DISCHARGE / FLAME SENSOR
UVTRON®
What is the UVTRON®?

The UVTRON is an ultraviolet ON/OFF sensor that uses the photoelectric effect of metal and gas multiplication effect. As the UVTRON detects the light (ultraviolet radiation) in a flame, it provides outstanding high sensitivity and high-speed response compared to other methods such as smoke detection and heat detection.

High sensitivity

The UVTRON responds to faint ultraviolet emissions from flames, so it can accurately detect even small ignitions. Its high sensitivity allows reliable operation even in wide open space such as gymnasiums and other large composite facilities.

- **Sensitivity and distance from fire**
  - The UVTRON has a high sensitivity that allows it to accurately detect even small ignitions. Its high sensitivity enables reliable operation even in large spaces like gymnasiums and other composite facilities.

High speed response

As the UVTRON detects ultraviolet light, detection is possible immediately after an ignition or discharge. High-speed response in a few milliseconds makes it possible to take prompt action in the event of a fire or other emergency situation.

Compact / Light weight

Its compact size and lightweight enable the UVTRON to be employed even in compact detectors. Further, the best type of UVTRON can be selected according to the application or location from a product lineup that includes several shapes.

Solar blind

UVTRON has an extremely narrow spectral response range from 185 nm to 300 nm and is insensitive to visible light. And the Ni electrode does not respond to ultraviolet radiation in sunlight.

- **Spectral response**
  - The UVTRON has an extremely narrow spectral response range from 185 nm to 300 nm. It is insensitive to visible light and the Ni electrode does not respond to ultraviolet radiation in sunlight.
Applications

Flame detection
Used in a location without flames. Flames are detected immediately when an ignition occurs.

Combustion monitoring
Constantly monitors flames and detects abnormality such as flames going out.

Discharge detection
Mainly used near electrical contacts. In the event of a discharge, it is immediately detected.

EX: Forest/mountain
Forest fire detection

EX: Airplane
Fire detection in transportation vehicles and aircrafts

EX: Power plant
Discharge detection of transmission steel towers

EX: Power plant
Discharge detection of transformer plant and Power distribution panel

EX: Hydrogen station
Hydrogen flame detection

EX: Barbecue restaurant
Monitoring of roaster

EX: Factory monitoring sensor
Arson detection

EX: Shopping mall
Fire detection in large-scale facilities

EX: Warehouse
Fire detection in warehouses

EX: Factory
Laser processing machine

EX: Factory
Discharge detection of manufacturing process

Monitoring of boiler
EX: Factory

Fire detection in transportation vehicles and aircrafts

EX: Plane

Fire detection in warehouses

EX: Warehouse

Monitoring of roaster

EX: Barbecue restaurant
### Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>R13192</th>
<th>R9454</th>
<th>R2868</th>
<th>R9533</th>
<th>R244</th>
<th>R14388</th>
<th>R12257</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensional outline</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>Electrode material</td>
<td>Ni</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Spectral response range</td>
<td>185 to 260</td>
<td>185 to 300</td>
<td>nm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Supply voltage (DC)</td>
<td>420</td>
<td>500</td>
<td>400</td>
<td>400</td>
<td>575</td>
<td>420</td>
<td>425</td>
<td>V</td>
</tr>
<tr>
<td>Average discharge current</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>10</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Peak current</td>
<td>50</td>
<td>30</td>
<td>50</td>
<td>50</td>
<td>200</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Operation ambient temperature</td>
<td>-40 / +125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Max. discharge starting voltage (DC)</td>
<td>260</td>
<td>360</td>
<td>280</td>
<td>280</td>
<td>440</td>
<td>260</td>
<td>240</td>
<td>V</td>
</tr>
<tr>
<td>Typ. discharge sustaining voltage (DC)</td>
<td>185</td>
<td>300</td>
<td>240</td>
<td>230</td>
<td>330</td>
<td>185</td>
<td>170</td>
<td>V</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>1500</td>
<td>4000</td>
<td>5000</td>
<td>10000</td>
<td>480</td>
<td>10000</td>
<td>1200</td>
<td>min⁻¹</td>
</tr>
<tr>
<td>Background</td>
<td>5</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Estimated life</td>
<td>2500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10000</td>
<td></td>
<td>h</td>
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<tr>
<td>Min. discharge quenching current (DC)</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Average discharge current</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Weight</td>
<td>5.2</td>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
<td>3</td>
<td>5.3</td>
<td>5</td>
<td>g</td>
</tr>
<tr>
<td>Suitable socket (Sold separately)</td>
<td>E678-9C</td>
<td>—</td>
<td>—</td>
<td>E678-8F</td>
<td>—</td>
<td>E678-9C</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

**A** Even at these current values, the electrodes are not consumed immediately, but the service life is noticeably reduced. Use the tube within the recommended current values.

**B** This is the maximum momentary current that can be handled if its full width at half maximum is less than 10 µs.

**C** These are representative values for a wavelength of 200 nm and a light input of 10 pW/cm². Think of these values as relative sensitivity values. In actual use, the sensitivity will vary with the wavelength of the ultraviolet radiation and the drive circuitry employed.

**D** Measured under room illuminations (approximately 500 lux) and recommended operating conditions. Note that these values may increase slightly when used outdoors due to external disturbance or the like.

**E** The service life varies depending on the driver circuit and ambient temperature. These values are for when the UVTRON is used at normal discharge under recommended operating conditions. Since high ambient temperature reduces the service life, when high temperature is expected such as in a burner monitor application, consider taking cooling measures such as air-cooling. If the UVTRON is covered by warranty for one year after delivery.

**F** When configuring the tube with an external quenching circuit, use circuit constants so that the quenching time becomes longer than these values listed. When using a pulse driven circuit using CR, if the applied voltage is in the recommended range, the quenching time \( t_q \) can be calculated with the following formula. (Refer to the diagram of the recommended operating circuit.)

\[
 t_q = 0.5 \times \frac{C_1 \cdot R_1}{R_1 + C_1} 
\]

**G** min⁻¹ indicates a counts/min.

### Dimensional outline (Unit: mm) / Angular sensitivity

#### R13192

[Diagram of R13192]

- Cathode
- Anode
- Cathode lead
- Anode lead
- MAX
- MIN
- 90°
- 60°
- 30°

#### HDD PIN

- 4 PIN BASE
- JEDEC NO. E9-37
- HARD PIN

#### Angular sensitivity

- 90°
- 60°
- 30°
- 0°
Driver circuits

Recommended circuit

This circuit is suitable for creating a high voltage DC power supply by converting low DC voltage of dry cells or the like with a DC-DC converter (oscillating voltage booster circuit) and can be operated reliably with minute current. As the voltage supplied to the UVTRON is DC, there is no dead time. As such, it can be applied to fire detection circuit with high-speed response.

\[
\begin{align*}
\text{SUPPLY VOLTAGE} & : C_1: 220 \text{ pF} \\
& : 500 \text{ V} \\
\text{R1: 10 M}\Omega & \quad \text{4.7 k}\Omega^* \\
\text{ANODE} & \quad \text{UVTRON} \\
\text{CATHODE} & \quad \text{10 k}\Omega \\
\text{PULSE OUTPUT} & : 1000 \text{ pF} \\
\end{align*}
\]

* To reduce the effect of lead wire’s stray capacitance, connect the 4.7 kΩ resistor within 2.5 cm of the tip of the UVTRON anode lead.

Recommended circuit

This circuit is suitable for creating a high voltage DC power supply by converting low DC voltage of dry cells or the like with a DC-DC converter (oscillating voltage booster circuit) and can be operated reliably with minute current. As the voltage supplied to the UVTRON is DC, there is no dead time. As such, it can be applied to fire detection circuit with high-speed response.

Related products

Driver circuit for UVTRON

This is a compact high-voltage power supply and signal processing circuit for driving the UVTRON. Operation is possible by connecting a UVTRON and applying low voltage. Since the signal processing circuit cancels the UVTRON’s sporadic background noise (cosmic rays, unexpected ultraviolet light, etc.), there is little false detection, and the signal output can be used as-is.

The circuit is available in two types: a high-volume production type with a fixed supply voltage and a variable-voltage experiment/evaluation type with a supply voltage selector DIP switch.

### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description / Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type No.</td>
<td>C10807</td>
<td>C10423</td>
</tr>
<tr>
<td>Type of supply voltage</td>
<td>Voltage clamp</td>
<td></td>
</tr>
<tr>
<td>UVTRON supply voltage (DC)</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td>Signal output</td>
<td>Open collector output</td>
<td></td>
</tr>
<tr>
<td>Output voltage Max.</td>
<td>50 or less</td>
<td>40 or less</td>
</tr>
<tr>
<td>Output current Max.</td>
<td>80 or less</td>
<td>50 or less</td>
</tr>
<tr>
<td>Output pulse time width</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Quenching time</td>
<td>Approx. 25</td>
<td>Approx. 18</td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>12 to 24</td>
<td>12 to 24</td>
</tr>
<tr>
<td>Current consumption</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-10 to +50</td>
<td>-10 to +100</td>
</tr>
<tr>
<td>Operating humidity range</td>
<td>Below 80 % (no condensation)</td>
<td>Below 80 % (no condensation)</td>
</tr>
<tr>
<td>Dimensions (W × H × D)</td>
<td>50 × 12 × 36</td>
<td>45 × 9.8 × 33</td>
</tr>
</tbody>
</table>

**NOTE:**

★ Since the power impedance of the power supply is very high, the supply voltage cannot be measured with an ordinary voltmeter.

★ A measuring instrument with a 10 GΩ or higher input impedance is necessary to measure high voltage.

★ The UVTRON supply voltage can be selected to match the UVTRON being used.
This is a lamp for checking the UVTRON operation. It has an appropriate spectrum for checking the UVTRON operation and can be incorporated with the UVTRON. Checking the UVTRON operation increases the reliability of security equipment.

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**Checker lamp for UVTRON UV source L9657-03**

This is a lamp for checking the UVTRON operation. It has an appropriate spectrum for checking the UVTRON operation and can be incorporated with the UVTRON. Checking the UVTRON operation increases the reliability of security equipment.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description / Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral distribution</td>
<td>185 to 400</td>
<td>nm</td>
</tr>
<tr>
<td>Window material</td>
<td>UV glass</td>
<td>—</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 1</td>
<td>g</td>
</tr>
<tr>
<td>Maximum ratings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>Peak current</td>
<td>200</td>
<td>µA</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-40 / +125</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-20 / +60</td>
<td>°C</td>
</tr>
<tr>
<td>Discharge starting voltage (DC)</td>
<td>Max. 260</td>
<td>V</td>
</tr>
<tr>
<td>Recommended discharge current</td>
<td>150</td>
<td>µA</td>
</tr>
<tr>
<td>Guaranteed life</td>
<td>1000</td>
<td>h</td>
</tr>
</tbody>
</table>

**Spectral distribution**

Data below 200 nm is for reference.

**NOTE:**

1. Operating at a current higher than this value may drastically shorten the operating life.
2. Life end is defined as the time that the radiant intensity falls to 50% of its initial value.
3. Use in a dark environment may cause an operation delay longer than 0.5 seconds after a lamp-on command signal is received.

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**Checker lamp driver circuit C13428**

This is a driver circuit for the UVTRON operation check light source (UV source L9657 series). The UV source can be turned on at a constant current of approximately 150 µA by applying a voltage between 5.5 V to 12 VDC. In addition, an LED lights momentarily when the lamp lights to help the UV source to turn on. When the lamp lights, the LED turns off.

**GENERAL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description / Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>+5.5 to +12</td>
<td>V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>40</td>
<td>mA</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-10 to +50</td>
<td>°C</td>
</tr>
<tr>
<td>Operating humidity range</td>
<td>80 or less</td>
<td>%</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-10 to +50</td>
<td>°C</td>
</tr>
<tr>
<td>Lamp current</td>
<td>150 (Can be adjusted on the trimmer)</td>
<td>µA</td>
</tr>
<tr>
<td>Lamp not lit</td>
<td>LED lighting</td>
<td>—</td>
</tr>
<tr>
<td>Lamp lit</td>
<td>LED extinction</td>
<td>—</td>
</tr>
<tr>
<td>Dimensions (W × H × D)</td>
<td>45 × 4.5 × 33</td>
<td>mm</td>
</tr>
</tbody>
</table>

---

**Spectral distribution**

WAVELENGTH (nm)

RELATIVE IRRADIANCE (%)
Precautions

**PRECAUTIONS**

**About background**
When a voltage is applied to the UVTRON, discharge may occasionally occur in the UVTRON even with no incidence of ultraviolet radiation. This phenomena is called background. Major causes of background are as follows:

1. Radiations such as cosmic rays
   Discharge may take place due to gas ionization inside the UVTRON which is caused by incident radiations such as alpha-rays, beta-rays, and gamma rays.

2. Static electricity
   If objects charged with static electricity are moved close to the UVTRON or touch it, the gas inside the UVTRON may become ionized by the high electric field, resulting in a discharge.

To prevent faulty operation caused by background, a properly designed signal processing circuit is required. For further details, refer to our technical publication or contact our sales office.

**About UV radiations in living environments**

The UVTRON may operate by mistake when extraneous ultraviolet radiations enter it. There are many different ultraviolet radiation sources in our daily life. The following list provides examples of such sources that may be found in common circumstances.

- 1. Sparks from arc welding (These emit very high ultraviolet radiations.)
- 2. Electrical sparks (such as those by pantograph of an electric train and a motor.)
- 3. Sterilization lamps (such as low-pressure mercury lamps)
- 4. Halogen lamps (such as display spotlights)
- 5. Lamps with high color rendering properties such as xenon lamps and metal halide lamps

**CAUTION:** Since the UVTRON has very high sensitivity it, can detect even weak ultraviolet radiations leaking from unexpected sources. Therefore, sufficient care must be taken to eliminate extraneous ultraviolet radiations from the area where the UVTRON is installed.

**Humidity**

Humidity around the leads for the UVTRON generates leak current, dropping the anode voltage, and stopping the tube from operating. In particular, if dirt, dust etc. get on the leads, that makes it easier for humidity to be absorbed, so keep the area around the leads clean.

**Protect the window of the UVTRON from stains**

Contamination of the light input surface (window) with stains and dirt causes a reduction in the ultraviolet transmittance and a decrease in sensitivity. When handling the UVTRON, wear gloves to keep stains such as oil or fingerprints away from the window. After the UVTRON is installed into a unit, periodic cleaning of the window with gauze dipped in alcohol is suggested.

**Avoid heating the leads of the UVTRON**

If leads of the UVTRON are heated to a high temperature, the glass bulb may crack or the electrodes may be adversely influenced, becoming the cause of faulty operation. For UVTRONs with hard pin leads, the use of special making sockets available from Hamamatsu is recommended. When soldering the UVTRON directly on a printed circuit board, it is recommended to use a pair of heat sink to pinch the root of the lead in order to avoid heat conduction to the leads. The soldering process must be conducted below 350°C within 5 seconds. Avoid using a solder tank for flow soldering, etc. After soldering, be sure to wipe off the soldering flux completely with alcohol, etc.

**Vibration and shock**

The UVTRON and the various driver circuits have passed the tests shown in the following table. But, if they are dropped or otherwise exposed to strong shock, the glass may break, the internal electrodes may deform, or the electrical characteristics may degrade. So handle them with great care. Further, if the lead wires are cut with a nipper or processed in other ways, the internal electrodes may be subject to vibration or shock exceeding the values in the following table. This may degrade the electrical characteristics in the same manner as when the UVTRON is dropped.

<table>
<thead>
<tr>
<th>UVTRON</th>
<th>Vibration test (sine wave) IEC 60068-2-6</th>
<th>Shock test IEC 60068-2-27</th>
</tr>
</thead>
<tbody>
<tr>
<td>R9454, R9533</td>
<td>3.0 mm peak to peak, 200 m/s², 10 Hz to 2000 Hz</td>
<td>10000 m/s², 1 ms</td>
</tr>
<tr>
<td>Other</td>
<td>1.5 mm peak to peak, 100 m/s², 10 Hz to 500 Hz</td>
<td>1000 m/s², 11 ms</td>
</tr>
<tr>
<td>Driving circuit</td>
<td>0.7 mm peak to peak, 10 Hz to 55 Hz</td>
<td>1000 m/s², 11 ms</td>
</tr>
</tbody>
</table>

**Avoid connecting the UVTRON with reverse polarity**

The UVTRON has an electrical polarity, an anode and a cathode. If the connection of these electrodes is reversed by mistake, it causes faulty operation. Be sure to connect these electrodes correctly, as indicated in the technical data sheet, etc.

**Avoid bending the leads of the UVTRON unnecessarily**

Leads of the UVTRON are likely to break at the roots (the lead-to-glass sealing portions) due to oxidation at the time of glass sealing. When bending the leads, hold the roots with such as a pair of long-nose pliers and bend the forward portion. The leads may be bent (and bent back again) one time only.

**Operate the UVTRON within the optimum supply voltage range**

The optimum supply voltage ranges are specified for each type of UVTRON. Operation at a supply voltage outside the optimum range may result in faulty operation. Be sure to operate the UVTRON within the optimum range of supply voltage, as specified in the technical data sheet.

**WARRANTY**

The Hamamatsu UVTRONs are warranted to the original purchaser against defects in materials or workmanship for a period of one year from the date of delivery. This warranty is limited to replacement of defective products. This warranty shall not apply to faults or malfunctions in cases in which the product has been misused with regard to the precautions above or damaged by natural disasters.

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Precautions