HAMAMATSU

PHOTOMULTIPLIER TUBE R9110

High Sensitivity and Lower Dark Current
Wide Spectral Range with Low ENI, 8 mm × 6 mm Photocathode Size

FEATURES

- **Low Dark Current ..... 5 nA (after 30 minutes)**
- **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 (at 1000 V)**
  - **Luminous ..... 10 000 A/lm**
- **High Signal to Noise Ratio**

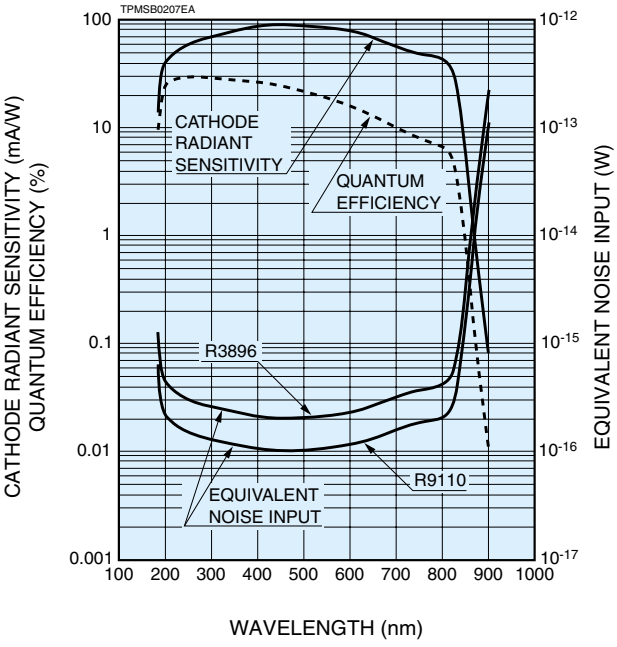
The R9110 is a 28 mm (1-1/8 inch) diameter, 9-stage, side-on type photomultiplier tube having an extended red multialkali photocathode same as the R3896. The R9110 features very low dark current, extremely high quantum efficiency, high gain, good S/N ratio and wide spectral response from UV to near infrared.
The R9110 is directly pin compatible with the R3896.



GENERAL

Parameter		Description/Value	Unit
Spectral Response		185 to 900	nm
Peak Wavelength		450	nm
Photocathode	Material	Multialkali	—
	Minimum Effective Area	8 × 6	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. 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



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MAXIMUM RATINGS (Absolute Maximum Values at 25 °C)

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/W
		at 450 nm	—	90	—	mA/W
		at 633 nm	—	73	—	mA/W
		at 852 nm	—	5.0	—	mA/W
	Red/White Ratio [C]		—	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
Time Response	Anode Pulse Rise Time [G]		—	2.2	—	ns
	Electron Transit Time [H]		—	22	—	ns
	Transit Time Spread (TTS) [I]		—	1.2	—	ns
Anode Current Stability [J]	Light Hysteresis		—	0.1	—	%
	Voltage Hysteresis		—	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 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	

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.

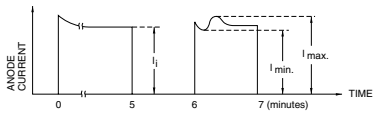
G: The rise time is the time for the output pulse to rise from 10% to 90% of the peak amplitude when the entire photocathode is illuminated by a delta function light pulse.

H: 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.

I: 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

J: 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 volts with an anode current of 1 microampere 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 then reduced to the previous value and the tube is re-illuminated for a minute to measure the variation.

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	

K: Cathode, Dy: Dynode, P: Anode

NOTE: For a high speed pulse measurement, below voltage divider ratio is recommended.

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

Figure 2: Anode Luminous Sensitivity and Gain Characteristics

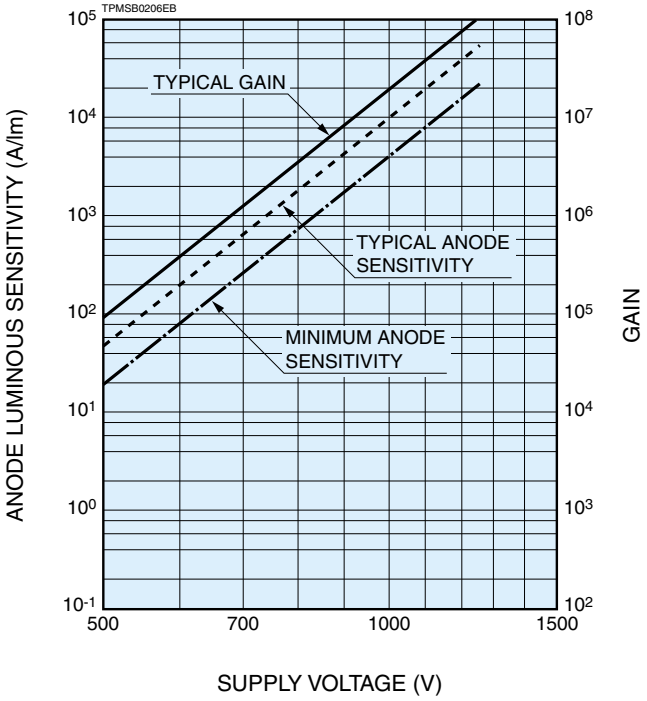


Figure 3: Typical Time Response

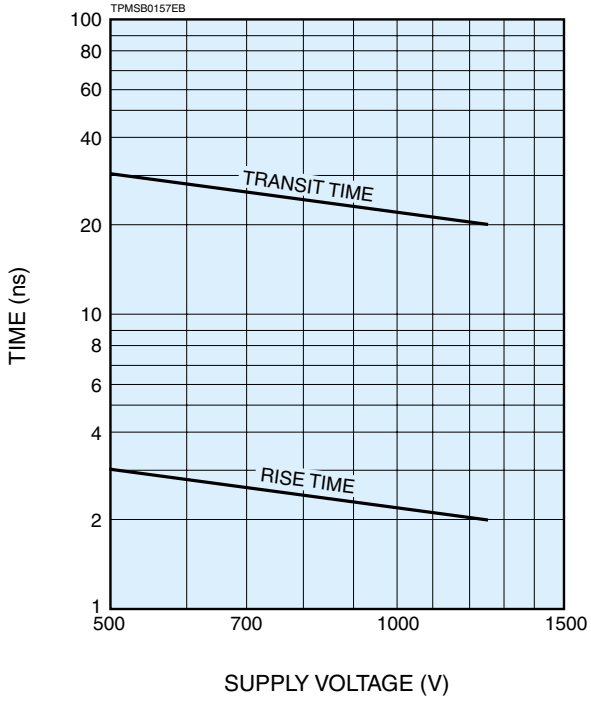
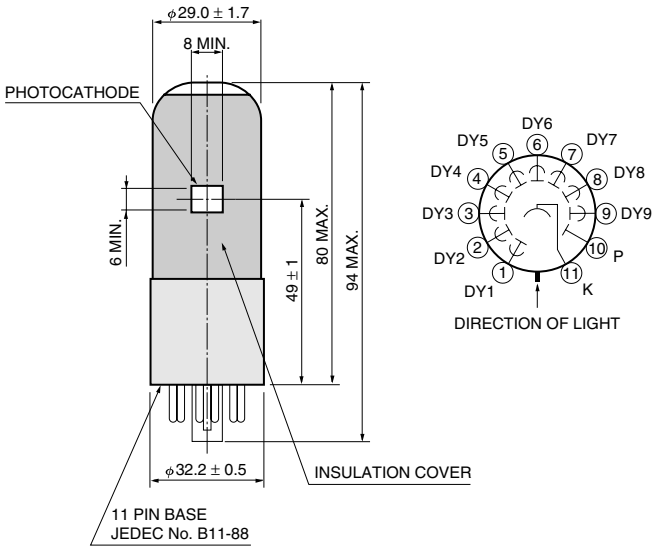


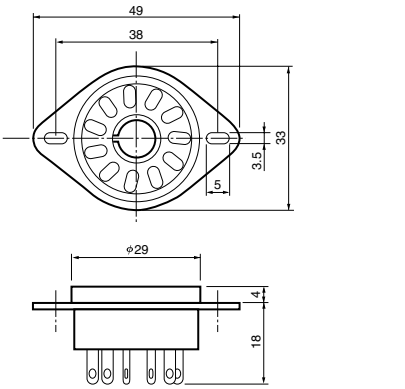
Figure 4: Dimensional Outline and Basing Diagram (Unit: mm)



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Figure 5: Socket (Unit: mm) Sold Separately

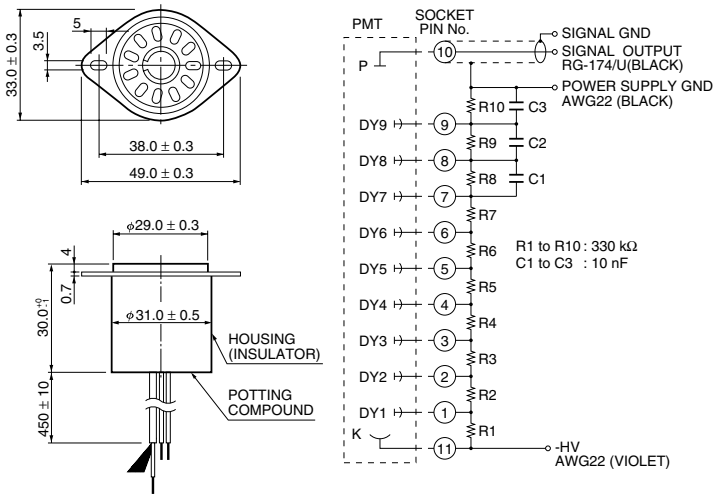
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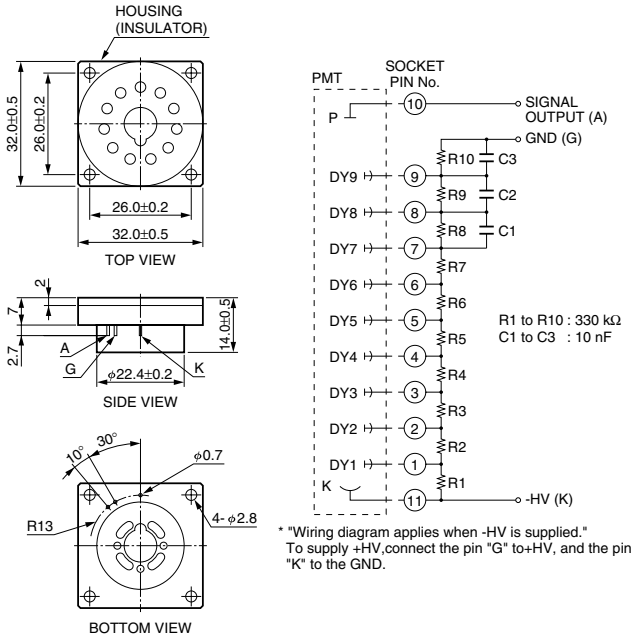
Figure 6: D Type Socket Assembly (Unit: mm) Sold Separately

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

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