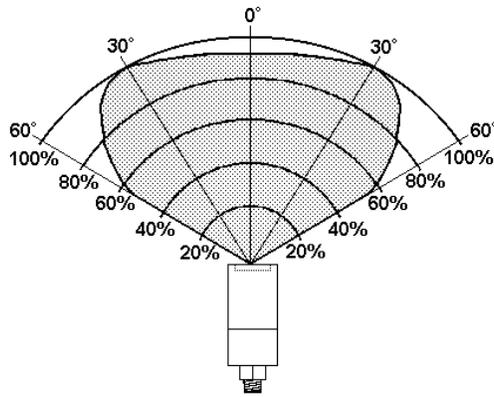


Figure 2 - Detector cone of vision

CHAPTER 2 INSTALLATION

What's in the package

Remove all the components from the packing box(s) carefully; check components against the packing list. Inspect all components for obvious damage and broken/loose parts. Notify the carrier and distributor immediately if damage is found or parts are missing.

Mounting the Detector

There are many factors that you should be aware of when positioning your fire detector(s).

Cone of vision

The UVU-140-A & UVU-140-AR fire detectors have a nominal 120 degree cone of vision when measured in accordance to NFPA 72 guidelines. *Figure 2* shows the cone of vision and detector response to a UV source at various distances.

Range

The practical application distance is up to about 80 feet (25 metres). The distance is directly related to the intensity of the ultraviolet radiation source. Programming the UVU-140-A & UVU-140-AR fire detectors to require a high count rate results in low system sensitivity.

Environmental Factors

Airborne contamination such as steam, oil mist, ice build up and smoke can impair the detection capabilities of UV fire detectors and should be avoided.

Since the UVU -140-A & UVU-140-AR fire detectors are designed to detect fires by responding to the ultraviolet (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. For a list of some common UV absorbing chemical vapours see **Appendix B**.

False Alarms

Arc Welding, long duration lightning flashes, cracked mercury lamps, cracked halogen lamps, and X-rays may cause false alarms and should be avoided.

NOTE:

Ultraviolet detectors are sensitive to arc welding and if this type of radiation can be expected, nuisance alarms must be controlled through proper application including careful positioning and shielding of the detectors. Some applications may require a UV/IR system.

CAUTION:

Caution must be exercised if the detection system is turned off, as the hazardous area will not be protected. .

Lightning strikes can trigger the detector but this can be solved by pointing the sensor cone of vision below the horizon and setting the time delay to 7 seconds.

Cracked mercury or halogen lamps in the vicinity of the fire detector should be replaced as soon as they are discovered.

UV radiation other than that produced by an actual fire is referred to as “background UV”. An example of a high level of background UV could be 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 other reflective surfaces may also cause unusually high levels of UV radiation to enter the building from the flare. In a situation like this, the fire detection system response must be carefully checked and the sensitivity level adjusted high enough, so that this “background UV” will not cause false alarms.

UV fire detectors respond to radiation other than ultraviolet. X-rays can activate the detector and are often used in industrial inspection. It may be necessary to disable the system when X-ray is conducted nearby.

Position and Density of Detectors

The UVU-140-A & UVU-140-AR fire detectors have a nominal 120 degree cone of vision when measured in accordance to NFPA 72 guidelines. In an application such as a loading dock with a ceiling height of 25 feet (7.5 metres) where it is desired to have complete detector coverage at floor level and a detector is mounted 2 feet (0.6 metres) from the ceiling and pointed straight down, the distance from the detector to the designated level would be 23 feet (7 metres). The detector has a 120 degree cone of vision and would cover a circular area 80 feet (24 metres) 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 UV detectors close to the ceiling of enclosed buildings if smoke might accumulate before the break-out of flame. It is preferable to mount the detectors on walls a few feet (about 1

metre) below the ceiling where they may respond before being obscured by smoke. Consider shortening time delay settings when smoke is expected to accumulate during a fire. If dense smoke is likely to accumulate prior to flame (as in an electrical fire), supplement UV detectors with other protection.

The detector should be mounted in a low vibration area be easy to access for cleaning purposes and should not have glass or plexiglass windows between the device and the potential fire. Locate detectors to ensure an unobstructed view of the area to be monitored. To minimize dirt accumulation around the vi surfaces, mount the detectors so that the internal vi source tube is on top. **The silver external reflector should be placed directly over the vi source tube.** Refer to *Figures 4 and 5* for the detector and swivel mount dimensions. Refer to *Figure 3* for a diagram of the assembled detector and swivel mount assembly.

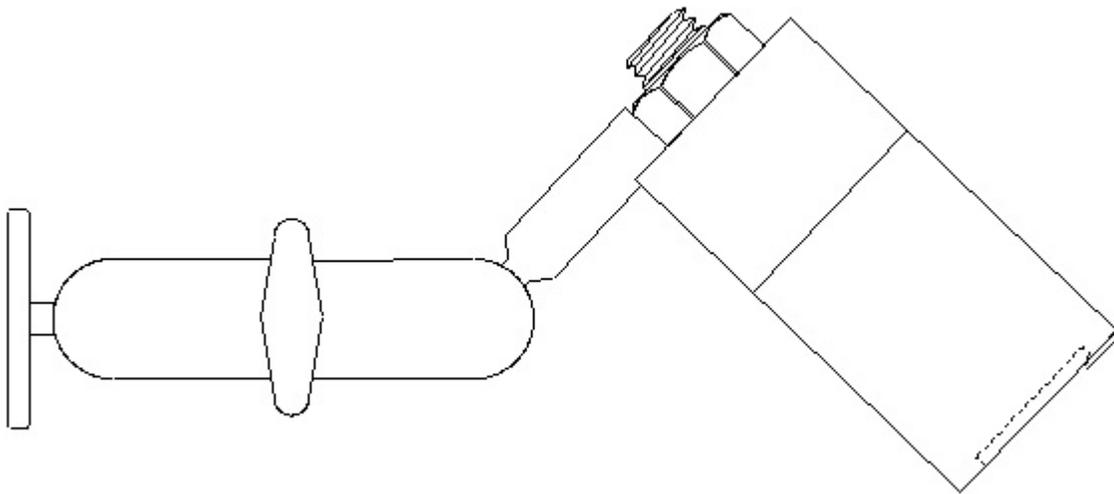


Figure 3 - Detector with Swivel Mount

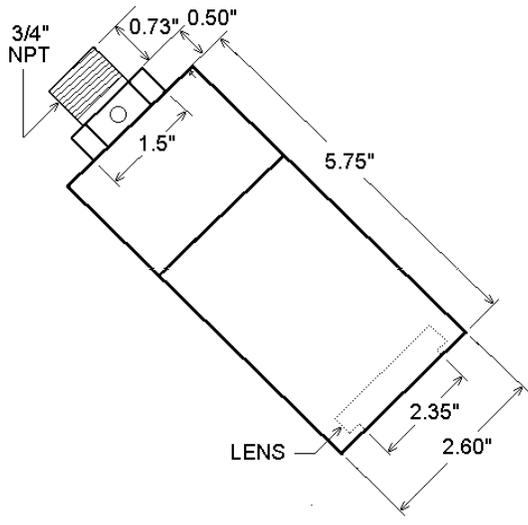


Figure 4 - Detector Dimensions

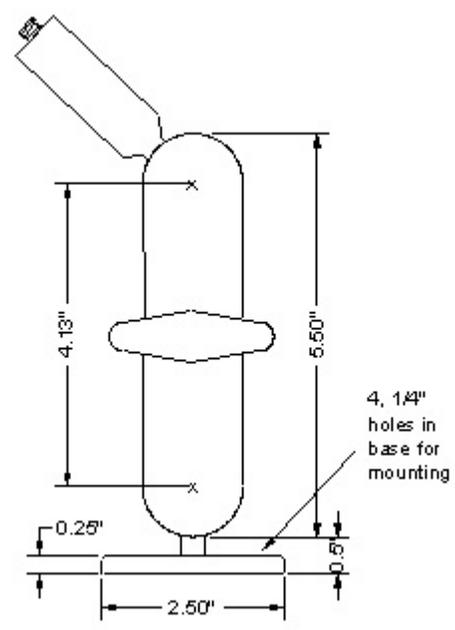


Figure 5 - Swivel Mount Dimensions

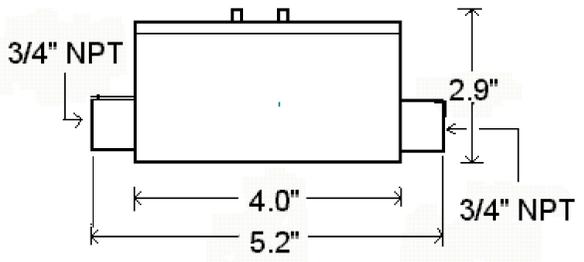


Figure 6 - JB4-UV-T Junction Box Side View

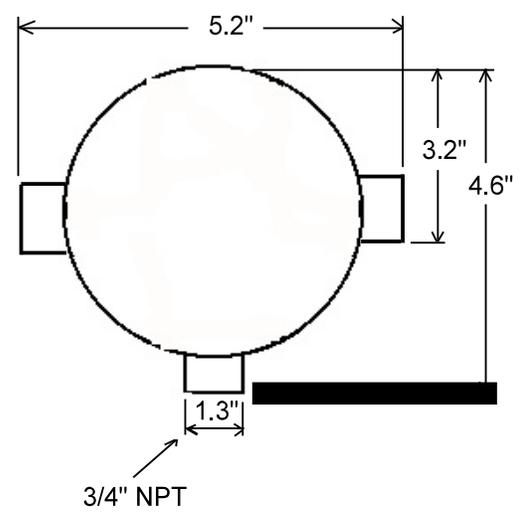


Figure 7 - JB4-UV-T Junction Box Top View

General Wiring Requirements

NOTE:

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, due to 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'. Recommended detector cable is four conductor, shielded, 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 if 16 AWG shielded conductor is used.

The UVU-140-A & UVU-140-AR are factory sealed complete with four feet of four conductor, 18 AWG cable rated 300V. No seal is required.

Wiring Diagram for UVU-140-A

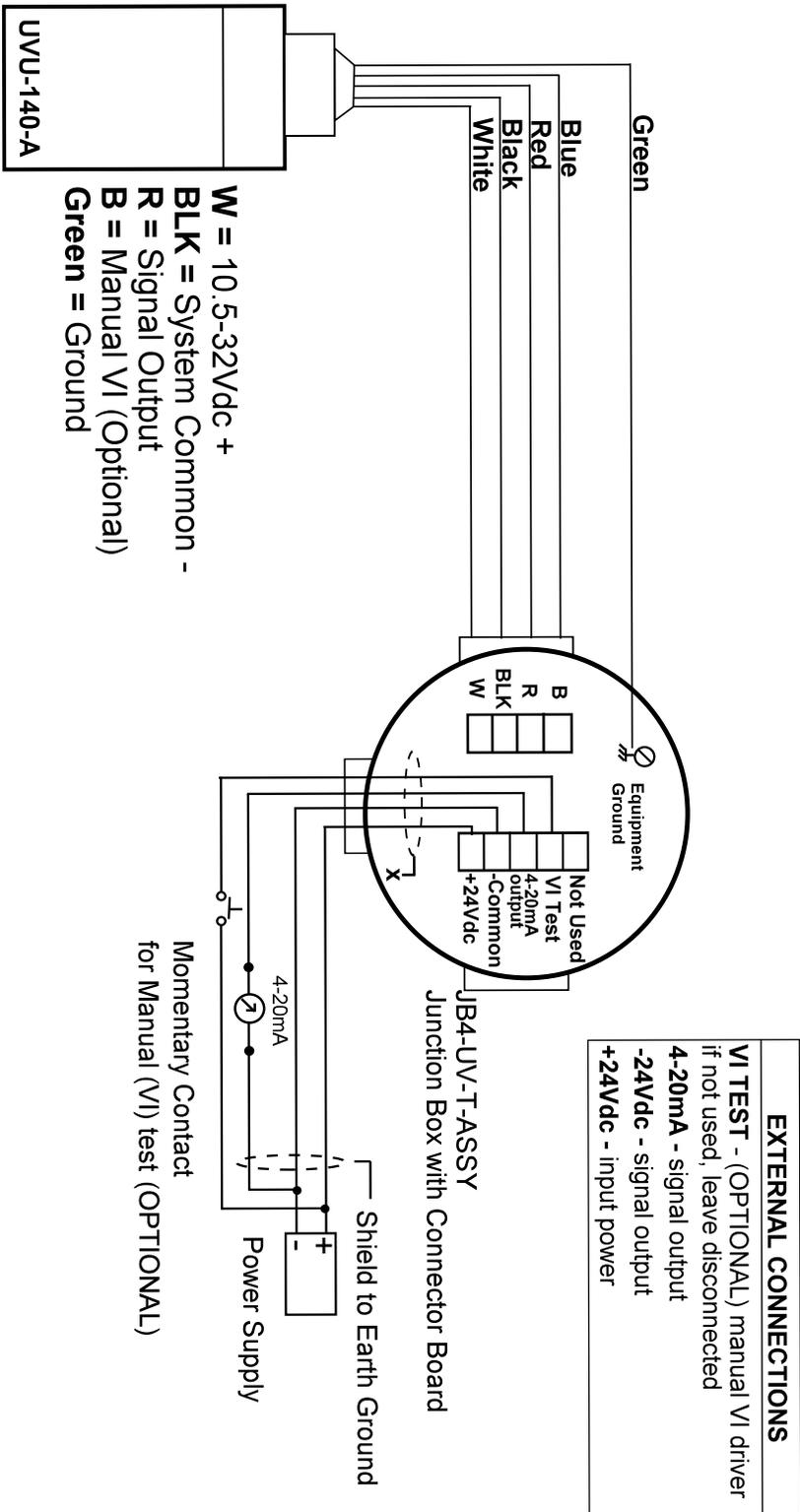
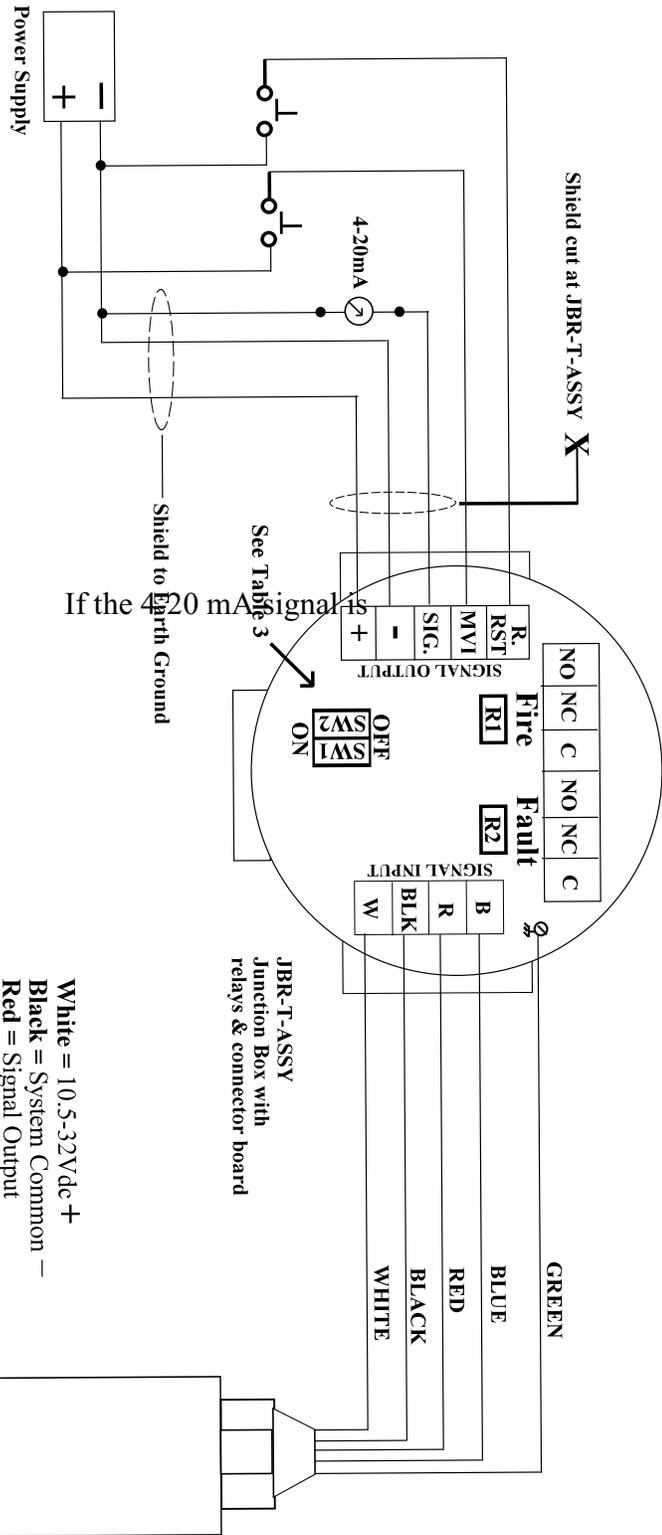


Figure 8 - Wiring for UVU-140-A

Wiring Diagram for UVU-140-AR

SIGNAL OUTPUT to external monitoring devices

R, RST - remote reset (OPTIONAL)
MVI - manual VI driver (OPTIONAL)
(S) 4-20mA SIGNAL OUTPUT
(-) - 24Vdc "system common"
(+) + 24Vdc input power



NOTE:
 If the 4-20 mA signal is connected to (-) system common

Figure 9 - Wiring for UVU-140-AR

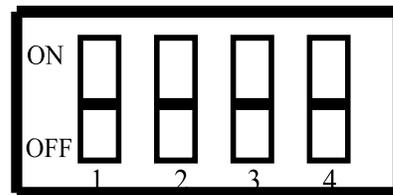
Detector Settings

System Sensitivity

The UV tube count rate generated by different fires at the same distance is unpredictable. Generally if a fire doubles in size, the tube response is increased by about 60 percent. The UVU-140-A & UVU-140-AR detectors have selectable sensitivity settings which allow for various applications regardless of the severity of the hazard and the action required if a fire occurs. The system can be adjusted to various sensitivity levels by setting the detectors to respond at a pre-determined detector count rate. The count rate is dependent upon the intensity of the ultraviolet radiation reaching the detector, which in turn depends on the type of fuel, temperature, flame size, distance from the detector and concentration of UV absorbing vapours present. Setting the UVU-140-A & UVU-140-AR detectors to respond to a **low count rate** results in **high system sensitivity**. Adjustments are made by setting the DIP switch on the bottom of the internal module. The factory settings are **5 second time delay at 24 counts per second (cps), the fire relay is de-energized and latching**.

Table 1 - Detector Sensitivity Settings

SYSTEM SENSITIVITY SETTINGS		
	Switch 1	Switch 2
8 Counts (cps)	ON	ON
16 Counts (cps)	ON	OFF
24 Counts (cps)	OFF	ON
32 Counts (cps)	OFF	OFF



DIP Switch Located on Bottom of Module

Figure 10 - DIP switch operation and location

System Time Delay

Time delay can be set via dip switches located on the bottom of the electronics module . See Figure 7.

Table 2 - Alarm Response Delay Settings

SYSTEM TIME DELAY SETTINGS		
	Switch 3	Switch 4
3 Seconds	ON	ON
4 Seconds	ON	OFF
5 Seconds	OFF	ON
7 Seconds	OFF	OFF

Coil and Relay Settings

The DIP switch is located in the JBR-T assembly.

Table 3 - Coil and Relay Status

COIL AND RELAY SETTINGS TABLE		
	Switch 1	Switch 2
De-energized and non-latching	ON	ON
Energized and non-latching	ON	OFF
De-energized and latching	OFF	ON
Energized and latching	OFF	OFF

CHAPTER 3 START UP AND TEST

Start up Procedure

NOTE:

Be sure that the detector is correctly aimed at the potential hazard and that no obstructions interfere with its line of vision. UV absorbing gases should not exist between the detector and the potential hazard.

Check Out Procedure

CAUTION:

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

Automatic vi Test

NOTE:

The automatic vi system continuously monitors the operation of the detector. However, it is important that the system be manually checked using the MANUAL check procedure (described on page 12) on a regular basis. The whole system (including external equipment) should be checked periodically using a UV test lamp to simulate a fire.

The detector performs an automatic vi test every 30 seconds. If the automatic vi test fails, the UVU-140-A or UVU-140-AR current output will decrease to 2mA indicating a dirty window or other obstruction in front of the detector tube. The UVU-140-A or UVU-140-AR current output will remain at 2mA until the problem is corrected. If the obstruction was only temporary, the detector will return to normal operation with a current output of 4mA the next time the automatic vi test is successful.

Manual vi Test Procedure

The detector has a manual vi input. The manual vi test is performed by connecting this input to the system power for the duration of the test. This can be done by connecting a momentary contact pushbutton between system power and the manual vi input, and then holding the pushbutton to perform the test.

NOTE:

The manual vi feature is optional on the UVU-140-A (If not used, leave unconnected or tied to system common).

CAUTION:

The detector will stay in the manual vi test mode as long as the manual vi input is held at the system power voltage. During the manual vi test all other detector functions are disabled. It is therefore imperative that, after this test is performed, the manual vi test input be released.

Test Procedures:

1. Connect the manual vi test input (UVU-140-A) terminal to system power by either a direct connection or a manual push button.

NOTE:

On UVU-140-AR detectors, connect the MVI signal output terminal (on the JBR-T relay box) to system power by either a direct connection or a manual push button.

CAUTION:

DO NOT connect system power to the blue wire on the UVU-140-AR detector. Doing so will damage the fire detector.

2. Hold the manual vi input at this voltage for at least *two seconds*.
3. *Two seconds* after the test has commenced, the detector will have a current output that corresponds to the quality of the vi reading obtained (*see Table 4*).
4. Release the manual vi test input. The detector will immediately return to normal operation if a vi fault is not present.
5. If a vi fault is present, the current output will indicate 2mA.

Manual Check Procedure

The whole system should be checked periodically with a UV test lamp 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 vi circuit.

CAUTION:

Secure all output loads connected to the fire detector to prevent unwanted activation.

1. Direct the UV test lamp into the detector viewing window.

The UVU-140-A or UVU-140-AR current output will change with the amount of ultraviolet light being detected (see *Table 4*).

2. Turn off the UV test lamp.
3. Repeat steps 1 & 2 for all detectors in the system.
4. After all detectors have been checked, return the system to the normal operating mode.
5. Restore power to output loads or remove any mechanical blocking devices.

CHAPTER 4 NORMAL OPERATION

Normal Operation

In normal operation the detector outputs 4mA.

Fire Condition

In a fire condition the detector outputs 20mA.

Current & Relay Output Conditions

The 4-20mA DC current output transmits system information to other devices. The current output can only be wired for non-isolated operation. The current output can have a maximum external loop resistance of 600 Ohms at 10.5 to 32Vdc. *Table 4* shows the current output levels for various conditions.

Table 4 - Current & Relay Output Conditions

Current Output	Situation
0mA	Shorted signal output or loss of power
1mA	Internal power fault or system power out of range. Fault relay activated on UVU-140-AR
2mA	Automatic or manual vi test failure. Fault relay activated on UVU-140-AR
4mA	Normal operation
6mA	Background UV source
10mA	Manual vi test (adequate) clean all optical surfaces.
11mA	Manual vi test (good) optical surfaces are moderately clean
12mA	Manual vi test (excellent) all optical surfaces are clean
16mA	Instant alarm
20mA	Fire condition detected. Fire relay activated on UVU-140-AR

CHAPTER 5 MAINTENANCE

Routine Maintenance

The UVU-140-A & UVU-140-AR fire detectors require no periodic calibration. To maintain maximum sensitivity, the viewing window and reflector should be cleaned on a routine basis depending on the type and amount of contaminants in the area.

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

The o-ring 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 UV detectors, since silicone lubricant on or near the combustible gas sensor will cause permanent damage to the sensing element.

Troubleshooting

The automatic vi (visual integrity) feature continuously checks the detector for correct response. If a problem is detected, *Table 4* shows the current output levels for various situations.

Cleaning Viewing Window and Reflector

When cleaning the viewing window and reflector use a clean, lint free cloth and the cleaning solution provided with the detector. Use only recommended cleaning solutions, as some cleaners can leave a residue that can block UV radiation.

Repositioning vi Adjustment Allen Screw

The UV sensor module has an adjustable Allen Screw. This adjustable Allen Screw controls the amount of light released from the vi source during visual integrity testing. To increase the amount of UV light released, turn the Allen Screw counter-clockwise, this will open the orifice and allow more light to pass through. An ideal setting with a clean lens and reflector would yield an analog output of 12mA during the manual vi test, which represents an excellent response level when performing a manual vi check.

Device Repair and Return

The UVU-140-A and UVU-140-AR fire detectors 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 Common Ultra-Violet Absorbing Gases

Since the UVU -140-A & UVU-140-AR fire detectors are 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
Cyclopentadiene
O-Dichlorobenzene
P-Dichlorobenzene

Methyl Methacrylate
Alpha-Methylstyrene
Naphthalene
Nitroethane
Nitrobenzene
Nitromethane
1-Nitropropane
2-Nitropropane
2-Pentanone
Phenol
Phenyl Glycide Ether
Pyridine
Hydrogen Sulfide
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Toluene
Xylene

Appendix C 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	32.10	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 CLOSED LOOP RESISTANCE.



Distributed By:

2721 Hopewell Place N.E.
Calgary, Alberta, Canada T1Y 7J7
Telephone: (403) 219-0688 Fax: (403) 219-0694
www.net-safety.com
E-mail: netsafe@net-safety.com