

**New Electro-Optical Design**  
**Wide Effective Area, Low Noise Bialkali Photocathode**  
**185 nm to 710 nm, 28 mm (1-1/8 Inch) Diameter, 9-stage, Side-on Type**

## FEATURES

- New Electro-Optical Design Structure
- Low Noise
- Wide Effective Area ..... 10 mm × 24 mm
- High Cathode Sensitivity (Luminous) ..... 100  $\mu\text{A}/\text{lm}$
- High Anode Sensitivity (Luminous) ..... 1000  $\text{A}/\text{lm}$
- R4220 Wide Effective Area Type

## APPLICATIONS

- Spectroscopy
- Biomedical
- Environmental Monitoring

## SPECIFICATIONS

### GENERAL

| Parameter                          | Description/Value          | Unit |
|------------------------------------|----------------------------|------|
| Spectral Response                  | 185 to 710                 | nm   |
| Wavelength of Maximum Response     | 410                        | nm   |
| Photocathode Material              | Low Noise Bialkali         | —    |
| Minimum Effective Area             | 10 × 24                    | mm   |
| Window Material                    | UV glass                   | —    |
| Dynode 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                | —    |
| Suitable Socket                    | E678-11A (Sold Separately) | —    |
| Suitable D Type Socket Assembly    | E717-63 (Sold Separately)  | —    |
| Weight                             | Approx. 45                 | g    |
| Operating Ambient Temperature      | -30 to +50                 | °C   |
| Storage Temperature                | -30 to +50                 | °C   |

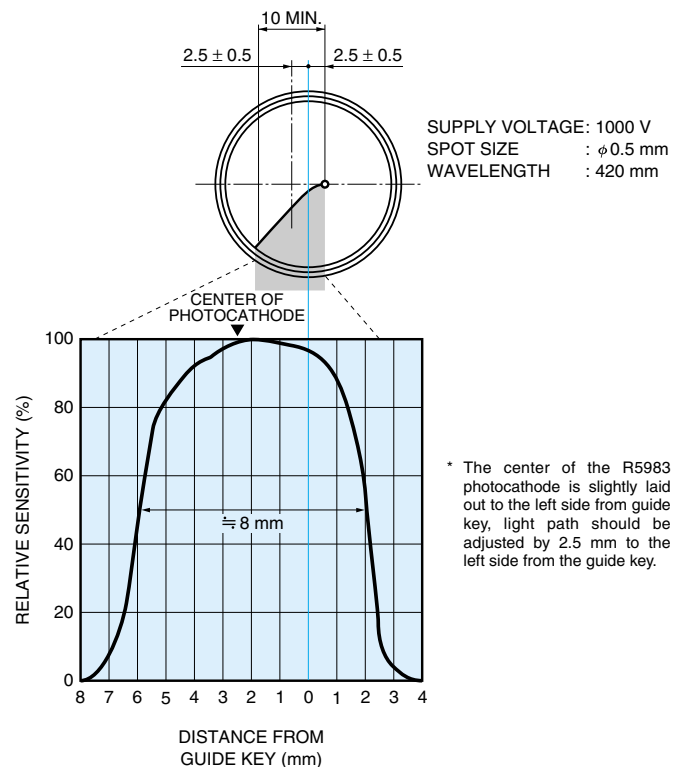
### MAXIMUM RATINGS (Absolute Maximum Values)

| Parameter                            | Value | Unit |
|--------------------------------------|-------|------|
| Supply Voltage                       |       |      |
| Between Anode and Cathode            | 1250  | V    |
| Between Anode and Last Dynode        | 250   | V    |
| Average Anode Current <sup>(A)</sup> | 0.1   | mA   |

NOTE (A): Averaged over any interval of 30 seconds maximum.



Figure 1: Typical Anode Uniformity



TPMSB0122EB

# PHOTOMULTIPLIER TUBE R5983, R5983P

## CHARACTERISTICS (at 25 °C)

| Parameter                                     | R5983<br>for General Purpose |                         |      | R5983P<br>for Photon Counting |                         |      | Unit            |
|---|------------------------------|-------------------------|------|-------------------------------|-------------------------|------|-----------------|
|   | Min.                         | Typ.                    | Max. | Min.                          | Typ.                    | Max. |                 |
| Cathode Sensitivity                           |                              |                         |      |                               |                         |      |                 |
| Quantum Efficiency at 320 nm (Peak)           | —                            | 23                      | —    | —                             | 23                      | —    | %               |
| Luminous <sup>A</sup>                         | 60                           | 100                     | —    | 60                            | 100                     | —    | μA/lm           |
| Radiant at 410 nm (Peak)                      | —                            | 70                      | —    | —                             | 70                      | —    | mA/W            |
| Blue Sensitivity Index (CS 5-58) <sup>B</sup> | —                            | 8.0                     | —    | —                             | 8.0                     | —    | —               |
| Anode Sensitivity                             |                              |                         |      |                               |                         |      |                 |
| Luminous <sup>C</sup>                         | 500                          | 1000                    | —    | 500                           | 1000                    | —    | A/lm            |
| Radiant at 410 nm                             | —                            | 7.0 × 10 <sup>5</sup>   | —    | —                             | 7.0 × 10 <sup>5</sup>   | —    | A/W             |
| Gain <sup>C</sup>                             | —                            | 1 × 10 <sup>7</sup>     | —    | —                             | 1 × 10 <sup>7</sup>     | —    |                 |
| Anode Dark Current <sup>D</sup>               |                              |                         |      |                               |                         |      |                 |
| After 30 minute Storage in the Darkness       | —                            | 0.2                     | 2.0  | —                             | —                       | —    | nA              |
| Anode Dark Counts <sup>E</sup>                | —                            | —                       | —    | —                             | 10                      | 50   | s <sup>-1</sup> |
| ENI (Equivalent Noise Input) <sup>F</sup>     | —                            | 3.6 × 10 <sup>-17</sup> | —    | —                             | 3.6 × 10 <sup>-17</sup> | —    | W               |
| Time Response                                 |                              |                         |      |                               |                         |      |                 |
| Anode Pulse Rise Time <sup>G</sup>            | —                            | 2.2                     | —    | —                             | 2.2                     | —    | ns              |
| Electron Transit Time <sup>H</sup>            | —                            | 22                      | —    | —                             | 22                      | —    | ns              |
| Anode Current Stability <sup>J</sup>          |                              |                         |      |                               |                         |      |                 |
| Current Hysteresis                            | —                            | 0.1                     | —    | —                             | 0.1                     | —    | %               |
| Voltage Hysteresis                            | —                            | 1.0                     | —    | —                             | 1.0                     | —    | %               |

## NOTES

A: 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.

B: 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 condition as Note A.

C: Measured with the same light source as Note A and with the anode-to-cathode supply voltage and voltage distribution ratio shown in Table 1 below.

D: Measured with the same supply voltage and voltage distribution ratio as Note C after removal of light.

E: Measured at the voltage producing the gain of 1 × 10<sup>6</sup>.

F: 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.

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

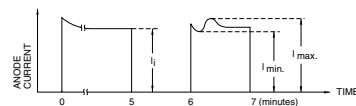
where q = Electronic charge (1.60 × 10<sup>-19</sup> coulomb).  
 I<sub>db</sub> = Anode dark current (after 30 minute storage) in amperes.  
 G = Gain.  
 Δf = Bandwidth of the system in hertz. 1 hertz is used.  
 S = Anode radiant sensitivity in amperes per watt at the wavelength of peak response.

G: The rise time is the time for the output pulse to rise from 10 % to 90 % of the peak amplitude when the whole 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.

J: Hysteresis is temporary instability in anode current after light and voltage are applied.

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



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### (1) Current Hysteresis

The tube is operated at 750 volts with an anode current of 1 micro-ampere 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.

Table 1: Voltage Distribution Ratio

| Electrode          | K | Dy1 | Dy2 | Dy3 | Dy4 | Dy5 | Dy6 | Dy7 | Dy8 | Dy9 | P |
|--------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|
| Distribution Ratio | 1 | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1 |

Supply Voltage : 1000 V dc

K : Cathode, Dy : Dynode, P : Anode

Figure 2: Typical Spectral Response

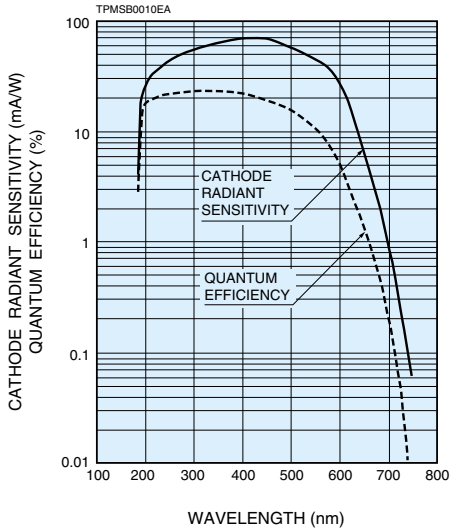


Figure 3: Typical Gain and Anode Dark Current

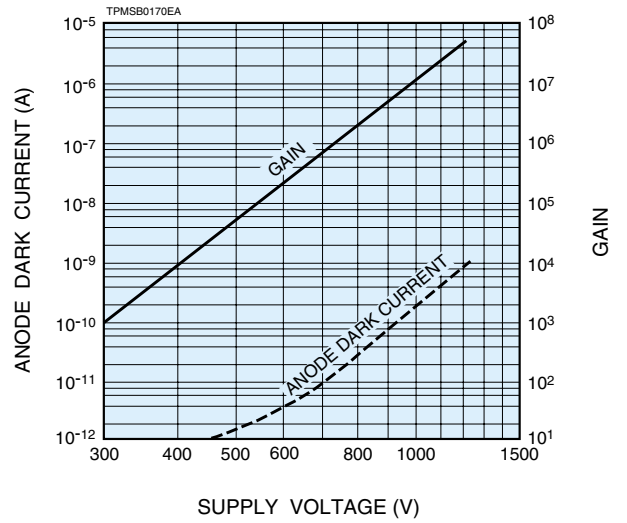


Figure 4: Typical ENI vs. Wavelength

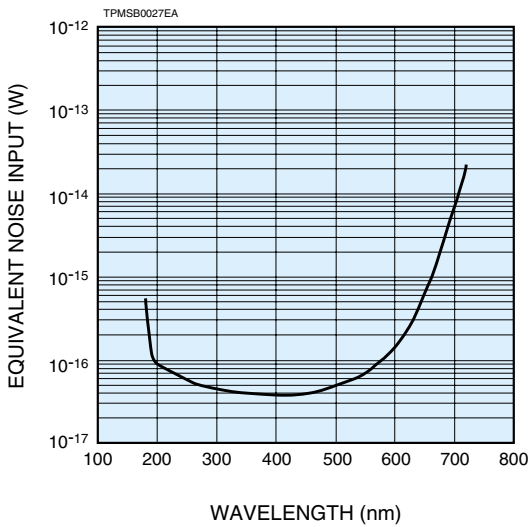


Figure 5: Typical Single Photon Pulse Height Distribution for R5983P

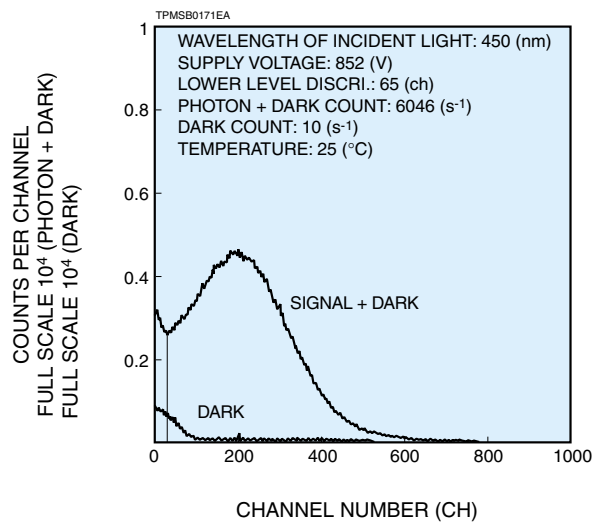
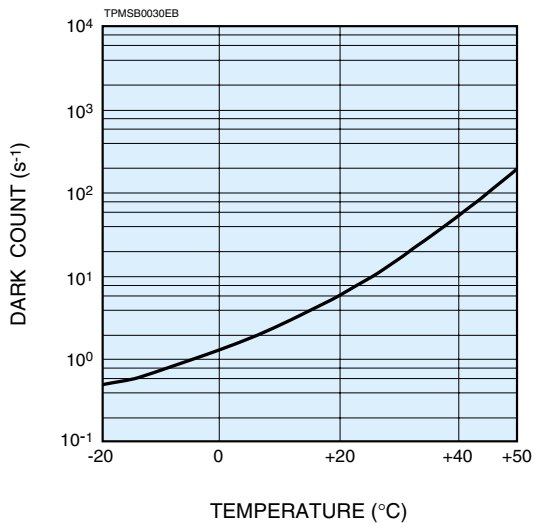
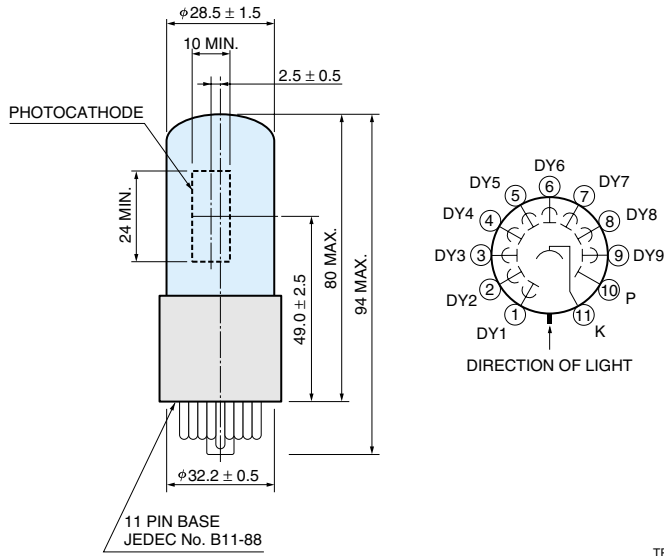


Figure 6: Typical Temperature Characteristics of Dark Count for R5983P



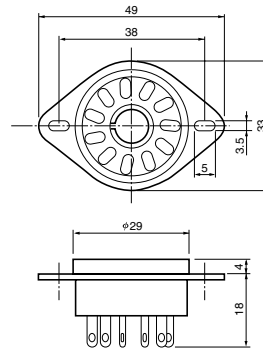
# PHOTOMULTIPLIER TUBE R5983, R5983P

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



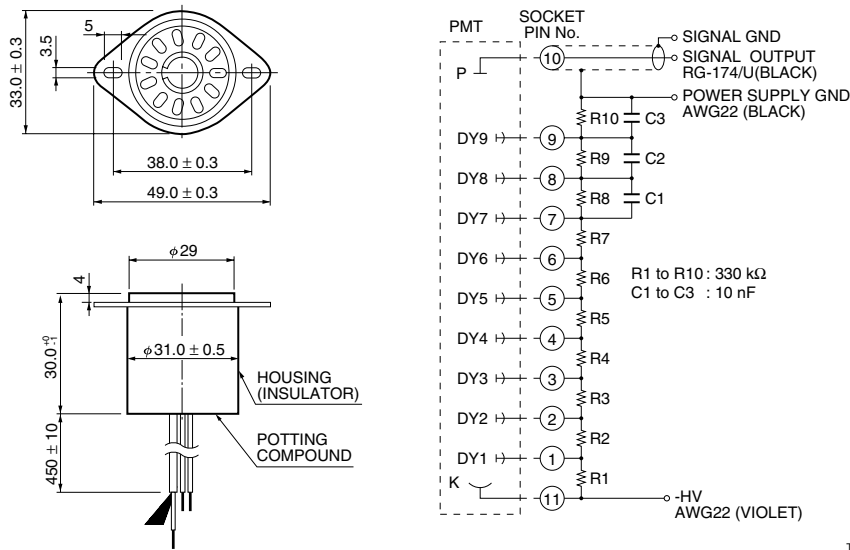
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Figure 8: Socket E678-11A (Sold Separately)



TACCA0064EA

Figure 9: D Type Socket Assembly E717-63 (Sold Separately)



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\* 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.

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