

Boston Electronics Corporation

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Flame Sensors

Many customers have asked about using our solid state UV detectors as flame sensors and fire alarms. This works fine for the standard SiC or GaN devices if the source is not too far away and if there are no interfering light sources such as sunlight or room lights, as in boilers, for which high temperature packaging has been developed (HT-suffix). However, when the source is distant or there is light interference, both SiC and GaN have the following problems:

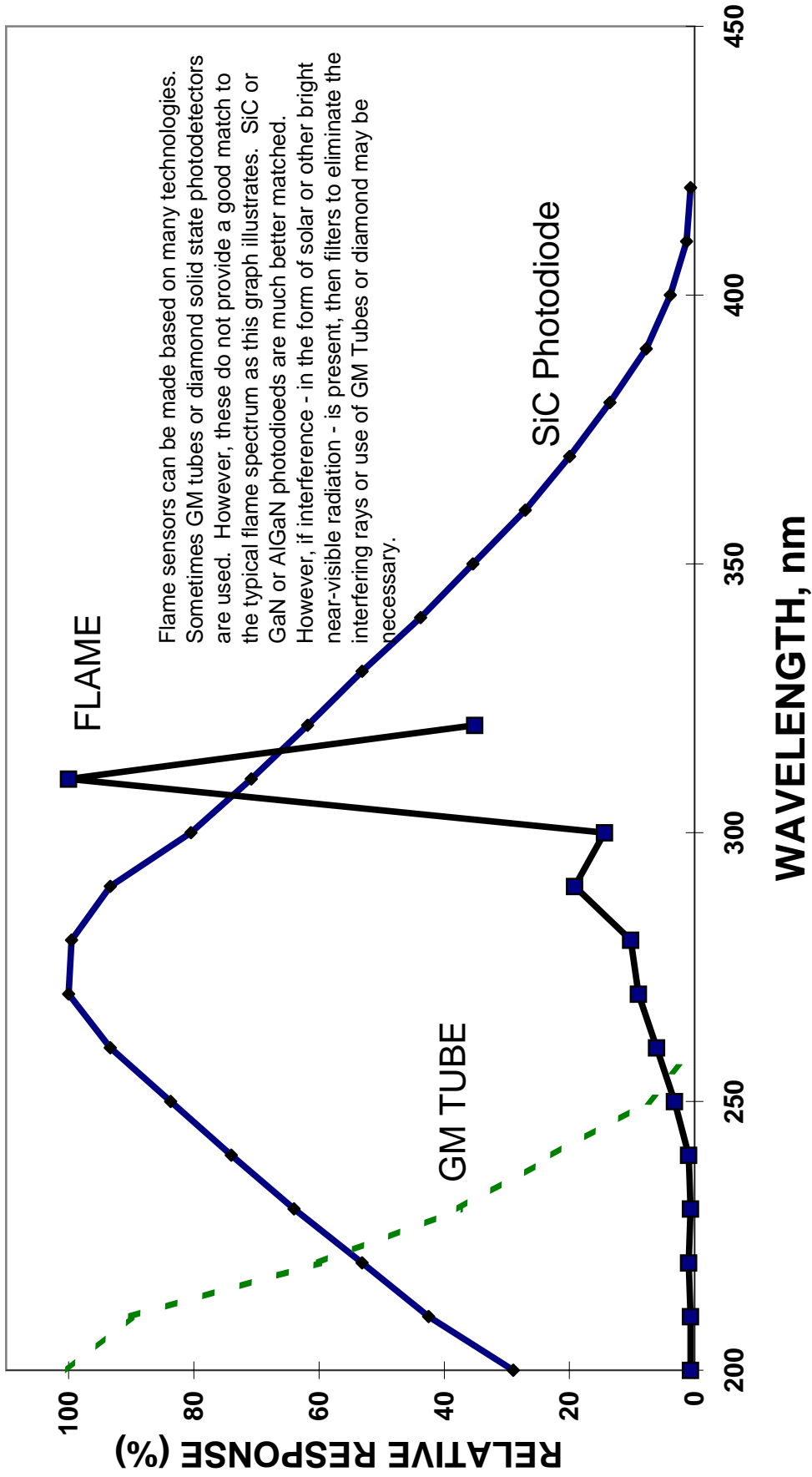
1. the active area is not large so signal falling on it and output in turn is small
2. room lights or sunlight give a much higher signal than does the flame unless optical filters are used
3. optical filters that pass the 310 nm flame peak (see preceding graph) do not cut off steeply enough to eliminate sunlight, which is blocked by Ozone at wavelengths below about 320 nm but is significant above 320 nm.

One solution to this problem is to use a very sensitive photomultiplier tube that is blind to wavelengths longer than 260 nm. Flames are not very bright at wavelengths shorter than 260 nm, BUT photomultipliers are VERY SENSITIVE, and the active area of the R2868 is large, 5 x 12 mm. In fact, the Hamamatsu R2868 we offer (see following) actually counts single photons and produces pulses (counts) that are suitably processed by the companion C3704 drive circuit. The output of the C3704 is a 50V pulse of 10 msec width that can be extended by adding a capacitor.

Further details of the R2868 and C3704 follow. Prices are at the end of this publication.

Can a solid-state device be developed that will serve as a general-purpose flame sensor which is immune to room lights and sun light? Maybe. Our new TiO₂ Schottky photodiodes have much larger active area and lower cost per mm² than SiC and GaN devices, which are based on costly exotic single crystal semiconductors. We are looking for a partner who will explore the appropriate filtering for TiO₂ devices as flame detectors.

UV DETECTOR RESPONSIVITY AND HYDROCARBON FLAME EMISSION SPECTRUM



Quick Detection of Flame from Distance, Compact UV Sensor with High Sensitivity and Wide Directivity, Suitable for Flame Detectors and Fire Alarms.

Hamamatsu R2868 is a UV TRON ultraviolet detector that makes use of the photoelectric effect of metal and the gas multiplication effect. It has a narrow spectral sensitivity of 185 to 260 nm, being completely insensitive to visible light. Unlike semiconductor detectors, it does not require optical visible-cut filters, thus making it easy to use.

In spite of its small size, the R2868 has wide angular sensitivity (directivity) and can reliably and quickly detect weak ultraviolet radiations emitted from flame due to use of the metal plate cathode (eg. it can detect the flame of a cigarette lighter at a distance of more than 5 m.).

The R2868 is well suited for use in flame detectors and fire alarms, and also in detection of invisible discharge phenomena such as corona discharge of high-voltage transmission lines.

APPLICATIONS

- Flame detectors for gas/oil lighters and matches
- Fire alarms
- Combustion monitors for burners
- Inspection of ultraviolet leakage
- Detection of discharge
- Ultraviolet switching

GENERAL

Parameters	Rating	Units
Spectral Response	185 to 260	nm
Window Material	UV glass	—
Weight	Approx. 1.5	g
Dimensional Outline	See Fig. 3	—

MAXIMUM RATINGS

Parameters	Rating	Units
Supply Voltage	400	Vdc
Peak Current ¹⁾	30	mA
Average Discharge Current ²⁾	1	mA
Operating Temperature	-20 to +60	°C

CHARACTERISTICS (at 25°C)

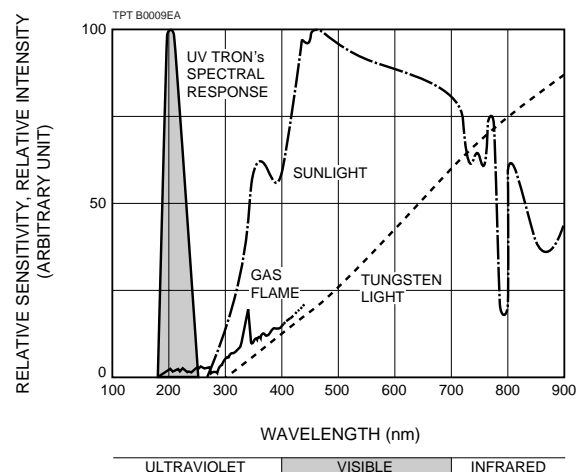
Parameters	Rating	Units
Discharge Starting Voltage (with UV radiation)	280	Vdc Max.
Recommended Operating Voltage	325±25	Vdc
Recommended Average Discharge Current	100	µA
Background ³⁾	10	cpm Max
Sensitivity ⁴⁾	5000	cpm Typ.



NOTES:

- 1) This is the maximum momentary current that can be handled if its full width at half maximum is less than 10 µs.
- 2) If the tube is operated near this or higher, the service life is noticeably reduced. Use the tube within the recommended current values.
- 3) Measured under room illuminations (approximately 500 lux) and recommended operating conditions. Note that these values may increase if the following environmental factors are present.
 1. Mercury lamps, sterilization lamps, or halogen lamps are located nearby.
 2. Direct or reflected sunlight is incident on the tube.
 3. Electrical sparks such as welding sparks are present.
 4. Radiation sources are present.
 5. High electric field (including static field) generates across the tube.
- 4) These are representative values for a wavelength of 200 nm and a light input of 10 pW/cm². In actual use, the sensitivity will vary with the wavelength of the ultraviolet radiation and the drive circuitry employed.

Figure 1: UV TRON's Spectral Response and Various Light Sources



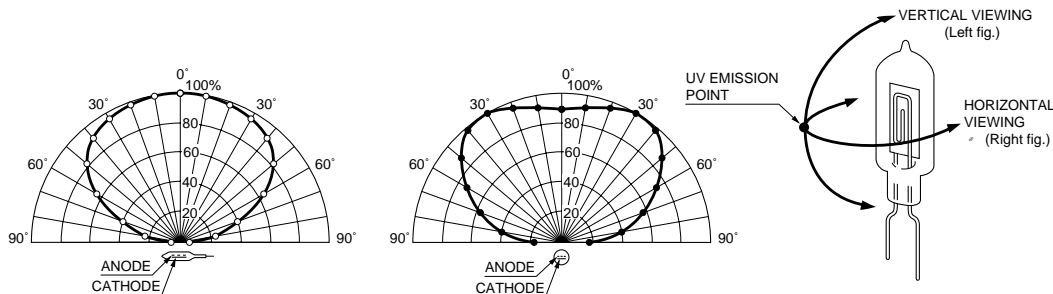
Subject to local technical requirements and regulations, availability of products included in this promotional material may vary. Please consult with our sales office.

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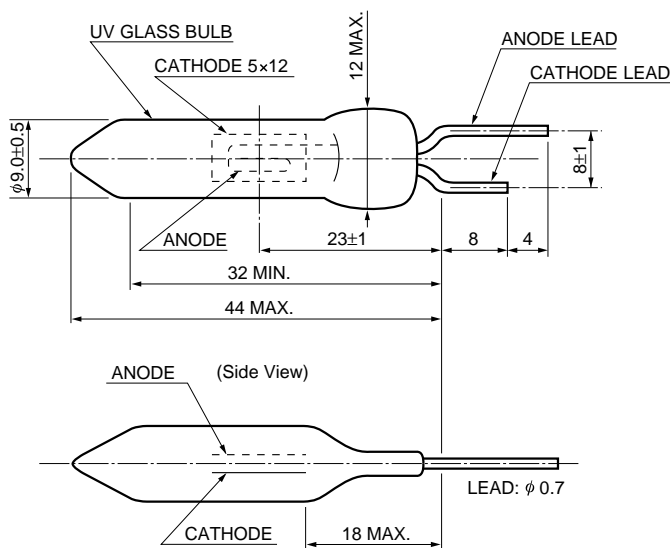
FLAME SENSOR UV TRON® R2868

Figure 2: Angular Sensitivity (Directivity)



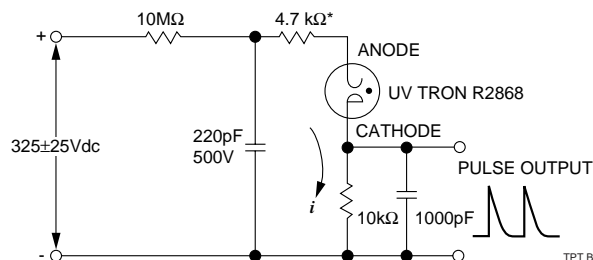
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Figure 3: Dimensional Outline (Unit: mm)



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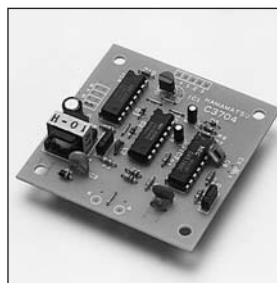
Figure 4: Recommended Operating Circuit



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* Be sure to connect the 4.7 kΩ resistor within 2.5 cm from the anode lead end of UV TRON.

• UV TRON Driving Circuit C3704 series (Option)



Hamamatsu also provide the driving circuit C3704 series for R2868 operation. C3704 series include a high voltage power supply and a signal processing circuit in printed circuit board, which allows to operate R2868 easily as a flame sensor with the low input voltage (DC 6 to 30 V) only. For the details, please refer to the datasheet of C3704 series.

PRECAUTIONS FOR USE

• **Ultraviolet Radiation**

The UV TRON itself emits ultraviolet radiation in operation. When using two or more UV TRONs at the same time in close position, care should be taken so that they do not optically interfere with each other.

• **Vibration and Shock**

The UV TRON is designed in accordance with the standards of MIL-STD-202F (Method 204D/0.06 inch or 10g, 10- 500Hz, 15 minutes, 1 cycle) and MIL-STD-202F (Method 213B/100g, 11ms, Half-sine, 3 times). However, should a strong shock be sustained by the UV TRON (e.g. if dropped), the glass bulb may crack or the internal electrode may be deformed, resulting in deterioration of electrical characteristics. So extreme care should be taken in handling the tube.

• **Polarity**

Connect the UV TRON with correct polarity. Should it be connected with reverse polarity, operating errors may occur.

WARRANTY.

The UV TRON is covered by a warranty for a period of one year after delivery. The warranty is limited to replacement of any defective tube due to defects traceable to the manufacturer.

HAMAMATSU

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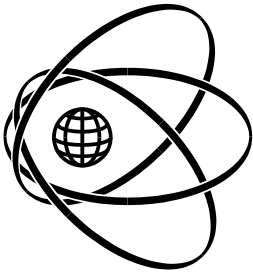
France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10

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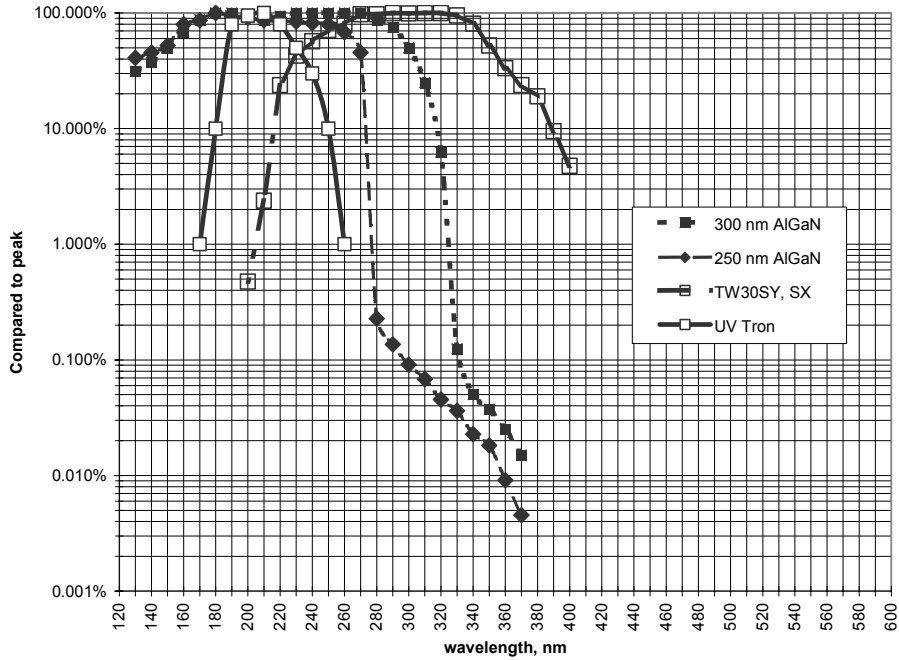
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Created in Japan



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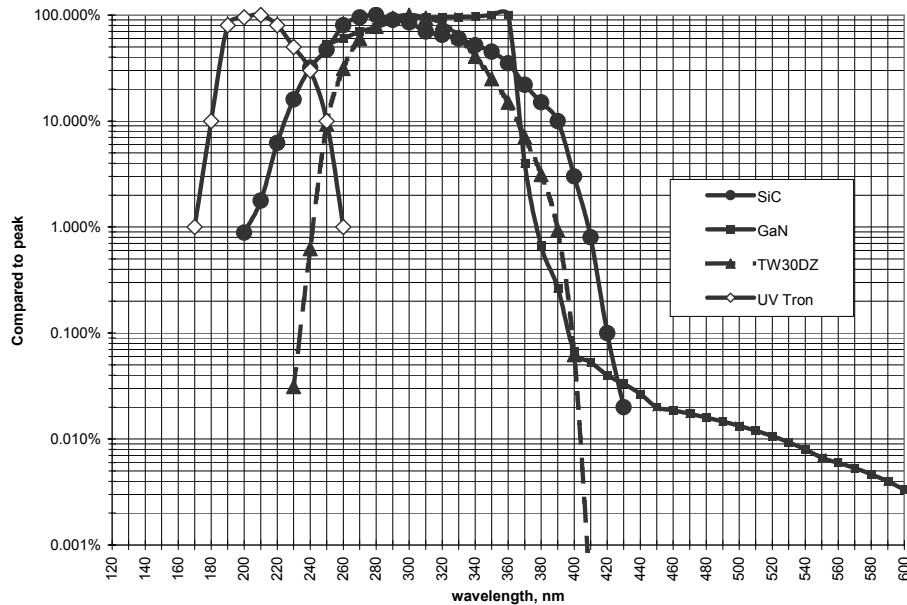
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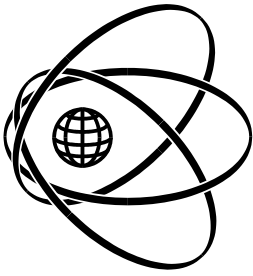
AlGaIn and unfiltered TiO₂ UV Photodiode Relative Spectral Response



For most photodetectors, only the region of highest response is of interest. However, for UV detectors the user is sometimes concerned about response to interfering light sources, especially sunlight or room lights in the visible and near-UV.

SiC, GaN and filtered TiO₂ UV Photodiode Relative Spectral Response





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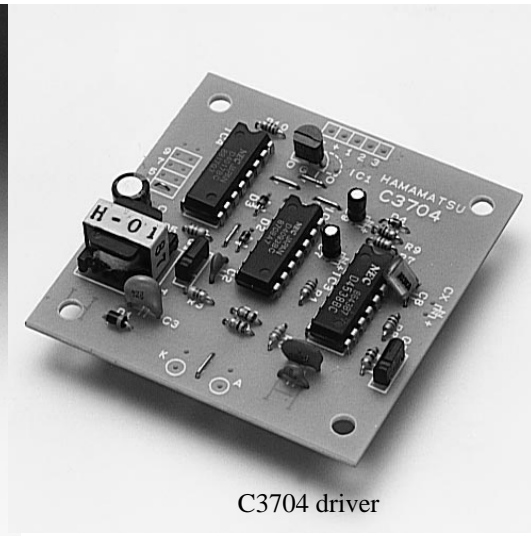
UV TRON prices

These devices are principally used for detection of flames from a distance. One can detect the flame of a cigarette lighter at 15 feet.

Part	Description	1	10	50	100
R2868	UV Tron tube	\$37.00	\$33.00	32.00	27.00
C3704-02	Drive circuit, 5 VDC @ 300 μ A	\$30.00	\$25.00	\$22.69	\$18.98



UV TRONS



C3704 driver