

PATENT PENDING

## High Q.E Multialkali Photocathode New Electro-Optical Design 28mm (1-1/8 Inch) Diameter, 9-Stage, Side-On Type

### FEATURES

● **High Sensitivity**

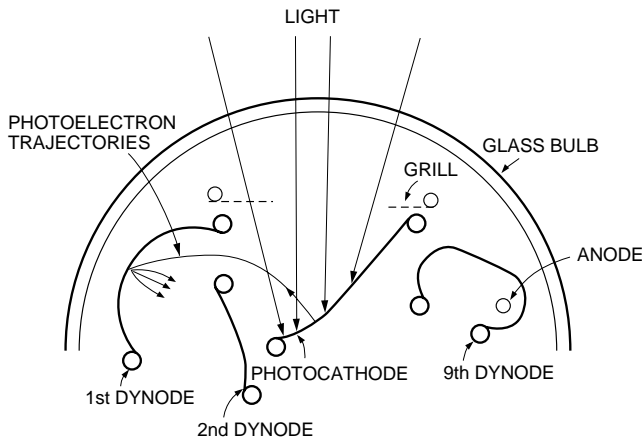
Luminous .....	525 $\mu$ A/lm (Typ.)
Radiant	
at 450nm (peak) .....	90mA/W (Typ.)
at 633nm .....	73mA/W (Typ.)
Quantum Efficiency	
at 260nm (peak) .....	30% (Typ.)
at 633nm (peak) .....	14% (Typ.)

- **Wide Spectral Response** ..... 185 to 900nm
- **High Signal to Noise Ratio**
- **Newly Designed Electro Optical Structure**

### APPLICATIONS

- **Biomedical Analysis**  
Blood Analyzer, Flow Cytometer, DNA Sequencer
- **Environmental Monitoring**  
NOx Analyzer
- **Spectroscopy**  
Fluorescence Spectrometer, Raman Spectrometer,  
UV-VIS Spectrometer
- **Semiconductor Industry**  
Wafer Inspection, Particle Counter

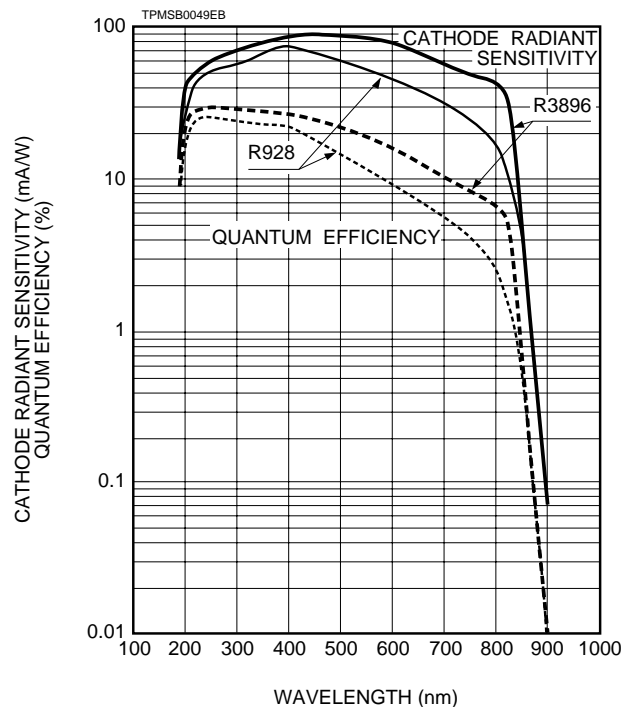
Figure 1: Electro Optical Structure



TPMSC0024EA



Figure 2: Typical Spectral Response



# PHOTOMULTIPLIER TUBE R3896

## GENERAL

Parameter	Description/Value	Unit
Spectral Response	185 to 900	nm
Wavelength of Maximum Response	450	nm
Photocathode Material	Multialkali	—
Minimum Effective Area	8 × 24	mm
Window Material	UV glass	—
Dynode Structure	Circular-cage	—
Number of Stages	9	—
Direct Interelectrode Capacitances Anode to Last Dynode	4	pF
Anode to All Other Electrodes	6	pF
Base	JEDEC No. B11-88	—
Weight	Approx. 45	g
Suitable Socket	E678-11A (option)	—

## MAXIMUM RATINGS (Absolute Maximum Values)

Parameter	Value	Unit
Supply Voltage		
Between Anode and Cathode	1250	Vdc
Between Anode and Last Dynode	250	Vdc
Average Anode Current <sup>A</sup>	0.1	mA
Ambient Temperature	-80 to +50	°C

## CHARACTERISTICS (at 25°C)

Parameter	Min.	Typ.	Max.	Unit
Cathode Sensitivity				
Luminous <sup>B</sup>	475	525	—	μA/lm
Radiant at 254nm	—	60	—	mA/W
450nm	—	90	—	mA/W
633nm	—	73	—	mA/W
852nm	—	5.0	—	mA/W
Quantum Efficiency at 254nm	—	29.3	—	%
450nm	—	24.8	—	%
633nm	—	14.3	—	%
852nm	—	0.73	—	%
Blue <sup>C</sup>	—	15	—	μA/lm-b
Red/White Ratio <sup>D</sup>	—	0.4	—	—
Anode Sensitivity				
Luminous <sup>E</sup>	3000	5000	—	A/lm
Gain <sup>E</sup>	—	9.5 × 10 <sup>6</sup>	—	—
Anode Dark Current <sup>F</sup> (after 30min. storage in the darkness)	—	10	50	nA
Time Response				
Anode Pulse Rise Time <sup>G</sup>	—	2.2	—	ns
Electron Transit Time <sup>H</sup>	—	22	—	ns
Transit Time Spread (TTS) <sup>I</sup>	—	1.2	—	ns
Anode Current Stability <sup>J</sup>				
Current 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: The value is cathode output current when a blue filter(Coming 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.
- D: 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.
- E: Measured with the same light source as Note B and with the voltage distribution ratio shown in Table 1 below.

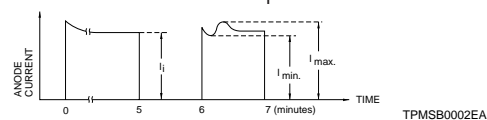
**Table 1: Voltage Distribution Ratio**

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

Supply Voltage : 1000Vdc, 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 amplitude. 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 signal 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.

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



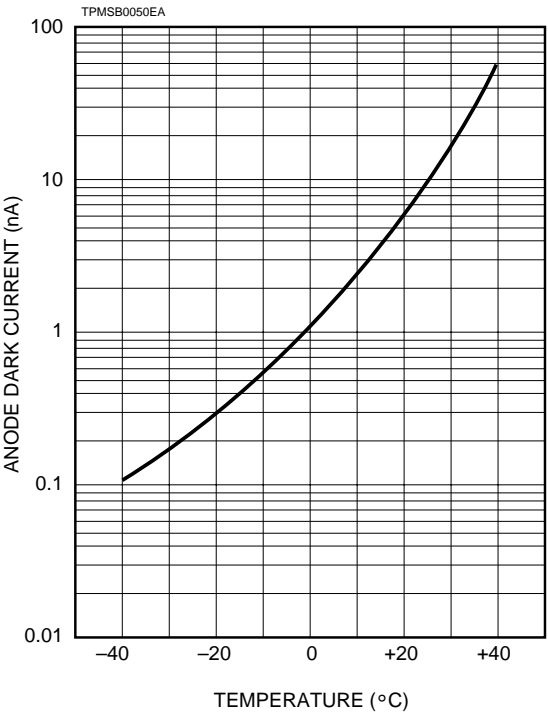
### (1) Current Hysteresis

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 by the previous light level for a minute to measure the variation.

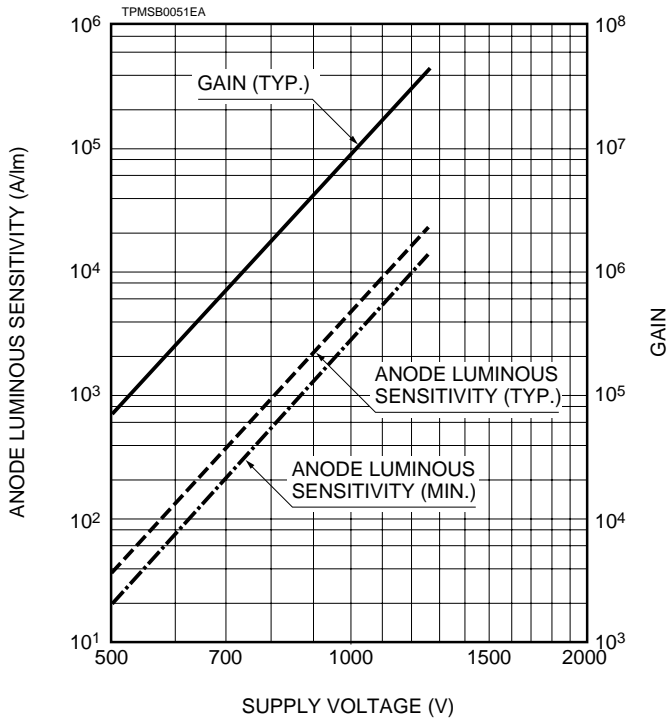
### (2) Voltage Hysteresis

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.

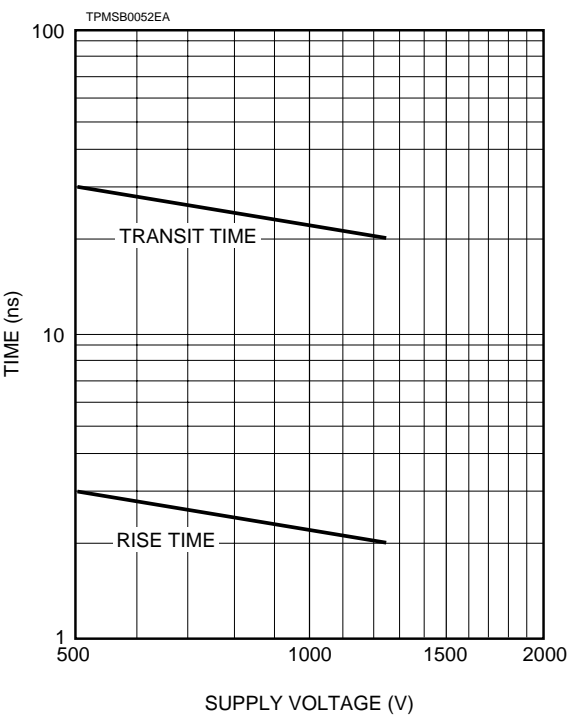
**Figure 3: Typical Temperature Characteristics of Dark Current (at 1000V, after 30minutes storage)**



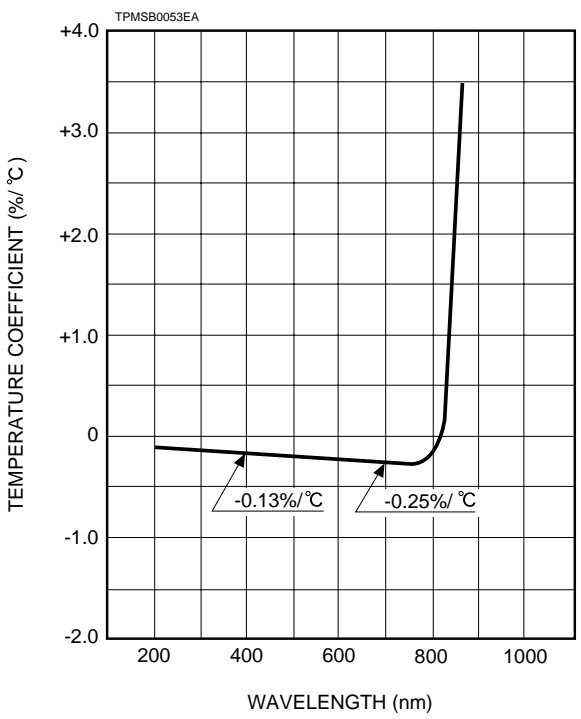
**Figure 4: Anode Luminous Sensitivity and Gain Characteristics**



**Figure 5: Typical Time Response**



**Figure 6: Typical Temperature Coefficient of Anode Sensitivity**



# PHOTOMULTIPLIER TUBE R3896

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

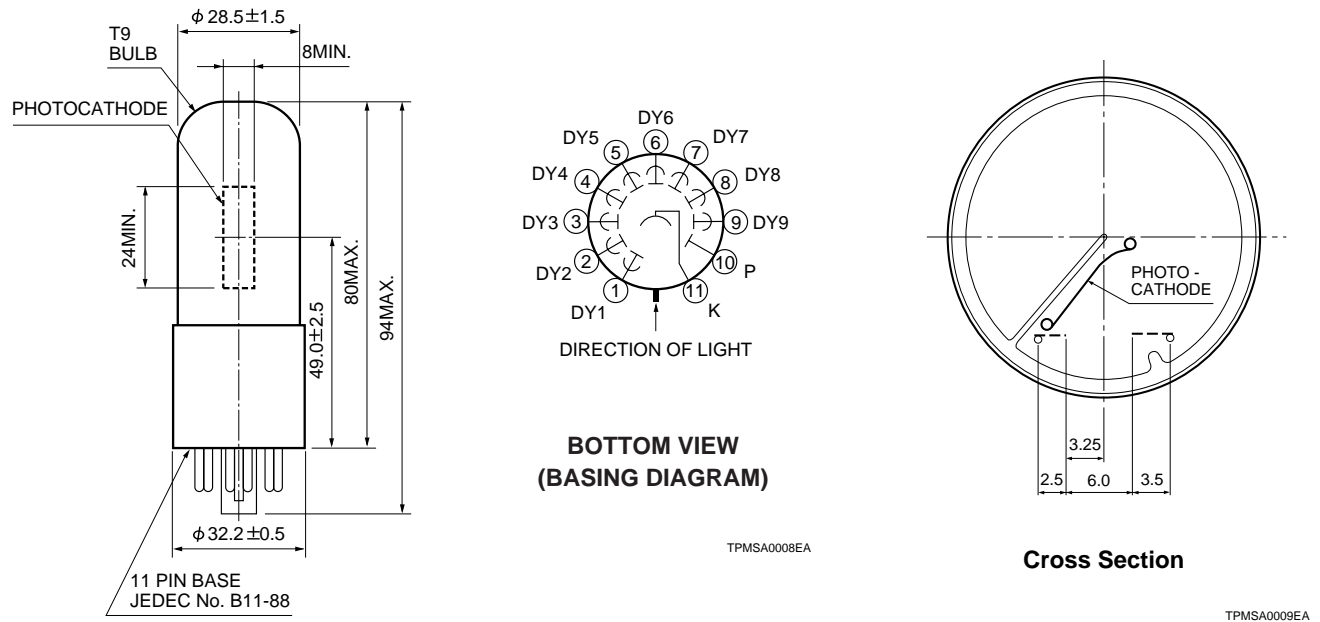
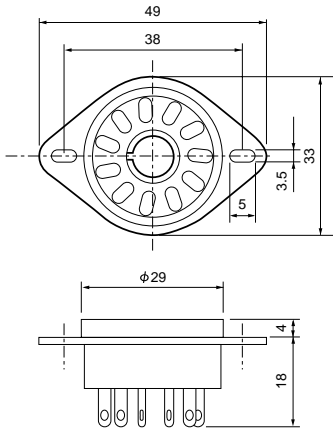


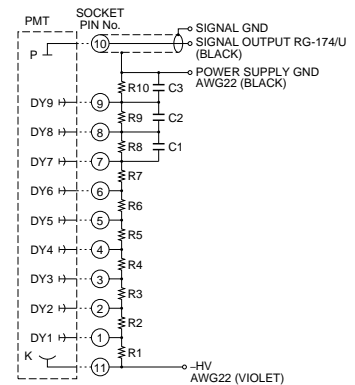
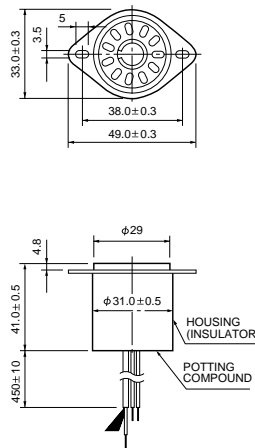
Figure 8: Optional Accessories (Unit:mm)

## Socket E678-11A



TACCA0064EA

## D Type Socket Assembly E717-21



R to R10 : 330kΩ  
C1 to C3 : 0.01 μF

TACCA0002ED

※ 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.

※ PATENT PENDING : JAPAN 4, USA 4, EUROPE 4

# HAMAMATSU

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