HAMAMATSU

PHOTOMULTIPLIER TUBES
R2693, R2693P

Transmission Mode Low Noise Bialkali Photocathode
28 mm (1-1/8 inch) Diameter, Side-on Type

FEATURES

- Low Dark Current
- Low Dark Counts (R2693P)
- Wide Photocathode
- Excellent Spatial Uniformity
- Fast Time Response

APPLICATIONS

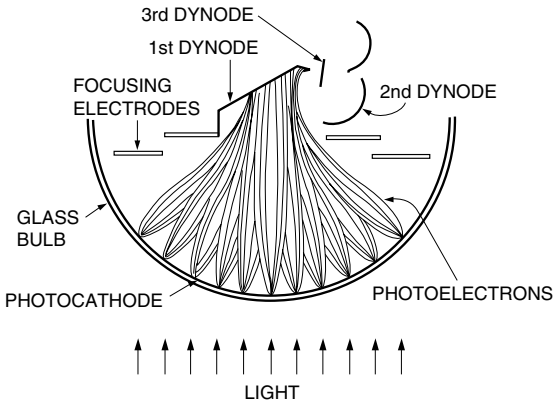
- Fluorescence Detector
- Chemiluminescence Detector
- Light Scattering Detector

SPECIFICATIONS

GENERAL

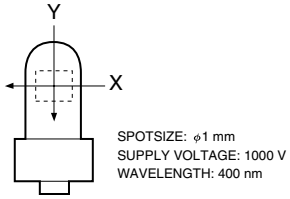
Parameter		Description/Value	Unit
Spectral Response		185 to 650	nm
Wavelength of Maximum Response		375	nm
Photocathode	Material	Low noise bialkali	—
	Minimum Effective Area	16 (H) × 18 (W)	mm
Window Material		UV glass	—
Dynode	Structure	Circular-cage	—
	Number of Stages	9	—
Direct Interelectrode Capacitances	Anode to Last Dynode	1.2	pF
	Anode to All Other Electrodes	3.4	pF
Base		11-pin base JEDEC No. B11-88	—
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)	—

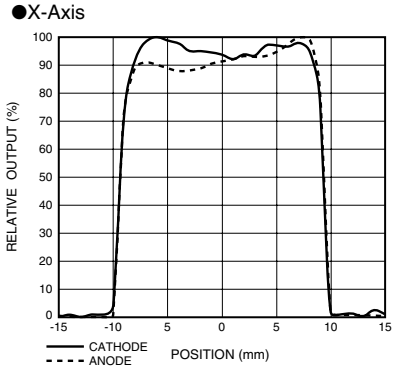
Figure 1: Electron Trajectories

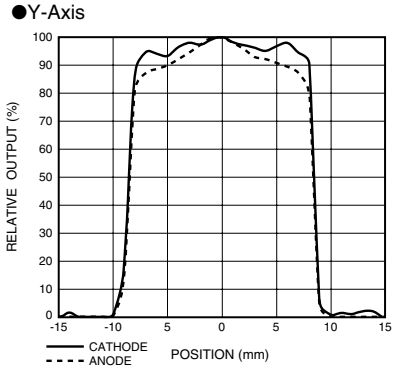


TPMSC0003EC

Figure 2: Typical Spatial Uniformity







TPMSB0066EB

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 Ⓐ		0.1	mA

CHARACTERISTICS (at 25 °C)

Parameter		R2693 for General Purpose			R2693P for Photon Counting			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Cathode Sensitivity	Quantum Efficiency at 375 nm	—	20.5	—	—	20.5	—	%
	Luminous Ⓑ	30	50	—	30	50	—	μA/lm
	Radiant at 375 nm (Peak)	—	62	—	—	62	—	mA/W
	Blue Sensitivity Index Ⓒ	—	7.0	—	—	7.0	—	μA/lm-b
Anode Sensitivity	Luminous Ⓓ	100	300	—	100	300	—	A/lm
	Radiant at 375 nm (Peak)	—	3.7×10^5	—	—	3.7×10^5	—	A/W
Gain Ⓓ		—	6×10^6	—	—	6×10^6	—	—
Anode Dark Current Ⓔ (After 30 min Storage in Darkness)		—	0.5	5.0	—	0.1	2.0	nA
Anode Dark Counts	Pulse Hight Distribution Ⓕ	—	—	—	—	20	50	s^{-1}
	at Plateau Voltage Ⓖ	—	—	—	—	10	50	s^{-1}
ENI (Equivalent Noise Input) Ⓗ		—	8.6×10^{-17}	—	—	3.9×10^{-17}	—	W
Time Response Ⓓ	Anode Pulse Rise Time Ⓙ	—	1.2	—	—	1.2	—	ns
	Electron Transit Time Ⓚ	—	18	—	—	18	—	ns
	Transit Time Spread (FWHM) Ⓛ	—	1.0	—	—	1.0	—	ns
Anode Current Stability Ⓜ	Current Hysteresis	—	0.5	—	—	0.5	—	%
	Voltage Hysteresis	—	1.0	—	—	1.0	—	%

NOTES

Ⓐ: Averaged over any interval of 30 seconds maximum.

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

Ⓒ: 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.

Ⓓ: 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	····	Dy7	Dy8	Dy9	P
Ratio	1	1	1	1	·····	1	1	1	

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

Pulse Height Distribution

Electrodes	K	Dy1	Dy2	Dy3	····	Dy7	Dy8	Dy9	P
Ratio	1	1	1	1	·····	1	1	1	

Supply Voltage: Note F, K: Cathode, Dy: Dynode, P: Anode

Plateau

Electrodes	K	Dy1	Dy2	Dy3	····	Dy7	Dy8	Dy9	P
Ratio	1	1	1	1	·····	1	2	1	

Supply Voltage: Plateau Voltage, K: Cathode, Dy: Dynode, P: Anode

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

Ⓕ: Measured at the voltage producing the gain of 1×10^6

Ⓖ: Plateau voltage at the test up in HPK

Ⓗ: 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.

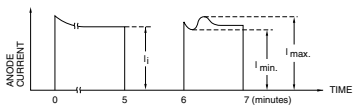
Ⓙ: The rise time is the time for the output pulse to rise from 10 % to 90 % of the peak amplitude when the entire photocathode is illuminated by a delta function light pulse.

Ⓚ: 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 amplitube. In measurement, the whole photocathode is illuminated.

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

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

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



TPMSB0002EA

(1)Current 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 3: Typical Spectral Response

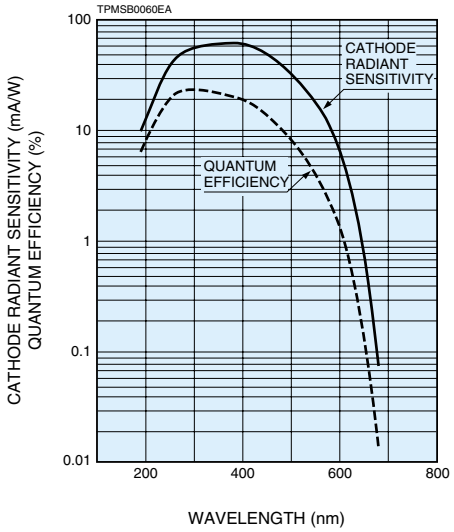


Figure 4: Typical Time Response

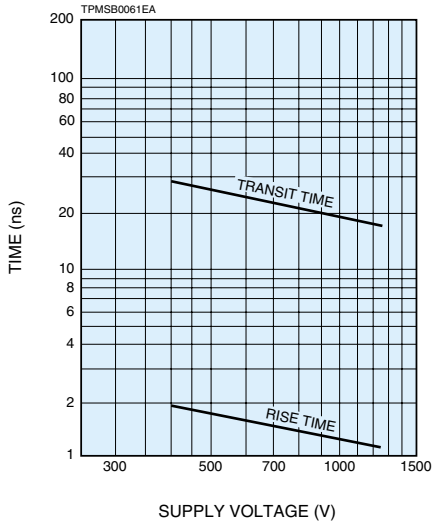


Figure 5: Typical Gain and Anode Dark Current (R2693)

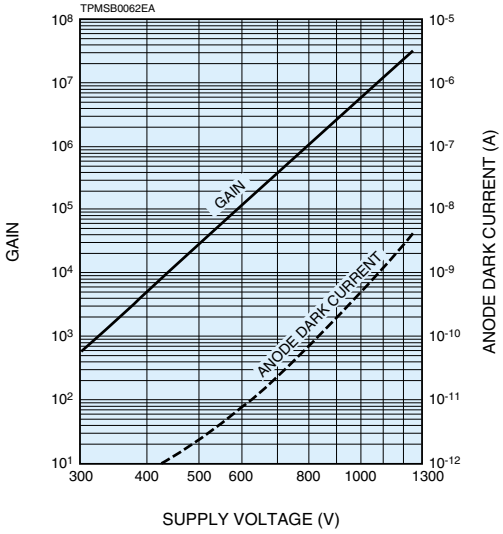


Figure 6: Typical Single Photoelectron Pulse Height Distribution (R2693P)

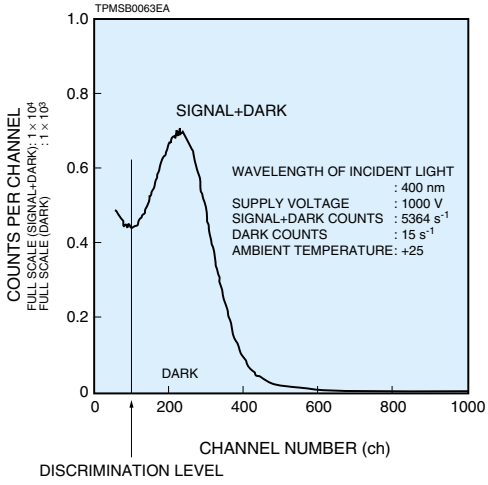


Figure 7: Typical Temperature Coefficient of Anode Sensitivity

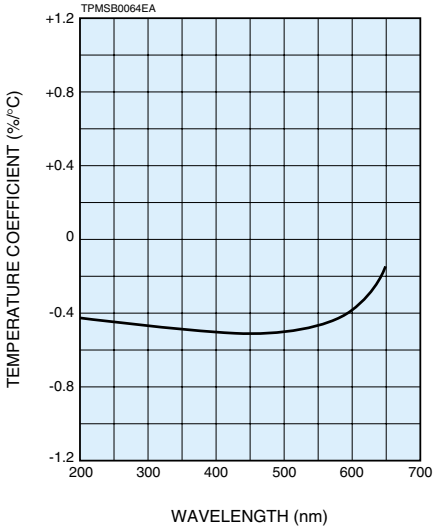


Figure 8: Typical Temperature Characteristics of Dark Current (R2693) (at 1000 V, after 30 min storage)

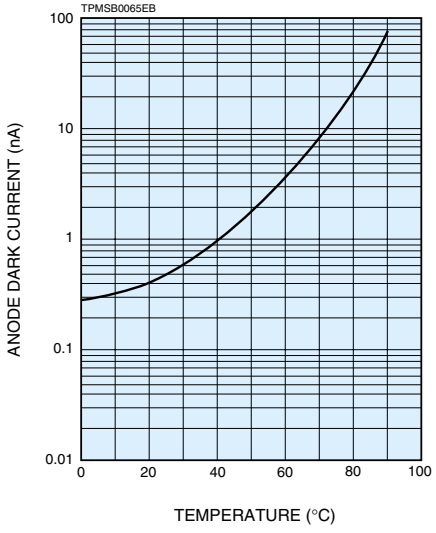
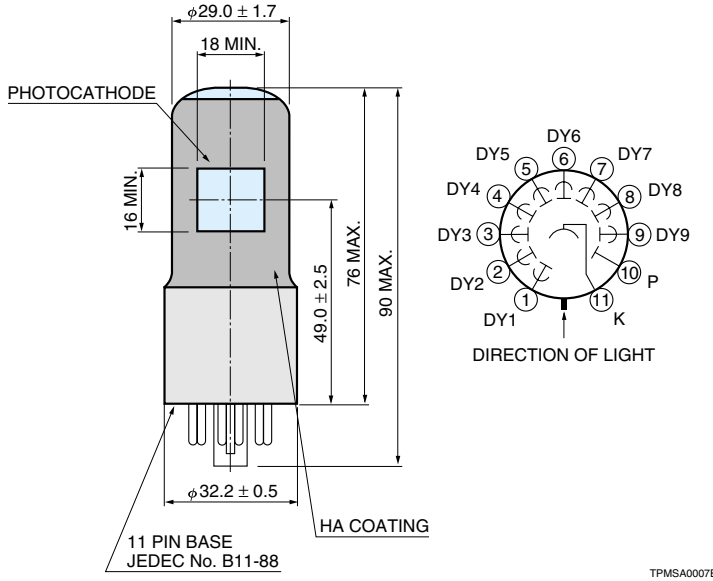


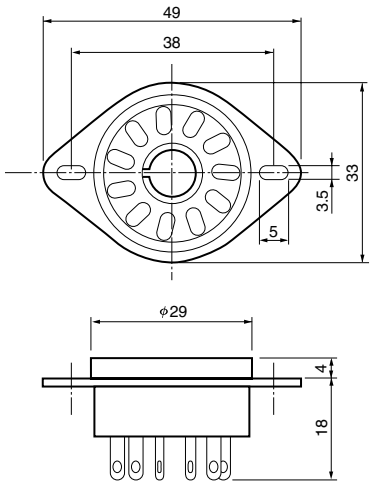
Figure 9: Dimensional Outline and Basing Diagram (Unit: mm)



TPMSA0007ED

Figure 10: Socket (Unit: mm) Sold Separately

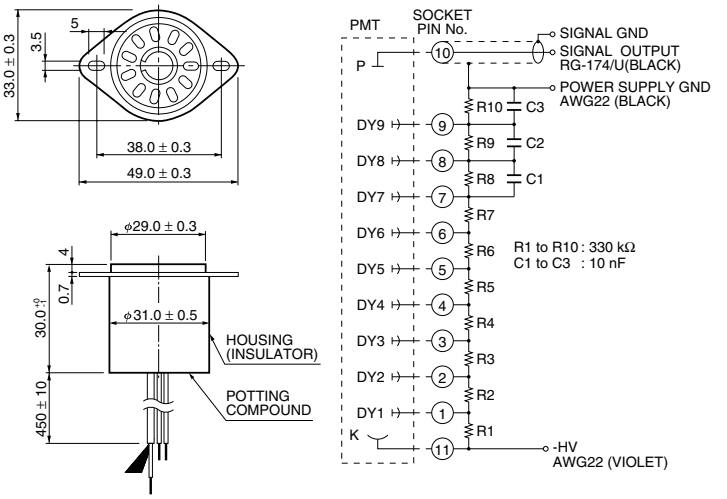
E678-11A



TACCA0064EA

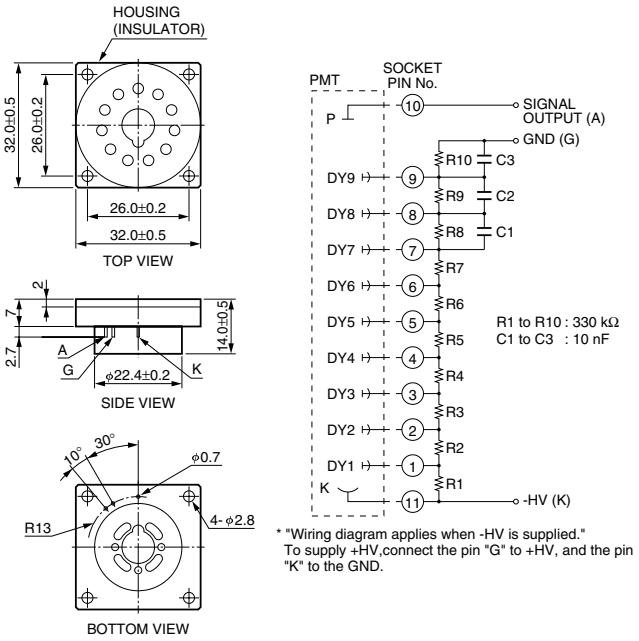
Figure 11: D Type Socket Assembly (Unit: mm) Sold Separately

E717-63



TACCA0002EH

E717-74



TACCA0277EA

* 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.

HAMAMATSU WEB SITE www.hamamatsu.com
HAMAMATSU PHOTONICS K.K., Electron Tube Division
314-5, Shimokanzo, Iwata City, Shizuoka Pref., 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P. O. Box 6910, Bridgewater. N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: usa@hamamatsu.com
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658 E-mail: info@hamamatsu.de
France: Hamamatsu Photonics France S.A.R.L.: 19, 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 E-mail: infos@hamamatsu.fr
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road Welwyn Garden City Hertfordshire AL7 1BW, United Kingdom, Telephone: 44-(0)1707-294888, Fax: 44(0)1707-325777 E-mail: info@hamamatsu.co.uk
North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171-41 SOLNA, Sweden, Telephone: (46)8-509-031-00, Fax: (46)8-509-031-01 E-mail: info@hamamatsu.se
Italy: Hamamatsu Photonics Italia: S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39)02-935 81 733, Fax: (39)02-935 81 741 E-mail: info@hamamatsu.it

TPMS1014E02
JAN. 2007. IP