HAMAMATSU

PHOTOMULTIPLIER TUBE
R2949
(Low Dark Counts Type of R928)

Modified R928, 8 × 6mm Photocathode Area Size
Low Dark Counts, Extended Red Multialkali, High Sensitivity
For Photon Counting Applications

FEATURES

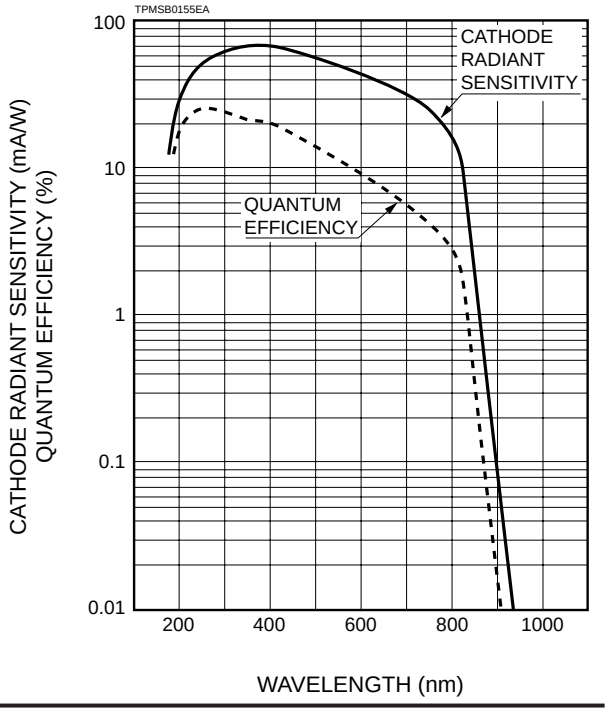
- **Low Dark Counts ..... 300cps (at 25°C)**
- **Low Dark Current ..... 2nA (after 30min.)**
- **Wide Spectral Response ..... 185 to 900 nm**
- **High Cathode Sensitivity**
  - **Luminous 200μA/lm**
  - **Radiant at 400nm 68mA/W**
- **High Anode Sensitivity (at 1000V)**
  - **Luminous 2000A/lm**
  - **Radiant at 400nm ..... 6.8×10^5A/W**
- **Low Drift and Hysteresis**

The R2949 is a 28mm (1-1/8 inch) diameter, 9-stage, side-on type photomultiplier tube having the same extended red multialkali photocathode as the R928. The R2949 features very low dark counts, extremely high quantum efficiency, high gain, good S/N ratio and wide spectral response from UV to near infrared.
The R2949 is well suited for use in various low-level photometries such as general single photon counting applications and fluorescence life time measurement.
The R2949 is directly interchangeable with the R928.

GENERAL

Parameter		Description/Value	Unit
Spectral Response		185 to 900	nm
Wavelength of Maximum Response		400	nm
Photocathode	Material	Multialkali	—
	Minimum Useful Size	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. 45	g
Suitable Socket (Option)		E678-11A	—
Suitable Socket Assembly (Option)		E717-21	—

Figure 1: Typical Spectral Response



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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	Quantum Efficiency	at 255nm	—	25.3	—	%
	Luminous [B]		140	200	—	μA/lm
	Radiant	at 194nm	—	18	—	mA/W
		at 254nm	—	52	—	mA/W
		at 400nm	—	68	—	mA/W
		at 633nm	—	41	—	mA/W
		at 852nm	—	3.5	—	mA/W
	Red/White Ratio [C] with R-68 Filter		0.1	0.3	—	—
	Blue [D]		—	7.5	—	μA/lm-b
Anode Sensitivity	Luminous [E]		1000	2000	—	A/lm
	Radiant	at 194nm	—	1.8×10^5	—	A/W
		at 254nm	—	5.2×10^5	—	A/W
		at 400nm	—	6.8×10^5	—	A/W
		at 633nm	—	4.1×10^5	—	A/W
		at 852nm	—	3.5×10^4	—	A/W
Gain [E]			—	1.0×10^7	—	—
Anode Dark Counts [F]		at +25°C	—	300	500	cps
		at -20°C	—	3	—	cps
Anode Dark Current [F]			—	2	25	nA
ENI (Equivalent Noise Input) [G]			—	1.2×10^{-16}	—	W
Time Response [E]	Anode Pulse Rise Time [H]		—	2.2	—	ns
	Electron Transit Time [J]		—	22	—	ns
Anode Current Stability [K]	Current Hysteresis		—	0.1	—	%
	Voltage Hysteresis		—	1.0	—	%

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 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 anode-to-cathode supply voltage and voltage distribution ratio shown in Table 1.

F: Measured with the same supply voltage and the voltage distribution ratio as Note E after 30 minute storage in the darkness.

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.

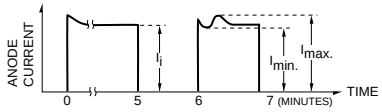
$$ENI = \frac{\sqrt{2q \cdot Idb \cdot G \cdot \Delta f}}{S}$$

where q = Electronic charge (1.60×10^{-19} coulomb)
Idb = Anode dark current (after 30 minute storage) in darkness) 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. Hysteresis is temporary instability in anode current after light and voltage are applied.



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

(1) Current 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 at 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 microampere 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 Sensitivity and Gain Characteristics

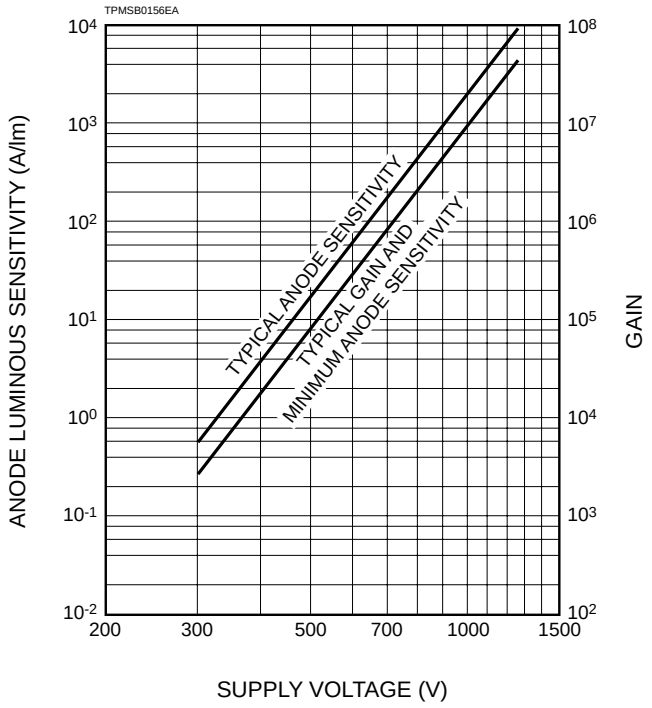


Figure 3: Typical Time Response

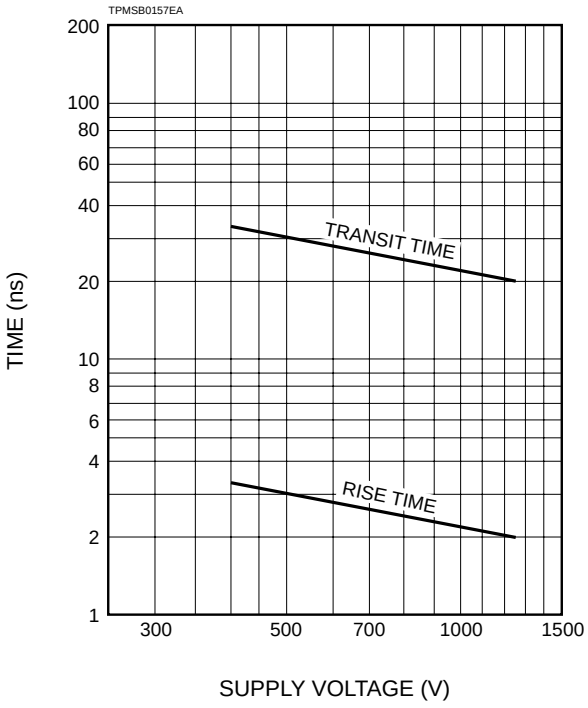


Figure 4: Typical Temperature Coefficient of Anode Sensitivity

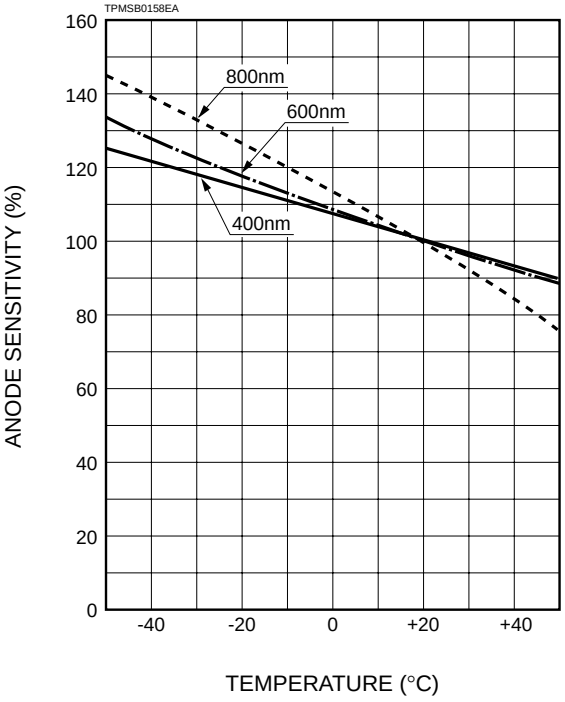


Figure 5: Typical Temperature Characteristic of Dark Counts

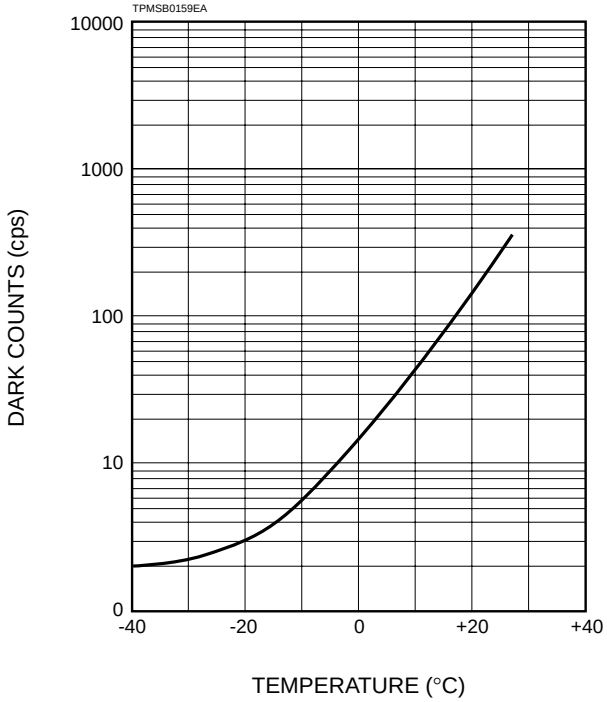


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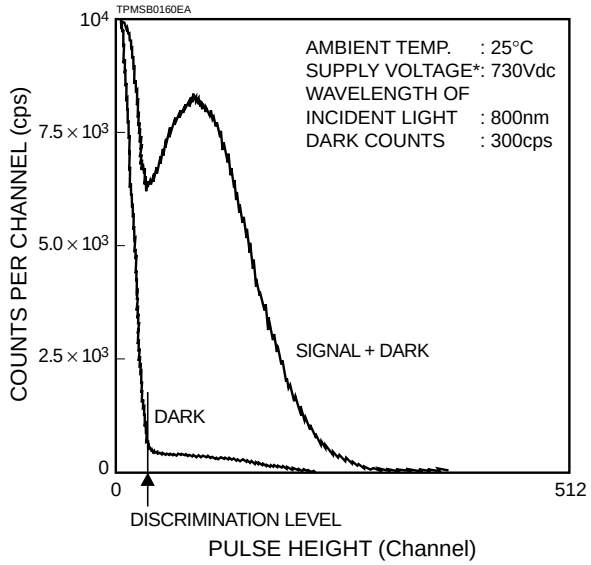
Figure 6: Single Photon Pulse Height Distribution



* The supply voltage is set at gain to be 1×10^6

Figure 7: Dimensional Outline and Basing Diagram (Unit: mm)

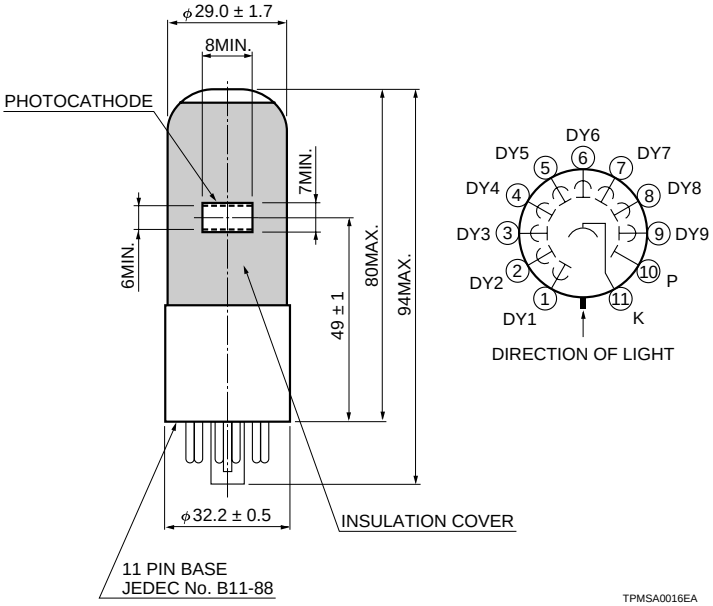
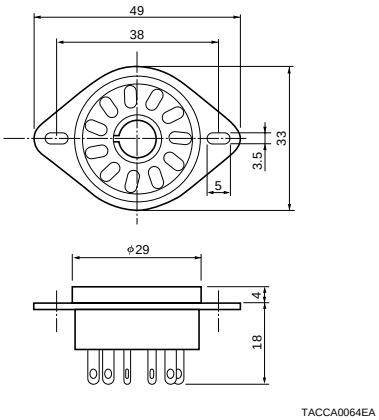


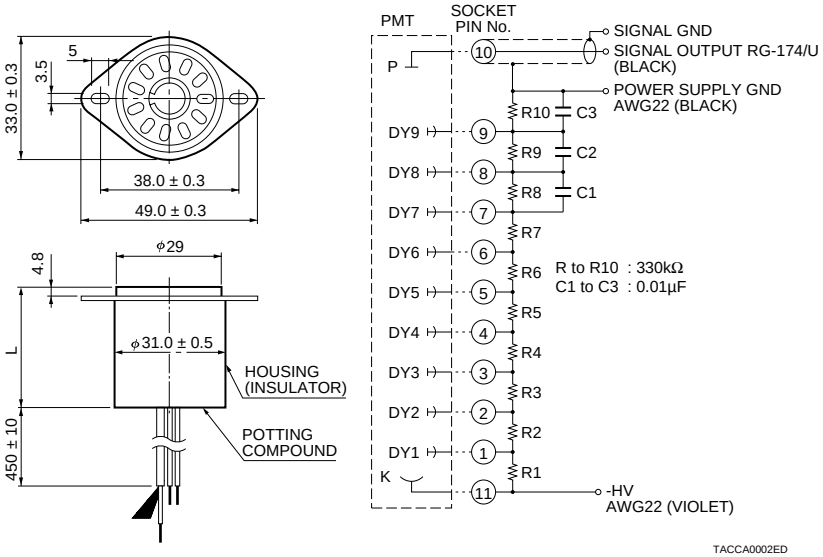
Figure 8: Optional Accessories (Unit: mm)

E678-11A (Socket)



* 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.

D Type Socket Assembly E717-21



Warning-Personal Safety Hazards
Electrical Shock — Operating voltage applied to this device presents shock hazard.

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