HAMAMATSU

PHOTOMULTIPLIER TUBES
R3788, R4332

High Sensitivity, Bialkali Photocathode
28 mm (1-1/8 Inch) Diameter, 9-Stage, Side-On Type

FEATURES

- **Wide Spectral Response**
  - **R3788 ..... 185 nm to 750 nm**
  - **R4332 ..... 160 nm to 750 nm**
- **High Cathode Sensitivity**
  - **Luminous ..... 120 μA/lm Typ.**
  - **Radiant at 420 nm ..... 90 mA/W Typ.**
  - **Quantum Efficiency at 210 nm ..... 40 % Typ. (R4332)**
- **High Anode Sensitivity (at 1000 V)**
  - **Luminous ..... 1200 A/lm Typ.**
  - **Radiant at 420 nm ..... 9.0×10^5 A/W Typ.**

APPLICATIONS

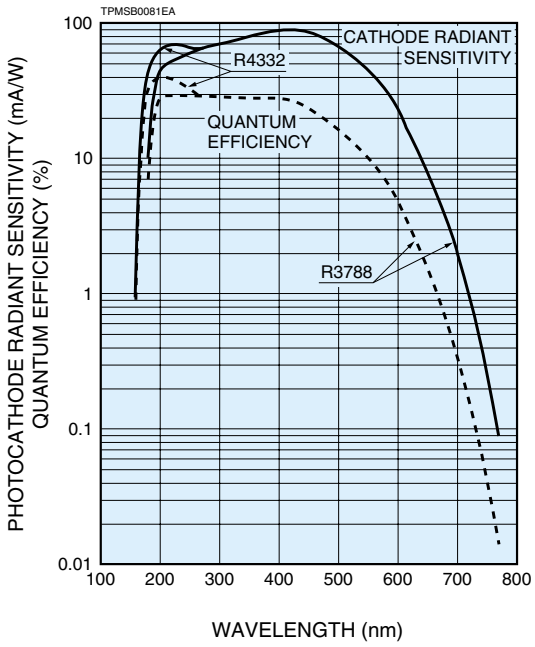
- **Fluorescence Spectrophotometers**
- **Emission Spectrophotometers**
- **Atomic Absorption Spectrophotometers**

SPECIFICATIONS

GENERAL

Parameter		Description/Value	Unit
Spectral Response	R3788	185 to 750	nm
	R4332	160 to 750	nm
Wavelength of Maximum Response		420	nm
Photocathode	Material	Bialkali	—
	Minimum Effective Area	8 × 24	mm
Window Material	R3788	UV glass	—
	R4332	Fused silica	—
Dynode	Secondary Emitting Surface	Bialkali	—
	Structure	Circular-cage	—
	Number of Stages	9	—
Direct Interelectrode Capacitances	Anode to Last Dynode	4	pF
	Anode to All Other Electrodes	6	pF
Base		11-pin base JEDEC No. B11-88	—
Weight		Approx. 45	g
Operating Ambient Temperature		-30 to +50	°C
Storage Temperature		-30 to +50	°C
Suitable Socket		E678–11A (Sold Separately)	—
Suitable Socket Assembly		E717–63 (Sold Separately)	—
		E717–74 (Sold Separately)	

Figure 1: Typical Spectral Response



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MAXIMUM RATINGS (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1250	V
	Between Anode and Last Dynode	250	V
Average Anode Current [A]		0.1	mA

CHARACTERISTICS (at 25 °C)

Parameter			R3788 Min.	R3788 Typ.	R3788 Max.	R4332 Min.	R4332 Typ.	R4332 Max.	Unit
Cathode Sensitivity	Quantum Efficiency (at Peak Wavelength)		—	30 (at 250 nm)	—	—	40 (at 210 nm)	—	%
	Luminous [B]		100	120	—	100	120	—	μA/lm
	Radiant	at 194 nm	—	31	—	—	60	—	mA/W
		at 210 nm	—	50	—	—	68	—	mA/W
		at 420 nm	—	90	—	—	90	—	mA/W
	Red/White Ratio [C]		—	0.01	—	—	0.01	—	—
	Blue Sensitivity Index [D]		—	10	—	—	10	—	—
Anode Sensitivity	Luminous [E]		500	1200	—	500	1200	—	A/lm
	Radiant	at 194 nm	—	3.1×10^5	—	—	6.0×10^5	—	A/W
		at 210 nm	—	5.0×10^5	—	—	6.8×10^5	—	A/W
		at 420 nm	—	9.0×10^5	—	—	9.0×10^5	—	A/W
Gain [E]			—	1.0×10^7	—	—	1.0×10^7	—	—
Anode Dark Current [F] (After 30 min Storage in Darkness)			—	5	50	—	5	50	nA
ENI (Equivalent Noise Input) [G]			—	1.4×10^{-16}	—	—	1.4×10^{-16}	—	W
Time Response [E]	Anode Pulse Rise Time [H]		—	2.2	—	—	2.2	—	ns
	Electron Transit Time [I]		—	22	—	—	22	—	ns
	Transit Time Spread (TTS) [J]		—	1.2	—	—	1.2	—	ns
Anode Current Stability [K]	Light Hysteresis		—	0.1	—	—	0.1	—	%
	Voltage Hysteresis		—	1.0	—	—	1.0	—	%

NOTES

A: Averaged over any interval of 30 seconds maximum.

B: The light source is a tungsten filament lamp operated at a distribution temperature of 2856K. Supply voltage is 100 V between the cathode and all other electrodes connected together as anode.

C: Red/White ratio is the quotient of the cathode current measured using a red filter (Toshiba R-68) interposed between the light source and the tube by the cathode current measured with the filter removed under the same conditions as Note B.

D: The value is cathode output current when a blue filter (Corning CS 5-58 polished to 1/2 stock thickness) is interposed between the light source and the tube under the same condition as Note B.

E: Measured with the same light source as Note B and with the voltage distribution ratio shown in Table 1 below.

Table 1: Voltage Distribution Ratio

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	P
Distribution Ratio	1	1	1	1	1	1	1	1	1	1	

Supply Voltage: 1000 V, K: Cathode, Dy: Dynode, P: Anode

F: Measured with the same supply voltage and voltage distribution ratio as Note E after removal of light.

G: ENI is an indication of the photon-limited signal-to-noise ratio. It refers to the amount of light in watts to produce a signal-to-noise ratio of unity in the output of a photomultiplier tube.

$$ENI = \frac{\sqrt{2q \cdot Idb \cdot G \cdot \Delta f}}{S}$$

where q = Electronic charge (1.60×10^{-19} coulomb).
Idb = Anode dark current(after 30 minutes storage) in amperes.
G = Gain.
Δf = Bandwidth of the system in hertz. 1 hertz is used.
S = Anode radiant sensitivity in amperes per watt at the wavelength of peak response.

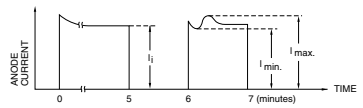
H: The rise time is the time for the output pulse to rise from 10 % to 90 % of the peak amplitude when the entire photocathode is illuminated by a delta function light pulse.

I: The electron transit time is the interval between the arrival of delta function light pulse at the entrance window of the tube and the time when the anode output reaches the peak amplitude. In measurement, the whole photocathode is illuminated.

J: Also called transit time jitter. This is the fluctuation in electron transit time between individual pulses in the signal photoelectron mode, and may be defined as the FWHM of the frequency distribution of electron transit times.

K: Hysteresis is temporary instability in anode current after light and voltage are applied.

$$\text{Hysteresis} = \frac{I_{max.} - I_{min.}}{I_i} \times 100\ (\%)$$



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(1)Light Hysteresis
The tube is operated at 750 V with an anode current of 1 μA for 5 minutes. The light is then removed from the tube for a minute. The tube is then re-illuminated by the previous light level for a minute to measure the variation.

(2)Voltage Hysteresis
The tube is operated at 300 V with an anode current of 0.1 μA for 5 minutes. The light is then removed from the tube and the supply voltage is quickly increased to 800 V. After a minute, the supply voltage is then reduced to the previous value and the tube is re-illuminated for a minute to measure the variation.

Figure 2: Anode Luminous Sensitivity and Gain Characteristics

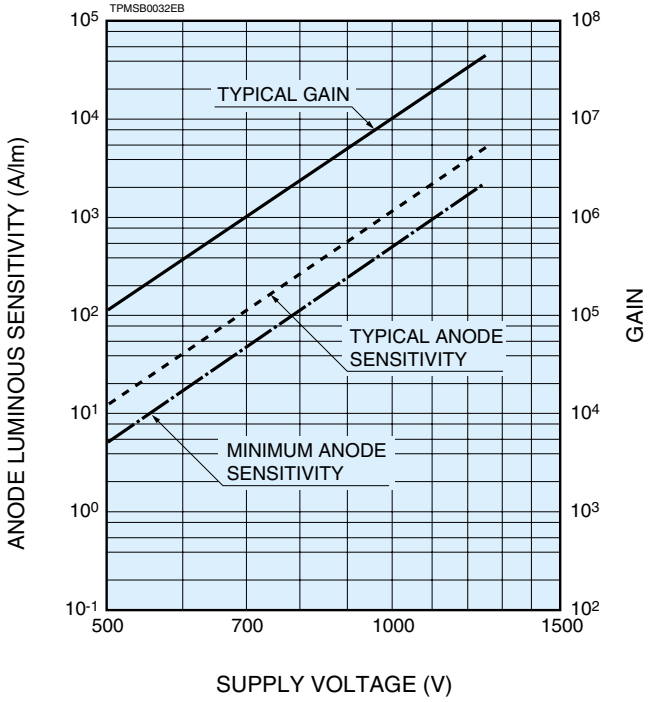

Figure 3: Typical Time Response

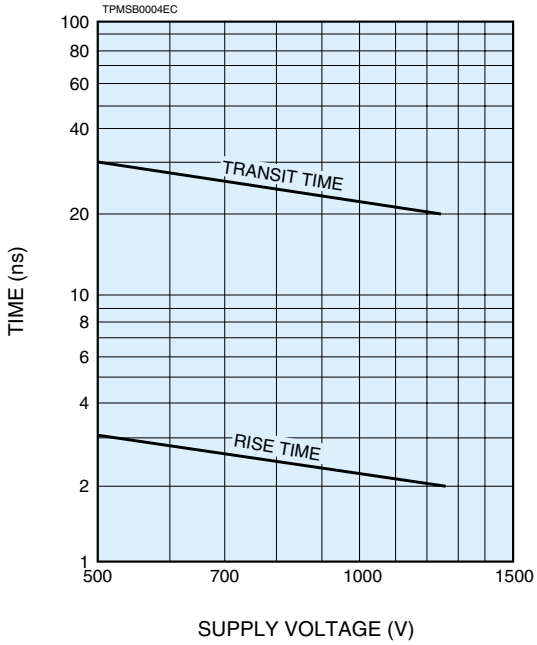

Figure 4: Typical ENI with Wavelength

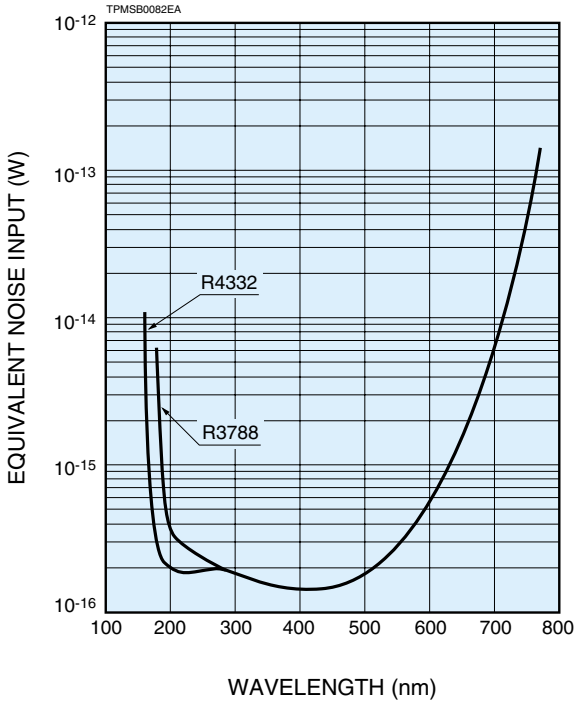

Figure 5: Typical EADCI (Equivalent Anode Dark Current Input) vs. Supply Voltage

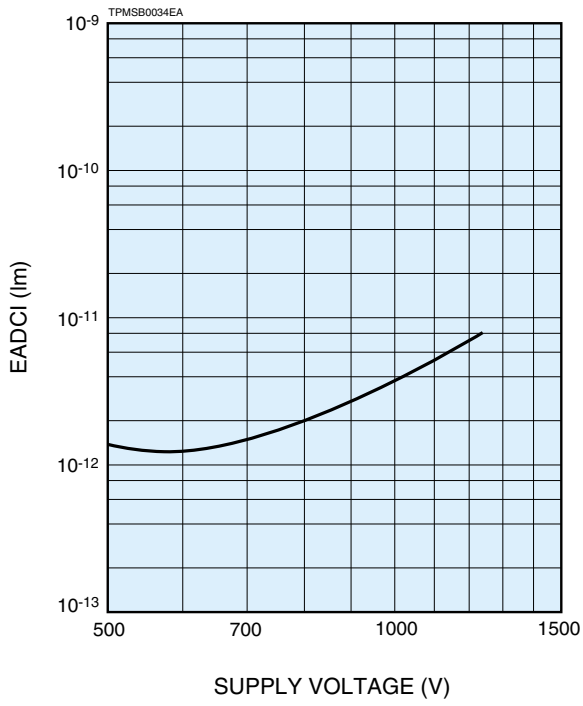

Figure 6: Dimensional Outline and Basing Diagram (Unit: mm)

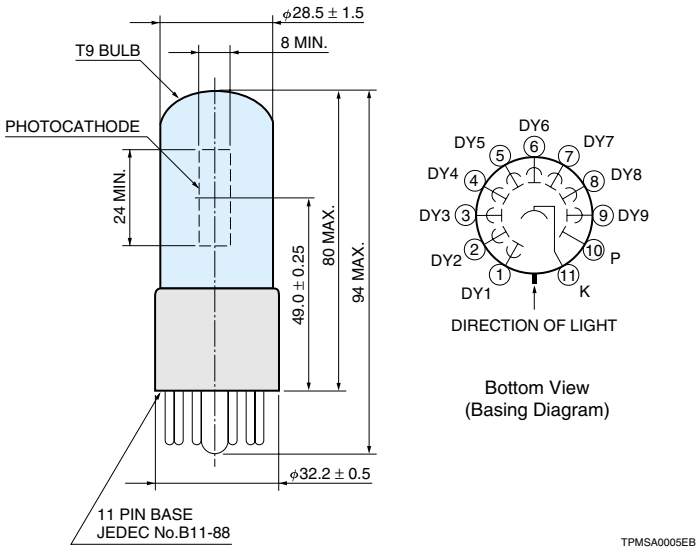

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Figure 7: Socket (Unit: mm) Sold Separately

E678-11A

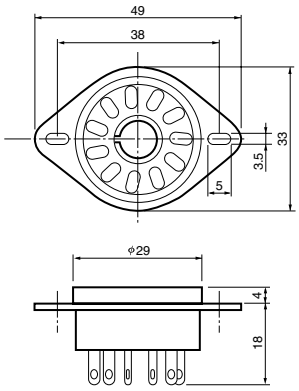

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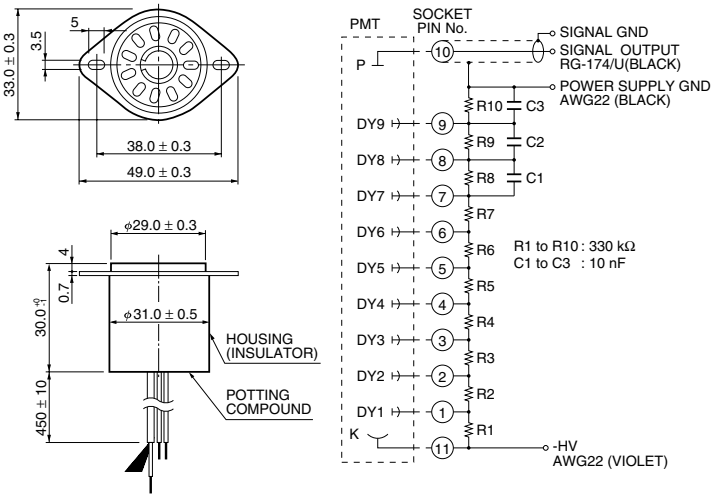
Figure 8: D Type Socket Assembly (Unit: mm) Sold Separately

E717-63



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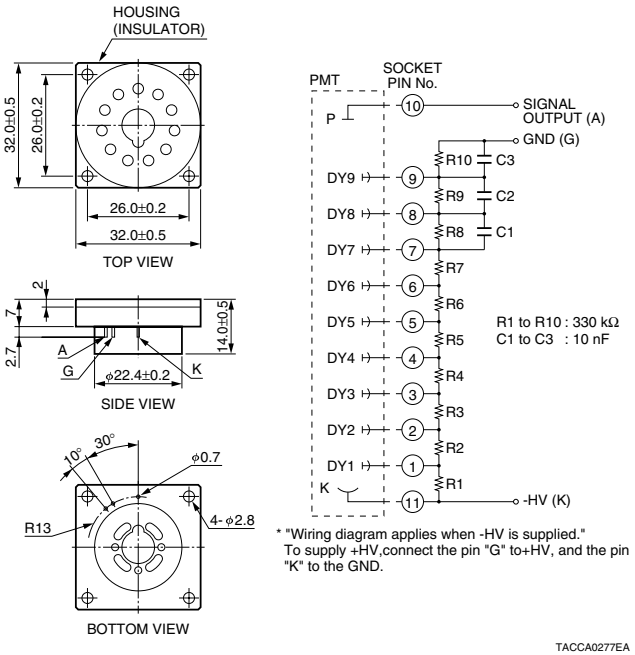
E717-74



* "Wiring diagram applies when -HV is supplied."
To supply +HV,connect the pin "G" to+HV, and the pin "K" to the GND.

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* Hamamatsu also provides C4900 series compact high voltage power supplies and C6270 series DP type socket assemblies which incorporate a DC to DC converter type high voltage power supply.

Warning–Personal Safety Hazards

Electrical Shock–Operating voltages applied to this device present a shock hazard.

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