Photomultiplier Tube

S-4 RESPONSE

VERY SMALL, RUGGEDIZED, SIDE-ON, 9-STAGE TYPE

TESTED FOR SHOCK, VIBRATION, CONSTANT ACCELERATION,
AND TEMPERATURE CYCLING

For Ultra-Compact Systems in Low-Light Detection and
Measurement Applications

GENERAL

Spectral Response
Wavelength of Maximum Response
Cathode
Minimum projected length
Minimum projected width
Minimum projected area
Secondary-Emitting Surface
Window
Direct interelectrode Capacitances (Approx.)
Anode-to-dynode No. 9
Anode to all other electrodes
Maximum Overall Length
Excluding semiflexible leads
Length
Bulb top to useful center cathode area
Maximum Diameter
Operating Position
Weight (Approx.)
Bulb
Magnetic Shield
Base
Basing Designation for BOTTOM VIEW

Lead 1 - Anode
Lead 3 - Dynode No. 8
Lead 4 - Dynode No. 7
Lead 5 - Dynode No. 6
Lead 6 - Dynode No. 5
Lead 7 - Dynode No. 4
Lead 8 - Dynode No. 3
Lead 9 - Dynode No. 2
Lead 10 - Dynode No. 1
Lead 11 - Photocathode
Lead 12 - Dynode No. 9

DIRECTION OF INCIDENT RADIATION

MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC Supply Voltage
Between anode and cathode
Between anode and dynode No. 9
Between consecutive dynodes
Between dynode No. 1 and cathode

1250 V
250 V
250 V
250 V
Average Anode Current \({}^f\) ................. 20 \(\mu\)A
Ambient Temperature ........................................ 75 °C
Lead Temperature ............................................. 250 °C

1/16" ± 1/32" from protective seal for 10 sec. max.

**CHARACTERISTICS RANGE VALUES**

Under conditions with dc supply voltage \(E\) across a voltage divider providing 1/10 of \(E\) between cathode and dynode No.1; 1/10 of \(E\) for each succeeding dynode stage; and 1/10 of \(E\) between dynode No.9 and anode.

*With \(E = 1000\) volts (except as noted)*

<table>
<thead>
<tr>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4000 angstroms</td>
<td>(7.3 \times 10^4)</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode Radiant, at 4000 angstroms</td>
<td>(0.034)</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous, at 0 c/s(^g)</td>
<td>(20)</td>
<td>A/1m</td>
</tr>
<tr>
<td>Cathode Luminous(^h)</td>
<td>(2 \times 10^{-5})</td>
<td>A/1m</td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 3800 Angstroms (Approx.)</td>
<td>(10.5)</td>
<td>%</td>
</tr>
<tr>
<td><strong>Current Amplification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.1 \times 10^6)</td>
<td></td>
</tr>
<tr>
<td><strong>Equivalent Anode-Dark-Current Input</strong></td>
<td>(1 \times 10^{-10})</td>
<td>(5 \times 10^{-10})</td>
</tr>
<tr>
<td></td>
<td>(1 \times 10^{-13})</td>
<td>(5.1 \times 10^{-13})</td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Time</strong></td>
<td>(1.4 \times 10^{-9})</td>
<td>s</td>
</tr>
<tr>
<td><strong>Electron Transit Time</strong></td>
<td>(6 \times 10^{-9})</td>
<td>s</td>
</tr>
</tbody>
</table>

*With \(E = 750\) volts (except as noted)*

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<td>Cathode Radiant, at 4000 angstroms</td>
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</tr>
<tr>
<td>Luminous, at 0 c/s(^g)</td>
<td>(10)</td>
<td>A/1m</td>
</tr>
<tr>
<td>Cathode Luminous(^h)</td>
<td>(2 \times 10^{-5})</td>
<td>A/1m</td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 3800 Angstroms (Approx.)</td>
<td>(10.5)</td>
<td>%</td>
</tr>
<tr>
<td><strong>Current Amplification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3 \times 10^5)</td>
<td></td>
</tr>
<tr>
<td><strong>Equivalent Anode-Dark-Current Input</strong></td>
<td>(1 \times 10^{-10})</td>
<td>(5 \times 10^{-10})</td>
</tr>
<tr>
<td></td>
<td>(1 \times 10^{-13})</td>
<td>(5.1 \times 10^{-13})</td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Time</strong></td>
<td>(1.8 \times 10^{-9})</td>
<td>s</td>
</tr>
<tr>
<td><strong>Electron Transit Time</strong></td>
<td>(7.4 \times 10^{-9})</td>
<td>s</td>
</tr>
</tbody>
</table>

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\(a\) Alternate designation is Multiplier Phototube.

\(b\) On a plane parallel to the grill wires. See Schematic Arrangement of Structure.

\(c\) Made by Corning Glass Works, Corning, N.Y.

\(d\) Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago 22, Illinois, or equivalent.

\(e\) Operation with a supply voltage \(E\) of less than 500 volts dc is usually not recommended. If such a supply voltage is used, illumination must be limited to such a value that the average cathode photocurrent does not exceed approximately \(5 \times 10^{-9}\) ampere.

\(f\) Averaged over any interval of 30 seconds maximum.
Under the following conditions: The light source is a tungsten-filament lamp having a lime glass envelope. It is operated at a color temperature of 2870°K. A light input of 1 microlumen is used and the approximate spot size of the beam incident on the tube envelope is 0.35 inch by 0.05 inch. The tube is rotated to provide maximum anode output current.

Under the following conditions: The light source is a tungsten-filament lamp having a lime glass envelope. It is operated at a color temperature of 2870°K. The value of light flux is 0.001 lumen and 100 volts is applied between cathode and all other electrodes connected as anode. The approximate spot size of the beam incident on the tube envelope is 0.35 inch by 0.05 inch. The tube is rotated to provide maximum output current.

At a tube temperature of 22°C. Dark current may be reduced by use of a refrigerant.

With supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen.

At 4000 angstroms.

Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transit time variation and is measured under conditions with the incident light fully illuminating the photocathode.

The electron transit time is the time interval between the arrival of a delta function light pulse at the entrance window of the tube and the time at which the output pulse at the anode terminal reaches peak amplitude. The transit time is measured under conditions with the incident light fully illuminating the photocathode.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE
is shown at the front of this section

ENVIRONMENTAL TESTS

The 8571 is designed to withstand the following environmental tests:

Shock. With no voltage applied, the 8571 is subjected to a total of 18 impact shocks, three in each direction of the three orthogonal axes, on apparatus which applies half-wave sinusoidal shock pulses. The peak acceleration of the impact shock is 30 ± 3g's and the time duration is 11 ± 1 milliseconds.

Vibration. With no voltage applied, the 8571 is vibrated, in each of the three orthogonal axes and as specified below, on apparatus which applies variable-sinusoidal frequency vibration to the tube. A vibration sweep has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 5 to 2000 and back to 5 cycles per second. Six vibration sweeps are performed for each axis and the total test period is 1-1/2 hours.
<table>
<thead>
<tr>
<th>Double Amplitude inches</th>
<th>Acceleration g's</th>
<th>Frequency c/s</th>
<th>Total Sweep Duration Per Axis minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45</td>
<td>-</td>
<td>5-30</td>
<td>30-2000</td>
</tr>
<tr>
<td>-</td>
<td>20</td>
<td>30-2000</td>
<td>2000-30</td>
</tr>
<tr>
<td>0.45</td>
<td>-</td>
<td>30-5</td>
<td></td>
</tr>
</tbody>
</table>

Constant Acceleration. With no voltage applied, the 8571 is subjected for five minutes to an acceleration test level of 15 g's in both directions of the three orthogonal axes in a centrifuge providing constant acceleration.

Temperature Cycling. With no voltage applied, the 8571 is subjected to temperature cycling from -45°C to +75°C and back to -45°C in a period of 8 hours. Three temperature cycles are performed.

SCHEMATIC ARRANGEMENT OF STRUCTURE
(Top View)

DATA 2
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
R₁ through R₁₀ = 20,000 to 5,000,000 ohms.

NOTE 1: Adjustable between approximately 500 and 1250 volts.

NOTE 2: Capacitors C₁ through C₃ should be connected near tube base for optimum high-frequency performance.

NOTE 1: Minimum projected cathode length and width on plane parallel to grid wires.

NOTE 2: Soldering or welding to the leads within this region is not recommended.

NOTE 3: A 0.15 inch minimum hole diameter should be provided in circuit boards or similar mounting arrangements to allow for clearance of the exhaust tip of the 8571.
Typical Time Resolution Characteristics

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING
1/10 OF E BETWEEN CATHODE AND DYNODE No.1; 1/10 OF E
FOR EACH SUCCEEDING DYNODE STAGE; AND 1/10 OF E
BETWEEN DYNODE No. 9 AND ANODE.
PHOTOCATHODE FULLY ILLUMINATED.

<table>
<thead>
<tr>
<th>TIME — SECONDS</th>
<th>10^{-8}</th>
<th>10^{-9}</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>8</td>
<td>1250</td>
</tr>
<tr>
<td>900</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

TRANSIT TIME

RISE TIME
Average Anode Characteristics

DYODE - No. 1 - TO - CATHODE VOLTS * 100
EACH SUCCEEDING - DYODE - STAGE VOLTS * 100
LIGHT SOURCE IS A TUNGSTEN - FILAMENT LAMP
OPERATED AT COLOR TEMPERATURE OF 2870° K.
Typical Sensitivity and Current Amplification Characteristics

Supply Voltage (E) Across Voltage Divider Providing 1/10 of E Between Cathode and Dynode No. 1; 1/10 of E for Each Successing Dynode Stage; and 1/10 of E Between Dynode No. 9 and Anode.

Sensitivity — Amperes/Lumen (Color Temp. 2870° K)

Maximum Sensitivity
Typical Amplification
Typical Sensitivity
Minimum Sensitivity

Supply Volts (E) Between Anode and Cathode

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/10 OF E PER STAGE.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 22° C

EQUIVALENT ANODE-DARK-CURRENT INPUT — LUMENS

LUMINOUS SENSITIVITY — AMPERES/LUMEN

92CM-12842
Typical Effect of Magnetic Field on Anode Current

PHOTOCATHODE IS FULLY ILLUMINATED,
UNIFORM MAGNETIC FIELD PARALLEL TO
MAJOR (Z) AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE
FOR LINES OF FORCE TOWARD TUBE BASE.
ANODE-TO-CATHODE VOLTS = 1000

MAGNETIC FIELD INTENSITY — GAUSS
RELATIVE ANODE CURRENT

92CM-13015