HAMAMATSU

PHOTOMULTIPLIER TUBE
R1477-06

High Sensitivity Multialkali Photocathode (185 nm to 900 nm)
28 mm (1-1/8 Inch) Diameter, 9-stage, Side-On

FEATURES

- **High Cathode Sensitivity**
  - **Radiant at 450nm ..... 80 mA/W**
  - **Luminous ..... 375 μA/lm**
  - **Quantum Efficiency at 370 nm..... 24 %**
- **Wide Spectral Response ..... 185 to 900 nm**
- **Low Anode Dark Current ..... 3 nA at 1000 V (after 30 minute storage)**

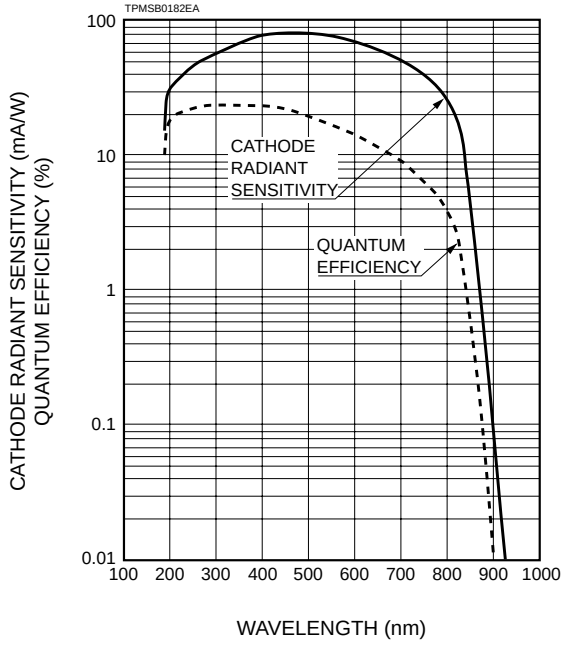
APPLICATIONS

- **UV to IR Spectrophotometers**
- **Laser Detection Systems**
- **Pollution Monitors**

The R1477-06 has a high sensitivity multialkali photocathode (even higher than the R928). The spectral response covers a wide range from 185 to 900 nm with a peak response at approximately 450 nm. The R1477-06 also features the combination of high gain and low dark current.

The R1477-06 is recommended for use in spectrophotometry and other low light level applications requiring super-high cathode sensitivity from the UV to the near IR regions of the spectrum.

Figure 1: Typical Spectral Response



GENERAL

Parameter		Description/Value	Unit
Spectral Response		185 to 900	nm
Wavelength of Maximum Response		450	nm
Photocathode	Material	Multialkali	—
	Minimum Effective Area	8 × 24	mm
Window Material		UV glass	—
Dynode	Secondary Emitting Surface	Multialkali	—
	Structure	Circular-cage	—
	Number of Stages	9	—
Direct Interelectrode Capacitances	Anode to Last Dynode	Approx. 4	pF
	Anode to All Other Electrodes	Approx. 6	pF
Base		11-pin base JEDEC No. B11-88	—
Weight		Approx. 45	g
Suitable Socket		E678-11A (Option)	—
Suitable Socket Assembly		E717-21 (Option)	—

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PHOTOMULTIPLIER TUBE R1477-06

MAXIMUM RATINGS (Absolute Maximum Values at 25°C)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1250	Vdc
	Between Anode and Last Dynode	250	Vdc
Average Anode Current [A]		0.1	mA
Ambient Temperature		-80 to +50	°C

CHARACTERISTICS (at 25°C)

Parameter			Min.	Typ.	Max.	Unit
Cathode Sensitivity	Luminous [B]		350	375	—	μA/lm
	Radiant	at 254 nm	—	40	—	mA/W
		at 450 nm	—	80	—	mA/W
		at 633 nm	—	62	—	mA/W
		at 852 nm	—	5.0	—	mA/W
	Quantum Efficiency	at 370 nm	—	24	—	%
	Red/White Ratio [C]		0.25	0.35	—	—
	Blue [D]		—	1.0	—	μA/lm-b
Anode Sensitivity	Luminous [E]		1000	2000	—	A/lm
	Radiant	at 254nm	—	2.4×10^5	—	A/W
		at 450nm	—	4.2×10^5	—	A/W
		at 633nm	—	3.3×10^5	—	A/W
		at 852nm	—	2.7×10^4	—	A/W
Gain [E]			—	5.3×10^6	—	—
Anode Dark Current [F] (After 30 minute storage in the darkness)			—	3	50	nA
ENI (Equivalent Noise Input) [G]			—	1.7×10^{-16}	—	W
Time Response [E]	Anode Pulse Rise Time [H]		—	2.2	—	ns
	Electron Transit Time [J]		—	22	—	ns
	Transit Time Spread (TTS) [K]		—	1.2	—	ns
Anode Current Stability [L]	Current Hysteresis		—	0.1	—	%
	Voltage Hysteresis		—	1	—	%

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= 1000Vdc
K: Cathode, Dy: Dynode, P: Anode

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 volts 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 conditions as Note B.

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

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.

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

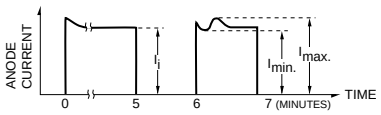
where q = Electronic charge (1.60×10^{-19} coulomb)
Idb = Anode dark current (after 30 minute storage) in amperes
G = Gain
Δf = Bandwidth of the system in hertz. 1 hertz is used.
S = Anode radiant sensitivity in amperes per watt at the wavelength of peak response.

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.

J: 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.

K. 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.

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



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

(1) Current Hysteresis
The tube is operated at 750 volts with an anode current of 1 micro-ampere 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 volts with an anode current of 0.1 micro-ampere for 5 minutes. The light is then removed from the tube and the supply voltage is quickly increased to 800 volts. After a minute, the supply voltage is 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

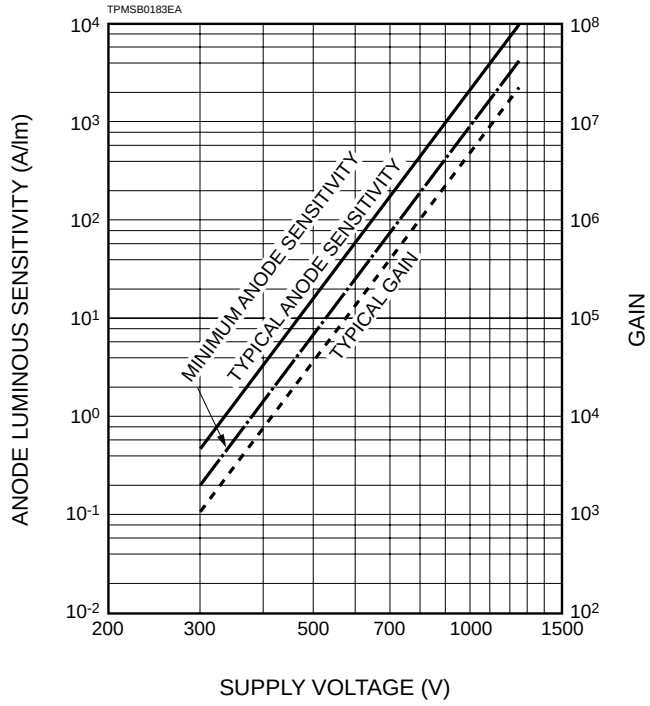


Figure 3: Typical Time Response

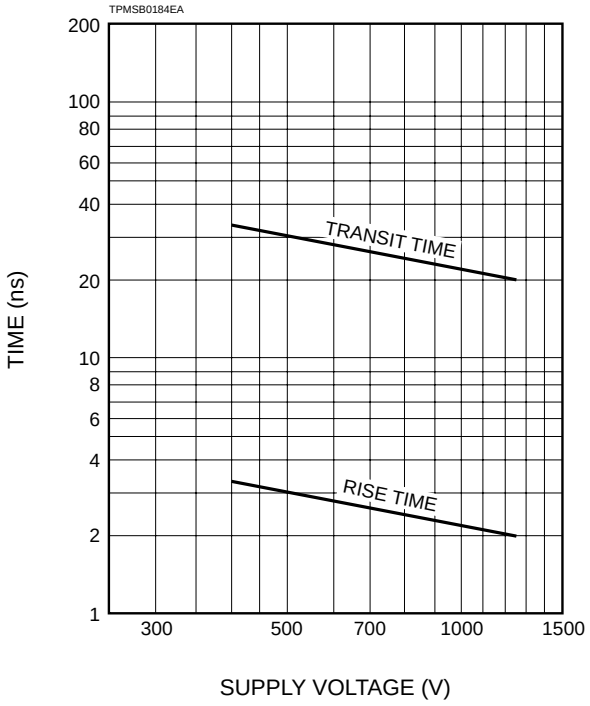


Figure 4: Typical Temperature Coefficient of Anode Sensitivity

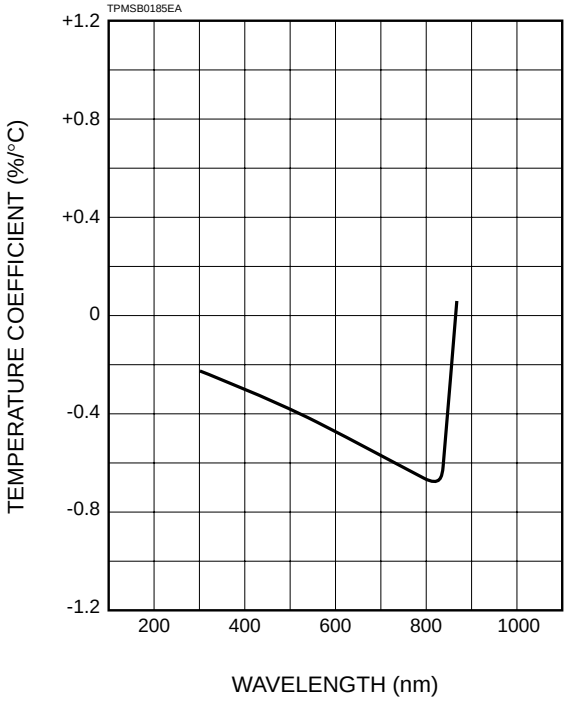


Figure 5: Typical Temperature Characteristic of Dark Current (at 1000V, after 30 minute storage)

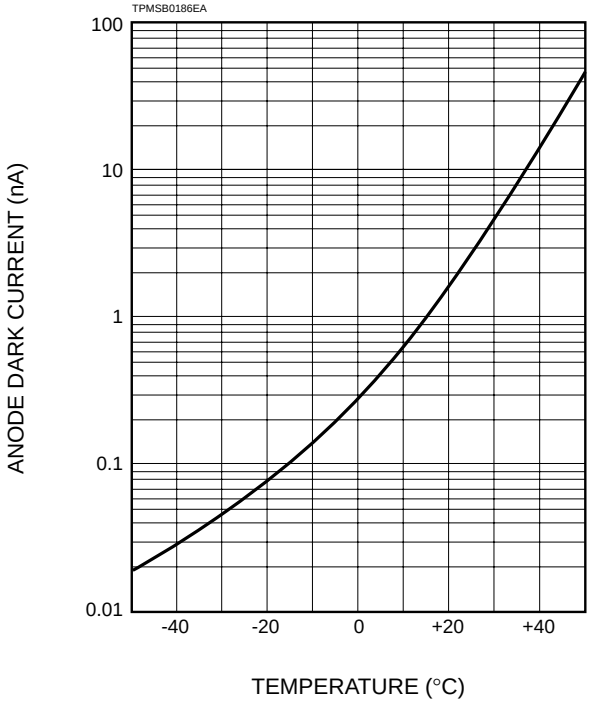


Figure 6: Dimensional Outline and Basing Diagram (Unit: mm)

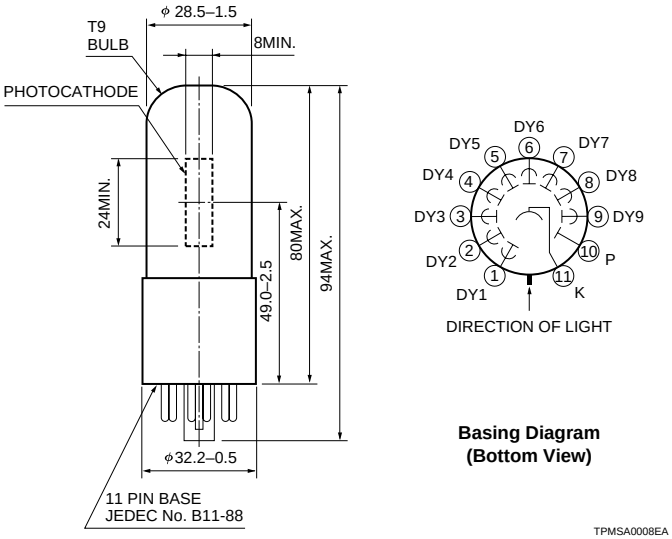


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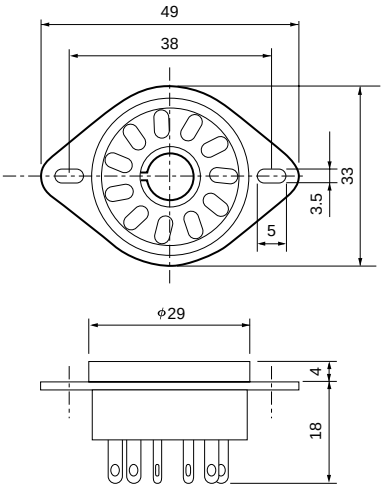
Figure 7: Optional Accessories (Unit: mm)

E678-11A (Socket)



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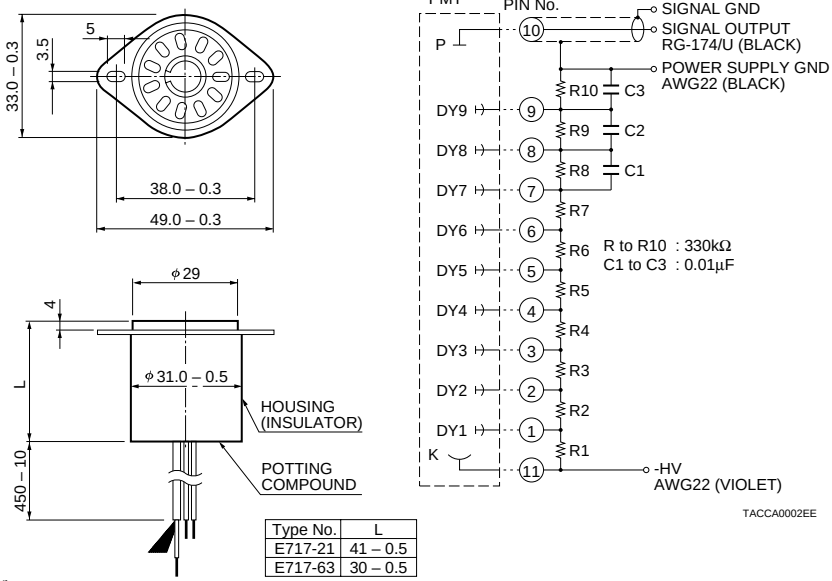
D Type Socket Assembly E717-21



Type No.	L
E717-21	41 – 0.5
E717-63	30 – 0.5

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* Hamamatsu also provides C4900 series modular type 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 voltage
applied to this device presents shock hazard.

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