

FEATURES

- Low dark current 5 nA (after 30 minutes)
- Low dark counts (R9110P) 1000 s⁻¹
- Wide spectral response 185 nm to 900 nm
- High cathode sensitivity
 - Luminous 525 μA/lm
 - Radiant at 450 nm 90 mA/W
 - QE at 450 nm 24.8 %
- High anode sensitivity
 - Luminous 10 000 A/lm
- High signal to noise ratio

APPLICATIONS

- Biofluorescence detection
- Laser scanning microscope
- Spectroscopy
- Bioluminescence detection
- Medical inspection

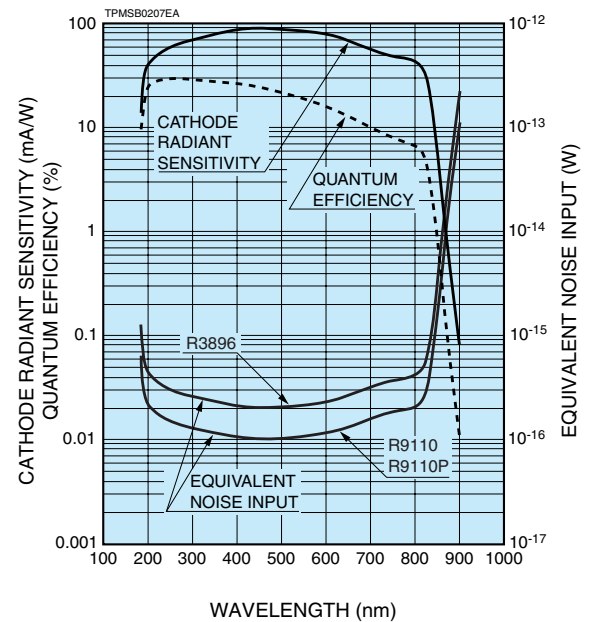


SPECIFICATIONS

GENERAL

Parameter	Description / Value	Unit
Spectral response	185 to 900	nm
Wavelength of maximum response	450	nm
Photocathode	Material	Multialkali
	Minimum effective area	8 × 6
Window material	UV glass	—
Dynode	Structure	Circular-cage
	Number of stages	9
Direct interelectrode capacitances	Anode to last dynode	Approx. 4
	Anode to all other electrodes	Approx. 6
Base	11-pin base	—
Weight	Approx. 46	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 and equivalent noise input



PHOTOMULTIPLIER TUBES

R9110, R9110P (For Photon Counting)

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		Min.	Typ.	Max	Unit		
Cathode sensitivity	Quantum efficiency	at 254 nm	—	29.3	—	%	
		at 450 nm	—	24.8	—	%	
		at 633 nm	—	14.3	—	%	
		at 852 nm	—	0.73	—	%	
	Luminous ^(B)			400	525	—	μA/lm
		Radiant	at 254 nm	—	60	—	mA/lm
	at 450 nm		—	90	—	mA/W	
	at 633 nm		—	73	—	mA/W	
	at 852 nm		—	5.0	—	mA/W	
	Red / White ratio ^(C)		0.2	0.4	—	—	
Blue sensitivity index ^(D)		—	15	—	—		
Anode sensitivity	Luminous ^(E)	4000	10 000	—	A/lm		
Gain ^(E)		—	1.9×10^7	—	—		
Anode dark current ^(F) (After 30 min storage in darkness)		—	5	15	nA		
Anode dark counts ^(G) (for the R9110P)		—	1000	2000	s ⁻¹		
ENI (Equivalent noise input) ^(H)		—	1.0×10^{-16}	—	W		
Time response ^(F)	Anode pulse rise time ^(I)		—	2.2	—	ns	
	Electron transit time ^(J)		—	22	—	ns	
	Transit time spread (TTS) ^(K)		—	1.2	—	ns	

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 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	1

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

- (F) Measured with the same supply voltage and voltage distribution ratio shown in Table 1.
- (G) Measured at the plateau voltage.

Table 2: Voltage distribution ratio for plateau test

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	P
Distribution ratio	1	1	1	1	1	1	1	1	2	1	1

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

- (H) 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.

$$ENI = \frac{\sqrt{2q \cdot I_{db} \cdot G \cdot f}}{S} \quad (W)$$

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

- (I) 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 single photoelectron mode, and may be defined as the FWHM of the frequency distribution of electron transit times.

Figure 2: Anode luminous sensitivity and gain characteristics

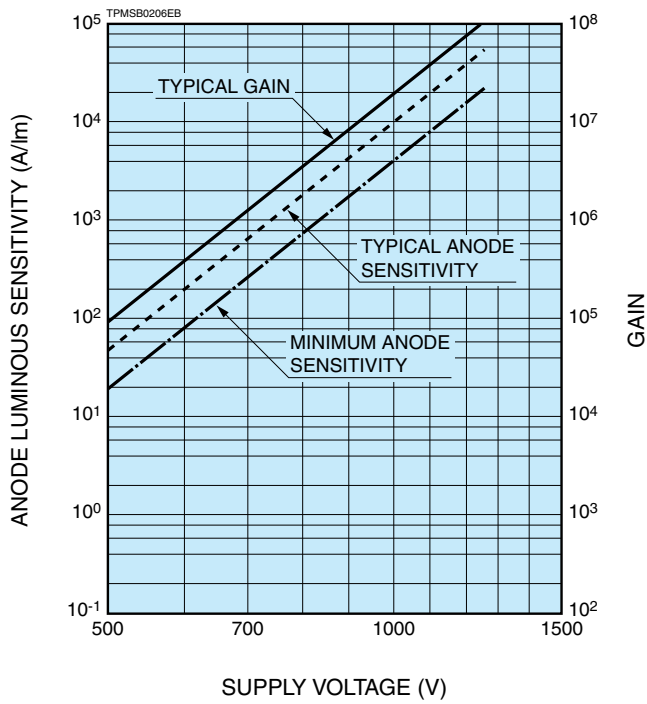


Figure 3: Typical time response

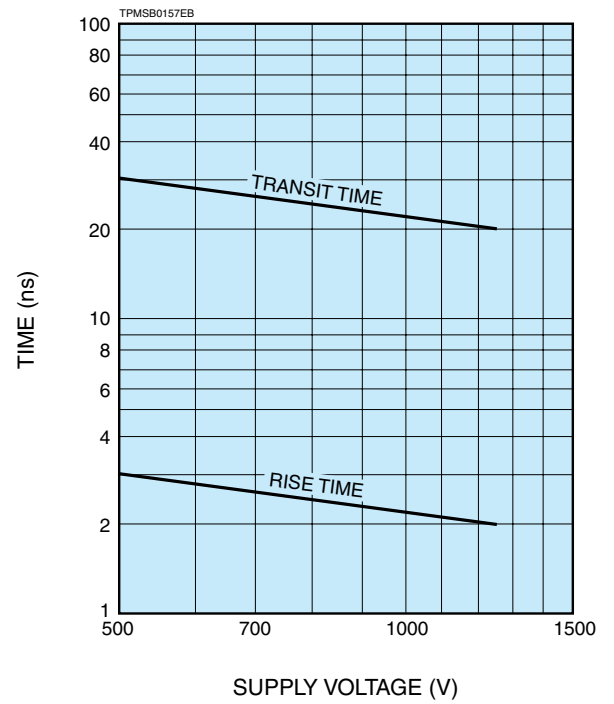
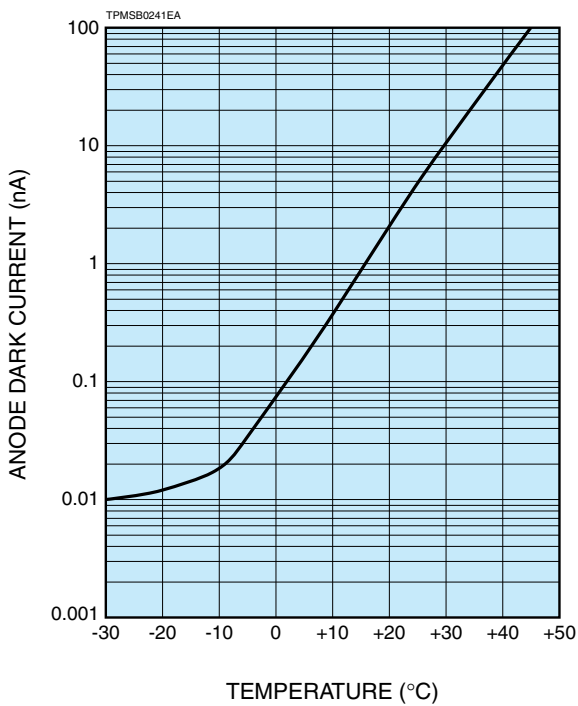
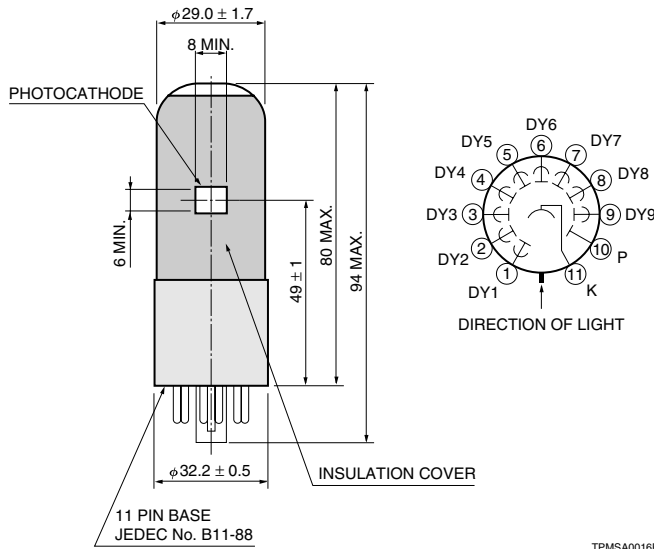


Figure 4: Typical temperature characteristics of dark current (R9110) (at 1000 V, after 30 min storage)



PHOTOMULTIPLIER TUBES R9110, R9110P (For Photon Counting)

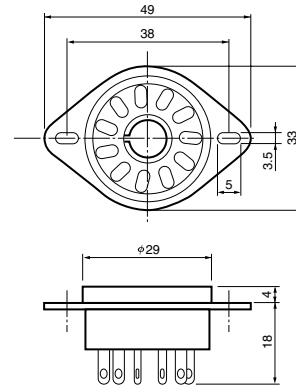
Figure 5: Dimensional outline and basing diagram (Unit: mm)



TPMSA0016EC

Figure 6: Socket (Unit: mm) Sold separately

E678-11A

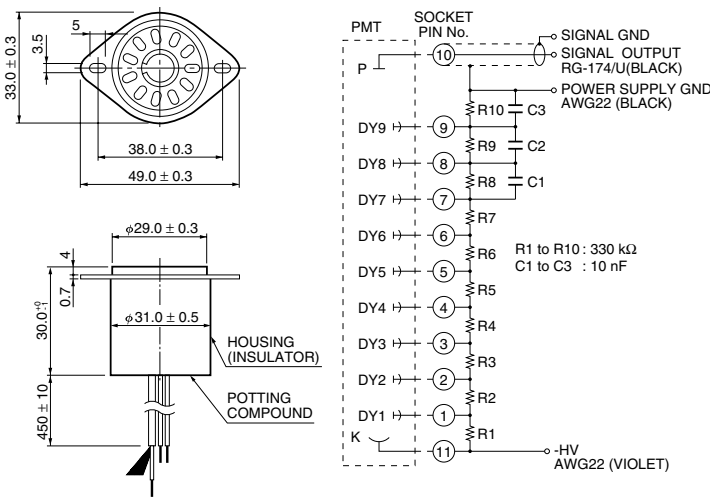


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Figure 7: Accessories (Unit: mm)

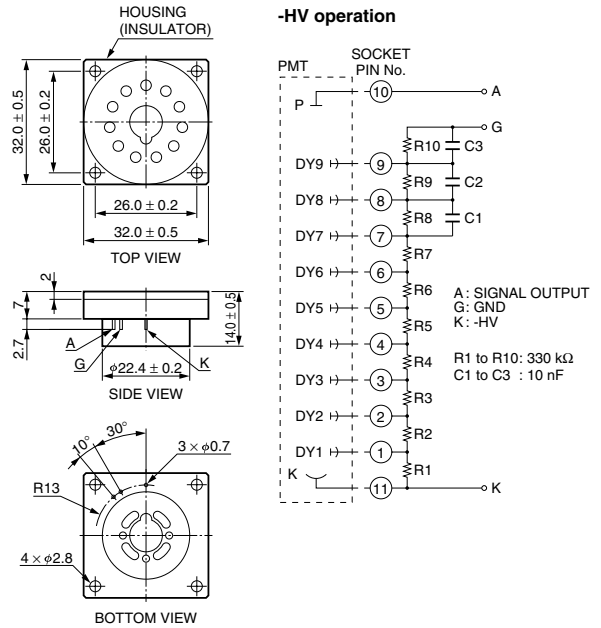
Sold separately

D type socket assembly E717-63



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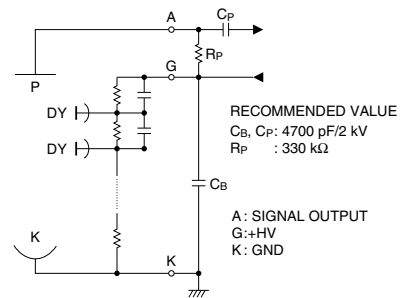
D type socket assembly E717-74



TACCA0277EC

+HV operation

Cb, Cp and Rp must be connected as follows.



TACCA0343EA

* Hamamatsu also provides C4900 series compact high voltage power supplies and C12597-01, C8991 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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