HAMAMATSU

PHOTOMULTIPLIER TUBES
R3310-02, R4330-02

InGaAs (Cs) Photocathode, Wide Spectral Response, 51mm (2") Dia., Head-on Type For Photon Counting : Low Dark Counts, Excellent P.H.D.

■ APPLICATIONS

- Raman Spectroscopy
- Fluorescent Spectroscopy
- Astrophysical Measurement
- Laser Detection

■ FEATURES

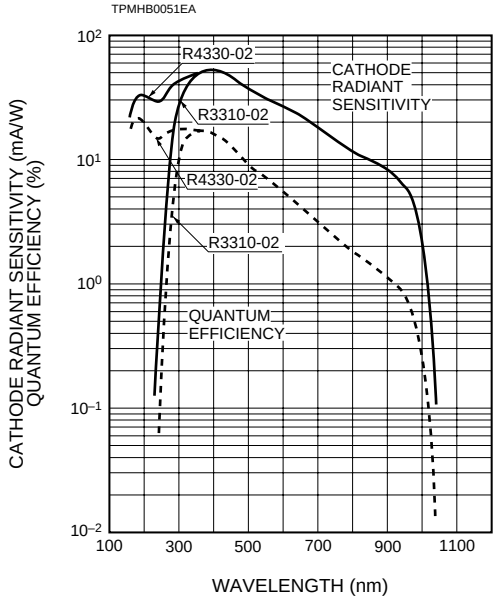
Wide Spectral Response
R3310-02 ..... 300 to 1040nm
R4330-02 .....160 to 1040nm
High Quantum Efficiency in IR ..... 0.25% at 1μm
Fast Rise Time ..... 3.0ns at 1500V
Excellent Single Photoelectron Pulse Height Distribution
..... Peak to Valley Ratio 2.3 (at –20℃)
Low Dark Counts ..... 30cps Typ. (at –20℃)

Hamamatsu R3310-02 and R4330-02 are 51mm (2") diameter head-on type photomultiplier tubes having InGaAs (Cs) photocathodes, and linear focused CuBeO dynodes. The InGaAs (Cs) photocathode allows high sensitivity over a wide spectral range up to 1040nm.
The R3310-02 and the R4330-02 are selected for photon counting, and they feature low dark counts and excellent pulse height distribution (PHD) of single photoelectrons.

■ GENERAL

Parameter		Description/Value	Unit
Spectral Response			
R3310-02		300 to 1040	nm
R4330-02		160 to 1040	nm
Wavelength of Maximum Response		400	nm
Photocathode			
Material		InGaAs(Cs)	—
Minimum Effective Area		10×10	mm
Mode		Opaque	—
Window Material			
R3310-02		Borosilicate glass (K-free)	—
R4330-02		Synthetic silica glass	—
Dynode			
Secondary Emitting Surface		Cu-BeO	—
Structure		Linear Focused	—
Number of Stages		10	—
Direct Interelectrode Capacitances			
Anode to Last Dynode		Approx. 2	pF
Anode to All Other Electrodes		Approx. 3	pF
Base		21-pin Base	—
Suitable Socket		E678–21C (Supplied) E678–21D (Option)	—
Weight	R3310-02	110	g
	R4330-02	93	g

Figure 1: Typical Spectral Response



PHOTOMULTIPLIER TUBES R3310-02, R4330-02

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter	Value	Unit
Supply Voltage		
Between Anode and Cathode	2200	Vdc
Between Anode and Last Dynode	250	Vdc
Average Anode Current Ⓐ	1	μA
Average Pulse Count Rate Ⓑ	6×10^6	cps
Average Cathode Current Ⓒ	10	pA
Ambient Temperature Ⓓ	–80 to +50	℃

CHARACTERISTICS (at 25℃)

Parameter	Min.	Typ.	Max.	Unit
Cathode Sensitivity Ⓔ				
Quantum Efficiency				
at 253.7nm (Hg-Line) R4330 Series	—	15	—	%
at 1000nm	0.13	0.25	—	%
Luminous Ⓕ	80	150	—	μA/lm
Radiant at 253.7nm (Hg-Line) R4330 Series	—	30	—	mA/W
at 852.1nm (Cs-Line)	—	9.4	—	mA/W
at 900nm	—	8.1	—	mA/W
at 1000nm	1.1	2	—	mA/W
Red/White Ratio Ⓖ	—	0.4	—	—
Anode Sensitivity Ⓗ				
Luminous Ⓕ	15	50	—	A/lm
Radiant at 253.7nm (Hg-Line) R4330 Series	—	1.0×10^4	—	A/W
at 852.1nm (Cs-Line)	—	3.1×10^3	—	A/W
at 900nm	—	2.7×10^3	—	A/W
at 1000nm	—	6.6×10^2	—	A/W
Gain Ⓗ	—	3.3×10^5	—	—
Equivalent Anode Dark Current Ⓙ	—	5	20	nA
Anode Dark Current Ⓚ	—	30	150	cps
Single Photoelectron PHD (Peak to Valley Ratio)	—	2.3	—	—
Time Response Ⓗ				
Anode Pulse Rise Time Ⓛ	—	3.0	—	ns
Electron Transit Time Ⓜ	—	23	—	ns

NOTES

Ⓐ Averaged over any interval of 30 seconds maximum.

Ⓑ Measured at single photoelectron level. The discriminator level is set at valley point.

Ⓒ In practical operation, the cathode current should be lower than 2pA to prevent shortening the life of the photocathode.

Ⓓ For cooling operation, another ceramic socket, type number E678-21D is recommended, because the teflon socket type number E678-21C supplied with the tube is not suitable for cooling operation due to its high thermal expansion coefficient. Alternatively, it is recommended to solder a resistor, capacitor, etc. directly on stem pins using a socket contact (100-2520S) supplied by Winchester.

Ⓔ Supply voltage is 150 volts between the cathode and all other electrodes.

Ⓕ The light source is a tungsten filament lamp operated at a distribution temperature of 2856K.

Ⓖ The quotient of the cathode sensitivity measured with the light source is the same as Note Ⓔ passing through a red filter (Toshiba R-68) divided by the cathode luminous sensitivity without the red filter.

Ⓗ Measured with supply voltage and voltage distribution ratio in Table 1.

Ⓙ Measured with supply voltage to provide the anode luminous sensitivity of 40 (A/lm) and the voltage distribution ratio in Table 1 after 30 minutes storage in the darkness.

Ⓚ Measured with supply voltage that gives 2×10^6 gain and with the voltage distribution ratio shown in Table 1 after one hour storage in the cooler set at –20℃. The discriminator is set at 1/3 of a single photoelectron level.

Ⓛ The rise time is the time it takes 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.

Ⓜ 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 when the output pulse reaches the peak amplitude. In measurement the entire photocathode is illuminated.

Warning–Personal Safety Hazards
Electrical Shock — Operating voltages applied to this device present a shock hazard.

Table 1:Voltage Distribution Ratio

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	Dy10	P
Distribution Ratio	3	1.5	1	1	1	1	1	1	1	1	1	

Supply Voltage : 1500Vdc, K : Cathode, Dy : Dynode, P : Anode

Figure 2: Typical Single Photoelectron Pulse Height Distribution

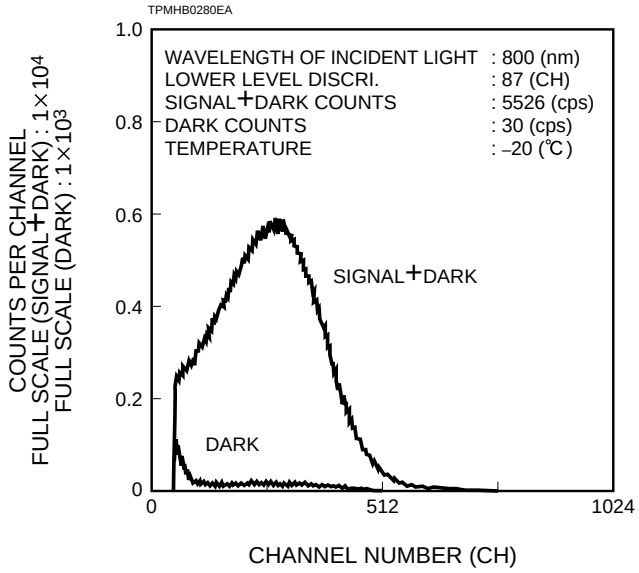


Figure 3: Typical Gain

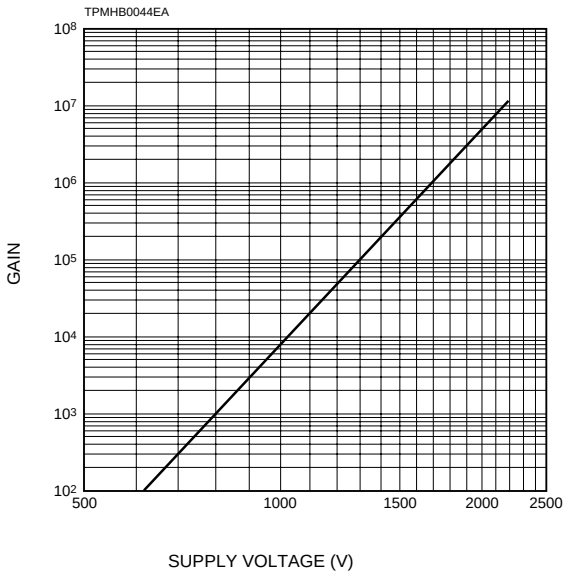


Figure 4: Typical Time Response

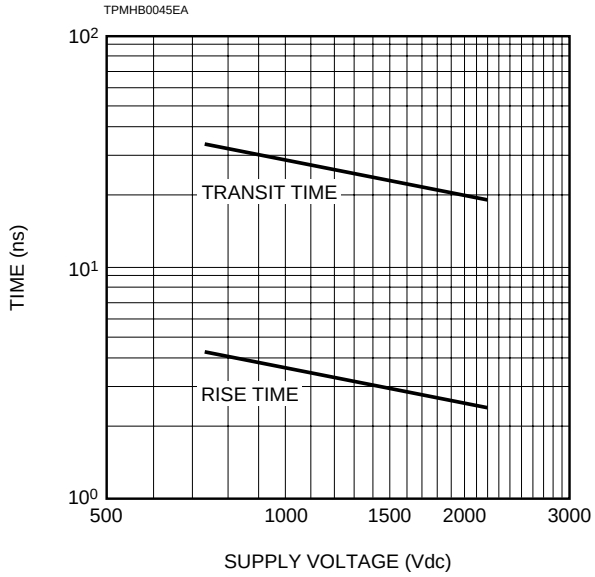


Figure 5: Typical Temperature Coefficient of Quantum Efficiency

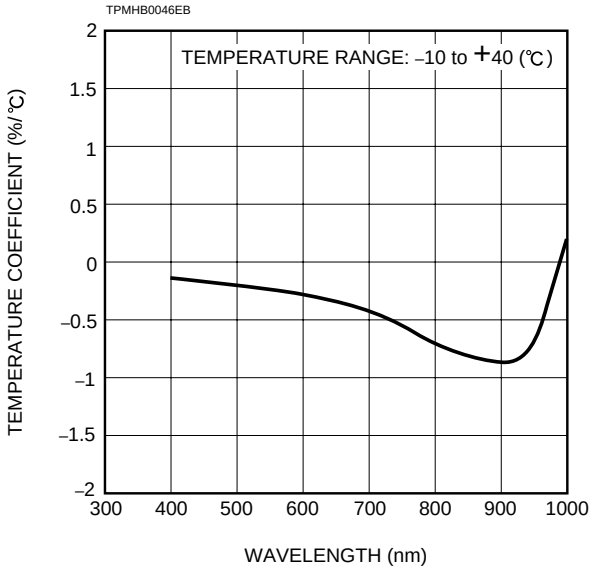
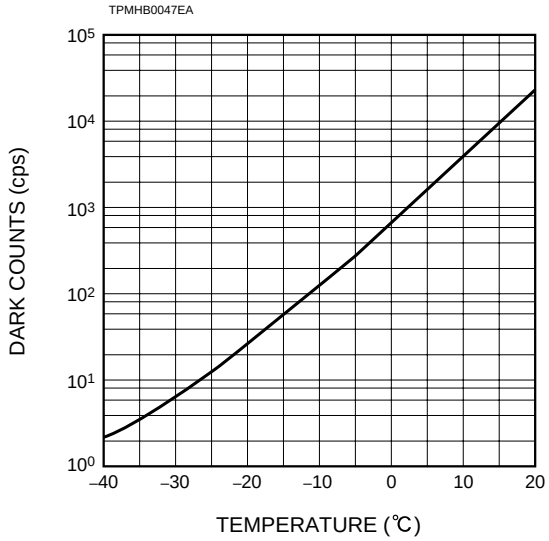


Figure 6: Typical Dark Counts vs. Temperature

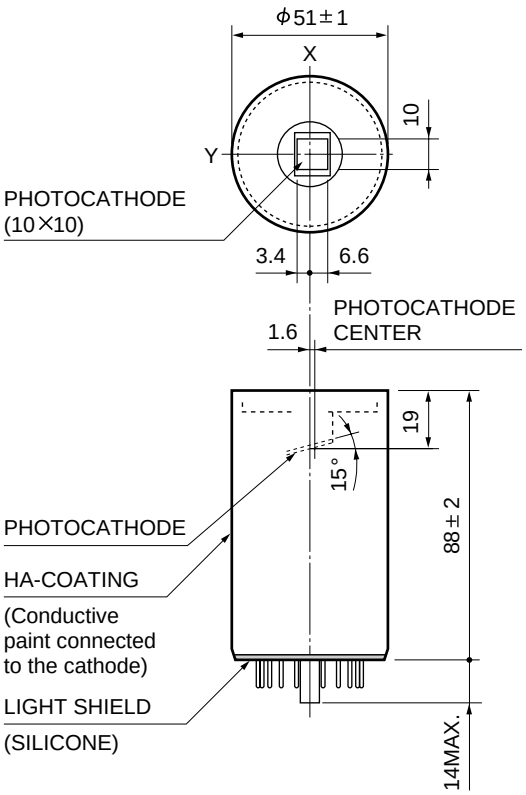


COOLING

As Figure 6 shows, the dark counts of the R3310-02 and R4330-02 decreases by cooling the tube. Therefore, when performing photon counting, it is recommended that the tube be cooled down to about –20℃. The cooler C2761 which features temperature control from –30℃ to 0℃ is available from HAMAMATSU.

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

a) TUBE



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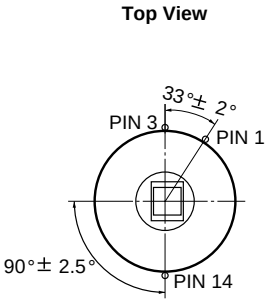
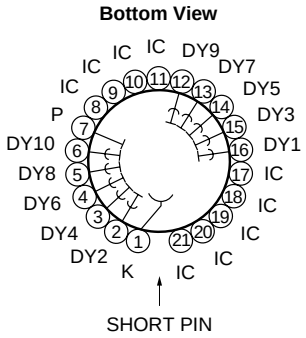
Orientation of Photocathode with Respect to Base pin





Dy : Dynode
K : Photocathode
P : Anode
IC : Internal Connection
(should not be used)

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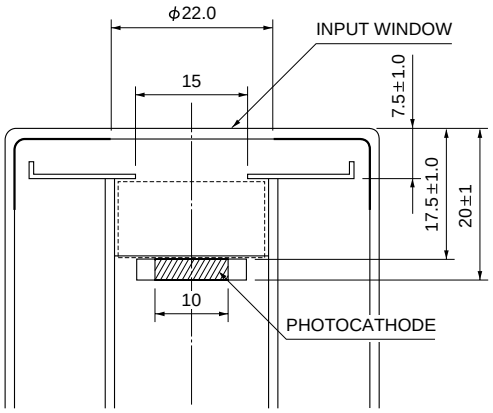
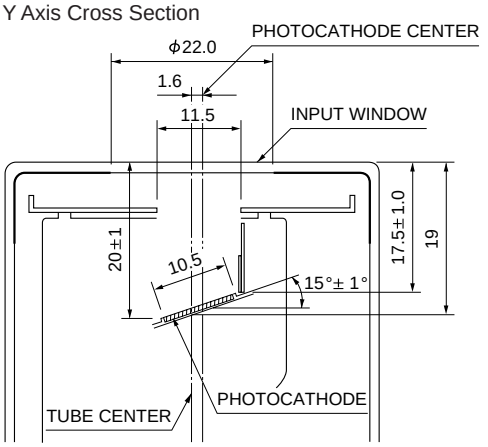
b) PHOTOCATHODE

X Axis Cross Section



Y Axis Cross Section



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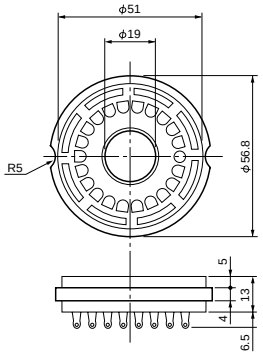
c) SOCKET(Refer to NOTES Ⓓ)

E678–21C (SUPPLIED)



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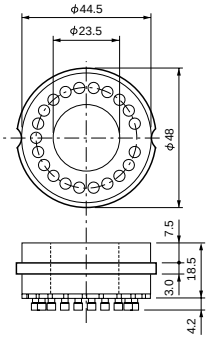
E678–21D (OPTION)



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REMARKS

- HA coating
  The R3310-02 and R4330-02 are coated with the conductive paint connected to the cathode, which is covered with an insulating material (HA coating). This method decreases noise. Care should be taken not to damage the insulating cover wrapping around the bulb.

CAUTIONS

- Use the HAMAMATSU SOCKET E678-21C or E678-21D.
- When soldering the voltage dividers to the socket, the PMT should be inserted in the socket.

HAMAMATSU

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