HAMAMATSU

PHOTOMULTIPLIER TUBES
R2658
R2658P (For Photon Counting)

High QE in Near IR Region Due to InGaAs (Cs) Photocathode For Spectrophotometers with 185 to 1010 nm range, Fluorescence and Laser Applications and Photon Counting (R2658P) in the Near Infrared Region, etc.

FEATURES

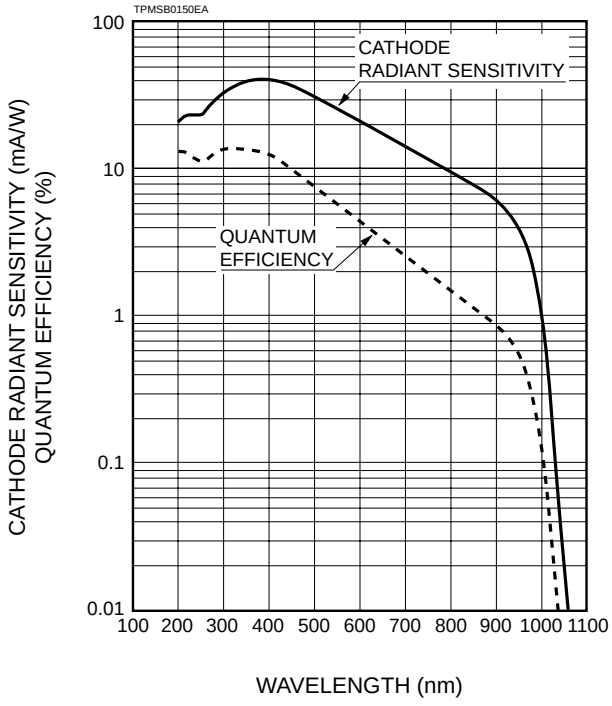
- **High QE in Near IR Region ..... QE 0.13% at 1 μm**
- **Wide Wavelength Range ..... 185 to 1010 nm**
- **Low Dark Current ..... 1 nA at 1250 V (Typ.)**

The R2658 and the R2658P are 28 mm (1-1/8 inch) diameter side-on photomultiplier tubes using a newly developed InGaAs semiconductor photocathode.
The InGaAs photocathode is sensitive from UV to near IR radiations (as long as over 1010 nm) longer than wavelength limit of GaAs photocathode, and yet offers low dark current. The dark current is 2 orders lower than the commercial S-1 photocathode. Therefore, they are well suited for low light detection in the near IR region including fluorescence lifetime measurements. Time response, gain, and dimensions are identical with the conventional 28 mm (1-1/8 inch) diameter side-on tubes with a GaAs photocathode.
The R2658P is a photon counting version of the R2658 with low dark counts.

GENERAL

Parameter		Description/Value	Unit
Spectral Response		185 to 1010	nm
Wavelength of Maximum Response		400	nm
Photocathode	Material	InGaAs (Cs)	—
	Minimum Effective Area	3 × 12	mm
Window Material		UV glass	—
Dynode	Secondary Emitting Surface	Cu-BeO	—
	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)		E717-63	—

Figure 1: Typical Spectral Response



PHOTOMULTIPLIER TUBES R2658, R2658P

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1500	Vdc
	Between Anode and Last Dynode	250	Vdc
Average Anode Current [A]		1	µA
Ambient Temperature		-80 to +50	°C

CHARACTERISTICS (at 25°C)

Parameter			Min.	Typ.	Max.	Unit
Cathode Sensitivity	Quantum Efficiency	at 330 nm	—	14	—	%
		at 1000 nm	0.02	0.13	—	%
	Luminous [B]		50	100	—	µA/lm
	Radiant	at 194 nm	—	20	—	mA/W
		at 254 nm	—	23	—	mA/W
		at 400 nm	—	40	—	mA/W
		at 633 nm	—	19	—	mA/W
		at 852 nm	—	7.6	—	mA/W
		at 1000 nm	0.16	1	—	mA/W
	Red/White Ratio [C]		0.25	0.4	—	—
Anode Sensitivity	Luminous [D]		5	16	—	A/lm
	Radiant	at 194 nm	—	3.2×10^3	—	A/W
		at 254 nm	—	3.7×10^3	—	A/W
		at 400 nm	—	6.4×10^3	—	A/W
		at 633 nm	—	3.0×10^3	—	A/W
		at 852 nm	—	1.2×10^3	—	A/W
		at 1000 nm	—	1.6×10^2	—	A/W
Gain [D]			—	1.6×10^5	—	—
Anode Dark Current [E] After 30 minute storage in the darkness			—	1	10	nA
Anode Dark Count (for the R2658P) [F]			—	50	300	s^{-1}(cps)
ENI (Equivalent Noise Input) [G]			—	1.1×10^{-15}	—	W
Time Response [D]	Anode Pulse Rise Time [H]		—	2.0	—	ns
	Electron Transit Time [J]		—	20	—	ns
Anode Current Stability [K]	Current Hysteresis		—	2	—	%
	Voltage Hysteresis		—	2	—	%

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 2856 K. 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 condition as Note B.

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

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

F: Measured at the voltage producing the gain of 1×10^6 and the voltage distribution ratio shown in table 1 below. The photocathode is cooled at -20 °C.

G: ENI is an indication of the photo-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. Hysteresis is temporary instability in anode current after light and voltage are applied.

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= 1250 Vdc
K: Cathode, Dy: Dynode, P: Anode

Figure 2: Anode Luminous Sensitivity and Gain Characteristics

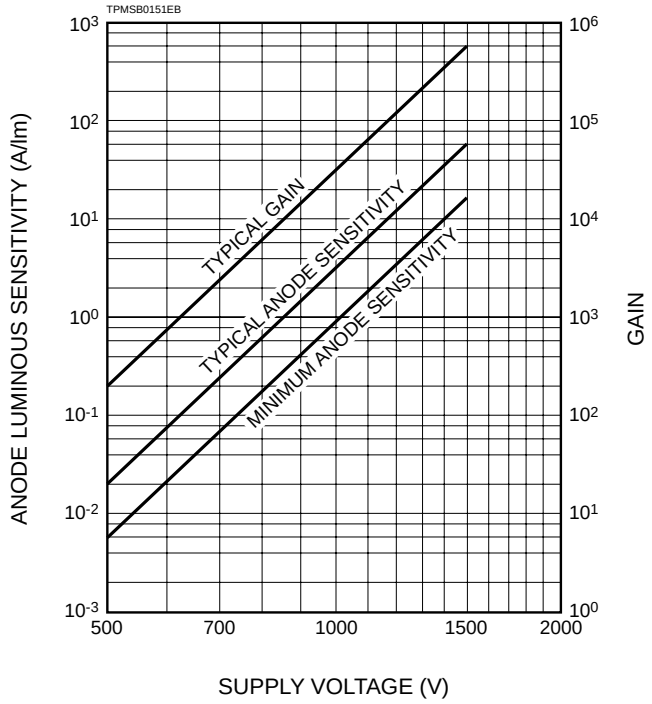


Figure 3: Typical Time Response

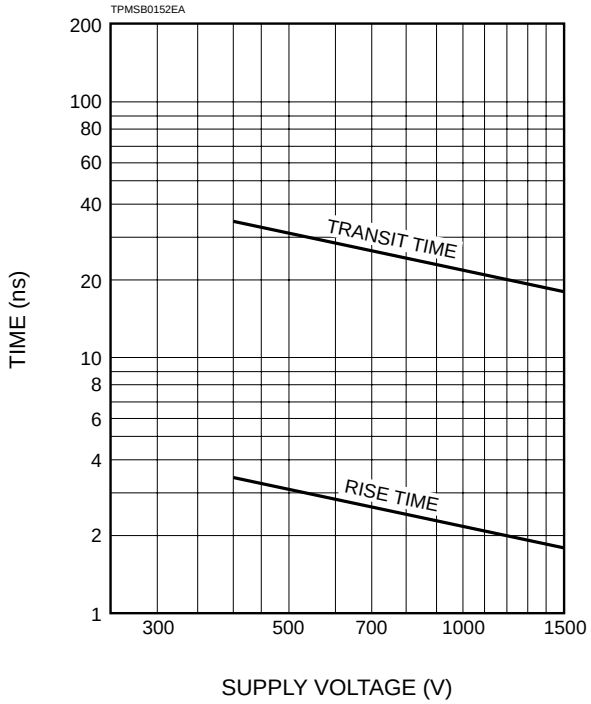


Figure 4: Temperature Coefficient

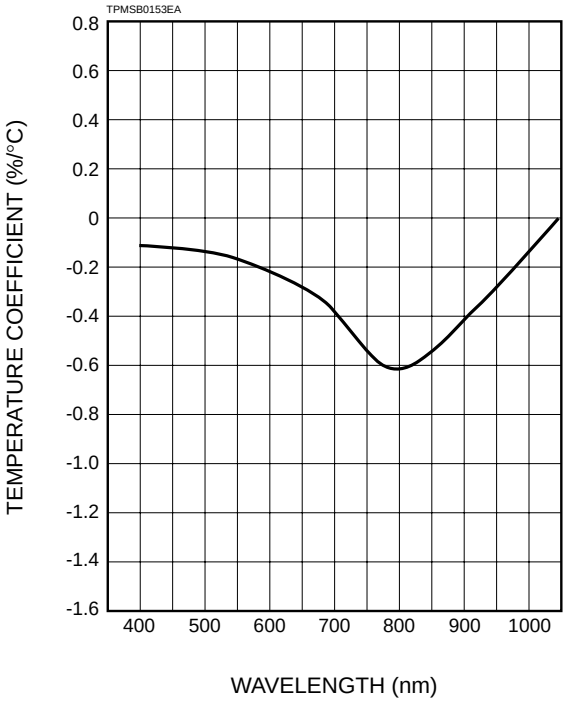


Figure 5: Typical Temperature Characteristic of Dark Current and Dark Count (R2658P)

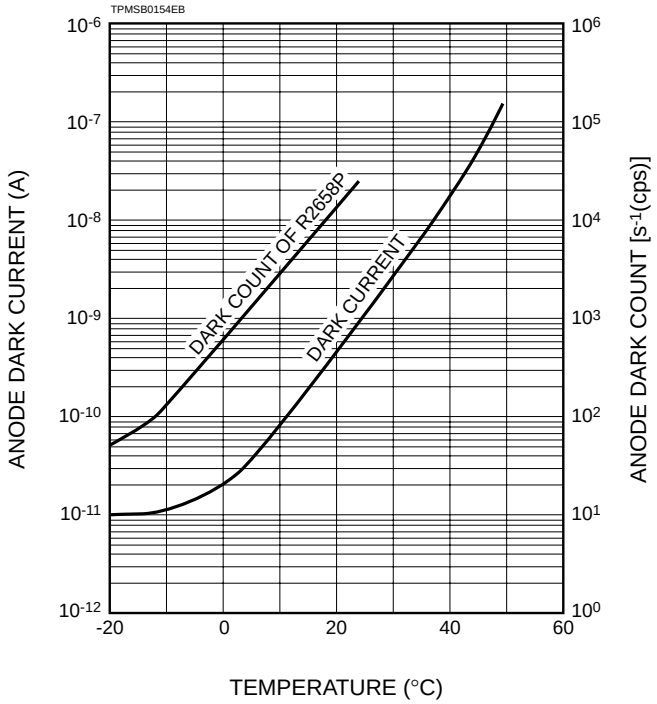


Figure 6: Dimensional Outline and Basing Diagram (Unit: mm)

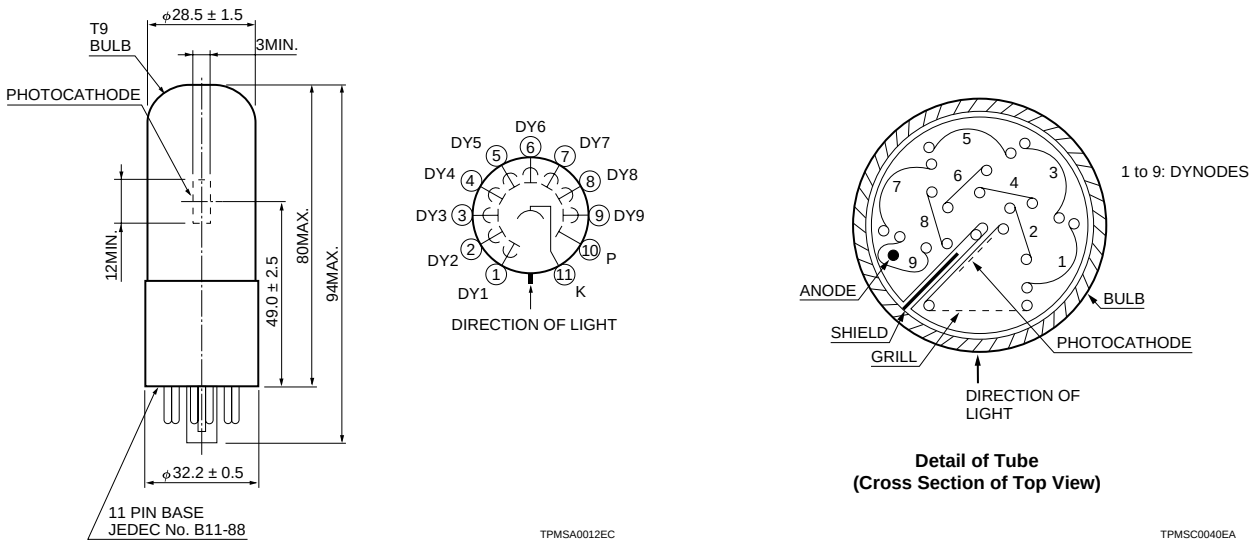
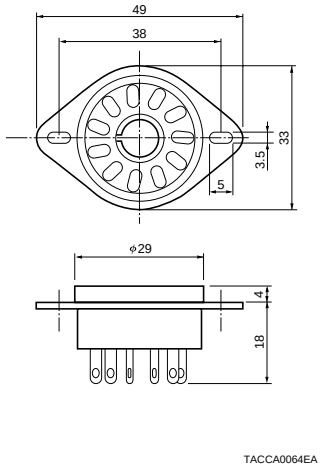
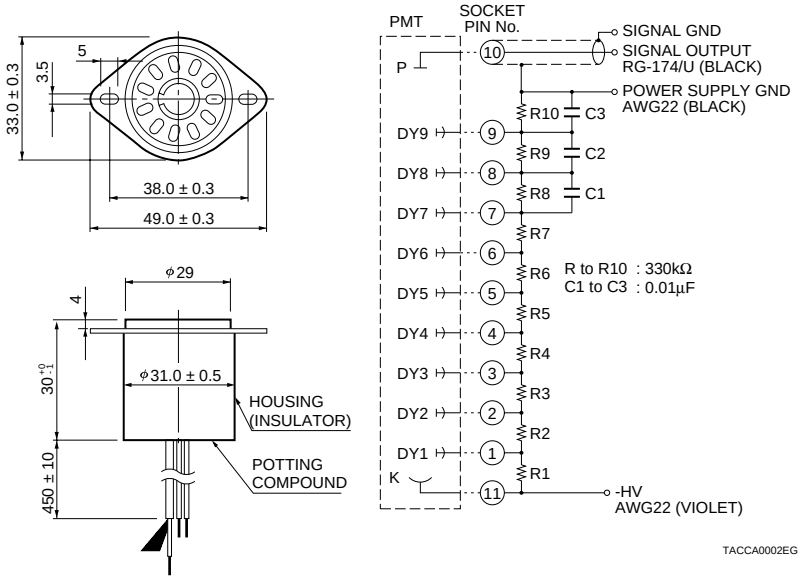


Figure 7: Optional Accessories (Unit: mm)

(a) E678-11A (Socket)



(a) E717-63 (Socket Assembly)



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

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