HAMAMATSU

TECHNICAL DATA

PHOTOMULTIPLIER TUBES R3318, R3318-01

Low Profile Photomultiplier Tubes For Scintillation Counting, Especially For Gamma Camera Square-shaped (2"x2") Envelope, High Space Efficiency Bialkali Photocathode, 10-stages, Head-On Type

FEATURES

	Typical Values
● High Quantum Efficiency (at 420 nm)	27 %
● High Pulse Height Resolution	
with ^{137}Cs Radiation Source	6.7 %
with ^{57}Co Radiation Source	8.8 %
● High Stability	
Anode Current Drift (D.C.Output)	3 %
Long Term (MGD) (For 16 hours at 1000 cps)	0.5%
Short Term (From 10000 cps to 1000 cps)	0.5%

GENERAL

Spectral Response	300 to 650 nm (see Fig. 1)
Wavelength of Maximum Response	420 ± 30 nm
Photocathode Material	Bialkali
Window	
Material	Borosilicate glass
Index of Refraction at 420 nm	1.500 ± 0.001
Faceplate Flatness	Less than ± 50 µm
Shape	Plano-plano
Dynode	
Secondary Emitting Surface	Bialkali
Structure	Box and grid/mesh combination
Number of Stages	10
Direct Interelectrode Capacitances (approx)	
Anode to Dynode No.10	5.0 pF
Anode to All Other Electrodes	12.0 pF
Socket	Hamamatsu E678-14A (Option)

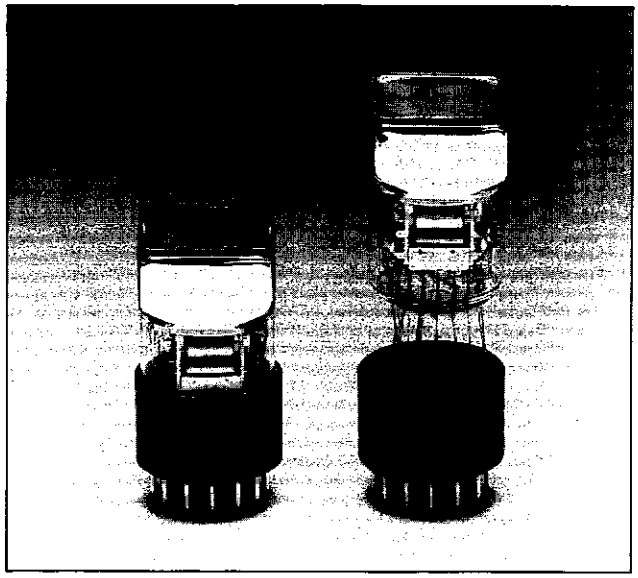
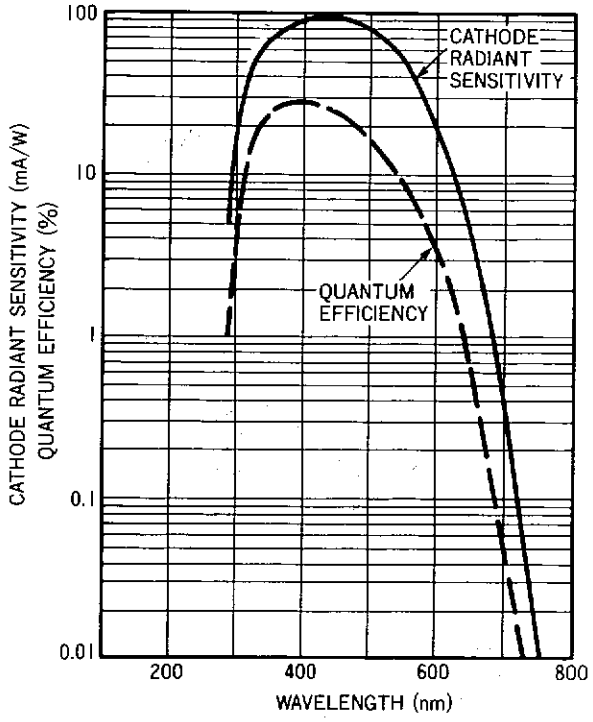


Figure 1: Typical Spectral Response



MAXIMUM RATINGS (Absolute Maximum Values)

Supply Voltage	
Between Anode and Cathode	1500 Vdc
Between Anode and Last Dynode	250 Vdc
Average Anode Current [A]	0.1 mA
Average Cathode Current [A]	50 nA
Ambient Temperature	−80°C to +50°C

CHARACTERISTICS (at 25°C)

	Min.	Typ.	Max.	Units
Cathode Sensitivity				
Quantum Efficiency at 420 nm	—	27	—	%
Luminous [B]	80	100	—	μA/*lm*
Blue [C]	10.0	11.5	—	μA/*lm*-b
Anode Sensitivity				
Luminous [D]	3	30	—	A/*lm*
Blue [E]	—	3.5	—	A/*lm*-b
Current Amplification [D]	—	3×10^5	—	—
Anode Dark Current [F]	—	2	20	nA
Time Response [D]				
Anode Pulse Rise Time [G]	—	4.8	—	ns
Electron Transit Time [H]	—	45	—	ns
Transit Time Spread [J]	—	5.8	—	ns
Pulse Height Resolution [K]				
with ^{137}Cs	—	6.7	—	%
with ^{57}Co	—	8.8	—	%
Stability				
Anode Current Drift (DC Output) [L]	—	3	—	%
Long Term (MGD) [M]	—	0.5	—	%
Short Term [M]	—	0.5	—	%

Table 1: Voltage Distribution Ratio

Electrode	K	G	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	Dy10	P
Distribution ratio	1	1	1	1	1	1	1	1	1	1	1		1

Supply Voltage: 1000 Vdc K: Cathode G: Grid Dy: Dynode P: Anode

NOTES

A. Averaged over any interval of 30 seconds maximum and the whole photocathode is illuminated.

B. The light source is a tungsten filament lamp operated at a distribution temperature of 2856K. The light input is 0.01 *lm* and 150 volts are applied between the cathode and all other electrodes connected together as anode.

C. The value is cathode output current when a blue filter (Corning CS No. 5-58 polished to 1/2 stock thickness) is interposed between the light source and the tube under the same condition as Note B.

D. Measured with the same light source as Note B and the light input is 0.1μ*lm*. The anode-to-cathode supply voltage and voltage distribution ratio are shown in Table 1.

E. The value is anode output current when a blue filter (Corning CS No. 5-58 polished to 1/2 stock thickness) is interposed between the light source and the tube under the same condition as Note D.

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

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 a delta function light pulse at the entrance window of the tube and the time the output pulse reaches the peak amplitude. In measurement the entire photocathode is illuminated.

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

K. The pulse height resolution is measured with an NaI(Tl) scintillator (2" diameter x 2" thickness manufactured by Bicron type 2R2P or Harshaw Chemical BV type 8D8) and with the same supply voltage and voltage distribution ratio as Note D.

L. The change in anode current for a period of 1 hour after warm-up of 10 minutes with an initial anode current of 100μA.

M. A ^{137}Cs source and an NaI(Tl) scintillator on Note K are used to measure the pulse height resolution. The tube is allowed to warm up for 1 hour.

1) Long term (Mean gain deviation)
This is defined as follows when the tube is operated for 16 hours at a constant count rate of 1000 cps.

$$Dg = \frac{\sum_{i=1}^{n} |P\text{-}Pi|}{n} \cdot \frac{100}{P}(\%)$$

Where P is the mean pulse height averaged over n readings, P*i* is the pulse height at the *i*-th reading, and n is the total number of readings.

2) Short term
This is gain shift with count rate. The tube is first operated at about 10000 cps. The photo-peak count rate is then decreased to approximately 1000 cps by increasing the distance between the ^{137}Cs source and scintillator coupled to the tube.

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

Figure 2: Anode Sensitivity and Amplification Characteristics

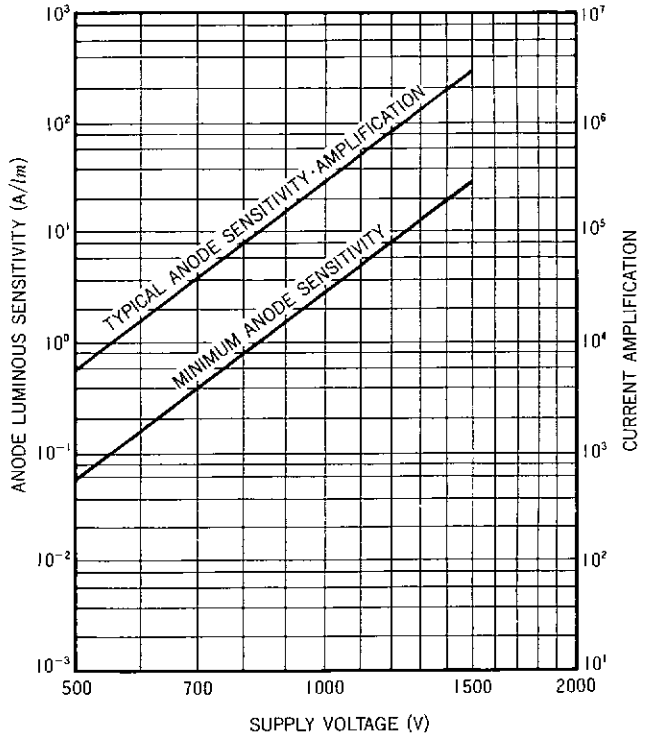


Figure 3: Typical Time Response

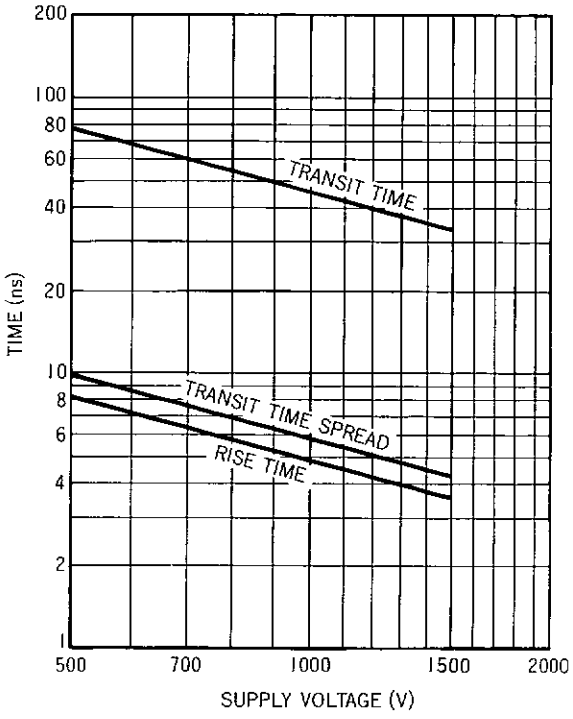


Figure 4: Typical Temperature Coefficient of Anode Current

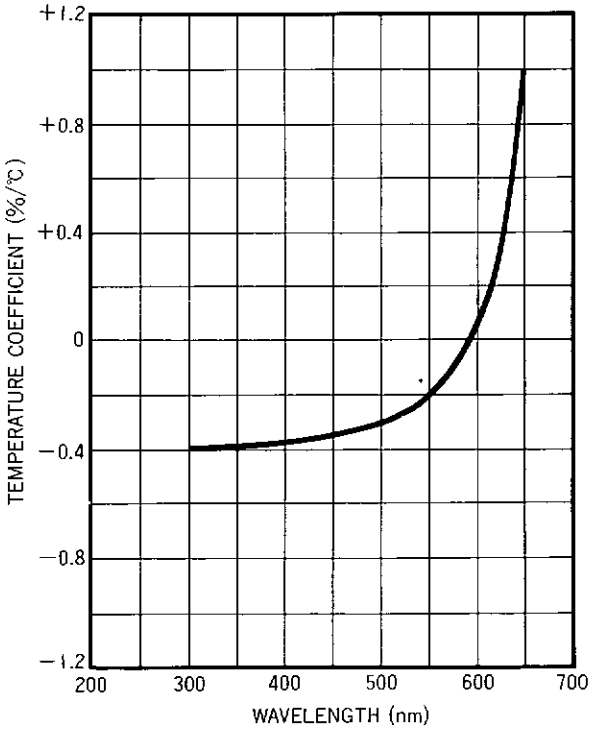
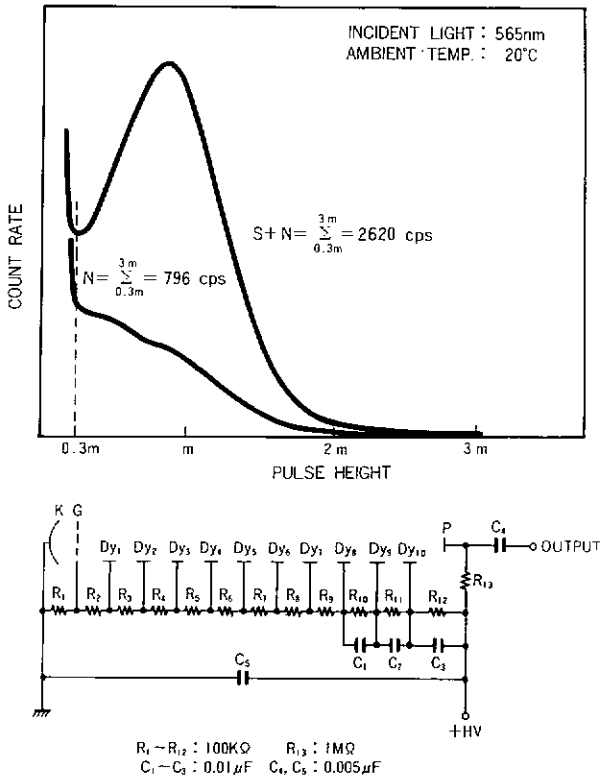


Figure 5: Example of Single Photoelectron Pulse Height Distribution



"m" is determined to satisfy the following equation.

$$\sum_{0.3m}^{m} (\text{count rate}) = \sum_{m}^{3m} (\text{count rate})$$

Figure 6: Typical Temperature Characteristics of Pulse Height Using ^{57}Co and 2" dia. NaI (Tl)

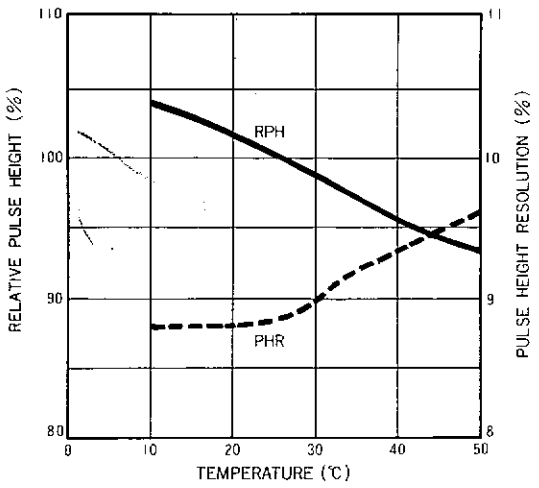


Figure 7: Typical Temperature Characteristics of Dark Current

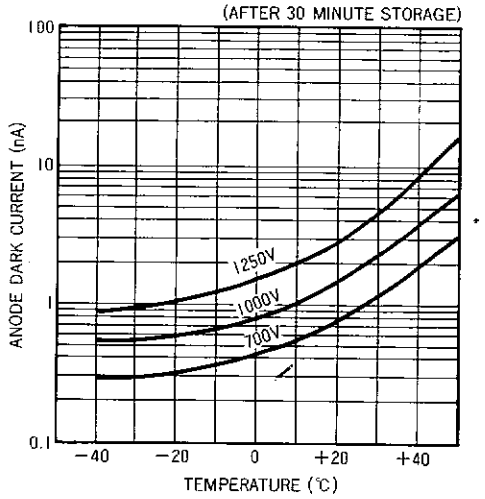


Figure 8: Typical Effect by Magnetic Fields

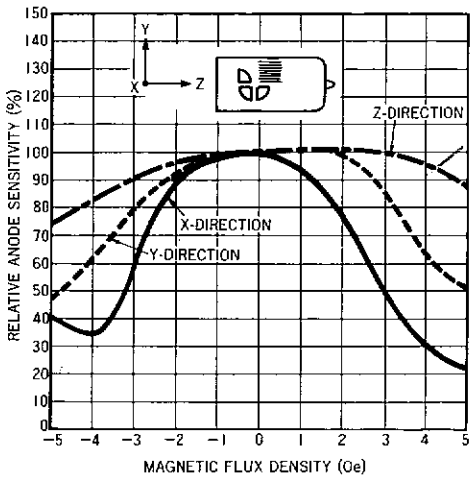


Figure 9: Dimensional Outlines (Unit: mm)

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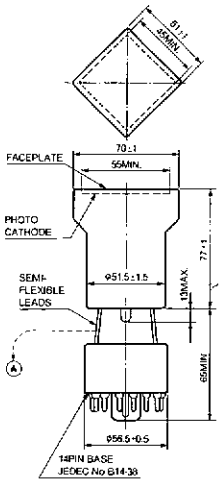
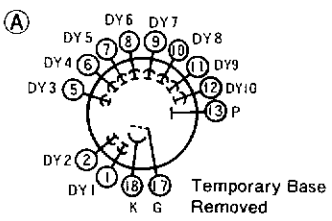
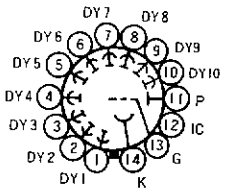


Basing Diagram (Bottom View)





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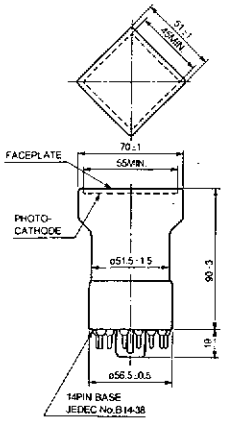


Basing Diagram (Bottom View)

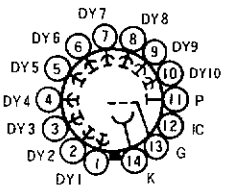
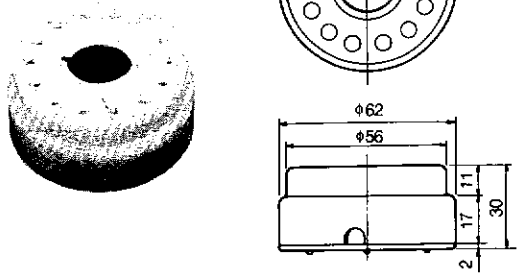


Figure 10: Socket (Unit: mm)

E678-14A (Option)



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