PHOTOSENSITIVE DEVICE SECTION

This Section contains data on phototubes of the single-unit, twin-unit, and multiplier types; photocells; television camera tubes such as image orthicons, iconoscopes, and vidicons; and other devices employing photosensitive materials.

For further Technical Information, write to Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J.
<table>
<thead>
<tr>
<th>Spectral Response</th>
<th>Diameter (nominal)</th>
<th>No. of Stages</th>
<th>Secondary Emitting Surface</th>
<th>RCA Tube Types</th>
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### VACUUM AND GAS PHOTODIODES

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### IMAGE-CONVERTER TUBES

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### CAMERA TUBES

#### VIDICONS

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<thead>
<tr>
<th>Tube Diameter inches</th>
<th>Television Film Pick-up</th>
<th>Live Television and Industrial</th>
<th>Space Military and Industrial</th>
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<td>8134/V1</td>
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### CAMERA TUBES

**VIDICONS® (Cont’d)**

<table>
<thead>
<tr>
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<th>Television Film Pickup</th>
<th>Live Television and Industrial</th>
<th>Space Military, and Industrial</th>
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### IMAGE ORTHICONS

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<th>Live Television Pickup</th>
<th>Military and Industrial</th>
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<td>4415/S, 4416/S</td>
<td>4401V1/L</td>
<td>4401V1/L</td>
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<td>7513b</td>
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<td>7198A(b)</td>
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<td>7513/S, 4513/S</td>
<td>5820A/L</td>
<td>7629A</td>
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### IMAGE-INTENSIFIER ORTHICON

**Combined Image-Converter and Image Orthicon Sections**

<table>
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<tr>
<th>Tube Diameter inches</th>
<th>Recommended Service</th>
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<tbody>
<tr>
<td></td>
<td>Extremely Low-Light Level Television Cameras</td>
</tr>
<tr>
<td>5</td>
<td>4470</td>
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</table>

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\(a\) This surface is being replaced gradually by Be-O.

\(b\) Has extended spectral response in the near-ultraviolet. Maximum response occurs at about 4200 angstroms. The approximate spectral range, at the 10 per cent points, is from 2500 to 6500 angstroms.

\(c\) A spectral-response S-designation has not been assigned for these bialkali photocathode types. Maximum response occurs at about 3850 angstroms for approximate spectral range, at the 10 per cent points, is from 2600 to 6000 angstroms for type 8575 and from 3100 to 6100 for types 4523, 4524, and 4525.

\(d\) These types utilize a P2O phosphor screen except type 4449A which has a P11 phosphor screen.
Variants of each vidicon type having fiber-optics faceplates, reticles, and/or radiation-resistant faceplates can often be supplied to meet the needs of specific applications.

Ruggedized type.

Types 4415/S, 4416/S are available as a trio having matched characteristics. The 4415/S's are for use in the red and green channels and the 4416/S is for use in the blue channel. Types 7513/S, 4513/S are also available as a set of three tubes having matched characteristics. Types 7513/S are for the red and green channels and type 4513/S for the blue.

A trio of these tubes having matched characteristics is available as three type 7513/S.

For the luminance channel in 4-tube color cameras.
DEFINITIONS of Photosensitive-Device Terms

Radiant Sensitivity. The quotient of output current by incident radiant power of a given wavelength, at constant electrode voltages.

Radiant Intensity Sensitivity. The quotient of output current by incident radiant power per unit area, at constant electrode voltages.

Cathode Radiant Sensitivity. The quotient of current leaving the photocathode by incident radiant power of a given wavelength.

Luminous Sensitivity. The quotient of output current by incident luminous flux, at constant electrode voltages.

Luminous Intensity Sensitivity. The quotient of the output current by the incident luminous intensity, at constant electrode voltages.

Cathode Luminous Sensitivity. The quotient of current leaving the photocathode by the incident luminous flux.

Illumination Sensitivity. The quotient of output current by the incident illumination, at constant electrode voltages.

Dynamic Sensitivity. The quotient of the modulated component of the electrical output by the modulated component of the incident radiation.

Current Amplification. Ratio of the output current to the photocathode current, at constant electrode voltages.

Equivalent Anode-Dark-Current Input. The quotient of the anode dark current by the luminous sensitivity.

Equivalent Noise Input. That value of incident luminous flux which when modulated in a stated manner produces an rms output current equal to the rms noise current within a specified bandwidth.

Electrode Dark Current. The electrode current which flows when there is no radiant flux incident on the photocathode.

Transit-Time Spread. The increase in width of the output pulse over that of the input pulse. Pulse width is measured at 50 per cent of the pulse height.

Pulse Rise Time. The time required for the instantaneous amplitude of the pulse to go from 10 per cent to 90 per cent of the peak value.

Median. That value in a series such that half of the devices in the series are on one side of it, and half on the other.
PHOTOTUBE SENSITIVITY AND SENSITIVITY MEASUREMENTS

GENERAL CONSIDERATIONS

The range of luminous-sensitivity limits given for a phototube on the data sheets of this Section is that which the tube will display when operated under low-current conditions.

If the tube is to be operated under conditions approaching its maximum-current rating, the equipment design should provide for a wider sensitivity range having a minimum value equal to one-half of that shown for low-current operation. The sensitivity of a phototube under such high-current conditions is dependent upon the tube type, as follows:

1. Single-Unit and Twin Phototubes

a. Gas Types: For high-current operation, and particularly in applications in which the type is subjected to these higher values continuously, a drop in sensitivity below the values for low-current operation may be expected, the extent of the drop being affected by the severity of the operating conditions. After a period of idleness, a gas phototube usually recovers most of its initial sensitivity.

b. Vacuum Types: Unlike gas phototubes, this class of phototubes shows negligible drop in sensitivity values for different degrees of illumination and over long periods of use. The output current of a vacuum phototube is a linear function of the exciting illumination under normal operating conditions. The frequency response is flat up to frequencies at which transit-time effects become the limiting factor.

2. Multiplier Phototubes

Although RCA Multiplier Phototubes are vacuum types, a drop in sensitivity is to be expected from this class of phototubes when operated at high anode-current values. The extent of the drop is affected by the nature and severity of the operating conditions to which the tube is subjected. After a period of idleness, the multiplier phototube usually recovers a substantial percentage of this loss of sensitivity. Multiplier-phototube-sensitivity values are dependent on the respective amplification of each dynode stage. Hence, large variations in sensitivity can be expected between individual tubes of a given type. The overall amplification of a multiplier phototube is equal to the average amplification per stage raised to the n power, where n is the number of stages. Thus, very small variations in amplification per stage produce very large changes in overall tube amplification.

Because these overall changes are very large, it is advisable for designers to provide adequate adjustment of the supply voltage per stage so as to be able to adjust the amplification of individual tubes to the desired design value. It is suggested that an overall voltage-adjustment (continued on next page)
range of at least 2 to 1 be provided. When the output current can be controlled by change in the illumination of the photocathode of the multiplier phototube, the required range of adjustment in the voltage per stage can be reduced.

SENSITIVITY MEASUREMENTS

The luminous-sensitivity values shown on the data pages of this section are measured according to the following procedures:

1. Single-Unit and Twin Phototubes
   a. Gas Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. For the 0-cycle measurements, a light input of 0.1 lumen is used, unless otherwise specified. For the 5000- and 10000 cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean. For all measurements, a dc anode-supply voltage of 90 volts and a 1.0-megohm load resistor are employed. Under these conditions, the effect of tube capacitance is negligible.
   b. Vacuum Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A steady light input of 0.1 lumen is used, unless otherwise specified, together with a dc anode-supply voltage of 250 volts and a 1-megohm load resistor.

2. Multiplier Phototubes
   The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A light flux of 10 microlumens from a rectangular aperture approximately 0.8" long and 0.2" wide is projected normal to the cathode in the direction noted on the basing diagram and outline. The load resistor has a value of 0.01 megohm. The applied voltages are specified on the individual data sheets.
SPECTRAL CHARACTERISTIC OF HUMAN EYE & OF TUNGSTEN LAMP AT COLOR TEMPERATURE OF 2870 K

EYE CURVE IS ON BASIS OF EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

WAVELENGTH ANGSTROMS

RELATIVE ENERGY DISTRIBUTION OF LAMP-ARBITRARY UNITS
RELATIVE SENSITIVITY OF EYE-ARBITRARY UNITS

OCT. 20, 1947
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-I RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY (μA/μWATT) AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

WAVELENGTH—ANGSTROMS

ULTRA VIOLET VIOLET BLUE GREEN YELLOW RED INFRA RED

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6056R6
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOTUBE HAVING
S-3 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY
(μA/μWATT) AT 100-UNIT POINT,
SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF
MAXIMUM
VALUE

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<td>11000</td>
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ULTRA VIOLET
VIOLET
BLUE
GREEN
YELLOW
RED
INFRA RED

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6057R6
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K.
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOTUBE HAVING S-5 RESPONSE
FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

WAVELENGTH — ANGSTROMS

RELATIVE SENSITIVITY
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOTUBE HAVING
S-8 RESPONSE
FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY
AT 100-UNIT POINT; SEE DATA SHEET
FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

ULTRA-VIOLET
VIOLET
BLUE
GREEN
YELLOW
RED
NIR
RED
IR

ELECTRON TUBE DIVISION
RODO CORPORATION OF AMERICA, HARISON, NEW JERSEY

92CM-6592R3
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING
S-9 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET
FOR SPECIFIC TYPE.
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

WAVELENGTH—ANGSTROMS

RELATIVE SENSITIVITY

ULTRA VIOLET BLUE GREEN YELLOW RED INFRA RED CSEED BTHE MOTE

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-7821R2
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE

For Equal Values of Radiant Power at All Wavelengths

RANGE OF MAXIMUM VALUE

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-12 RESPONSE

For equal values of Radiant Power at All Wavelengths

For value of radiant sensitivity at 100-unit point, see data sheet for specific type.
For equal values of radiant flux at all wavelengths,

TENTATIVE SPECTRAL-SENSITIVITY

S-13 RESPONSE

CHARACTERISTIC OF PHOTOEUBE HAVING

FOR VALUE OF RADIAN1 T SENSITIVITY

AT 100-UNIT POINT, SEE DATA SHEET

FOR SPECIFIC TYPE.
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOJUNCTION CELL HAVING S-14 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT INTENSITY SENSITIVITY OR RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA FOR SPECIFIC TYPE.
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOCONDUCTIVE CELL HAVING S-15 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

ULTRA VIOLET GREEN RED
VIOLET BLUE INFRA RED

ELECTRON TUBE DIVISION
RAD"O CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9206AI
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-17 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

RELATIVE SENSITIVITY

WAVELENGTH—ANGSTROMS

ULTRA VIOLET BLUE GREEN YELLOW RED INFRARED

3000 5000 7000 9000 11000

300 400 6200 400

ELECTRON TUBE DIVISION

RCA CORPORATION OF AMERICA, HARRISON, NEW JERSEY
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-18 RESPONSE

For Equal Values of Radiant Power at All Wavelengths

[Diagram showing a graph with wavelength on the x-axis and relative sensitivity on the y-axis, with various color regions labeled.]
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-19 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

<table>
<thead>
<tr>
<th>WAVELENGTH (ANGSTROMS)</th>
<th>RELATIVE SENSITIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>20</td>
</tr>
<tr>
<td>3000</td>
<td>40</td>
</tr>
<tr>
<td>4000</td>
<td>60</td>
</tr>
<tr>
<td>5000</td>
<td>80</td>
</tr>
<tr>
<td>6000</td>
<td>100</td>
</tr>
<tr>
<td>7000</td>
<td>80</td>
</tr>
<tr>
<td>8000</td>
<td>60</td>
</tr>
<tr>
<td>9000</td>
<td>40</td>
</tr>
</tbody>
</table>

ULTRAVIOLET
BLUE
GREEN
YELLOW
RED
INFRA RED

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9582
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-20 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

FOR VALUE OF RADIANT SENSITIVITY AT 100-UNIT POINT, SEE DATA SHEET FOR SPECIFIC TYPE.

RANGE OF MAXIMUM VALUE

RELATIVE SENSITIVITY

3000 5000 7000 9000 11000
ULTRA VIOLET BLUE GREEN YELLOW RED INFRA RED
WAVELENGTH—ANGSTROMS
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-21 RESPONSE

FOR EQUAL VALUES OF RADIANT POWER AT ALL WAVELENGTHS
SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870°K

CURVE B: SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH BLUE FILTER (CORNING NO. 5113 POLISHED TO 1/2 STOCK THICKNESS)
SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED RED-INFRARED FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870°K

CURVE B: SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH RED-INFRARED FILTER (COMBINATION OF CORNING, GLASS CODE NO. 3482 AND NO. 5850 FILTERS)
SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED INFRARED FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K.
CURVE B: SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INFRARED FILTER (CORNING NO. 2540).
SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED RED FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K
CURVE B: SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH RED FILTER (CORNING NO. 2488).
DASHED PORTION IS EXTRAPOLATED.
SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER

SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH BLUE FILTER (CORNING C.S. No.5-58 POLISHED TO 1/2 STOCK THICKNESS). MAXIMUM FILTER TRANSMISSION OCCURS AT 4300 ANGSTROMS AND IS 60 PER CENT.
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

ANODE - SUPPLY VOLTS = 90
VOLTAGE DROP IN LOAD - VERY SMALL
CAPACITANCE EFFECTS - MADE NEGLIGIBLE

CURVE A: PHOTOTUBE HAVING S-1 OR S-3 RESPONSE
CURVE B: PHOTOTUBE HAVING S-4 RESPONSE

RELATIVE SENSITIVITY - DECIBELS

APRIL 30, 1947
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HAVERSON, NEW JERSEY
RCA Type II Spectral Response

For equal values of signal-output current at all wavelengths, signal-output microamperes from scanned area of 1/2" x 3/8" = 0.02. Dark current (microamperes) = 0.02.

Microamperes/microwatt of radiant energy vs. wavelength (angstroms).

- Ultra-violet
- Blue
- Green
- Yellow
- Red
- Infrared

Wavelength (angstroms) range from 3000 to 8000.
FOR EQUAL VALUES OF INCIDENT RADIANT POWER AT ALL WAVELENGTHS.

WAVELENGTH — ANGSTROMS

0 20 40 60 80 100

RELATIVE SENSITIVITY

3000 4000 5000 6000 7000

ULTRA-VIOLET  VIOLET  BLUE  GREEN  YELLOW  RED  INFRARED

92LM-2586

RCA Type IV Spectral Response
Photomultiplier Tube

9-Stage, Side-On Type
Having S-4 Spectral Response

GENERAL
Spectral Response ........................................... S-4
Wavelength of Maximum Response. 4000 ± 500 angstroms
Cathode, Opaque ........................................... Cesium-Antimony
Minimum projected length$^a$ ......................... 0.94 in (2.4 cm)
Minimum projected width$^a$ ........................... 0.31 in (0.8 cm)
Window ...................................................... Lime Glass (Corning$^b$ No.0080), or equivalent

Index of refraction at 4360 angstroms ............... 1.523

Dynodes:
Substrate .................................................. Nickel
Secondary-Emitting Surface ................. Cesium-Antimony
Structure .......... Circular-Cage, Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.9 ............................. 4.4 pF
Anode to all other electrodes ............... 6.0 pF
Maximum Overall Length ......................... 3.68 in (9.3 cm)
Seated Length ........................................ 3.12 in (7.9 cm)
Maximum Diameter .................................. 1.31 in (3.3 cm)
Bulb ...................................................... T9
Base .......... Small-Shell Submagnal 11 Pin, (JEDEC Group 2, No.B11-88), Non-hygrosopic

Socket .......... Amphenol$^c$ No.78S11T, or equivalent
Magnetic Shield ........ Millen$^d$ No.80801B, or equivalent
Operating Position .............. Any
Weight (Approx.) ....................... 1.6 oz

ABSOLUTE-MAXIMUM RATINGS

DC or Peak AC Supply Voltage:
Between anode and cathode .................. 1250 max. V
Between anode and dynode No.9 ........... 250 max. V
Between consecutive dynodes ............... 250 max. V
Between dynode No.1 and cathode .......... 250 max. V
Average Anode Current$^f$ .................... 0.1 max. mA
Ambient Temperature$^g$ ..................... +75 max. °C

RCA Electronic Components
### 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></th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^b) at 4000 angstroms</td>
<td>-</td>
<td>(1.2 \times 10^5)</td>
<td>-</td>
</tr>
<tr>
<td>Luminous(^l) (2870(^\circ) K)</td>
<td>(40)</td>
<td>(120)</td>
<td>(800)</td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^k) at 4000 angstroms</td>
<td>-</td>
<td>0.04</td>
<td>-</td>
</tr>
<tr>
<td>Luminous(^m) (2870(^\circ) K)</td>
<td>(2 \times 10^{-5})</td>
<td>(4 \times 10^{-5})</td>
<td>-</td>
</tr>
<tr>
<td><strong>Quantum Efficiency</strong> at 3800 angstroms</td>
<td>-</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td><strong>Current Amplification</strong></td>
<td>-</td>
<td>(3 \times 10^6)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Anode Dark Current</strong>(^n)</td>
<td>-</td>
<td>(1 \times 10^{-9})</td>
<td>(1 \times 10^{-8})</td>
</tr>
<tr>
<td><strong>Equivalent Anode Dark Current</strong> Input(^n)</td>
<td>(-)</td>
<td>(5 \times 10^{-11})</td>
<td>(5 \times 10^{-10})</td>
</tr>
<tr>
<td><strong>Equivalent Noise Input</strong>(^q)</td>
<td>(-)</td>
<td>(4.8 \times 10^{-14})</td>
<td>(4.8 \times 10^{-13})</td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Time</strong> at 1250 V</td>
<td>(-)</td>
<td>(1.6 \times 10^{-9})</td>
<td>-</td>
</tr>
<tr>
<td><strong>Electron Transit Time</strong> at 1250 V</td>
<td>(-)</td>
<td>(1.6 \times 10^{-8})</td>
<td>-</td>
</tr>
</tbody>
</table>

\(a\) On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

\(b\) Made by Corning Glass Works, Corning, NY 14830.

\(c\) Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 50, IL 60650.

\(d\) Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

\(f\) Averaged over any interval of 30 seconds maximum.

→ Indicates a change.
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 SUCCEEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE No. 9 AND ANODE.

SENSITIVITY — AMPERES/LUMEN (COLOR TEMP. 2870°K)

SUPPLY VOLTAGE (E) — VOLTS

CURRENT AMPLIFICATION

92LM - 3019

DATA 6
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A
FUNCTION OF SIMULTANEOUS MODULATION OF
DYNODES NO. 5 AND NO. 6

| ANODE - TO - DYNODE No. 9 VOLTS \( \times \) 200 |
| VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODES |
| No. 5 AND No. 6 \( \times \) 100 |
| A CONSTANT VOLTAGE DIFFERENCE OF 100 VOLTS IS MAINTAINED |
| BETWEEN DYNODES No. 5 AND No. 6 DURING MODULATION. |
| ANODE IS AT GROUND POTENTIAL. |

<table>
<thead>
<tr>
<th>RELATIVE ANODE CURRENT</th>
<th>DYNODE - No. 5 VOLTS (REFERRED TO ANODE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-600</td>
</tr>
<tr>
<td>0.5</td>
<td>-500</td>
</tr>
<tr>
<td>1</td>
<td>-400</td>
</tr>
<tr>
<td>2</td>
<td>-300</td>
</tr>
<tr>
<td>3</td>
<td>-200</td>
</tr>
<tr>
<td>4</td>
<td>-100</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

92CM-11375
Tube operation at room temperature or below is recommended.

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1036 lumens per watt.

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 and a light input of 10 microlumens is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1036 lumens per watt.

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 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1036 lumens per watt.

Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The “on” period of the pulse is equal to the “off” period.

At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1036 lumens per watt.

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.

**DIMENSIONAL OUTLINE**

Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters.

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>.09</td>
<td>2.3</td>
<td>.31</td>
<td>7.9</td>
<td>1.31</td>
<td>33.2</td>
</tr>
<tr>
<td>.190</td>
<td>4.8</td>
<td>.402</td>
<td>10.2</td>
<td>1.94</td>
<td>49.2</td>
</tr>
<tr>
<td>.250</td>
<td>6.3</td>
<td>.94</td>
<td>23.8</td>
<td>3.12</td>
<td>79.2</td>
</tr>
<tr>
<td>.270</td>
<td>6.8</td>
<td>1.18</td>
<td>29.9</td>
<td>3.68</td>
<td>93.4</td>
</tr>
</tbody>
</table>

∅ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.
DETAIL A (Top View)

TERMINAL DIAGRAM (Bottom View)

Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10: Anode
Pin 11: Photocathode
R₁ through R₁₀ = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

Note 2: Capacitors C₁ through C₃ should be connected at tube socket for optimum high-frequency performance.

Leads to all capacitors should be as short as possible to minimize inductance effects.

The capacitor values will depend upon the shape and the amplitude of the anode-current pulse, and the time duration of the pulse, or train of pulses. When the output pulse is assumed to be rectangular in shape, the following formula applies:

\[ C = 100 \frac{\text{i} \cdot \text{t}}{\text{V}} \]

where C is in farads
\( \text{i} \) is the amplitude of anode current in amperes
\( \text{V} \) is the voltage across the capacitor in volts
and \( \text{t} \) is the time duration of the pulse in seconds

This formula applies for the anode-to-final dynode capacitor. The factor 100 is used to limit the voltage change across the capacitor to 1% maximum during a pulse. Capacitor values for preceding stages should
take into account the smaller values of dynode currents in these stages. Conservatively, a factor of approximately 2 per stage is used. Capacitors are not required across those dynode stages where the dynode current is less than 1/10 of the current through the voltage-divider network.

For other shaped pulses or for a train of pulses, the total charge $q$ should be substituted for $(i^*t)$ and the following formula applies:

$$C = 100 \frac{q}{V}$$

where $q = \int i(t) \, dt$ coulombs

**TYPICAL ANODE CHARACTERISTICS**

![Diagram of anode characteristics]

VOLTS / STAGE = 100
LIGHT SOURCE IS A TUNGSTEN FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

---

RCA Electronic Components

DATA 4
8-69
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY = RA / WATT PER CENT
QUANTUM EFFICIENCY = I / RELATIVE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH — ANGSTROMS

RCA Electronic Components
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH

SPOT SIZE: 1MM DIA. APPROX.
VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.

TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL

SPOT SIZE: 1MM DIA. APPROX.
GRILL TOWARD OBSERVER, BASE DOWN.
CATHODE WIDTH PROJECTED NORMAL TO PLANE OF GRILL.
VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.
TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE = CONSTANT
ZERO-DEGREE ROTATIONAL POSITION OF TUBE IS ESTABLISHED
BY A COLLIMATED LIGHT BEAM PERPENDICULAR TO AND
FILLING THE PLANE OF THE GRILL.
TUBE MOUNTED VERTICALLY WITH ALLOWANCE MADE FOR ROTATION
ABOUT MAJOR TUBE AXIS.
ROTATIONAL POSITION (TOP VIEW) CLOCKWISE = (-)
ROTATIONAL POSITION (TOP VIEW) COUNTERCLOCKWISE = (+)

TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A
FUNCTION OF DYNODE-NO. 6 VOLTS

ANODE SUPPLY VOLTS (E) = 1000
VOLTS PER STAGE EXCEPT FOR DYNODE-NO. 6 STAGE = 100
TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS

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

LUMINOUS SENSITIVITY — AMPERES/LUMEN

SUPPLY VOLTAGE (E) — VOLTS

700 900 1000 1880

EADCI — LUMEN
EADCI — WATT
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNOE No. 1, 1/10 OF E FOR EACH SUCCEEDING DYNOE STAGE, AND 1/10 OF E BETWEEN DYNOE No. 9 AND ANODE.
PHOTOCATHODE IS FULLY ILLUMINATED.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE FOR LINES OF FORCE TOWARD TUBE BASE.
TUBE IS DEGAUSSED PRIOR TO TEST AND IS AGAIN DEGAUSSED BEFORE FLUX DIRECTION IS CHANGED.

TYPICAL TIME-RESOLUTION CHARACTERISTICS

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

Electronic Components
DATA 7
Multiplier Phototube

9-STAGE, SIDE-ON TYPE

Especially Useful in Colorimetric and Spectroscopic Applications. High Sensitivity to Green-and-Blue Rich Light

General:

Spectral Response .............................................. S-8
Wavelength of Maximum Response .................. 3650 ± 500 angstroms
Cathode, Opaque ........................................ Cesium-Bismuth
Minimum projected length a . ....... 15/16”
Minimum projected width a ......... 5/16”
Window ........................................................ Lime Glass b
Dynode Material ........................................ Cesium-Antimony
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.9 ........................................... 4.4 pf
Anode to all other electrodes .......... 6.0 pf
Maximum Overall Length .............. 3-11/16”
Maximum Seated Length ................... 3-1/8”
Length from Base Seat to Center of Useful Cathode Area . . 1-15/16” ± 3/32”
Maximum Diameter ...................................... 1-5/16”
Operating Position ...................................... Any
Weight (Approx.) ........................................ 1.6 oz
Bulb ................................................................. T9
Socket ................................................... Amphenol® No.78S11T, or equivalent
Magnetic Shield ......................................... Perfection Mica Co.® No.P-101-2, or equivalent
Base .......................................................... Small-Shell Submagnal 11-Pin (JEDEC Group 2, No.B11-88), Non-hygroscopic

Basing Designation for BOTTOM VIEW ................. 11K

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

Maximum Ratings, Absolute-Maximum Values:
Supply Voltage Between Anode and Cathode (DC or Peak AC) ......... 1250 max. volts
Supply Voltage Between Dynode No.9 and Anode (DC or Peak AC) .. 250 max. volts
Supply Voltage Between Consecutive Dynodes (DC or Peak AC) ...... 250 max. volts
Supply Voltage Between Dynode No.1 and Cathode (DC or Peak AC) .. 250 max. volts
Average Anode Current a .............. 1 max. ma
Ambient Temperature ......................... 50 max. °C

---

DATA 1

Electronic Components and Devices
Harrison, N.J.

10-63
Characteristics Range Values:

Under conditions with 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>Sensitivity:</td>
<td>Radiant, at 3650 angstroms.</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>Cathode radiant, at 3650 angstroms.</td>
<td>2.3x10^{-3}</td>
</tr>
<tr>
<td></td>
<td>Luminous, at 0 cps f</td>
<td>0.115</td>
</tr>
<tr>
<td></td>
<td>Cathode luminous.</td>
<td>1.5x10^{-6}</td>
</tr>
<tr>
<td>Current Amplification.</td>
<td></td>
<td>3.3x10^{5}</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input at a luminous sensitivity of 0.4 a/lm.</td>
<td></td>
<td>7.5x10^{-9}</td>
</tr>
<tr>
<td>Equivalent Noise Input k</td>
<td></td>
<td>7.5x10^{-12}</td>
</tr>
</tbody>
</table>

With E = 750 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td>Radiant, at 3650 angstroms</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Cathode radiant, at 3650 angstroms</td>
<td>2.3x10^{-3}</td>
</tr>
<tr>
<td></td>
<td>Luminous, at 0 cps f</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>Cathode luminous.</td>
<td>1.5x10^{-6}</td>
</tr>
<tr>
<td>Current Amplification.</td>
<td></td>
<td>4.8x10^{4}</td>
</tr>
</tbody>
</table>

a On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

b Corning No.0080, Corning Glass Works, Corning, New York, or equivalent.

c Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.

d Made by Magnetic Shield Division, Perfection Mica Co., 1829 Civic Opera Bldg., 20 North Wacker Drive, Chicago 6, Illinois.

e Averaged over any interval of 30 seconds maximum.

f 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 and a light input of 10 micromometers is used.

g 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 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

h At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

i For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

j Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

→ Indicates a change.
NOTE 1: CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT CENTER OF BOTTOM OF BASE.

TYPICAL ANODE CHARACTERISTICS

VOLTS/STAGE = 100
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.
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 succeeding dynode stage; and 1/10 of E between dynode No. 9 and anode.

Sensitivity—amperes/lumen (color temp. 2870° K)

Typical Amplification

Maximum Sensitivity

Typical Sensitivity

Minimum Sensitivity

Anode-to-cathode supply volts (E)

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES EQUAL VOLTS PER STAGE. LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K. DASHED PORTION INDICATES INSTABILITY. TUBE TEMPERATURE = 25°C

EQUVALENT ANODE—DARK—CURRENT INPUT—LUMENS

LUMINOUS SENSITIVITY—AMPERES/LUMEN

92CS-9680

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Photomultiplier Tube

9-STAGE, SIDE-ON TYPE
For Detection and Measurement of Ultraviolet and Visible Radiation

GENERAL
Spectral Response............... S-5
Wavelength of Maximum Response... 3400 ± 500 angstroms
Cathode, Opaque ............. Cs-Sb
Minimum projected lengtha..... 15/16 inch
Minimum projected widtha... 5/16 inch
Window ................ Ultraviolet-Transmitting Glassb
Index of refraction at 5893 angstroms 1.47

Dynodes
Substrate ................ Ni
Secondary-emitting surface ... Cs-Sb
Structure ............... Circular Cage

Direct Interelectrode Capacitances (Approx.)
Anode to dynode No.9.............. 4.4 pF
Anode to all other electrodes ... 6.0 pF
Maximum Overall Length .......... 3-11/16 inch
Maximum Seated Length .......... 3-1/8 inch
Length from Base Seat to Center of Useful Cathode Area .......... 1-15/16 ± 3/32 inch
Maximum Diameter ............. 1-5/16 inch
Operating Position ............. Any
Weight (Approx.) ............ 1.6 oz
Envelope ................ JEDEC T9
Base .................. Small-Shell Submagnal II-Pin
(JEDEC Group 2, No.811-88), Non-hygroscopic
Socket ................ Amphenolc No.78S11T, or equivalent
Magnetic Shield .......... Millen Part No.808018, or equivalent

TERMINAL DIAGRAM (Bottom View)

Pin 1—Dynode No.1
Pin 2—Dynode No.2
Pin 3—Dynode No.3
Pin 4—Dynode No.4
Pin 5—Dynode No.5
Pin 6—Dynode No.6
Pin 7—Dynode No.7
Pin 8—Dynode No.8
Pin 9—Dynode No.9
Pin 10—Anode
Pin 11—Photocathode

Indicates a change.

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N.J.
DATA 1 4-66
### Absolute-Maximum Values

<table>
<thead>
<tr>
<th>DC or Peak AC Supply Voltage</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between anode and cathode</td>
<td>1250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between dynode No.9 and anode</td>
<td>250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between consecutive dynodes</td>
<td>250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
<td>250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average anode current</td>
<td>0.5 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>75 °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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 \( E = 1000 \text{ V} \) (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 3400</td>
<td>- ( 1.2 \times 10^5 )</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode radiant, at 3400</td>
<td>- ( 0.05 )</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous</td>
<td>- ( 17.5 )</td>
<td>100</td>
<td>500 A/Im</td>
</tr>
<tr>
<td>Cathode luminous</td>
<td>- ( 1 \times 10^{-5} )</td>
<td>-</td>
<td>A/Im</td>
</tr>
<tr>
<td>Quantum efficiency</td>
<td>-</td>
<td>19</td>
<td>%</td>
</tr>
</tbody>
</table>

| Current Amplification   | - \( 2.5 \times 10^6 \) | - | |

| Equivalent Anode-Dark- | - \( 2.5 \times 10^{-10} \) | - | 1m |
| Current Input          | - \( 2 \times 10^{-13} \) | - | 1m |

| Anode Dark Current     | - \( 5 \times 10^{-9} \) | 2.5 \( 10^{-8} \) | A |
| Equivalent Noise Input | - \( 7.5 \times 10^{-13} \) | - | 1m |
| Anode-Pulse Rise Time  | - \( 1.9 \times 10^{-9} \) | - | s |
| Electron Transit Time  | - \( 1.7 \times 10^{-8} \) | - | s |

a On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.
b Corning No.\( 9741 \), Corning Glass Works, Corning, New York, or equivalent.
c Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago, Illinois.
e Averaged over any interval of 30 seconds maximum.
f Tube operation at room temperature or below is recommended.
g This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1252 lumens per watt.
h This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1252 lumens per watt.
i 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°C and a light input of 10 microlumens is used.
j 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°C. The value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

--- Indicates a change.

**DATA 1**

RADIO CORPORATION OF AMERICA

Electronic Components and Devices

Harrison, N. J.
At a tube temperature of 22°C and with supply voltage \((E)\) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current may be reduced by use of a refrigerant.

For maximum signal-to-noise ratio, operation with a supply voltage \((E)\) below 1000 volts is recommended.

At 3400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 1252 lumen/watt.

Under the following conditions: Supply voltage \((E)\) is as shown, 22°C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870 K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

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.

**Typical Voltage-Divider Arrangement**

![Diagram](image)

\(R_1\) through \(R_{10} = 20,000\) to 1,000,000 ohms

**Note 1:** Adjustable between approximately 500 and 1250 volts.

**Note 2:** Capacitors \(C_1\) through \(C_3\) should be connected at tube socket for optimum high-frequency performance.

**Spectral-Sensitivity Characteristic of Photosensitive Device Having S-5 Response**

is shown at the front of this section.
DIMENSIONAL OUTLINE

DIMENSIONS IN INCHES

Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.
Equivalent-Noise-Input Characteristic

<table>
<thead>
<tr>
<th>VOLTS / STAGE</th>
<th>100</th>
<th>BANDWIDTH : kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIGHT SOURCE</td>
<td>TUNGSTEN, AT 2870°K INTERRUPTED AT 90 Hz</td>
<td>TO PRODUCE PULSES ALTERNATING BETWEEN ZERO AND FLUX VALUE SHOWN FOR ANY GIVEN TUBE TEMPERATURE; &quot;ON&quot; PERIOD OF PULSE EQUAL TO &quot;OFF&quot; PERIOD; RMS SIGNAL CURRENT = RMS NOISE CURRENT.</td>
</tr>
<tr>
<td>EXTERNAL SHIELD VOLTS RELATIVE TO ANODE VOLTS</td>
<td>± 1000</td>
<td></td>
</tr>
</tbody>
</table>

TUBE TEMPERATURE — °C

<table>
<thead>
<tr>
<th>-175</th>
<th>-150</th>
<th>-125</th>
<th>-100</th>
<th>-75</th>
<th>-50</th>
<th>-25</th>
<th>0</th>
<th>25</th>
<th>50</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
<td>200</td>
</tr>
</tbody>
</table>

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

DATA 3 4-66
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 succeeding dynode stage; and 1/10 of E between dynode No.9 and anode.

Sensitivity—Ampères/Lumen (Color Temp 2870°K)

Current Amplification

Supply Volts (E) between anode and cathode

92-LM-1216

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
DATA 4
4–66
Typical Effect of Magnetic Field on Anode Current

INCIDENT 0.187" DIA. LIGHT SPOT NORMAL TO AND CENTERED ON PHOTOCATHODE GRILL.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE FOR LINES OF FORCE TOWARD TUBE BASE.

Typical Time-Resolution Characteristics

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNOE NO.1; 1/10 OF E FOR EACH SUCCEEDING DYNOE STAGE; AND 1/10 OF E BETWEEN DYNOE NO.9 AND ANODE.
PHOTOCATHODE IS FULLY ILLUMINATED.
Typical Variation of Sensitivity as Tube is Rotated with Respect to Fixed Light Beam

**Supply Voltage Between Anode and Cathode = Constant**

Zero-degree rotational position of tube is established by a collimated light beam perpendicular to and filling the plane of the grill.

Tube mounted vertically with allowance made for rotation about major tube axis.

Rotational position (top view) clockwise = (-)
Rotational position (top view) counterclockwise = (+)

**Dynode Modulation Characteristics**

Anode supply volts (E) = 1000
Volts per stage except for Dynode-No.6 stage = 100

<table>
<thead>
<tr>
<th>Relative Output Current</th>
<th>Dynode-No.6 Volts (Referred to Anode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>-300</td>
</tr>
<tr>
<td>60</td>
<td>-400</td>
</tr>
<tr>
<td>40</td>
<td>-500</td>
</tr>
<tr>
<td>20</td>
<td>-600</td>
</tr>
</tbody>
</table>

**Supply Voltage**

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE = CONSTANT

ZERO-DEGREE ROTATIONAL POSITION OF TUBE IS ESTABLISHED
BY A COLLIMATED LIGHT BEAM PERPENDICULAR TO AND
FILLING THE PLANE OF THE GRILL.

TUBE MOUNTED VERTICALLY WITH ALLOWANCE MADE FOR ROTATION
ABOUT MAJOR TUBE AXIS.

ROTATIONAL POSITION (TOP VIEW) CLOCKWISE = (-)
ROTATIONAL POSITION (TOP VIEW) COUNTERCLOCKWISE = (+)

**Relative Luminous Sensitivity**

<table>
<thead>
<tr>
<th>Degree of Rotation</th>
<th>Relative Luminous Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Degrees of Rotation**

-75 -50 -25 0 25 50 75
Typical Variation of Photocathode Sensitivity Along Tube Length

- **SPOT SIZE:** 1mm DIA., APPROX.
- **VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.**

![Graph showing variation along tube length](image)

Typical Variation of Photocathode Sensitivity Across Projected Width in Plane of Grill

- **SPOT SIZE:** 1mm DIA., APPROX.
- **GRILL TOWARD OBSERVER, BASE DOWN,** CATHODE WIDTH PROJECTED NORMAL TO PLANE OF GRILL.
- **VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.**

![Graph showing variation across width](image)
Photomultiplier Tube

**9-STAGE, SIDE-ON TYPE**

For Detection and Measurement of Ultraviolet and Visible Radiation

The 1P28A is the same as the 1P28 except for the following items:

### 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**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity ( J )</td>
<td>35</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>&quot;Red-to-White&quot; Ratio</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( J \) 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 and a light input of 10 microlumens is used.

### RED-TO-WHITE RATIO

The sensitivity of the 1P28A above the wavelength of 5800 angstroms is controlled. This control is important in applications where a high-level of sensitivity in the red region of the spectral-response characteristic is required. The degree of this controlled sensitivity in the red region is specified by a "red-to-white" ratio of anode currents. Anode current is measured first using a tungsten-lamp source, and then measured with a red filter interposed between the light source and phototube.

The anode current comprising the "white" portion of this ratio is measured with a light input of 10 microlumens. The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870 °K.

The anode current comprising the "red" portion of the ratio is measured under conditions identical with the "white" measurement except that the light input of 10 microlumens is transmitted through a red filter (Corning C.S. No. 2-112-manufactured by the Corning Glass Works, Corning, N.Y., or equivalent) which has the following characteristics: the transmittance of all wavelengths from 3000 to 5790 angstroms is less than 0.5%; the 37% transmittance point lies between 6030 and 6070 angstroms; the transmittance from 6400 to 7000 angstroms is greater than 80%; and the difference between the wavelengths where transmittance is 15% and 60% is not greater than 150 angstroms.
Gas Phototube

SIDE-ON TYPE HAVING S-3 RESPONSE

DATA

General:
Spectral Response ................. S-3
Wavelength of Maximum Response........... 4200 ± 1000 angstroms

Cathode:
Shape ................. Semicylindrical
Minimum projected length* ........... 1-1/4"
Minimum projected width* ........... 5/8"
Direct Interelectrode Capacitance (Approx.) ........... 3 µf
Maximum Overall Length ........... 4-1/8"
Maximum Seated Length ........... 3-1/2"
Seated Length to Center of Cathode ........... 2-1/8" ± 3/32"

Maximum Diameter ........... 1-1/8"
Operating Position ........... Any
Weight (Approx.) ........... 1.1 oz  
Bulb. ........... T8
Socket. ........... Amphenol No. 77-MIP-4-T, or equivalent
Base. ........... Dwarf-Shell Small 4-Pin (JEDEC No. A4-26)
Basing Designation for BOTTOM VIEW ........... 2K

Pin 1—No Connection  
Pin 2—Anode  
Pin 3—No Connection  
Pin 4—Photocathode

Maximum Ratings, Absolute—Maximum Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANODE-SUPPLY VOLTAGE (DC or Peak AC)</td>
<td>80 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td>AVERAGE CATHODE-CURRENT DENSITY</td>
<td>50 max.</td>
<td>25 max.</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>10 max.</td>
<td>5 max.</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>100 max.</td>
<td>100 max.</td>
</tr>
</tbody>
</table>

Characteristics:

With an anode-supply voltage of 90 volts unless otherwise specified

Min. Median Max.

Sensitivity:
Radiant, at 4200 angstroms ........... 0.011 amp/watt
Luminous:
At 0 cps. ........... 20 40 70 µa/lumen
At 5000 cps ........... 35 31 µa/lumen
At 10000 cps ........... 9 9 µa/lumen
Gas Amplification Factor ........... 9
Anode Dark Current at 25°C ........... 0.10 µa

*Indicates a change.
Minimum Circuit Values:

With an anode-supply voltage of 80 or less 100 volts

DC Load Resistance:
- For dc currents above 5 μa... 0.1 min. - megohm
- For dc currents below 5 μa... 0 min. - megohms
- For dc currents above 3 μa... 2.5 min. megohms
- For dc currents below 3 μa... 0.1 min. megohm

a on plane perpendicular to indicated direction of incident light.
b Averaged over any interval of 30 seconds maximum.
c For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.
d The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-3 RESPONSE and FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES shown at the front of this section

DIMENSIONAL OUTLINE shown under Type IP37 also applies to the IP29

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
AVERAGE ANODE CHARACTERISTICS

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.
Gas Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:
Spectral Response ............................................. S-4
Wavelength of Maximum Response ...................... \(4000 \pm 500\) angstroms
Cathode:
Shape .................................................................. Semicylindrical
Minimum projected length\(a\) .......................... 1-1/4"
Minimum projected width\(a\) .............................. 5/8"
Direct Interelectrode Capacitance (Approx.) .... 3 \(\mu\)f
Maximum Overall Length .................................. 4-1/8"
Maximum Seated Length .................................... 3-1/2"
Seated Length to Center of Cathode .............. \(2-1/8" \pm 3/32"\)
Maximum Diameter ........................................ 1-1/8"
Operating Position ........................................Any
Weight (Approx.) ........................................... 1.1 oz
Bulb.................................................................... TB
Socket .......................................................... Amphenol No.77-MIP-4-T, or equivalent
Base ............................................................ Dwarf-Shell Small 4-Pin (JEDEC No.A4-26)
Basing Designation for BOTTOM VIEW ........ 2K

Pin 1 - No Connection
Pin 2 - Anode
Pin 3 - No Connection
Pin 4 - Photocathode

DIRECTION OF LIGHT

Maximum Ratings, Absolute-Maximum Values:

\[\begin{array}{ccc}
\text{ANODE-SUPPLY VOLTAGE} & \text{Rating I} & \text{Rating II} \\
(DC or Peak AC) & 80 \text{ max.} & 100 \text{ max.} & \text{volts} \\
\text{AVERAGE CATHODE-CURRENT DENSITY} & 50 \text{ max.} & 25 \text{ max.} & \mu\text{A/sq. in.} \\
\text{AVERAGE CATHODE CURRENT} & 10 \text{ max.} & 5 \text{ max.} & \mu\text{A} \\
\text{AMBIENT TEMPERATURE} & 75 \text{ max.} & 75 \text{ max.} & ^\circ\text{C} \\
\end{array}\]

Characteristics:

With an anode-supply voltage of 90
volts unless otherwise specified

\[\begin{array}{ccc}
\text{Min.} & \text{Median} & \text{Max.} \\
\text{Sensitivity:} & & \\
\text{Radiant, at 4000 angstroms} & - & 0.13 & - & \mu\text{A}/\mu\text{A} \\
\text{Luminous}\(^c\) & & \\
\text{At 0 cps} & 75 & 135 & 205 & \mu\text{A}/\text{lumen} \\
\text{At 5000 cps} & - & 124 & - & \mu\text{A}/\text{lumen} \\
\text{At 10000 cps} & - & 108 & - & \mu\text{A}/\text{lumen} \\
\text{Gas Amplification Factor}\(^d\) & & \\
\text{Anode Dark Current at 25^\circ C} & - & 5.5 & - & \mu\text{A} \\
\end{array}\]

\(^c\) Indicates a change.
Minimum Circuit Values:

With an anode-supply voltage of 80 or less

DC Load Resistance:
- For dc currents above 5 μA: 0.1 min. - 1 megohm
- For dc currents below 5 μA: 0 min. - 1 megohm
- For dc currents above 3 μA: 2.5 min. - 0.1 megohm
- For dc currents below 3 μA: 0.1 min. - 1 megohm

On plane perpendicular to indicated direction of incident light.
Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS
OF GAS PHOTOTUBES

are shown at the front of this section

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 5581 also applies to the 1P37

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
The 1P39 is like the 929, except that the 1P39 has a maximum dark current of 0.005 µa at 250 volts, and has a non-hygroscopic base which insures a value of resistance between anode and cathode pins about 10 times higher than conventional bases under adverse service conditions of high humidity.

--- indicates a change.

The 1P40 is like the 930, except that the 1P40 has a maximum dark current of 0.005 µa at 90 volts, and has a non-hygroscopic base which insures a value of resistance between anode and cathode pins about 10 times higher than conventional bases under adverse service conditions of high humidity.

--- indicates a change.
IP41
GAS PHOTOTUBE
HEAD-ON TYPE WITH S-I RESPONSE

General:
Spectral Response ............................................ S-1
Wavelength of Maximum Response .............. 8000 ± 1000 angstroms
Cathode:
Shape .......................................................... Circular
Minimum diameter ........................................ 9/16"
Direct Interelectrode Capacitance .............. 1.8 μf
Maximum Overall Length .......................... 2-1/16"
Maximum Seated Length .......................... 1-19/32"
Axial Distance from Bulb Top to Plane through
Periphery of Cathode Area ....................... 5/16" ± 3/32"
Maximum Diameter ........................................ 9/32"
Mounting Position .................................. Any
Weight (Approx.) ............................................. 0.3 oz
Bulb .......................................................... T6
Base .......................................................... Small-Shell Peewee 3-Pin (JETEC No.A3-1)
Basing Designation for BOTTOM VIEW .......... 2AR

Maximum Ratings, Absolute Values:

<table>
<thead>
<tr>
<th>Anode-Supply Voltage</th>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(DC or Peak AC)</td>
<td>70 max.</td>
<td>90 max.</td>
</tr>
<tr>
<td>Average Cathode-Current Density°</td>
<td>40 max.</td>
<td>20 max.</td>
</tr>
<tr>
<td>Average Cathode Current°</td>
<td>3 max.</td>
<td>1.5 max.</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>100 max.</td>
<td>100 max.</td>
</tr>
</tbody>
</table>

Characteristics, With 90 Volts on Anode:

Sensitivity:
Radiant, at
8000 angstroms .................................. 0.008 μamp/μwatt
Luminous:
At 0 cps ........................................... 50 μamp/lumen
At 5000 cps ...................................... 77 μamp/lumen
At 10000 cps ................................... 67 μamp/lumen
Gas Amplification Factor ........................ 8.5 μamp/lumen
Anode Dark Current
at 25 °C ........................................... 0.1 μamp

See next page.  → indicates a change.
Minimum Circuit Values:

With anode-supply voltage of 70 or less 90 volts

DC Load Resistance:

For dc currents above
1.5 µamp. .................. 0.1 min. \( \text{mégohm} \)

For dc currents below
1.5 µamp. .................. 0 min. \( \text{mégohm} \)

For dc currents above
1 µamp. .................. 2.5 min. \( \text{mégohms} \)

For dc currents below
1 µamp. .................. 0.1 min. \( \text{mégohms} \)

Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870 °K. A dc anode supply of 90 volts and a 1-mégohm load resistor are used. For the 0-cycle measurements, a light input of 0.06 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-I Response
and
FREQUENCY-RESPONSE CHARACTERISTICS
of Gas Phototubes
are shown at the front of this Section
AVERAGE ANODE CHARACTERISTICS

ANODE MICROAMPERES

ANODE VOLTS
Vacuum Phototube

HEAD-ON TYPE WITH S-9 RESPONSE

DATA

General:
Spectral Response: S-9
Wavelength of Maximum Response: 4800 ± 500 angstroms
Cathode, Semitransparent:
  Shape: Circular
  Window:
    Area: 0.03 sq. in.
    Minimum diameter: 0.19" 
Direct Interelectrode Capacitance: 1.9 μf
Maximum Overall Length: 1-11/32" ± 1/16"
Maximum Diameter: 1/4"
Operating Position: Any
Weight (Approx.): 0.1 oz
Bulb: T2
Terminal Diagram (See Dimensional Outline)

Small End: Anode
Large End: Cathode

Maximum Ratings, Absolute-Maximum Values:

- ANODE-SUPPLY VOLTAGE (DC or PEAK AC): 180 max. volts
- AVERAGE CATHODE-CURRENT DENSITY*: 25 max. μA/sq. in.
- AVERAGE CATHODE CURRENT*: 0.4 max. μA
- AMBIENT TEMPERATURE: 75 max. °C

Characteristics:

With an anode-supply voltage of 180 volts unless otherwise specified

- Sensitivity:
  Radiant, at 4800 angstroms: 0.025 μA/μW
  Luminous#: 20 37 70 μA/lumen
  Anode Dark Current at 25° C: 0.005 μA

* Averaged over any interval of 30 seconds maximum.
# For conditions where the light source is a tungsten-filament lamp operated a color temperature of 2870° K. The supply voltage is 180 volts, the load resistor is 1 megohm, and the light input is 0.015 lumen.

⇒ Indicates a change.
OPERATING CONSIDERATIONS

Exposure to intense illumination, such as direct sunlight, may decrease the sensitivity of the IP42 even though no voltage is applied to the tube. The magnitude and duration of the decrease depend on the length of the exposure.

Shielding of the IP42 and its leads to the amplifier is recommended when amplifier gain is high or when the phototube load resistance is high. Whenever frequency response is important in a phototube circuit, the leads from the phototube to the amplifier should be made short so as to minimize capacitance shunting of the phototube load. It is important that insulation of associated circuit parts and wiring be adequate.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-9 Response
is shown at front of this Section

NOTE: WHEN TUBE IS ROTATED ABOUT THE LONGITUDINAL AXIS OF ITS CATHODE TERMINAL, NO PART OF THE ANODE TERMINAL WILL FALL OUTSIDE OF A 0.241"-DIAMETER CIRCLE CONCENTRIC WITH THE LONGITUDINAL AXIS OF THE CATHODE TERMINAL.

92C5-679IR2

— indicates a change.
AVERAGE ANODE CHARACTERISTICS

ANODE MICROAMPERES

LIGHT FLUX, LUMENS = 0.000

0.005

0.015

0.020

0.030

0.050

0.100

0.200

ANODE VOLTS

50

100

150

200

92CM-10757

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 2
8-60
Gas Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

**DATA**

**General:**
- Spectral Response: S-1
- Wavelength of Maximum Response: 8000 ± 1000 angstroms

**Cathode:**
- Shape: Semicylindrical
- Minimum projected length*: 1-1/4"
- Minimum projected width*: 5/8"
- Direct Interelectrode Capacitance (Approx.): 3 µf
- Maximum Overall Length: 4-1/8"
- Maximum Seated Length: 3-1/2"
- Seated Length to Center of Cathode: 2-1/8" ± 3/32"
- Maximum Diameter: 1-1/8"
- Operating Position: Any
- Weight (Approx.): 1.1 oz
- Bulb: Amphenol No.77-MIP-4-T, or equivalent
- Base: Dwarf-Shell Small 4-Pin (JEDEC No.A4-26)

**Basing Designation for BOTTOM VIEW:** 2K

<table>
<thead>
<tr>
<th>Pin 1</th>
<th>No Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2</td>
<td>Anode</td>
</tr>
<tr>
<td>Pin 3</td>
<td>No Connection</td>
</tr>
<tr>
<td>Pin 4</td>
<td>Photocathode</td>
</tr>
</tbody>
</table>

**Maximum Ratings, Absolute-Maximum Values:**

<table>
<thead>
<tr>
<th></th>
<th>Rating 1</th>
<th>Rating 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANODE-SUPPLY VOLTAGE (DC or Peak AC)</td>
<td>80 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td>AVERAGE CATHODE-CURRENT DENSITY</td>
<td>50 max.</td>
<td>25 max. µA/sq. in.</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>10 max.</td>
<td>5 max. µA</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>100 max.</td>
<td>100 max. °C</td>
</tr>
</tbody>
</table>

**Characteristics:**

*With an anode-supply voltage of 90 volts unless otherwise specified*

**Min. Median Max.**

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Radiant, at 8000 angstroms</th>
<th>0.0084</th>
<th>amp/watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminous:</td>
<td>At 0 cps</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>At 5000 cps</td>
<td>-</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>At 10000 cps</td>
<td>-</td>
<td>67</td>
</tr>
<tr>
<td>Gas Amplification Factor</td>
<td>-</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current at 250° C.</td>
<td>-</td>
<td>0.1 µA</td>
<td></td>
</tr>
</tbody>
</table>

*Indicates a change.*
Minimum Circuit Values:

<table>
<thead>
<tr>
<th>DC Load Resistance:</th>
<th>80 or less</th>
<th>100 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>For dc currents above</td>
<td>5 µa.</td>
<td>0.1 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>megohm</td>
</tr>
<tr>
<td>For dc currents below</td>
<td>5 µa.</td>
<td>0 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>megohms</td>
</tr>
<tr>
<td>For dc currents above</td>
<td>3 µa.</td>
<td>2.5 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>megohms</td>
</tr>
<tr>
<td>For dc currents below</td>
<td>3 µa.</td>
<td>0.1 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>megohm</td>
</tr>
</tbody>
</table>

- **a** On plane perpendicular to indicated direction of incident radiation.
- **b** Averaged over any interval of 30 seconds maximum.
- **c** For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.
- **d** The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

**SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-I RESPONSE**

and

**FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES**

are shown at the front of this section.

**DIMENSIONAL OUTLINE**

shown under Type IP37 also applies to the 868

**AVERAGE-ANODE-CHARACTERISTICS CURVE**

shown under Type IP41 also applies to the 868
VACUUM PHOTOTUBE
LOW-LEAKAGE TYPE WITH ANODE-TERMINAL CAP AND S-I RESPONSE
For light-measuring and relay applications

DATA

General:
Spectral Response: S-I
Wavelength of Maximum Response: 8000 ± 1000 angstroms
Cathode:
Shape: Semicylindrical
Minimum projected length*: 1-9/16"
Minimum projected width*: 5/8"
Direct Inteletrode Capacitance: 2.2 µf
Maximum Overall Length: 4-7/16"
Seated Length: 3-11/16" ± 1/8"
Seated Length to Center of Cathode: 2-1/8" ± 3/32"
Maximum Diameter: 1-1/8"
Mounting Position: Any
Weight (Approx.): 1.1 oz
Bulb: Small (JETEC No.C1-1)
Cap.: Dwarf-Shell Small 4-Pin (JETEC No.A4-26)
Base: Basing Designation for BOTTOM VIEW: 1A

Maximum Ratings, Absolute Values:
ANODE-SUPPLY VOLTAGE (DC or Peak AC): 500 max. volts
AVERAGE CATHODE-CURRENT DENSITY*: 30 max. µamp/sq.in.
AVERAGE CATHODE CURRENT*: 10 max. µamp
AMBIENT TEMPERATURE: 100 max.

Characteristics, At 250 Volts on Anode:
Min. Median Max.
Sensitivity:
Radiant, at 8000 angstroms: 0.0018 µamp/µwatt
Luminous*: 12 20 40 µamp/Tumen
Anode Dark Current: 0.005 µamp
at 25°C

* On plane perpendicular to indicated direction of incident light.
  - Averaged over any interval of 30 seconds maximum.
  - For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-I Response is shown at front of this Section.

DATA
Gas Phototube

**SIDE-ON TYPE HAVING S-1 RESPONSE**

**DATA**

**General:**
- Spectral Response: S-1
- Wavelength of Maximum Response: $8000 \pm 1000$ angstroms

**Cathode:**
- Shape: Semicylindrical
- Minimum projected length: 1-1/4”
- Minimum projected width: 5/8”
- Direct interelectrode capacitance (Approx.): 3 $\mu$F
- Maximum Overall Length: 4-1/8”
- Maximum Seated Length: 3-1/2”
- Seated Length to Center of Cathode: 2-1/8” $\pm$ 3/32”
- Maximum Diameter: 1-1/8”
- Operating Position: Any
- Weight (Approx.): 1.1 oz

**Bulb:**
- T8

**Socket:**
- Amphenol No.77-MIP-4-T, or equivalent

**Base:**
- Dwarf-Shell Small 4-Pin (JEDEC No.A4-26)

**Basing Designation for BOTTOM VIEW:**
- 2K

**Pin 1 - No Connection**
**Pin 2 - Anode**
**Pin 3 - No Connection**
**Pin 4 - Photocathode**

**Maximum Ratings, Absolute-Maximum Values:**

<table>
<thead>
<tr>
<th>Rating 1</th>
<th>Rating 2</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 max.</td>
<td>90 max.</td>
<td>ANODE-SUPPLY VOLTAGE (DC or Peak AC)</td>
</tr>
<tr>
<td>50 max.</td>
<td>25 max.</td>
<td>AVERAGE CATHODE-CURRENT DENSITY</td>
</tr>
<tr>
<td>10 max.</td>
<td>5 max.</td>
<td>AVERAGE CATHODE CURRENT</td>
</tr>
<tr>
<td>100 max.</td>
<td>100 max.</td>
<td>AMBIENT TEMPERATURE</td>
</tr>
</tbody>
</table>

**Characteristics:**

- With an anode-supply voltage of 90 volts unless otherwise specified

**Min. Median Max.**

**Sensitivity:**
- Radiant, at 8000 angstroms: 0.014 amp/watt
- Luminous:
  - At 0 cps: 120 $\mu$a/lumen
  - At 5000 cps: 120 $\mu$a/lumen
  - At 10000 cps: 105 $\mu$a/lumen
- Gas Amplification Factor: 10.5
- Anode Dark Current at 25° C: 0.1 $\mu$a

- Indicates a change.

**RADIO CORPORATION OF AMERICA**
Electron Tube Division
Harrison, N. J.

DATA 3-61
Minimum Circuit Values:

With an anode-supply voltage of

<table>
<thead>
<tr>
<th>DC Load Resistance:</th>
<th>70 or less</th>
<th>90</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>For dc currents above</td>
<td>0.1 min.</td>
<td>-</td>
<td>megohm</td>
</tr>
<tr>
<td>For dc currents below</td>
<td>0 min.</td>
<td>-</td>
<td>megohms</td>
</tr>
<tr>
<td>For dc currents above</td>
<td>2.5 min.</td>
<td>2.5</td>
<td>megohms</td>
</tr>
<tr>
<td>For dc currents below</td>
<td>0.1 min.</td>
<td>0.1</td>
<td>megohm</td>
</tr>
</tbody>
</table>

a. On plane perpendicular to indicated direction of incident radiation.

b. Averaged over any interval of 30 seconds maximum.

c. For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

d. The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSSENSITIVE DEVICE HAVING S-1 RESPONSE and FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES are shown at the front of this section.

DIMENSIONAL OUTLINE shown under Type IP37 also applies to the 918. 

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
AVERAGE ANODE CHARACTERISTICS

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.
VACUUM PHOTOTUBE
LOW-LEAKAGE TYPE WITH CATHODE-TERMINAL CAP AND S-1 RESPONSE
For light-measuring and relay applications

The 919 is the same as the 917 except for the following item:

General:
Base . . . . . Dwarf-Shell Small 4-Pin (JETEC No. A4-26)
Basing Designation for BOTTOM VIEW . . . . . . . . . . . . . . . 1B

Pin 1 - No Connection
Pin 2 - Anode
Pin 3 - No Connection
Pin 4 - No Connection
Cap - Cathode

DIRECTION OF LIGHT

DIVISION RACOR CORPORATION OF AMERICA, HARRISON, NEW JERSEY.
Gas Phototube

SIDE-ON, TWIN-UNIT TYPE HAVING S-I RESPONSE

DATA

General:
Spectral Response ........................................... S-1
Wavelength of Maximum Response .................. 8000 ± 1000 angstroms
Cathode (Each):
Shape ........................................................ Quarter-Cylindrical
Minimum projected length a .......................... 1-3/16"
Minimum projected width a .......................... 1/4"
Direct Interelectrode Capacitances (Approx.):
Cathode to cathode b .................................. 1.8 µµf
Cathode to anode c ...................................... 1.6 µµf
Anode to anode d ........................................ 0.4 µµf
Maximum Overall Length .................................. 4"
Maximum Seated Length ................................... 3-3/8"
Seated Length to Center of Cathodes .............. 2-1/8" ± 3/32"
Maximum Diameter ......................................... 1-3/16"
Operating Position ......................................... Any
Weight (Approx.) ........................................... 1.1 oz
Bulb ............................................................... T9
Socket ........................................................ Amphenol No.77-M1P-4-T, or equivalent
Base .......................................................... Small-Shell Small 4-Pin (JEDEC No.A4-5)
Basing Designation for BOTTOM VIEW ...................... 48G

Pin 1 – Photocathode of Unit No.2
Pin 2 – Anode of Unit No.2
Pin 3 – Anode of Unit No.1
Pin 4 – Photocathode of Unit No.1

DIRECTION OF RADIATION

Maximum Ratings, Absolute-Maximum Values:
Values are for Each Unit

<table>
<thead>
<tr>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANODE-SUPPLY VOLTAGE (DC or Peak AC)</td>
<td>70 max.</td>
</tr>
<tr>
<td>AVERAGE CATHODE-CURRENT</td>
<td></td>
</tr>
<tr>
<td>DENSITY e</td>
<td>30 max.</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT e</td>
<td>4 max.</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>100 max.</td>
</tr>
</tbody>
</table>

°C

µa/sq.in.

volts

µµf

µµf

µµf

°C

Indicates a change.
Characteristics:

Values are for each unit with an anode-supply voltage of 90 volts unless otherwise specified.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 8000 angstroms.</td>
<td>0.0094</td>
<td>0.0094</td>
<td></td>
</tr>
<tr>
<td>Luminous:*</td>
<td>50</td>
<td>100</td>
<td>175</td>
</tr>
<tr>
<td>At 0 cps.</td>
<td>100</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>At 5000 cps</td>
<td>85</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>At 10000 cps</td>
<td>74</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Ratio of Luminous Sensitivities</td>
<td>0.5</td>
<td>1.15</td>
<td>2.0</td>
</tr>
<tr>
<td>(Unit No.1 to Unit No.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Amplification Factor</td>
<td>-</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Anode Dark Current at 25°C</td>
<td>-</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Minimum Circuit Values:**

Values are for each unit.

With an anode-supply voltage of

- **70 or less**
- **90**
- **volts**

DC Load Resistance:

- For dc currents above 2 μa. | 0.1 min. |
- For dc currents below 2 μa. | 0 min. |
- For dc currents above 1 μa. | 2.5 min. |
- For dc currents below 1 μa. | 0.1 min. |

- On plane perpendicular to indicated direction of incident radiation.
- With anodes grounded.
- Each unit, with other unit grounded.
- With cathodes grounded.
- Averaged over any interval of 30 seconds maximum.
- For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.04 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.
- The ratio of luminous sensitivity at an anode-supply voltage of 90 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.04 lumen, and the load resistor has a value of 1 megohm.

**SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-I RESPONSE**

**and**

**FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES**

are shown at the front of this section.

**DIMENSIONAL OUTLINE**

shown under Type 5584 also applies to the 920
AVERAGE ANODE CHARACTERISTICS
Each Unit

LIGHT SOURCE IS A TUNGSTEN—FILAMENT
LAMP OPERATED AT COLOR TEMPERATURE
OF 2870° K.
GAS PHOTOTUBE
CARTRIDGE TYPE WITH S-1 RESPONSE
For relay applications

DATA

General:
Spectral Response: S-1
Wavelength of Maximum Response: 8000 ± 1000 angstroms

Cathode:
Shape: Semicylindrical
Minimum projected length*: 7/8"
Minimum projected width*: 1/2"
Direct Interelectrode Capacitance: 1 µµf
Overall Length: 1-21/32" ± 1/16"
Seated Length: 1-13/32" ± 1/32"
Length from Center of Useful Cathode Area to Plane A-A' (See Dimensional Outline): 11/16" ± 1/16"
Maximum Diameter: 0.890"
Weight (Approx.): 0.4 oz
Mounting Position: Any
Terminals:
Recessed cap: JETEC No. J1-23
Protruding cap: JETEC No. J1-24
Basing Designation: 2A0

Recessed Cap} Anode Protruding Cap} Cathode

DIRECTION OF LIGHT: INTO CONCAVE SIDE OF CATHODE

Maximum Ratings, Absolute Values:
ANODE-SUPPLY VOLTAGE (DC or Peak AC): 90 max. volts
AVERAGE CATHODE-CURRENT DENSITY°: 30 max. µamp/sq.in.
AVERAGE CATHODE CURRENT°: 3 max. µamp
AMBIENT TEMPERATURE: 100 max. °C

Characteristics, At 90 Volts on Anode:

Min. Median Max.
Sensitivity:
Radiant, at 8000 angstroms: 0.012 µamp/µwatt
Luminous:
At 0 cps: 75 135 205 µamp/lumen
At 5000 cps: 119
At 10000 cps: 108
Gas Amplification Factor: 10
Anode Dark Current at 25°C: 0.01 µamp

° Indicates a change.

* on plane perpendicular to indicated direction of incident light.

0.4: See next page.
Minimum Circuit Values:

With anode-supply voltage of 70 or less 90 volts

DC Load Resistance:
For dc currents above
3 µamp ............. 0.1 min. — megohm
For dc currents below
3 µamp ............. 0 min. — megohm
For dc currents above
2 µamp ............. — 2.5 min. megohms
For dc currents below
2 µamp ............. — 0.1 min. megohm

Averaged over any interval of 30 seconds maximum. This value may be doubled when anode-supply voltage is limited to 70 volts.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K, a dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurements, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-I Response and
FREQUENCY-RESPONSE CHARACTERISTICS of Gas Phototubes are shown at the front of this Section

AVERAGE ANODE CHARACTERISTICS for Type 921 are the same as those shown for Type 830...
VACUUM PHOTOTUBE
CARTRIDGE TYPE WITH S-I RESPONSE
For relay applications

DATA

General:
Spectral Response .... S-I
Wavelength of Maximum Response .... 8000 ± 1000 angstroms

Cathode:
Shape .... Semicylindrical
Minimum projected length .... 5/8"
Minimum projected width .... 1/2"
Direct Interelectrode Capacitance .... 1 µf
Overall Length .... 1-21/32" + 1/32" - 1/16"
Seated Length .... 1-13/32" ± 1/32"
Length from Center of Useful Cathode Area to Plane A-A' (See Dimensional Outline) .... 11/16" ± 1/16"
Maximum Diameter .... 0.890"
Mounting Position .... Any
Weight (Approx.) .... 0.4 oz

Terminals:
Recessed cap .... JETEC No.J1-23
Protruding cap .... JETEC No.J1-24
Basing Designation .... 2AQ

Maximum Ratings, Absolute Values:
ANODE-SUPPLY VOLTAGE (DC or Peak AC) .... 500 max. volts
AVERAGE CATHODE-CURRENT DENSITY .... 30 max. µamp/sq.in.
AVERAGE CATHODE CURRENT .... 5 max. µamp
AMBIENT TEMPERATURE .... 100 max. °C

Characteristics, At 250 Volts on Anode:

Min. Median Max.

Sensitivity:
Radiant, at 8000 angstroms .... 0.0018 µamp/µwatt
Luminous .... 10 20 40 µamp/lumen
Anode Dark Current .... 0.005 µamp

* On plane perpendicular to indicated direction of incident light.
∞ Averaged over any interval of 30 seconds maximum.
△ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

= indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
VACUUM PHOTOTUBE

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-I Response is shown at the front of this Section

AVERAGE ANODE CHARACTERISTICS for Type 922 are the same as those shown for Type 917
923
GAS PHOTOTUBE
WITH S-1 RESPONSE

DATA

General:
Spectral Response .................. S-1
Wavelength of Maximum Response. ... 8000 ± 1000 Angstroms
Cathode:
Shape .................. Semi-Cylindrical
Minimum Projected Length* .......... 3/16"
Minimum Projected Width* .......... 5/8"
Direct Interelectrode Capacitance .... 2 μf
Maximum Overall Length. ........... 3-9/16"
Maximum Seated Length ............. 2-15/16"
Seated Length to Center of Cathode. .... 1-31/32" ± 3/32"
Maximum Diameter. .............. 1-3/16"
Bulb. ...................................... T-9
Mounting Position ................... Any
Base. ................................. Small-Shell Small 4-Pin
Basing Designation for BOTTOM VIEW: ... 2K

Pin 1 - No Connection
Pin 2 - Anode
Pin 3 - No Connection
Pin 4 - Cathode

Maximum Ratings, Characteristics, and Curves for the 923 are the same as those shown for Type 930.

* On plane perpendicular to indicated direction of incident light.

Indicates a change.

AUGUST 15, 1947
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

DATA
Vacuum Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

**General:**
Spectral Response: S-1
Wavelength of Maximum Response: $8000 \pm 1000$ angstroms

**Cathode:**
Shape: Semicylindrical
Minimum projected length: $13/16"$
Minimum projected width: $5/8"
Direct Interelectrode Capacitance (Approx.): $1.6 \mu f$
Maximum Overall Length: $2-5/8"$
Maximum Seated Length: $2-1/16"$
Seated Length to Center of Cathode: $1-13/32" \pm 3/32"$
Maximum Diameter: $1-9/32"$
Operating Position: Any
Weight (Approx.): 0.8 oz
Bulb: Cinch No. BJM-1, or equivalent
Base: Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No. 85-10)

**Maximum Ratings, Absolute-Maximum Values:**
ANODE-SUPPLY VOLTAGE (DC or Peak AC): 250 max. volts
AVERAGE CATHODE-CURRENT DENSITY: 30 max. $\mu A/$sq.in.
AVERAGE CATHODE CURRENT: 5 max. $\mu A$
AMBIENT TEMPERATURE: 100 max. $^\circ C$

**Characteristics:**

*With an anode-supply voltage of 250 volts*

<table>
<thead>
<tr>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 8000 angstroms:</td>
<td>0.0019</td>
<td>$\text{amp/watt}$</td>
</tr>
<tr>
<td>Luminous:</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Anode Dark Current at 25$^\circ$ C:</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

$\text{indicates a change.}$
On plane perpendicular to indicated direction of radiation.

Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°C. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTORESISTIVE DEVICE HAVING S-I RESPONSE
is shown at the front of this section.
**VACUUM PHOTOTUBE**

**CARTRIDGE TYPE WITH S-3 RESPONSE**

For colorimetric applications

---

**DATA**

**General:**

Spectral Response, ............................................. S-3
Wavelength of Maximum Response ......................... 4200 ± 1000 angstroms

**Cathode:**

Shape .......................................................... Semicircular
Minimum projected length* ............................... 7/8"
Minimum projected width* ............................... 1/2"
Direct Interelectrode Capacitance ...................... 1 µµf
Overall Length .............................................. 1-21/32" ± 1/16"
Seated Length .............................................. 1-13/32" ± 1/32"
Length from Center of Useful Cathode Area to Plane A-A' (See Dimensional Outline) ..... 11/16" ± 1/16"
Maximum Diameter .......................................... 0.890"
Weight (Approx.) ........................................... 0.4 oz
Mounting Position .......................................... Any
Terminals:
Recessed cap ................................................ JETEC No. J1-23
Protruding cap ............................................. JETEC No. J1-24
Basing Designation ......................................... 2AQ

**Maximum Ratings, Absolute Values:**

- **ANODE-SUPPLY VOLTAGE (DC or Peak AC):** 500 max. volts
- **AVERAGE CATHODE-CURRENT DENSITY**: 30 max. µamp/sq.in.
- **AVERAGE CATHODE CURRENT**: 5 max. µamp
- **AMBIENT TEMPERATURE**: 100 max. °C

**Characteristics, At 250 Volts on Anode:**

<table>
<thead>
<tr>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4200 angstroms</td>
<td>-</td>
<td>0.0018</td>
</tr>
<tr>
<td>Luminous</td>
<td>4</td>
<td>6.5</td>
</tr>
<tr>
<td>Anode Dark Current at 25°C.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* On plane perpendicular to indicated direction of incident light.
O Averaged over any interval of 30 seconds maximum.
△ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

---

12-56

**TUBE DIVISION**

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Anode Microamperes

Average Anode Characteristics

For Type 926 is the same as that shown for Type 921

Vacuum Phototube
Gas Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:
Spectral Response: ................. S-1
Wavelength of Maximum Response: ....... 6000 ± 1000 angstroms

Cathode:
Shape: .................. Semicylindrical
Minimum projected length*: ............ 11/16"
Minimum projected width*: ............... 7/16"
Direct Interelectrode Capacitance (Approx): ...................... 2 μf
Maximum Overall Length: .. .............. 2-13/32"
Maximum Seated Length: ................. 1-15/16"
Seated Length to Center of Cathode: ....... 1-1/4" ± 3/32"
Maximum Diameter: ..................... 0.669"
Operating Position: .......... Any
Weight (Approx.): .................. 0.3 oz
Bulb: .................................. T5-1/4
Socket: .............. Amphenol No. 78S3S-T, or equivalent
Base: ................... Small-Shell Peewee 3-Pin (JEDEC No. A3-1)
Basing Designation for BOTTOM VIEW: .............. 2F

DIRECTION OF RADIATION

Pin 1—No Internal Connection
Pin 2—Anode
Pin 3—Photocathode

Maximum Ratings, Absolute-Maximum Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANODE-SUPPLY VOLTAGE (DC or Peak AC)</td>
<td>70 max.</td>
<td>90 max.</td>
</tr>
<tr>
<td>Voltage</td>
<td>volts</td>
<td>volts</td>
</tr>
<tr>
<td>AVERAGE CATHODE-CURRENT DENSITYb</td>
<td>60 max.</td>
<td>30 max.</td>
</tr>
<tr>
<td>Density</td>
<td>μA/sq.in.</td>
<td>μA/sq.in.</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENTb</td>
<td>4 max.</td>
<td>2 max.</td>
</tr>
<tr>
<td>Current</td>
<td>μA</td>
<td>μA</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>100 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>°C</td>
</tr>
</tbody>
</table>

Characteristics:

With an anode-supply voltage of 90 volts unless otherwise specified

Sensitivity:
Radiant, at 8000 angstroms .......... 0.012 amp/watt

*Indicates a change.

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 1
3-62
Luminous:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 cps</td>
<td>75 µa/lumen</td>
<td>125 µa/lumen</td>
<td>185 µa/lumen</td>
</tr>
<tr>
<td>5000 cps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10000 cps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gas Amplification Factor:
- 10

Anode Dark Current at 25°C:
- 0.1 µa

Minimum Circuit Values:

With an anode-supply voltage of 70 or less...

- 90 volts

DC Load Resistance:
- For dc currents above 2 µa: 0.1 min.
- For dc currents below 2 µa: 0 min.
- For dc currents above 1 µa: 2.5 min.
- For dc currents below 1 µa: 0.1 min.

- a On plane perpendicular to indicated direction of radiation.
- b Averaged over any interval of 30 seconds maximum.
- c For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.
- d The ratio of luminous sensitivity at an anode-supply voltage of 90 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-I RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS
OF GAS PHOTOTUBES

are shown at the front of this section.
AVERAGE ANODE CHARACTERISTICS

Light source is a tungsten-filament lamp operated at color temperature of 2870° K.
Vacuum Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:
Spectral Response. ......................................... S-4
Wavelength of Maximum Response ..................... 4000 ± 500 angstroms
Cathode:
Shape. ......................................................... Semicylindrical
Minimum projected length* ........................ 13/16"
Minimum projected width* ............................. 5/8"
Direct Interelectrode Capacitance (Approx.) ........ 2.6 µf
Maximum Overall Length ................................ 3-1/16"
Maximum Seated Length .................................. 2-1/2"
Seated Length to Center of Cathode ................. 1-5/8" ± 3/32"
Maximum Diameter ........................................ 1-9/32"
Operating Position ........................................ Any
Weight (Approx.) ........................................... 0.9 oz
Bulb ................................................................ T9
Socket ............................................................... Cinch No. 8 JM-1, or equivalent
Base ............................................................... Intermediate—Shell Octal 5-Pin, Arrangement 1

Basing Designation for BOTTOM VIEW ................. 3J

Maximum Ratings, Absolute—Maximum Values:

AVERAGE CATHODE-DENSITY Density ................. 25 max. µA/sq.in.
AVERAGE CATHODE CURRENT ......................... 5 max. µA
AMBIENT TEMPERATURE ................................. 75 max. °C

Characteristics:

With an anode-supply voltage of 250 volts

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4000 angstroms.</td>
<td>0.044</td>
<td>0.044</td>
<td>0.044</td>
</tr>
<tr>
<td>Luminous*</td>
<td>25</td>
<td>45</td>
<td>70</td>
</tr>
<tr>
<td>Anode Dark Current at 25° C.</td>
<td>-</td>
<td>0.0125</td>
<td>µA</td>
</tr>
</tbody>
</table>

* Indicates a change.

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 1
11-62
On plane perpendicular to indicated direction of radiation.

Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

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

DIMENSIONAL OUTLINE
shown under Type 5581 also applies to the 929
AVERAGE ANODE CHARACTERISTICS

ANODE MICROAMPERES

ANODE VOLTS

LIGHT FLUX LUMENS 0.02 0.04 0.06 0.08

92CM-6151RI
Gas Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:
Spectral Response: S-1
Wavelength of Maximum Response: 8000 ± 1000 angstroms

Cathode:
Shape: Semicylindrical
Minimum projected length: 13/16"
Minimum projected width: 5/8"
Direct Interelectrode Capacitance (Approx.): 2.4 μf
Maximum Overall Length: 3-1/16"
Maximum Seated Length: 2-1/2"
Seated Length to Center of Cathode: 1-5/8" ± 3/32"
Operating Position: Any
Weight (Approx.): 0.9 oz
Bulb: Cinch No. BJM-1, or equivalent
Socket: Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No. 85-10)

Base: 3J

Basing Designation for BOTTOM VIEW:

Pin 1 - No Connection
Pin 2 - No Connection
Pin 4 - Anode
Pin 6 - No Connection
Pin 8 - Photocathode

Maximum Ratings, Absolute-Maximum Values:

<table>
<thead>
<tr>
<th></th>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode-Supply Voltage</td>
<td>70 max.</td>
<td>90 max.</td>
</tr>
<tr>
<td>(DC or Peak AC)</td>
<td>volts</td>
<td>volts</td>
</tr>
<tr>
<td>Average Cathode-CURRENT</td>
<td>60 max.</td>
<td>30 max.</td>
</tr>
<tr>
<td>Density</td>
<td>μa/sq. in.</td>
<td></td>
</tr>
<tr>
<td>Average Cathode Current</td>
<td>6 max.</td>
<td>3 max.</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>100 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td></td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

Characteristics:

With an anode-supply voltage of 90 volts unless otherwise specified

Min. Median Max.

Sensitivity:
Radiant, at 8000 angstroms: 0.013 → amp/watt→

Indicates a change.
**Luminous:**
- At 0 cps: 90, 135, 205 μa/lumen
- At 5000 cps: 111, 101 μa/lumen
- At 10000 cps: 100 μa/lumen

**Gas Amplification Factor:**
- 10

**Anode Dark Current at 25°C:**
- 0.1 μa

**Minimum Circuit Values:**

**With an anode-supply voltage of 70 or less:** 90 volts

**DC Load Resistance:**
- For dc currents above 3 μa: 0.1 min. → megohm
- For dc currents below 3 μa: 0 min. → megohms
- For dc currents above 2 μa: 2.5 min. → megohms
- For dc currents below 2 μa: 1 min. → megohms

---

**SPECTRAL-SENSITIVITY CHARACTERISTIC**

**OF PHOTOSENSITIVE DEVICE HAVING S-I RESPONSE**

**and**

**FREQUENCY-RESPONSE CHARACTERISTICS**

**OF GAS PHOTOTUBES**

are shown at the front of this section

**DIMENSIONAL OUTLINE**

shown under Type 5581 also applies to the 980

---

**RADIO CORPORATION OF AMERICA**

Electron Tube Division

Harrison, N. J.
AVERAGE ANODE CHARACTERISTICS

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.
Photomultiplier Tube

9-Stage, Side-On Type Having
S-4 Spectral Response

For general purpose applications in low-light level
detection and measurement systems.

GENERAL

Spectral Response .................................. S-4
Wavelength of Maximum Response .... 4000 ± 500 angstroms
Cathode, Opaque ................................. Cesium-Antimony
Minimum projected length\(^a\) ........ 0.94 in (2.4 cm)
Minimum projected width\(^a\) ........ 0.31 in (0.8 cm)
Window .................................. Lime Glass (Corning\(^b\) No. 0080),
or equivalent

Index of refraction at 4360 angstroms ........ 1.523

Dynodes:
Substrate .................................. Nickel
Secondary-Emitting Surface ........................ Cesium-Antimony
Structure .................................. Circular-Cage, Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.9 .................. 4.4 pF
Anode to all other electrodes .......... 6.0 pF
Maximum Overall Length ............... 3.68 in (9.3 cm)
Seated Length .............................. 3.12 in (7.9 cm)
Maximum Diameter ...................... 1.31 in (3.3 cm)

Base .................................. Small-Shell Submagnal 11 Pin, (JEDEC Group 2,
No. B11-88), Non-hygroscopic
Socket .................................. Amphenol\(^c\) No. 78S11T, or equivalent
Magnetic Shield ............................ Millen\(^d\) No. 80801B, or equivalent

Operating Position ...................... Any

Weight (Approx.) ...................... 1.6 oz

MAXIMUM RATINGS, Absolute-Maximum Values

DC or Peak AC Supply Voltage:
Between anode and cathode .................. 1250 max. V
Between anode and dynode No.9 ........ 250 max. V
Between consecutive dynodes ............ 250 max. V
Between dynode No.1, and cathode ........ 250 max. V
Average Anode Current \( f \) .................................. 1.0 max. mA
Ambient Temperature \( g \) .................................. +75 max. °C

**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>Characteristic</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant ( h ) at 4000 angstroms</td>
<td>- 8.3 x 10^4</td>
<td></td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous ( i ) (2870° K)</td>
<td>10</td>
<td>80</td>
<td>600</td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant ( k ) at 4000 angstroms</td>
<td>- 0.04</td>
<td></td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous ( m ) (2870° K)</td>
<td>- 4 x 10^{-5}</td>
<td></td>
<td>A/Im</td>
</tr>
<tr>
<td>Quantum Efficiency at 3800 angstroms</td>
<td>- 13</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td><strong>Current Amplification</strong></td>
<td>- 2 x 10^6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anode Dark Current</strong></td>
<td>- 5 x 10^{-9}</td>
<td>5 x 10^{-8}</td>
<td>A</td>
</tr>
<tr>
<td><strong>Equivalent Anode Dark Current</strong></td>
<td>- 2.5 x 10^{-10}</td>
<td>2.5 x 10^{-9}</td>
<td>lm</td>
</tr>
<tr>
<td>Input ( n )</td>
<td>- 2.4 x 10^{-13}</td>
<td>2.4 x 10^{-12}</td>
<td>W</td>
</tr>
<tr>
<td><strong>Equivalent Noise Input</strong></td>
<td>- 3 x 10^{-12}</td>
<td></td>
<td>lm</td>
</tr>
<tr>
<td>Input ( q )</td>
<td>- 2 x 10^{-15}</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Time</strong></td>
<td>- 1.6 x 10^{-9}</td>
<td></td>
<td>s</td>
</tr>
<tr>
<td><strong>Electron Transit Time</strong></td>
<td>- 1.6 x 10^{-8}</td>
<td></td>
<td>s</td>
</tr>
</tbody>
</table>

\( a \) On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

\( b \) Made by Corning Glass Works, Corning, NY 14830.

\( c \) Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 50, IL 60650.

\( d \) Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

\( f \) Averaged over any interval of 30 seconds maximum.

---

Made by RCA Electronic Components

**DATA 1**
Tube operation at room temperature or below is recommended.

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1036 lumens per watt.

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 and a light input of 10 microlumens is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1036 lumens per watt.

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 and a light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

At 4000 angstroms. These values are calculated from the EADCl values in lumens using a conversion factor of 1036 lumens per watt.

Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The “on” period of the pulse is equal to the “off” period.

At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1036 lumens per watt.

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.

**DIMENSIONAL OUTLINE**

Dimensions are in inches unless otherwise stated.

<table>
<thead>
<tr>
<th>Inch Dimension Equivalents in Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
</tr>
<tr>
<td>.09</td>
</tr>
<tr>
<td>.190</td>
</tr>
<tr>
<td>.250</td>
</tr>
<tr>
<td>.270</td>
</tr>
</tbody>
</table>

*The bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.*
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

R₁ through R₁₀ = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

Note 2: Capacitors C₁ through C₃ should be connected at tube socket for optimum high-frequency performance.
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH

SPOT SIZE: 1 MM DIA., APPROX.
VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.

TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL

SPOT SIZE: 1 MM DIA., APPROX.
GRILL TOWARD OBSERVER, BASE DOWN.
CATHODE WIDTH PROJECTED NORMAL TO PLANE OF GRILL.
VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.
TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM

Supply voltage between anode and cathode = constant
Zero-degree rotational position of tube is established by a collimated light beam perpendicular to and filling the plane of the grill.
Tube mounted vertically with allowance made for rotation about major tube axis.
Rotational position (top view) clockwise = (-)
Rotational position (top view) counterclockwise = (+)

TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-NO.6 VOLTS

Anode supply volts (E) x 1000
Volts per stage except for dynode-No.6 stage = 100

Electronic Components
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF SIMULTANEOUS MODULATION OF DYNODES NO. 5 AND NO. 6

Anode - TD - Dynode No. 9 Volts = 200
Volts per succeeding dynode stage except for dynodes No. 5 and No. 6 = 100
A constant voltage difference of 100 Volts is maintained between dynodes No. 5 and No. 6 during modulation. Anode is at ground potential.

Relative anode current

-600 8 6 4 2 -500 8 6 4 2
Dynode - No. 5 Volts (referred to anode)

92CM-11375
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 SUCCEEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE No. 9 AND ANODE.
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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 is fully illuminated. Uniform magnetic field parallel to major axis of tube. Positive values of magnetic flux are for lines of force toward tube base. Tube is degaussed prior to test and is again degaussed before flux direction is changed.

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 is fully illuminated.
TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS

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
Vacuum Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:
Spectral Response .......................................................... S-4
Wavelength of Maximum Response ................................. $4000 \pm 500 \text{ angstroms}$

Cathode:
Shape .................................................. Semicylindrical
Minimum projected length $a$ .................................. $11/16''$
Minimum projected width $a$ .................................. $7/16''$
Direct Interelectrode Capacitance (Approx.) .................. $1.5 \mu\text{f}$
Maximum Overall Length ........................................... 2-13/32''
Maximum Seated Length ............................................. 1-15/16''
Seated Length to Center of Cathode ......................... 1-1/4'' $\pm$ 3/32''
Maximum Diameter .................................................. 0.669''
Operating Position ................................................. Any
Weight (Approx.) ................................................. 0.4 oz
Bulb ............................................................... T5-1/4
Socket ......................................................... Amphenol No. 78535-T, or equivalent
Base ............................................................. Small-Shell Peewee 3-Pin (JEDEC No.A3-1)
Basing Designation for BOTTOM VIEW .................... 2F

Pin 1 - No Internal Connection
Pin 2 - Anode
Pin 3 - Photocathode

Direction of Light

Maximum Ratings, Absolute-Maximum Values:

ANODE-SUPPLY VOLTAGE (DC or Peak AC) .................. 250 max. volts
AVERAGE CATHODE-CURRENT DENSITY $b$ ................. 30 max. $\mu\text{A}/\text{sq. in.}$
AVERAGE CATHODE CURRENT $b$ .................................. 4 max. $\mu\text{A}$
AMBIENT TEMPERATURE .......................................... 75 max. $^\circ\text{C}$

Characteristics:

With an anode-supply voltage of 50 volts

Min. Median Max.

Sensitivity:
Radiant, at 4000 angstroms ................................. 0.020 $\mu\text{A}/\text{watt}$
Luminous $c$ .................................................. 19 $\mu\text{A}$/lumen
Anode Dark Current at 25$^\circ$C .............................. 0.005 $\mu\text{A}$

--- Indicates a change.
On plane perpendicular to indicated direction of incident light.
Averaged over any interval of 30 seconds maximum.
For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

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

DIMENSIONAL OUTLINE
shown under Type 927 also applies to the 934.
AVERAGE ANODE CHARACTERISTICS

LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.

ANODE MICRAMPERES

ANODE VOLTS

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
DATA 2
3-62
Vacuum Phototube

SIDE-ON TYPE HAVING S-5 RESPONSE

DATA

General:
Spectral Response. ....................................... S-5
Wavelength of Maximum Response .......................... 3400 ± 500 angstroms

Cathode:
Shape. .................................................. Semicylindrical
Minimum projected length .......................... 1-5/16"
Minimum projected width .......................... 5/8"

Direct Interelectrode Capacitance (Approx.). ...... 0.6 μf
Maximum Overall Length .......................... 4-1/4"
Seated Length .......................................... 3-9/16" ± 1/8"
Seated Length to Center of Cathode .................. 2" ± 1/16"
Maximum Diameter .......................... 1-9/32"

Operating Position ...................................... Any
Weight (Approx.) ......................................... 1 oz
Bulb .......................................................... T9
Cap. .................................................. Skirted Miniature (JEDEC No.C1-3)
Socket .................................................. Cinch No.8JM-1, or equivalent
Base .................................................. Intermediate-Shell Octal 5-Pin, Arrangement 1

Basing Designation for BOTTOM VIEW .................. 1C

Maximum Ratings, Absolute—Maximum Values:

ANODE—SUPPLY VOLTAGE
(DC or Peak AC). ......................................... 250 max. volts
AVERAGE CATHODE—CURRENT DENSITY\textsuperscript{b} ............. 30 max. μa/sq.in.
AVERAGE CATHODE CURRENT\textsuperscript{b} .......................... 10 max. μa
AMBIENT TEMPERATURE ..................................... 75 max. °C

Characteristics:

With an anode—supply voltage of 250 volts

Sensitivity:
Radiant, at 3400 angstroms .......................... 0.043 amp/watt
Luminous\textsuperscript{c} .................................. 18 35 70 μa/lumen
Anode Dark Current at 25° C. ......................... 0.0005 μa

\textsuperscript{a} Indicates a change.

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 5-62
a On plane perpendicular to indicated direction of radiation.
b Averaged over any interval of 30 seconds maximum.
c For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

**SPECTRAL-SENSITIVITY CHARACTERISTIC**
**OF PHOTOSENSITIVE DEVICE HAVING S-5 RESPONSE**
*is shown at the front of this section*

---

**PHOTO-CATHODE**

**CAP**
JEDEC No. CI-3

**PHOTO-CATHODE**

**T9 BULB**

**BASE**
JEDEC No. B5-10

**PHOTO-CATHODE**

92CM-64IR5

---

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
Multiplier Phototube

10-Stage, Head-On Type Having
S-11 Spectral Response

GENERAL

Spectral Response ......................... S-11
Wavelength of Maximum Response ...... 4400 ± 500 Å
Cathode, Semitransparent .......... Cesium-Antimony with
High- Conductivity Grating
Area including grating .............. 1.8 in² (11.6 cm²)
Minimum diameter ................. 1.5 in (3.8 cm)
Window .................... Corning® No.0080, or equivalent
Shape ....................... Plano-Plano
Index of refraction at 4360 angstroms .......... 1.523

Dynodes:
Substrate ......................... Copper-Beryllium
Secondary-Emitting Surface .......... Beryllium-Oxide
Structure .............. Circular-Cage, Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.10 ................. 4.4 pF
Anode to all other electrodes .......... 7.0 pF
Maximum Overall Length ............. 5.81 in (14.8 cm)
Seated Length .................. 4.88 ± 0.19 in (12.4 ± 0.48 cm)
Maximum Diameter ................. 2.31 in (5.9 cm)
Bulb ................................ T-16
Base ................ Medium-Shell Diheptal 14-Pin
(JEDEC No.B14-38), Non-hygroscopic
Socket ..................... Eby® No.9709-7, or equivalent
Magnetic Shield .......... Millen® Part No.80602B, or equivalent
Operating Position .............. Any
Weight (Approx.) ................. 5.2 oz (174 g)

ABSOLUTE-MAXIMUM RATINGS
DC Supply Voltage:
Between anode and cathode .......... 1500 max. V
Between anode and dynode No.10 .... 250 max. V
Between consecutive dynodes ......... 250 max. V
Between dynode No.1 and cathode .... 400 max. V
Between focusing electrode and cathode... 400 max. V
Average Anode Current\textsuperscript{e}... 2 max. mA
Average Cathode Current\textsuperscript{f}... 5 max. \mu A
Ambient Temperature\textsuperscript{g}... 75 max. °C

**CHARACTERISTICS RANGE VALUES**

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode. Focusing-electrode voltage is adjusted to that value between 10 and 60 per cent of dynode No.1 potential (referred to cathode) which provides maximum anode current.

With $E = 1250$ volts (Except as noted)

<table>
<thead>
<tr>
<th>Anode Sensitivity:</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant\textsuperscript{h} at 4400 angstroms...</td>
<td>$-4.8 \times 10^3$</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870° K)\textsuperscript{i}...</td>
<td>2.5</td>
<td>6</td>
<td>75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cathode Sensitivity:</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant\textsuperscript{k} at 4400 angstroms...</td>
<td>$-0.04$</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870° K)\textsuperscript{m}...</td>
<td>$3 \times 10^{-5}$</td>
<td>$5 \times 10^{-5}$</td>
<td>-</td>
</tr>
<tr>
<td>Current with blue light source (2870° K + C.S. No.5-58)\textsuperscript{n}...</td>
<td>$3 \times 10^{-8}$</td>
<td>$5 \times 10^{-8}$</td>
<td>-</td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 angstroms...</td>
<td>$11.5$</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Current Amplification...</td>
<td>$1.2 \times 10^5$</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current\textsuperscript{p}...</td>
<td>$4 \times 10^{-9}$</td>
<td>$4.5 \times 10^{-8}$</td>
<td>A</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current...</td>
<td>${2.5 \times 10^{-10}}$</td>
<td>$2.25 \times 10^{-9}$</td>
<td>1mW</td>
</tr>
<tr>
<td>Equivalent Noise Input\textsuperscript{f}...</td>
<td>$5.6 \times 10^{-12}$</td>
<td>$1.9 \times 10^{-11}$</td>
<td>1mW</td>
</tr>
</tbody>
</table>

\textsuperscript{o} Made by Corning Glass Works, Corning, NY 14830.
b Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, PA 19144.

c Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

d Averaged over any interval of 30 seconds maximum.

e Above this value of average cathode current, serious loss in linearity between light input and anode current will be caused by the resistivity of the cathode.

f Tube operation at room temperature or below is recommended.

g This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

h 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 and a light input of 10 microlumens is used.

i This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

j 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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

k Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness-Manufactured by the Corning Glass Works, Corning, NY 14830) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

l At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

m At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 804 lumens per watt.
Under the following conditions: Tube temperature 220°C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870°K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The “on” period of the pulse is equal to the “off” period.

At 4400 angstroms. These values are calculated from the ENI values in lumens using a conversion factor of 804 lumens per watt.

**TYPICAL VOLTAGE-DIVIDER ARRANGEMENT**

C\(_1\): 0.05 µF, 20%, 500 volts (dc working), ceramic disc  
C\(_2\): 0.02 µF, 20%, 500 volts (dc working), ceramic disc  
C\(_3\): 0.01 µF, 20%, 500 volts (dc working), ceramic disc  
C\(_4\): 0.005 µF, 20%, 500 volts (dc working), ceramic disc  
R\(_1\) through R\(_{10}\): 390,000 ohms, 5%, 1/2 watt  
R\(_{11}\): 910,000 ohms, 5%, 1/2 watt  
R\(_{12}\): 5 megohms, 20%, 1/2 watt, adjustable  

**Note 1:** Adjustable between approximately 500 and 1500 volts dc.  
**Note 2:** Component values are dependent upon nature of application and output signal desired.
© of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

Note 1: The grating consists of 12 equally spaced conductive strips having a maximum width of 0.02" (0.5 mm).

Note 2: Deviation from flatness will not exceed 0.010" from peak to valley.
### OUTLINE DIMENSIONS

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.81 max.</td>
<td>147.5 max.</td>
</tr>
<tr>
<td>B</td>
<td>4.88 ± .19</td>
<td>123.9 ± 4.8</td>
</tr>
<tr>
<td>C</td>
<td>1.5 min. dia.</td>
<td>38 min. dia.</td>
</tr>
<tr>
<td>D</td>
<td>2.31 max. dia.</td>
<td>58.6 max. dia.</td>
</tr>
<tr>
<td>F</td>
<td>2.00 ± .06 dia.</td>
<td>50.8 ± 1.5 dia.</td>
</tr>
</tbody>
</table>

### TERMINAL DIAGRAM (Bottom View)

- **Pin 1:** Dynode No.1
- **Pin 2:** Dynode No.2
- **Pin 3:** Dynode No.3
- **Pin 4:** Dynode No.4
- **Pin 5:** Dynode No.5
- **Pin 6:** Dynode No.6
- **Pin 7:** Dynode No.7
- **Pin 8:** Dynode No.8
- **Pin 9:** Dynode No.9
- **Pin 10:** Dynode No.10
- **Pin 11:** Anode
- **Pin 12:** Internal connection-Do not use
- **Pin 13:** Focusing Electrode
- **Pin 14:** Photocathode

**DIRECTION OF RADIATION:** Into End Of Bulb
Typical Spectral Response Characteristics

![Graph showing typical spectral response characteristics with labels for relative and absolute sensitivity and quantum efficiency.](image-url)
Typical EADCI and Anode Dark Current Characteristics

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE NO. 10 AND ANODE.

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 10 AND 60 PER CENT OF DYNODE NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

TUBE TEMPERATURE = 22°C
Typical Anode Characteristics

DYNODE-No.1-TO-CATHODE VOLTS=200
EACH SUCCEEDING-DYNODE-STAGE VOLTS=100
FOCUSING ELECTRODE ADJUSTED TO PROVIDE
MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
OPERATED AT COLOR TEMPERATURE OF 2870° K.
Sensitivity and Current Amplification Characteristics

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNOE No. 1; 1/12 OF E FOR EACH SUCCEEDING DYNOE STAGE; AND 1/12 OF E BETWEEN DYNOE No. 10 AND ANODE. FOCUSING ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.
Spectral Energy Distribution of 2870° K Light Source After Passing Through Indicated Filter

SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH BLUE FILTER (CORNING C.S. No.5-58 POLISHED TO 1/2 STOCK THICKNESS). MAXIMUM FILTER TRANSMISSION OCCURS AT 4300 ANGSTROMS AND IS 60 PER CENT.

RELATIVE ENERGY DISTRIBUTION

WAVELENGTH—ANGSTROMS

Electronic Components

DATA 6 5-69
Typical Effect of Magnetic Field on Anode Current

Magnetic Field is parallel to dynode-cage axis. Positive values are for lines of force from left to right with base down and base key toward observer.

Dynode - No.1 - to - Cathode Volts = 150
Each succeeding stage Volts = 100
Focusing-electrode voltage adjusted to give maximum anode current.
Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.24 INCH MINIMUM DIAMETER FLAT PHOTOCATHODE

For use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

The 2060 is identical to type 6199 in all respects except that it is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 2060 in a given system.

BASING DIAGRAM (Bottom View)
With Base Attached

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

TERMINAL CONNECTIONS (Bottom View)
With Base Removed

Lead 1 - Dynode No.1
Lead 2 - Dynode No.3
Lead 3 - Dynode No.5
Lead 4 - Dynode No.7
Lead 5 - Dynode No.9
Lead 6 - Anode
Lead 7 - Dynode No.10
Lead 8 - Dynode No.8
Lead 9 - Dynode No.6
Lead 10 - Dynode No.4
Lead 11 - Dynode No.2
Lead 13 - Photocathode
Note: Within 1.24-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.
Photomultiplier Tube

S-II RESPONSE  ELECTROSTATICALLY FOCUSED
10-STAGE, HEAD-ON, FLAT-FACEPLATE  DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Scintillation Counters

The 2061 is electrically similar to type 6342A except for the following performance characteristic and that the anode luminous sensitivity and equivalent noise input ratings shown for the 6342A do not apply for type 2061.

The 2061 is supplied with a medium-shell didephal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2061 should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTIC

Minimum Pulse Height\(a\)  0.13 V

\(a\) Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5% kilohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5% megohm resistor between cathode and dynode No.1, 450 ± 5% kilohm resistors between each succeeding stage including dynode No.10 to anode. The focusing electrode is adjusted to that value between 0% and 60% of dynode No.1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 \((\text{Cs-137})\) and a cylindrical 2 inch x 2 inch thallium-activated sodium-iodide scintillator \([\text{NaI(Tl)}]\) type 8D8, or equivalent are used. The scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs-137 is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2061 by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoises) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View)

With Base Attached

Pin 1 - Dynode No.1
Pin 2 - Dynode No.2
Pin 3 - Dynode No.3
Pin 4 - Dynode No.4
Pin 5 - Dynode No.5
Pin 6 - Dynode No.6
Pin 7 - Dynode No.7
Pin 8 - Dynode No.8
Pin 9 - Dynode No.9
Pin 10 - Dynode No.10
Pin 11 - Anode
Pin 12 - No Connection
Pin 13 - Focusing Electrode
Pin 14 - Photocathode

DIRECTION OF RADIATION: INTO END OF BULB

RADIO CORPORATION OF AMERICA

Electronic Components and Devices
Harrison, N. J.
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

- Lead 1 - Photocathode
- Lead 2 - Dynode No. 1
- Lead 3 - Dynode No. 2
- Lead 4 - Dynode No. 3
- Lead 5 - Dynode No. 4
- Lead 6 - Dynode No. 5
- Lead 7 - Dynode No. 6
- Lead 8 - Dynode No. 7
- Lead 13 - Dynode No. 8
- Lead 14 - Dynode No. 9
- Lead 15 - Dynode No. 10
- Lead 16 - Anode
- Lead 19 - Focusing Electrode

DIRECTION OF LIGHT: INTO END OF BULB

DIMENSIONAL OUTLINE

FACEPLATE (SEE NOTE)

PHOTOCATHODE

T16 BULB

13 FLEXIBLE LEADS .020 ±.005 DIA.

BASE JEDEC GROUP 5 No. B14-38

DIMENSIONS IN INCHES

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

DATA RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE 1.68 INCH MINIMUM DIAMETER CURVED PHOTOCATHODE

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

The 2062 is identical to type 6655A in all respects except that it is supplied with a medium-shell diaphragm base attached to flexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 2062 in a given system.

BASING DIAGRAM (Bottom View)
With Base Attached

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dynode No.1</td>
</tr>
<tr>
<td>2</td>
<td>Dynode No.2</td>
</tr>
<tr>
<td>3</td>
<td>Dynode No.3</td>
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<tr>
<td>4</td>
<td>Dynode No.4</td>
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<td>Dynode No.9</td>
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<tr>
<td>10</td>
<td>Dynode No.10</td>
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<tr>
<td>11</td>
<td>Anode</td>
</tr>
<tr>
<td>12</td>
<td>No Connection</td>
</tr>
<tr>
<td>13</td>
<td>Focusing Electrode</td>
</tr>
<tr>
<td>14</td>
<td>Photocathode</td>
</tr>
</tbody>
</table>

TERMINAL CONNECTIONS (Bottom View)
With Base Removed

<table>
<thead>
<tr>
<th>Lead</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Photocathode</td>
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<tr>
<td>2</td>
<td>Dynode No.1</td>
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<td>3</td>
<td>Dynode No.2</td>
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<td>Dynode No.7</td>
</tr>
<tr>
<td>9</td>
<td>Dynode No.8</td>
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<tr>
<td>10</td>
<td>Dynode No.9</td>
</tr>
<tr>
<td>11</td>
<td>Dynode No.10</td>
</tr>
<tr>
<td>12</td>
<td>Anode</td>
</tr>
<tr>
<td>13</td>
<td>Focusing Electrode</td>
</tr>
</tbody>
</table>
DIMENSIONAL OUTLINE

FACEPLATE (SEE NOTE)

PHOTOCATHODE

TIG BULB

13 FLEXIBLE LEADS .020±.005 DIA.

DIMENSIONS IN INCHES

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.
Photomultiplier Tube

10-STAGE, HEAD-ON FLAT-FACEPLACE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 1.68-INCH MINIMUM-DIAMETER, FLAT, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

For Use in Scintillation Counting Applications

The 2063 is electrically similar to type 8053 except for the following performance characteristics and that the anode luminous sensitivity and equivalent noise input ratings shown for the 8053 do not apply for type 2063.

The 2063 is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2063 should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTICS

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No. 10 and anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current.

Maximum Anode Dark Currenta...0.06 µA
Minimum Pulse Heightb...0.13 V

a Measured under the following conditions: Light incident on the photocathode is transmitted through a blue filter (Corning C.S. No.5-98, polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage is adjusted to obtain an anode current of 9 µA. Dark current is measured with the light source removed.

b Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5%-kiloohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage divider network having a 1.5 ± 5%-megohm resistor between cathode and dynode No. 1, 450 ± 5%-kiloohm resistors between each succeeding stage including dynode No. 10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current. The 662-KV photon from an isotope of cesium having an atomic mass of 137 (CaT)7 and a cylindrical 2 inch x 2 inch thallium-activated sodium-iodide scintillator (NaI(Tl)) type 8D6, or equivalent are used. This scintillator is manufactured by the Harshaw Chemical Company, 1945 East 97th Street, Cleveland 6, Ohio. The CaT7 is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2063 by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.

2063

DATA 1
6-66
BASING DIAGRAM (Bottom View) With Base Attached

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dynode No.1</td>
</tr>
<tr>
<td>2</td>
<td>Dynode No.2</td>
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<tr>
<td>3</td>
<td>Dynode No.3</td>
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<td>4</td>
<td>Dynode No.4</td>
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<td>Dynode No.5</td>
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<tr>
<td>6</td>
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<td>Dynode No.9</td>
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<tr>
<td>10</td>
<td>Dynode No.10</td>
</tr>
<tr>
<td>11</td>
<td>Anode</td>
</tr>
<tr>
<td>12</td>
<td>No Connection</td>
</tr>
<tr>
<td>13</td>
<td>Focusing Electrode</td>
</tr>
<tr>
<td>14</td>
<td>Photo-cathode</td>
</tr>
</tbody>
</table>

TERMINAL CONNECTIONS (Bottom View) With Base Removed

<table>
<thead>
<tr>
<th>Lead</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Focusing</td>
</tr>
<tr>
<td>2</td>
<td>Photocathode</td>
</tr>
<tr>
<td>3</td>
<td>Dynode No.1</td>
</tr>
<tr>
<td>4</td>
<td>Dynode No.2</td>
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<tr>
<td>5</td>
<td>Dynode No.3</td>
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<td>Dynode No.4</td>
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<td>Dynode No.7</td>
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<tr>
<td>10</td>
<td>Dynode No.8</td>
</tr>
<tr>
<td>11</td>
<td>Dynode No.9</td>
</tr>
<tr>
<td>12</td>
<td>Dynode No.10</td>
</tr>
<tr>
<td>13</td>
<td>Anode</td>
</tr>
</tbody>
</table>

DIMENSIONAL OUTLINE

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

DIMENSIONS IN INCHES
Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLACE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 2.59-INCH MINIMUM-DIAMETER, FLAT, CIRCULAR, SEMITRANSSPARENT PHOTOCATHODE AND S-11 RESPONSE

For Use in Scintillation Counting Applications

The 2064B is electrically similar to type 8054 except for the following performance characteristics and that the anode lumino- nuous sensitivity and equivalent noise input ratings shown for the 8054 do not apply for type 2064B.

The 2064B is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2064B should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTICS

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode-No.1 po- tential (referred to cathode) which will provide maximum anode current.

Maximum Anode Dark Current... 0.05 µA
Minimum Pulse Height... 6.18 V

- Measured under the following conditions: Light incident on the photo- cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microwatts. The supply voltage is adjusted to obtain an anode current of 9 µA. Dark current is measured with the light source removed.

- Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5% megaohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode volt- age of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5% megohm resistor between cathode and dynode No.1, 450 ± 5% kil- ohms resistors between each succeeding stage including dynode No.10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode-No.1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 (Cs137) and a cylindrical 3 inch x 3 inch thallium-activated sodium-iodide scintillator (NaI(Tl)), type 12A12, or equivalent are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs137 is in direct contact with the metal end of the scin- tillator. The faceplate end of the crystal is coupled to the 2064B by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.
BASING DIAGRAM (Bottom View)
With Base Attached

Pin 1 - Dynode No.1
Pin 2 - Dynode No.2
Pin 3 - Dynode No.3
Pin 4 - Dynode No.4
Pin 5 - Dynode No.5
Pin 6 - Dynode No.6
Pin 7 - Dynode No.7
Pin 8 - Dynode No.8
Pin 9 - Dynode No.9
Pin 10 - Dynode No.10
Pin 11 - Anode
Pin 12 - No Connection
Pin 13 - Focusing Electrode
Pin 14 - Photocathode

TERMINAL CONNECTIONS (Bottom View)
With base Removed

Lead 1 - Focusing Electrode
Lead 3 - Photocathode
Lead 4 - Dynode No.1
Lead 5 - Dynode No.2
Lead 7 - Dynode No.3
Lead 8 - Dynode No.4
Lead 9 - Dynode No.5
Lead 11 - Dynode No.6
Lead 13 - Dynode No.7
Lead 14 - Dynode No.8
Lead 15 - Dynode No.9
Lead 17 - Dynode No.10
Lead 19 - Anode
Note: Within 2.59-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
Photomultiplier Tube

**10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 4.38-INCH MINIMUM DIAMETER, FLAT, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-II RESPONSE**

**For Use in Scintillation Counting Applications**

The 2065 is electrically similar to type 8055 except for the following performance characteristics and that the anode luminous sensitivity and equivalent noise input ratings shown for the 8055 do not apply for type 2065.

The 2065 is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2065 should be removed prior to installing the tube in a given system.

**PERFORMANCE CHARACTERISTICS**

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode-No.1 potential (referred to cathode) which will provide maximum anode current.

<table>
<thead>
<tr>
<th>Maximum Anode Dark Current</th>
<th>Minimum Pulse Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05 μA</td>
<td>0.13 μV</td>
</tr>
</tbody>
</table>

*a* Measured under the following conditions: Light incident on the photocathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness — Manufactured by the Corning Glass Works, Corning, New York), from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage is adjusted to obtain an anode current of 9 μA. Dark current is measured with the light source removed.

*b* Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5-kilohm resistor and a total capacitance of 92 ± 3 pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5%-megohm resistor between cathode and dynode No.1, 450 ± 5%-kilohm resistors between each succeeding stage including dynode No.10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No.1 potential (referred to cathode) which will provide maximum anode current. The 662-keV photon from an isotope of cesium having an atomic mass of 137 (Cs$^{137}$) and a cylindrical 3 inch x 3 inch thallium-activated sodium-iodide scintillator (NaI(Tl)) type 12Al12, or equivalent are used. This scintillator is manufactured by Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs$^{137}$ is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2065 by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.
**BASING DIAGRAM (Bottom View)**

With Base Attached

- Pin 1 - Dynode No. 1
- Pin 2 - Dynode No. 2
- Pin 3 - Dynode No. 3
- Pin 4 - Dynode No. 4
- Pin 5 - Dynode No. 5
- Pin 6 - Dynode No. 6
- Pin 7 - Dynode No. 7
- Pin 8 - Dynode No. 8
- Pin 9 - Dynode No. 9
- Pin 10 - Dynode No. 10
- Pin 11 - Anode
- Pin 12 - No Connection
- Pin 13 - Focusing Electrode
- Pin 14 - Photocathode

**DIRECTION OF RADIATION:**

INTO END OF BULB

---

**TERMINAL CONNECTIONS (Bottom View)**

With Base Removed

- Lead 1 - Focusing Electrode
- Lead 3 - Photocathode
- Lead 4 - Dynode No. 1
- Lead 5 - Dynode No. 2
- Lead 7 - Dynode No. 3
- Lead 8 - Dynode No. 4
- Lead 9 - Dynode No. 5
- Lead 11 - Dynode No. 6
- Lead 13 - Dynode No. 7
- Lead 14 - Dynode No. 8
- Lead 15 - Dynode No. 9
- Lead 17 - Dynode No. 10
- Lead 19 - Anode

---

**DATA**

RADIO CORPORATION OF AMERICA

Electronic Components and Devices

Harrison, N. J.
DIMENSIONAL OUTLINE

FACEPLATE (SEE NOTE) 5.25 ±.06 DIA.

4.38 MIN. DIA. PHOTO-CATHODE

3.50 ±.19 J42 BULB

1.97 2.00 ±.06 DIA.

13 FLEXIBLE LEADS .020 ±.005 DIA.

.275 MAX. DIA. 1.25 MAX.

2.5 MIN. BASE

JEDEC GROUP 5
No. 814-38

Note: Within 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
Photomultiplier Tubes

Sturdy, 10-Stage, S-11, Head-On Types for Use Under Adverse Environmental Conditions

The 4439 differs from the 4438 in that it is supplied with a small-shell duodecal base attached to semiflexible leads to facilitate testing prior to installation. After testing, the attached base should be removed.

GENERAL

Spectral Response: S-11
Wavelength of Maximum Response: 4400 ± 500 Å
Cathode, Semitransparent: Cesium-Antimony
  Minimum area: 1.2 in² (7.7 cm²)
  Minimum diameter: 1.24 in (3.1 cm)
Window: Corning® No.0080, or equivalent
  Shape: Plane-Plano
  Index of refraction at 4360 angstroms: 1.523

Dynodes:
  Substrate: Nickel
  Secondary-Emitting Surface: Cesium-Antimony
  Structure: Circular-Cage Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.10: 4 pF
  Anode to all other electrodes: 5.5 pF
Maximum Overall Length (Excluding Semiflexible Leads): 3.91 in (9.9 cm)
Maximum Diameter: 1.56 in (3.9 cm)
Bulb: T-12
Base (Temporary for 4439 only): Small-Shell Duodecal 12-Pin (JEDEC No.B12-43). Non-hygroscopic
  Socket: Eby® No.9058, or equivalent
Magnetic Shield: See footnote c
Operating Position: Any
Weight (Approx.): 2 oz

MAXIMUM RATINGS, Absolute-Maximum Values:
DC Supply Voltage:
  Between anode and cathode: 1250 max. V
  Between anode and dynode No.10: 250 max. V
  Between consecutive dynodes: 200 max. V
  Between dynode No.1 and cathode: 300 max. V
### CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages as shown in Table I, except as noted.

With E = 1000 volts (Except as noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
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</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4400 angstroms</td>
<td>-</td>
<td>2.2 x 10^4</td>
<td>- A/W</td>
</tr>
<tr>
<td>Luminous</td>
<td>10</td>
<td>27</td>
<td>300 A/1m</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4400 angstroms</td>
<td>-</td>
<td>3.6 x 10^-2</td>
<td>- A/W</td>
</tr>
<tr>
<td>Luminous</td>
<td>3 x 10^-5</td>
<td>4.5 x 10^-5</td>
<td>- A/1m</td>
</tr>
<tr>
<td>With blue light</td>
<td>2.8 x 10^-8</td>
<td></td>
<td>- A</td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 angstroms</td>
<td></td>
<td>10.5</td>
<td>- %</td>
</tr>
<tr>
<td>Current Amplification</td>
<td></td>
<td>6 x 10^5</td>
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<tr>
<td>Anode Dark Current</td>
<td></td>
<td>1.6 x 10^-8</td>
<td>5 x 10^-8</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current In-</td>
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<tr>
<td>put</td>
<td>-</td>
<td>8 x 10^-10</td>
<td>2.5 x 10^-9</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>-</td>
<td>1 x 10^-12</td>
<td>- W</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>-</td>
<td>6.5 x 10^-12</td>
<td>- lm</td>
</tr>
<tr>
<td>Electron Transit Time</td>
<td>-</td>
<td>2.5 x 10^-9</td>
<td>- s</td>
</tr>
</tbody>
</table>

**Made by**
- Corning Glass Works, Corning, New York 14830.
- Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago, Ill., 60622, or equivalent.
- Averaged over any interval of 30 seconds maximum.
- Tube operation at room temperature or below is recommended.

* Indicates additions or changes.
This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

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 and a light input of 10 microlumens is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness — Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen.

At 4400 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 804 lumens per watt.

Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The “on” period of the pulse is equal to the “off” period.

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode.
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.

<table>
<thead>
<tr>
<th>Typical Potential Distribution</th>
<th>8.13% of Supply Voltage (E) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Dynode No.3 and Dynode No.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.4 and Dynode No.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.5 and Dynode No.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.6 and Dynode No.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.7 and Dynode No.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.8 and Dynode No.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.9 and Dynode No.10</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.10 and Anode</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>12.3</td>
</tr>
</tbody>
</table>

OPERATING CONSIDERATIONS

SHIELDING:

Electrostatic shielding of these tubes is ordinarily required. When a shield is used, it must be connected to the cathode terminal. The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding these tubes at the photocathode end of the tubes should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to $1 \times 10^{-12}$ ampere or less.
HIGH VOLTAGE WARNING:
The high voltages at which these tubes are operated are very dangerous. Before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE

R₁: 680,000 ohms, 5%, 1/2 watt
R₂ and R₃: 510,000 ohms, 5%, 1/2 watt
R₄ through R₁₁: 390,000 ohms, 5%, 1/2 watt

Note 1: Adjustable between approximately 500 and 1250 volts dc.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS

ANODE RETURN

C1: 0.05 µF, 20%, 500 volts, ceramic disc
C2: 0.02 µF, 20%, 500 volts, ceramic disc
C3: 0.01 µF, 20%, 500 volts, ceramic disc
C4: 0.005 µF, 20%, 500 volts, ceramic disc
C5 and C6: 0.005 µF, 20%, 3000 volts, ceramic disc
R1: 680,000 ohms, 5%, 1/2 watt
R2 and R3: 510,000 ohms, 5%, 1/2 watt
R4 through R11: 390,000 ohms, 5%, 1/2 watt
R12: 1 megohm, 5%, 1/2 watt
R13: 100,000 ohms, 5%, 1/2 watt

Note 1: Adjustable between approximately 500 and 1250 volts dc.

Note 2: Capacitors C1 through C6 should be connected at tube socket for optimum high-frequency performance.

Electronic Components

DATA 3
**LEAD CONNECTIONS**
Bottom View
(With Base Removed)

- Lead 1: Dynode No.1
- Lead 2: Dynode No.3
- Lead 3: Dynode No.5
- Lead 4: Dynode No.7
- Lead 5: Dynode No.9
- Lead 6: Anode
- Lead 7: Dynode No.10
- Lead 8: Dynode No.8
- Lead 9: Dynode No.6
- Lead 10: Dynode No.4
- Lead 11: Dynode No.2
- Lead 13: Photocathode

**TERMINAL DIAGRAM**
Bottom View
(With Temporary Base)

- Pin 1: Dynode No.1
- Pin 2: Dynode No.3
- Pin 3: Dynode No.5
- Pin 4: Dynode No.7
- Pin 5: Dynode No.9
- Pin 6: Anode
- Pin 7: Dynode No.10
- Pin 8: Dynode No.8
- Pin 9: Dynode No.6
- Pin 10: Dynode No.4
- Pin 11: Dynode No.2
- Pin 12: Photocathode
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note: Within 1.24" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

Note: Type 4438 is supplied without temporary B12-43 base.
Note 1: Lead is cut off within 0.04 inch of the glass button for indexing.

Note 2: Lead No. 12 is cut off within 0.04 inch of the glass button.

See Spectral Energy Distribution Curve at Front of this Section.
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

The supply voltage \( E \) is across a voltage divider which provides voltages as follows:

<table>
<thead>
<tr>
<th>Between</th>
<th>8.13% of ( E ) Multiplied by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No 1</td>
<td>1.7</td>
</tr>
<tr>
<td>Dynode No 1 and Dynode No 2</td>
<td>1.5</td>
</tr>
<tr>
<td>Dynode No 2 and Dynode No 3</td>
<td>1.3</td>
</tr>
<tr>
<td>Each succeeding dynode-stage anode and cathode</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>12.3</td>
</tr>
</tbody>
</table>

The supply voltage \( E \) is between anode and cathode.

<table>
<thead>
<tr>
<th>Supply Volts (E) between anode and cathode</th>
<th>Sensitivity - Amperes/Lumen (color temp 2970° K)</th>
<th>Current Amplification</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>2</td>
<td>10^7</td>
</tr>
<tr>
<td>600</td>
<td>2</td>
<td>10^6</td>
</tr>
<tr>
<td>700</td>
<td>2</td>
<td>10^5</td>
</tr>
<tr>
<td>800</td>
<td>2</td>
<td>10^4</td>
</tr>
<tr>
<td>900</td>
<td>2</td>
<td>10^3</td>
</tr>
<tr>
<td>1000</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- The sensitivity values are approximate.
- The current amplification values are for reference only.
- The graph shows the variation of sensitivity and current amplification with supply voltage.

Electronic Components
DATA 6
5-70
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

<table>
<thead>
<tr>
<th>BETWEEN:</th>
<th>0.13% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No. 1</td>
<td>1.7</td>
</tr>
<tr>
<td>Dynode No. 1 and Dynode No. 2</td>
<td>1.3</td>
</tr>
<tr>
<td>Dynode No. 2 and Dynode No. 3</td>
<td>1.3</td>
</tr>
<tr>
<td>Each succeeding Dynode-Stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>1.2</td>
</tr>
</tbody>
</table>

TUBE TEMPERATURE = 22°C
DASHED PORTION INDICATES INSTABILITY.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH—ANGSTROMS

ULTRAVIOLET
VIOLET
BLUE
GREEN
YELLOW
RED
INFRARED

92LM-2770

4438, 4439

RCA Electronic Components

DATA 7
5-70
TYPICAL TIME RESOLUTION CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO. 1, 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE, AND 1/12 OF E BETWEEN DYNODE NO. 10 AND ANODE. THE PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph showing typical time resolution characteristics.](image-url)
Multiplier Phototube

"RUGGEDIZED", 10-STAGE, HEAD-ON, ELECTROSTATICALLY FOCUSED FLAT-FACEPLATE TYPE

For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Industrial, Military, and Missile Applications

DATA

General:
Spectral Response ........................................... S-11
Wavelength of Maximum Response .................. 4400 ± 500 angstroms
Cathode, Semitransparent .................................. Cesium-Antimony
Shape .................................................. Flat, Circular
Minimum Area .............................................. 1.2 sq. in.
Minimum Diameter ...................................... 1.24"
Window .................................................. Lime Glass (Corning® No.0080), or equivalent Index of refraction ................. 1.51
Dynode Material .......................................... Cesium-Antimony
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No. 10 ................................. 4 pf
Anode to all other electrodes ......................... 7 pf
Maximum Overall Length ................................ 4.12"
Seated Length ............................................. 3.90" ± 0.12"
Maximum Diameter ....................................... 1.56"
Operating Position ....................................... Any
Weight (Approx.) ........................................... 2.2 oz
Bulb ......................................................... T12
Socket ..................................................... Amphenol® No.59-402, or equivalent Magnetic Shield ..................... Millen® No.80802C, or equivalent Base .................................. Ultrasound Small-Shell Duodecal 12-Pin, (JEDEC Group 4, No.812-186), Non-hygroscopic

Basing Designation for BOTTOM VIEW .............. 12AE

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

Maximum Ratings, Absolute-Maximum Values:
DC Supply Voltage Between Anode and Cathode .......... 1250 max. volts
DC Supply Voltage Between Dynode No.10 and Anode ...... 250 max. volts
DC Supply Voltage Between Consecutive Dynodes .......... 200 max. volts
DC SUPPLY VOLTAGE BETWEEN DYNODE No.1
AND CATHODE .............................. 300 max. volts
AVERAGE ANODE CURRENT* .................. 0.75 max. ma
AMBIENT TEMPERATURE ....................... 75 max. °C

Characteristics Range Values for Equipment Design:
Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 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>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4400 angstroms...</td>
<td>2.2 x 10^4</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms...</td>
<td>0.036</td>
<td>a/w</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 cps...</td>
<td>10</td>
<td>27</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode...</td>
<td>16</td>
<td>a/lm</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source...</td>
<td>3 x 10^-5</td>
<td>4.5 x 10^-5</td>
</tr>
<tr>
<td>With blue light source...</td>
<td>2.8 x 10^-8</td>
<td>a/lm</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>6 x 10^-5</td>
<td>a</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input at a luminous sensitivity of 20 a/lm...</td>
<td>8 x 10^-10</td>
<td>2.5 x 10^-9</td>
</tr>
<tr>
<td>Equivalent noise input...</td>
<td>4 x 10^-12</td>
<td>1.7 x 10^-11</td>
</tr>
<tr>
<td>Dark Current to Any Electrode Except Anode at 25° C...</td>
<td>7.5 x 10^-7</td>
<td>a</td>
</tr>
</tbody>
</table>

With E = 750 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4400 angstroms...</td>
<td>2.2 x 10^3</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms...</td>
<td>0.036</td>
<td>a/w</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 cps...</td>
<td>2.7</td>
<td>a/lm</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode...</td>
<td>1.6</td>
<td>a/lm</td>
</tr>
</tbody>
</table>

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Cathode luminous:

With tungsten light source \( g \)

\[ 3 \times 10^{-6} \quad 4.5 \times 10^{-3} \quad a/lm \]

With blue light source \( h, n \)

\[ 2.8 \times 10^{-8} \quad - \quad - \]

Current Amplification:

\[ - \quad 6 \times 10^{4} \quad - \]

a Made by Corning Glass Works, Corning, New York.
b Made by Amphenol Electronics Corporation, 1830 South 56th Avenue, Chicago 54, Illinois.
c Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.
d Averaged over any interval of 30 seconds maximum.
e 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 and a light input of 10 microlumens is used.
f An output current of opposite polarity to that obtained at the anode may be provided by using dynode No. 10 as the output electrode. With this arrangement, the load is connected in the dynode-No. 10 circuit and the anode serves only as collector. The curves shown in the accompanying typical anode Characteristics curve do not apply when dynode No. 10 is used as the output electrode.
g 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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
h Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No. 5–58, Glass Code No. 5113 polished to 1/2 Stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
i At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.
j For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.
k Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.
l See Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter at front of this Section.

SPECTRAL-SENSITIVITY CHARACTERISTIC

of PHOTORESPONSIVE DEVICE HAVING S-11 RESPONSE

is shown at the front of this Section
CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

NOTE: WITHIN 1.24 INCH DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010 INCH FROM PEAK TO VALLEY.
TYPICAL ANODE CHARACTERISTICS

DYNODE-No.1-TO-CATHODE VOLTS = 167
EACH SUCCEEDING STAGE VOLTS = 83
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870°K.
TYPICAL CHARACTERISTICS

Supply voltage (E) across voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode.

Sensitivity—amperes/lumen (color temp 2870° K)

Current amplification

Supply volts (E) between anode and cathode

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCEEDING STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE.

TUBE TEMPERATURE = 25°C
DASHED PORTION INDICATES INSTABILITY.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
Multiplier Phototube

"RUGGEDIZED", 10-STAGE, HEAD-ON, ELECTROSTATICALLY FOCUSED FLAT-FACEPLATE TYPE

For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Industrial, Military, and Missile Applications

**DATA**

**General:**
- Spectral Response: S-11
- Wavelength of Maximum Response: 4400 ± 500 angstroms
- Cathode, Semitransparent: Cesium-Antimony
- Shape: Flat, Circular
- Minimum area: 1.2 sq. in.
- Minimum diameter: 1.24" Window: Lime Glass (Corning® No.0080), or equivalent
- Index of refraction: 1.51
- Dynode Material: Cesium-Antimony
- Direct Interelectrode Capacitances (Approx.):
  - Anode to dynode No. 10: 3.2 pf
  - Anode to all other electrodes: 5.0 pf
- Maximum Overall Length (Excluding flexible leads): 3.18"
- Maximum Diameter: 1.56" Operating Position: Any
- Weight (Approx.): 3 oz
- Bulb: T12-I Magnetic Shield: Special
- Base:

**Terminal Diagram:** BOTTOM VIEW

**Maximum Ratings, Absolute-Maximum Values:**
- DC SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE: 1250 max. volts
- DC SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE: 250 max. volts
- DC SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES: 200 max. volts
DC SUPPLY VOLTAGE BETWEEN DYNODE NO.1 AND CATHODE: 300 max. volts
AVERAGE ANODE CURRENT: 0.75 max. ma.
AMBIENT TEMPERATURE: 75 max. °C

**Characteristic Range Values for Equipment Design:**

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode.

With $E = 1000$ volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>$-2.2 \times 10^4$</td>
<td>$-a/w$</td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>$-0.036$</td>
<td>$-a/w$</td>
<td></td>
</tr>
<tr>
<td>Luminous: At 0 cps</td>
<td>$10$</td>
<td>$27$</td>
<td>$300$ a/lm</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode</td>
<td>$-16$</td>
<td>$-a/lm$</td>
<td></td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>$3 \times 10^{-5}$</td>
<td>$4.5 \times 10^{-5}$</td>
<td>$-a/lm$</td>
</tr>
<tr>
<td>With blue light source</td>
<td>$2.8 \times 10^{-8}$</td>
<td>$-a$</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td>$6 \times 10^5$</td>
<td>$-a/lm$</td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode-Dark Current Input at a luminous sensitivity of 20 a/lm:</td>
<td>$8 \times 10^{-10}$</td>
<td>$2.5 \times 10^{-9}$ l/m</td>
<td></td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>$4 \times 10^{-12}$</td>
<td>$1.7 \times 10^{-11}$ l/m</td>
<td></td>
</tr>
<tr>
<td>Dark Current to Any Electrode Except Anode at 25°C</td>
<td>$7.5 \times 10^{-7}$</td>
<td>$a$</td>
<td></td>
</tr>
</tbody>
</table>

With $E = 750$ volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>$2.2 \times 10^3$</td>
<td>$-a/w$</td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>$0.036$</td>
<td>$-a/w$</td>
<td></td>
</tr>
<tr>
<td>Luminous: At 0 cps</td>
<td>$2.7$</td>
<td>$-a/lm$</td>
<td></td>
</tr>
<tr>
<td>With dynode No.10 as output electrode</td>
<td>$1.6$</td>
<td>$-a/lm$</td>
<td></td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>$3 \times 10^{-5}$</td>
<td>$4.5 \times 10^{-5}$</td>
<td>$-a/lm$</td>
</tr>
<tr>
<td>With blue light source</td>
<td>$2.8 \times 10^{-8}$</td>
<td>$-a$</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td>$6 \times 10^4$</td>
<td>$-$</td>
<td></td>
</tr>
</tbody>
</table>
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-II RESPONSE
is shown at the front of this section.
DIMENSIONS IN INCHES

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2\(^\circ\) IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE FLANGE.

NOTE: DEVIATION FROM FLATNESS WITHIN THE 1.24 INCH DIAMETER AREA WILL NOT EXCEED 0.010 INCH FROM PEAK TO VALLEY.
SPECIAL BASE
Pin Dimensions and Orientation and Index Guide

BULB

.38 MIN.

.30 MAX.

.25 MIN.

.27 MAX.

METAL FLANGE

1.25 MIN. DIA.

1.44 ± .02 DIA.

INDEX (NOTE 1)

NOTE 2

25.7°

25.7°

25.7°

25.7°

25.7°

25.7°

25.7°

25.7°

25.7°

74 ± .01 DIA.

DIMENSIONS IN INCHES

12-Lead Base 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

NOTE 1: LEAD IS CUT OFF WITHIN 0.04 INCH OF THE GLASS BUTTON FOR INDEXING.

NOTE 2: LEAD NO. 13 IS CUT OFF WITHIN 0.04 INCH OF THE GLASS BUTTON.
TYPICAL CHARACTERISTICS

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

Supply Voltage (E) across voltage divider providing 1/6 of E between cathode and dynode No.1, 1/12 of E for each succeeding dynode stage, and 1/12 of E between dynode No.10 and anode.

Current Amplification

Supply Volts (E) between anode and cathode.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCEEDING STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE.

TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
Multiplier Phototube

RUGGED VIBRATION-RESISTANT STRUCTURE

S-11 RESPONSE ELECTROSTATICALLY FOCUSED
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources. Especially Useful in Missile and Rocket Service and other Industrial and Military Applications where Severe Environmental Conditions may be Encountered.

The 4441A is the same as the 4441 except for the following:

Characteristics Range Values for Equipment Design:

With $E = 1000$ volts

Anode-Pulse Rise Time\(^a\) . . . . . . . . . $2.8 \times 10^{-9}$

With $E = 750$ volts

Equivalent Anode-Dark-Current Input at a luminous sensitivity of $20 \text{ a/lm}^{b,c}$ . . . . . . . . . $2.5 \times 10^{-9}$

ENVIRONMENTAL TESTS:

The 4441A is designed to withstand environmental tests equivalent to those specified in MIL-E-5272C\(^e\) for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

One-Hundred Per-Cent Shock and Vibration Testing:

Shock. These tests are performed first, per method of MIL-E-5272C\(^e\), Par.4.15.5.1, Proc.V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred percent testing of all 4441A's is performed. Each 4441A (non-operating) is subjected to three impact shocks in each direction of the three orthogonal axes. Each impact shock has a peak acceleration of $30 \pm 3$ g's and a time duration of $11 \pm 1$ milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies a variable-sinusoidal frequency vibration to the tube in accordance with MIL-E-5272C\(^e\), par.4.7.14 and par.4.7.14.1, except for the cycle duration. This test is performed on all 4441A tube types. Each 4441A (Operating under the conditions specified under Tube Rejection Criterion) is vibrated in each of the three orthogonal axes and as specified in the following schedule. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.
<table>
<thead>
<tr>
<th>Double Amplitude inches</th>
<th>Acceleration g's</th>
<th>Frequency cps</th>
<th>Cycle Duration Per Axis minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.050 ± 0.005</td>
<td>-</td>
<td>20-87</td>
<td>87-2000</td>
</tr>
<tr>
<td>-</td>
<td>20</td>
<td>2000-87</td>
<td>87-20</td>
</tr>
<tr>
<td>0.050 ± 0.005</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tube Rejection Criterion.** After completion of the shock tests, tubes are operated at an anode-to-cathode voltage of 1000 volts with the light level incident on the tube adjusted to provide an anode current of 8 microamperes. Electrical and/or mechanical tube failures due to shock or vibration are observed during the vibration test when the specified anode current is monitored. Tube rejection criterion for both tests is that the anode current of 8 microamperes will not change more than ± 20 per cent at any time during the vibration test for each axis.

**Design Tests:**

**Vibration.** These tests are performed under conditions equivalent to those described in MIL-E-5272C*, par.4.7.14 and par.4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes. The total test period for each tube is six hours.

**Acceleration.** These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C*, par.4.16.3, Proc.111 except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes and the tubes are non-operating.

*Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.
### Vidicon

**SpectraPlex Type for Single-Tube Color Cameras**

- Integral Dichroic Filter Stripes Optically **Encode Color Information**
- Signal Can Be NTSC (or PAL) Encoded
- Requires Only Moderate Studio Lighting—100 lumens/foot² (fc)
- Produces Fully Compatible Video for Black-and-White Monitors
- Familiar Vidicon Structure — Magnetic Focus and Deflection

#### General Data

**Electrical:**
- Heater Voltage
  - **6.3 ± 5% V**
- Heater Current at 6.3 Volts, ac or dc
  - **0.6 nominal A**
- Focusing Method
  - Magnetic
- Deflection Method
  - Magnetic
- **Direct Interelectrode Capacitance:**
  - Target to all other electrodes
    - **4.6 pF**

**Optical:**
- **Outer faceplate** glass is Corning code 7056 having a thickness of
  - **0.094" ± 0.012".**
- **Inner faceplate** Dark-Clad Fiber Optics
- **Photoconductor** Antimony Trisulfide
- Orientation of quality rectangle
  - Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and short index pin.
- **Maximum Useful Diagonal of Image**
  - **0.825 in (16 mm)**

**Mechanical:**
- Maximum Length
  - **6.475 in (164.5 mm)**
- Maximum Diameter
  - **1.135 in (28.83 mm)**
- **Bulb**
  - **T8**
- **Base**
  - Small-Button Ditetra 8-Pin (JEDEC No.EB-11)
- **Socket**
  - Cinch® No.8VT (133-98-11-015), or equivalent
- **Deflecting Yoke — Focusing Coil — Alignment Coil — Assembly**
  - Cleveland Electronics®
  - No.VDA-945, or equivalent
- **Operating Position**
  - Any
- **Weight (Approx.)**
  - **2 oz**

---

**RCA Electronic Components**

DATA 1

6-72
**Maximum and Minimum Ratings,**
**Absolute-Maximum Values:**
For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 Voltage</td>
<td>-</td>
<td>1000 V</td>
</tr>
<tr>
<td>Grid-No.4 and Grid-No.3 Voltage Difference</td>
<td>-</td>
<td>600 V</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>-</td>
<td>1000 V</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>-</td>
<td>350 V</td>
</tr>
<tr>
<td>Grid-No.2 Power Dissipation</td>
<td>-</td>
<td>1 W</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-150</td>
<td>0 V</td>
</tr>
<tr>
<td>Heater-Cathode Voltage</td>
<td>-125</td>
<td>10 V</td>
</tr>
<tr>
<td>Heater-Voltage Tolerance</td>
<td>-</td>
<td>5 %</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>-</td>
<td>70 V</td>
</tr>
<tr>
<td>Dark Current</td>
<td>-</td>
<td>0.25 µA</td>
</tr>
<tr>
<td>Peak Target Current</td>
<td>-</td>
<td>0.75 µA</td>
</tr>
</tbody>
</table>

**Faceplate:**
- Illumination: \( \{ \begin{align*} \text{Min.} & : 1000 \text{ lm/ft}^2 \\ \text{Max.} & : 10,000 \text{ lux} \end{align*} \) *\( \text{Typical Operating and storage temperature} \) 71 °C

**Typical Operation and Performance Data:**
For scanned area of 1/2" x 3/8" — Faceplate temperature of 30°C ± 3°C and standard TV scanning rate

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>900 V</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>540 V</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300 V</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-65 to -100 V</td>
</tr>
</tbody>
</table>

**Average “Gamma” of Transfer Characteristic for Signal-Output Current Between 30 nA and 300 nA**

- \( \text{Average “Gamma”} = 0.65 \)

**Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed**

- \( \text{Lag} = 25 \text{ %} \)

**Peak-to-Peak Blanking Voltage:**
- When applied to grid No.1: 75 V
- When applied to cathode: 20 V
Field Strength at Center of Focusing Coil

\[ 60 \pm 5 \text{ G} \]

Field Strength of Adjustable Alignment Coil

\[ 0 \text{ to } 4 \text{ G} \]

Peak Deflecting-Coil Current:
- Horizontal: \[ 269 \text{ mA} \]
- Vertical: \[ 45 \text{ mA} \]

Sensitivity Conditions
- Faceplate illumination (highlights): \[ 6 \text{ lm/ft}^2 \text{ (fc)} \]
- Dark current: \[ 30 \text{ nA} \]

Performance
- Target voltage: \[ 22 \text{ to } 45 \text{ V} \]
- Signal-Output Current: \[ 300 \text{ nA} \]

- This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

- Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, ILL 60007.

- Made by Cleveland Electronics Inc., 17877 St. Clair Avenue, Cleveland, OH 44110.

- These components are chosen to maximize resolution uniformity over the useful picture area of the camera tube. Resolution uniformity is necessary for good color uniformity.

- A description of the Absolute Maximum Rating is given in the General Section titled Rating System for Electron Tubes.

- Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10.

- Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

- For conditions where "white light" is uniformly diffused over entire tube face.

- With no blanking voltage on grid No.1.

- For initial signal-output current of 300 nanoamperes and a dark current of 30 nanoamperes.
The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

The alignment coil should be located on the tube so that its center is at a distance of 3-3/4 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

The target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

Indicated range serves only to illustrate the operating target-voltage range normally encountered.

Defined as the component of the highlight target current after dark-current component has been subtracted.

**Typical Range of Dark Current**

![Graph](image-url)
This test is performed using a uniformly illuminated test pattern containing two "zones" as shown in Figure 1. Illumination is for a peak signal current of 300 nanoamperes. Under these conditions, a blemish will be counted if its signal amplitude is greater than 45 nanoamperes under either illuminated or capped conditions. Some spots and fiber-optic distortion errors are more easily observed when viewing a red or a blue field. Therefore, Wratten filters numbers 25 or 47B (or equivalents) will be inserted into the light path to provide the red or blue fields. Table I shows the number of countable spots allowed. No two spots may be closer together than the distance equivalent to twenty TV lines.

Table I

For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

<table>
<thead>
<tr>
<th>Blemish Size (equivalent number of raster lines)</th>
<th>Zone 1</th>
<th>Zone 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>over 3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>over 1</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>1 or less</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*Spots of this size are allowed unless concentration causes a smudged appearance.
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

**Note 1** — Color encoding stripes, 530 line pairs/inch. The yellow (minus blue) stripes are shown vertically on the centerline, the cyan (minus red) stripes are 45° counterclockwise from the yellow stripes. The yellow stripes are perpendicular to the plane passing through tube axis and short index pin. This plane also defines the direction of horizontal scan.

**Note 2** — Within this distance, diameter of bulb is 1.025" + 0.003", - 0.030".
Typical System Response
(These data are obtained by "sweeping" the input of a camera system, employing a SpectraPlex vidicon type 4445 with the output of a Bausch & Lomb Monochromator Model 33-86-02.)
Typical Light Transfer Characteristic

ILLUMINATION UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
ONE (1) LUMEN/FT² IS APPROXIMATELY EQUAL TO TEN (10) LUX
Image-Converter Tube

S-11 RESPONSE
For Use as a High-Speed Light Shutter
In Extremely-High-Speed Photography

General:
Spectral Response: S-11
Wavelength of Maximum Response: 4400 ± 500 angstroms
Photocathode, Semitransparent:
Shape: Spherical, Circular
Window:
Area: 9.52 sq.cm (1.48 sq.in.)
Minimum diameter: 3.48 cm (1.37 in.)
Index of refraction: 1.48
Fluorescent Screen:
Shape: Flat, Circular
Phosphor: Pi11, Aluminized
Fluorescence: Blue
Phosphorescence: Blue
Persistence: Medium Short
Window:
Useful deflection area (Approx.): 18 sq.cm (2.8 sq.in.)
Minimum diameter: 7.1 cm (2.8 in.)
Index of refraction: 1.48
Direct Inter-electrode Capacitances (Approx.):
Grid No.1 to all other electrodes: 20 pf
Deflecting electrode DJ1 to deflecting electrode DJ2: 1 pf
Deflecting electrode DJ1 to all other electrodes: 6 pf
Deflecting electrode DJ2 to all other electrodes: 6 pf
Focusing Method: Electrostatic
Deflection Method: Electrostatic
Overall Length: 9.87" ± 0.06"
Diameter: 3.97" ± 0.07"
Operating Position: Any
Weight (Approx.): 28 oz
Terminal Connections (See Dimensional Outline):

G1 - Grid No.1
G2 - Grid No.2
DJ1 - Deflecting Electrode No.1
K - Photocathode
DJ2 - Deflecting Electrode No.2
Anode - (Grid No.3, Collector, Screen)

DIRECTION OF LIGHT: PERPENDICULAR TO PHOTOCATHODE END OF TUBE
Maximum Ratings, Absolute-Maximum Values:

DC Anode Voltage \(b\) ........................................ 15000 max. volts
DC Grid-No.2 Voltage \(b\) .................................. 2200 max. volts
Grid-No.1 Voltage \(e\) ...................................... 190 max. volts
Deflecting Electrode Voltage:
DJ1 and DJ2 \(c\) ............................................... ±1500 max. volts
Peak Photocathode Current \(d\) ................................ 0.02 max. ampere
Photocathode Current Density:
Peak \(d\) .................................................. 0.002 max. amp/cm\(^2\)
Average \(d\) ................................................ 0.1 max. \(\mu\)A/cm\(^2\)

Typical Operating Values:

Anode Voltage \(b\) ........................................ 15000 volts
Grid-No.2 Voltage \(f\) ..................................... 1500 to 1900 volts
Grid-No.1 Voltage \(b\) ...................................... Operating (Minimum) 110 to 170 volts
Cutoff (Maximum) ........................................ -90 volts
Deflection Factor ........................................... 1050 to 1250 volts/in.

Characteristics:

With conditions shown under Typical Operating Values and at an ambient temperature of 25°C

Min. Typical Max.

Photocathode Sensitivity:
- Radiant, at 4400 angstroms ................................ 0.04 - 0.78 amp/watt
- Luminous, at 0 cps \(g\) .................................. \(2 \times 10^{-5} \) - \(5 \times 10^{-5}\) amp/lumen

Paraxial Image
- Magnification (Cmx) \(h, i\) ................................ 0.69 - 0.78
- Distortion \(h, k\) ........................................... 0.03
- Paraxial Resolution \(b, m\) ................................ 25 - line-pairs/mm
- Edge Resolution \(b, m, n\) ................................ 15 - line-pairs/mm
- Radiant Power Gain, \(p, q\) .................................. 50 -

Equivalent Background
- Screen Brightness Input \(r\) .......................... \(5 \times 10^{-12}\) watts/sq.cm
- Screen Uniformity Factor \(t\) ................................ 1.3

For P11 Spectral-Energy Emission Characteristic curve, see front of Cathode-Ray Tube, Storage-Tube, & Microscope Section. See also accompanying Operating Considerations.

\(b\) referred to photocathode.
\(c\) referred to anode.
\(d\) over an interval not exceeding 1 microsecond.
\(e\) averaged over any interval of 8 minutes maximum.
\(f\) adjusted to minimize shadowing effects in the displayed image caused by the wires of grid No.1.
\(g\) for conditions where the light source is a tungsten-filament lamp having a lime glass envelope (Corning Glass Code No.0089, or equivalent). The lamp is operated at a color temperature of 2870° K. A light input of 0.01 lumen is used to irradiate a centered 1/2-inch diameter of the photocathode.
\(h\) defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the corresponding image points on the photocathode.

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
Determined as follows: The image incident on the photocathode is perpendicular to the grid-No.1 wires and consists of 2 parallel lines on a bright background approximately 0.16" in length and separated by a distance of 0.160 ± 0.002". The image on the photocathode is focused and positioned so that the separation between the image lines is an equal distance on both sides of the geometric center of the photocathode. The line spacing on the screen is measured adjacent to the faint image of the center grid-No.1 wire.

A second magnification value \( (\text{Emx}) \) is measured under the conditions established in (J) except that the lines are separated by a distance of \( 0.04^\circ ± 0.02^\circ \). Distortion (b) is defined by the equation:

\[
D = \frac{\text{Emx} - 1}{\text{Crnx}}
\]

Determined with a resolution pattern consisting of horizontal and vertical bars. The limiting resolution value is measured adjacent to the faint image of the center grid-No.1 wire and applies to both vertical and horizontal resolution.

Measured at the edge of a 1-inch diameter circle positioned concentric with the geometric center of the photocathode under the same conditions established in (J).

Under the following conditions: Light incident on the photocathode is transmitted through a blue filter (Corning C.S. No.5-58 filter from Melt No.5113 polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp having a 12-inch diameter. A lamp having a 1-inch diameter in the same position on the same receiver is then positioned to receive the radiant flux originally incident on the photocathode and its output current \( (I_2) \) is noted. Radiant power gain \( (G) \) is defined by the equation:

\[
G = \frac{2000 \times 0.04}{I_2}
\]

The coefficient 2000 is derived by assuming that the integrated light radiated by the screen is 79 per cent of that value that would be obtained if the light emitted by the screen has a cosine distribution.

See Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter at front of this Section.

Defined as that value of incident radiation required to cause an increase in screen brightness equal to the screen background brightness.

The ratio of the luminance values of the brightest area to the darkest area of the screen with the entire photocathode uniformly illuminated. The value of incident illumination on the photocathode is 1 footcandle and the light spot on the screen has a diameter of 0.10" ± 0.01".

A trace produced on the screen, when the center of the photocathode is irradiated with a 0.025-inch diameter light spot and an ac voltage is applied to the deflecting electrodes, will not deviate more than 4" from the plane passing through the center of the recessed ball cap of grid No.1 and the major axis of the tube. The angle produced by the trace and the faint images of the grid wires, that are observed when the photocathode is uniformly illuminated, will be 90° ± 3°.

**SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE**

is shown at front of this Section

**OPERATING CONSIDERATIONS**

Magnetic shielding of the 4449A is required to minimize the effects of extraneous fields on tube performance; ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken in its construction to insure that the case is completely demagnetized.
The P-11 phosphor screen employed by the 4449A emits high-intensity actinic blue fluorescence and has a persistence characteristic, within the range of 10 microseconds to 1 millisecond, that is dependent on the current density employed.

To prevent degradation in the resolution of deflected images care must be taken to assure that the deflecting voltage is free of ac ripple and that shielded semiflexible leads are used for making connection to the deflecting electrode terminals. Balanced deflection with respect to anode should be used.

Exposure Time. In practice, the shutter speeds attainable with the 4449A are limited by the ability of the external circuitry to supply to grid No. 1 good rectangular-wave pulses of sufficiently short duration. With perfect pulse-forming circuits, the minimum exposure time of the 4449A is limited by electron transit time which, for an anode voltage of 15 kilovolts, is in the order of 10^-9 seconds. Electrons are defocused if they are not beyond the influence of the gating control grid when its voltage returns to cutoff value at the end of the gating pulse.

The high voltage at which the 4449A is operated may be very dangerous. Great care should be taken in the design of apparatus to prevent the user from coming in contact with the high voltage. Precautions must include safeguards which eliminate all hazards to operating personnel. In the use of high-voltage tubes, such as the 4449A, it should always be remembered that high voltage may appear at normally low-potential points in the circuit because of capacitor breakdown or incorrect circuit connections. Before any part of the circuit is touched, the voltage-supply switch should be turned off and both terminals of any capacitors grounded.
For DETAIL "A" and "B" and notes, see back page.
NOTES FOR DIMENSIONAL OUTLINE

Note 1: Not to be used for mechanical support or electrical connection.

Note 2: The plane passing through the center of the recessed ball cap DJ2 and the major axis of the tube will not deviate more than 3° from the plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube.

Note 3: The plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube will not deviate more than 5° from the plane passing through the center of the recessed ball cap for grid No.1 and the major axis of the tube.

Note 4: This distance on the major axis of the tube is .33 ± .03.

DETAIL "A"

NOTE 4

GLASS FACEPLATE

DETAIL "B"

GLASS FACEPLATE

DIMENSIONS IN INCHES

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
Multiplier Phototube

**12-STAGE, HEAD-ON S-20 RESPONSE ENCLOSED, IN-LINE SPHERICAL-FACEPLATE TYPE DYNODE STRUCTURE HIGH CURRENT AMPLIFICATION EXTREMELY SHORT RISE TIME**


**General:**

- **Spectral Response:** S-20
- **Wavelength of Maximum Response:** 4200 ± 500 angstroms
- **Cathode, Semitransparent:** K-Na-Cs-Sb (Multialkali)
- **Shape:** Spherical, Circular
- **Minimum area:** 2.2 sq. in.
- **Minimum diameter:** 1.68 in.
- **Window:** Borosilicate Glass
- **Index of refraction:** 1.48
- **Dynode Material:** Copper-Beryllium

**Direct Interelectrode Capacitances (Approx.):**

- Anode to dynode No. 12: 3.8 pf
- Anode to all other electrodes: 5.7 pf
- Dynode No. 12 to all other electrodes: 6.8 pf
- **Maximum Overall Length:** 6.31" (16 cm)
- **Seated Length:** 5.50" ± 0.19"
- **Maximum Diameter:** 2.06"
- **Operating Position:** Any
- **Weight (Approx.):** 7 oz
- **Bulb:** T16
- **Socket:** Cinch® No.20-PM, or equivalent
- **Magnetic Shield:** Perfection Mica Co.®, or equivalent
- **Base:** Small-Shell Bidecal 20-Pin (JEDEC No.B20-102), Non-hygroscopic

**Basing Designation for BOTTOM VIEW:** 20E

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Internal Connection</td>
</tr>
<tr>
<td>2</td>
<td>Dynode No. 1</td>
</tr>
<tr>
<td>3</td>
<td>Dynode No. 3</td>
</tr>
<tr>
<td>4</td>
<td>Dynode No. 5</td>
</tr>
<tr>
<td>5</td>
<td>Dynode No. 7</td>
</tr>
<tr>
<td>6</td>
<td>Dynode No. 9</td>
</tr>
<tr>
<td>7</td>
<td>Dynode No. 11</td>
</tr>
<tr>
<td>8</td>
<td>Anode</td>
</tr>
<tr>
<td>9</td>
<td>Same as Pin 1</td>
</tr>
<tr>
<td>10</td>
<td>Same as Pin 1</td>
</tr>
<tr>
<td>11</td>
<td>Same as Pin 1</td>
</tr>
<tr>
<td>12</td>
<td>Dynode No. 12</td>
</tr>
<tr>
<td>13</td>
<td>Dynode No. 10</td>
</tr>
<tr>
<td>14</td>
<td>Dynode No. 8</td>
</tr>
<tr>
<td>15</td>
<td>Dynode No. 6</td>
</tr>
<tr>
<td>16</td>
<td>Dynode No. 4</td>
</tr>
<tr>
<td>17</td>
<td>Dynode No. 2</td>
</tr>
<tr>
<td>18</td>
<td>Same as Pin 1</td>
</tr>
<tr>
<td>19</td>
<td>(Focusing Electrode)</td>
</tr>
<tr>
<td>20</td>
<td>Photocathode</td>
</tr>
</tbody>
</table>

**Direction of Light:** INTO END OF BULB
Maximum Ratings, Absolute-Maximum Values:

DC Supply Voltage:
- Between anode and cathode: 2800 max. volts
- Between anode and dynode No.12: 400 max. volts
- Between consecutive dynodes: 400 max. volts
- Between dynode No.1 and cathode: 600 max. volts
- Between focusing electrode and cathode: 600 max. volts

Average Anode Current: 1 max. ma

Ambient-Temperature Range: -200 to +85 °C

Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I. Focusing electrode is connected to arm of a potentiometer between cathode and dynode No.1 and its voltage is adjusted to that value which provides maximum anode current.

With E = 2500 volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4200 angstroms</td>
<td>-</td>
<td>$4.3 \times 10^5$</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>-</td>
<td>0.064</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>250</td>
<td>1000</td>
<td>12000</td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>$1.1 \times 10^{-4}$</td>
<td>$1.5 \times 10^{-4}$</td>
<td>-</td>
</tr>
<tr>
<td>With blue light source</td>
<td>$5.5 \times 10^{-8}$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>With red light source</td>
<td>$3 \times 10^{-7}$</td>
<td>$5 \times 10^{-7}$</td>
<td>-</td>
</tr>
</tbody>
</table>

Current Amplification: - $6.6 \times 10^6$ -

Equivalent Anode-Dark-Current Input at a luminous sensitivity of 300 a/1m: - $1 \times 10^{-10}$ $1.3 \times 10^{-9}$ - lm

Anode-Pulse Rise Time: - $2 \times 10^{-9}$ - sec

Greatest Delay Between Anode Pulses: Due to position from which electrons are simultaneously released within a circle centered on tube.
face having a
diameter of-
1.4"............. - 3 x 10^{-10} psec
1.6"............. - 5 x 10^{-10} psec

With E = 1800 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4200 angstroms</td>
<td>4.3 x 10^4</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>-</td>
<td>0.064 a/w</td>
</tr>
<tr>
<td>Luminous, at 0 cps^e.</td>
<td>100</td>
<td>a/lm</td>
</tr>
<tr>
<td>Cathode Luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source^f.</td>
<td>1.1 x 10^{-4}</td>
<td>1.5 x 10^{-4}</td>
</tr>
<tr>
<td>With blue light source^g,h</td>
<td>5.5 x 10^{-8}</td>
<td>-</td>
</tr>
<tr>
<td>With red light source^j,k</td>
<td>3 x 10^{-7}</td>
<td>5 x 10^{-7}</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>4.6 x 10^5</td>
</tr>
<tr>
<td>Equivalent Anode- Dark-Current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input at a luminous sensitivity of 300 a/lm^m</td>
<td>1 x 10^{-10}</td>
<td>1.3 x 10^{-9}</td>
</tr>
<tr>
<td>Equivalent Noise Input^q</td>
<td>-</td>
<td>1.1 x 10^{-12}</td>
</tr>
</tbody>
</table>

a Corning No.7056, made by Corning Glass Works, Corning, New York, or equivalent.
b Made by Cinch Manufacturing Company, 1026 South Wabash Avenue, Chicago 24, Illinois.
c Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1929 Civic Opera Bldg., 20 North Wacker Drive, Chicago 6, Illinois, or equivalent.
d Averaged over any interval of 30 seconds maximum.
e 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 and a light input of 0.1 microlumen is used.
f 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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
g Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
h See Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Lights from 2870° K Source after Passing through Indicated Blue Filter at front of this Section.
i Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light-flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
See Spectral Characteristic of 28700K Light Source and Spectral Characteristic of Light from 28700K Source after passing through Indicated Red Filter at front of this Section.

At a tube temperature of 25°C, dark current may be reduced by use of a refrigerant.

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.

These values also represent the difference in time of transit between the photocathode and dynode No. 1 for electrons simultaneously released from the center and from the periphery of the specified areas.

Under the following conditions: Supply voltage (E) is as shown, 25°C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 28700K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

TABLE 1

VOLTAGE TO BE PROVIDED BY DIVIDER

<table>
<thead>
<tr>
<th>Between</th>
<th>6.95% of Supply Voltage (E) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.4</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.3 and Dynode No.4</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.4 and Dynode No.5</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.5 and Dynode No.6</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.6 and Dynode No.7</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.7 and Dynode No.8</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.8 and Dynode No.9</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.9 and Dynode No.10</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.10 and Dynode No.11</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.11 and Dynode No.12</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.12 and Anode</td>
<td>1</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to arm of potentiometer between cathode and dynode No. 1. The focusing-electrode voltage is varied to give maximum anode current.

OPERATING CONSIDERATIONS

The operating stability of the 4459 is dependent on the magnitude of the anode current and its duration. When the 4459 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4459 usually recovers a substantial percentage of such loss in sensitivity.

It is recommended that the average anode current be well below the maximum-rated value of 1 milliamperere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.
Electrostatic and/or magnetic shielding of the 4459 may be necessary.

Adequate light shielding should be provided to prevent extraneous light from reaching any part of the 4459.

The high voltages at which the 4459 is operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the exclosure of high-potential terminals and the use of Interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE is shown at the front of this Section

DIMENSIONS IN INCHES
Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.
TYPICAL ANODE CHARACTERISTICS

DYNOKE — No.1 — TO — CATHODE VOLTS = 250
DYNOKE — No.1 — TO — DYNOKE — No.2 VOLTS = 175
EACH SUCCEEDING — DYNOKE — STAGE VOLTS = 125
FOCUSING — ELECTRODE VOLTAGE ADJUSTED TO THAT VALUE BETWEEN CATHODE AND DYNOKE No.1 THAT PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN — FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

RADIO CORPORATION OF AMERICA
Electronic Components and Devices  Harrison, N. J.
SENSITIVITY AND AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>6.95% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; DY₁</td>
<td>2.0</td>
</tr>
<tr>
<td>DY₁ &amp; DY₂</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₂ &amp; DY₃</td>
<td></td>
</tr>
<tr>
<td>THROUGH</td>
<td></td>
</tr>
<tr>
<td>DY₁₂ &amp; ANODE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>14.4</td>
</tr>
</tbody>
</table>

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN CATHODE AND DYNODE No. 1 THAT PROVIDES MAXIMUM ANODE CURRENT.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>6.95% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; DY₁</td>
<td>2.0</td>
</tr>
<tr>
<td>DY₁ &amp; DY₂</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₂ &amp; DY₃</td>
<td></td>
</tr>
<tr>
<td>THROUGH</td>
<td></td>
</tr>
<tr>
<td>DY₁₂ &amp; ANODE</td>
<td>10.0</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>14.4</td>
</tr>
</tbody>
</table>

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN CATHODE AND DYNODE No.1 THAT PROVIDES MAXIMUM ANODE CURRENT.

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

TUBE TEMPERATURE = 25° C

LUMINOUS SENSITIVITY—AMPERES/LUMEN

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
FOCUSING-ELECTRODE VOLTAGE IS VARIED BY ADJUSTMENT OF POTENTIOMETER CONNECTED BETWEEN DYNODE NO.1 AND CATHODE.
TYPICAL ANODE-CURRENT CHARACTERISTIC

DYNODE-No.1-TO-CATHODE VOLTS = 200
DYNODE-No.1-TO-DYNOIDE-No.2 VOLTS = 140
VOLTS PER SUCCEEDING DYNOIDE STAGE
EXCEPT FOR DYNOIDE-NO.5 STAGE = 100
FOCUSING-ELECTRODE VOLTAGE ADJUSTED
TO THAT VALUE BETWEEN CATHODE AND
DYNOIDE NO.1 THAT PROVIDES MAXIMUM ANODE
CURRENT. ANODE IS AT GROUND POTENTIAL.
Multiplier Phototube

S-11 RESPONSE
"RUGGEDIZED", 10-STAGE, "HEAD-ON", ELECTROSTATICALLY FOCUSED FLAT-FACEPLATE TYPE IN-LINE DYNOE STAGES

For Detection and Measurement of Nuclear-Radiation and Low-Level Light in Compact Industrial and Military Equipment

General:
Spectral Response. ............................................. S-11
Wavelength of Maximum Response ........... 4400 ± 500 angstroms
Cathode, Semitransparent ......................... Cesium-Antimony
Minimum area .............................................. 0.2 sq. in.
Minimum diameter ..................................... 0.5 in.
Window ..................................................... Lime Glass (Corning® No.0080), or equivalent
Shape ...................................................... Plano-Concave
Index of refraction at 5893 angstroms ................. 1.51
Dynode Material ........................................ Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.10 ..................................... 2.4 pf
Anode to all other electrodes ............................. 3.2 pf
Maximum Overall Length
(Excluding semiflexible leads) ......................... 3.38"
Maximum Diameter ....................................... 0.78"
Operating Position ....................................... Any
Weight (Approx.) ........................................ 0.9 oz
Bulb .......................................................... T6
Magnetic Shield .......................................... Perfection Mica Co., or equivalent
Base ......................................................... Small-Button Thirteenar 12-Semiflexible Lead,
(JEDEC No.E12-72), and Protective Shell

Basing Designation for BOTTOM VIEW .......... 12BG

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

Maximum Ratings, Absolute-Maximum Values:
Supply Voltage (DC or Peak AC):
Between Anode and Cathode .......................... 1500 max. volts
Between Anode and Dynode No.10 ................. 300 max. volts
Between Consecutive Dynodes ...................... 250 max. volts
Between Dynode No.1 and Cathode .................. 400 max. volts
Average Anode Current .................................. 0.5 max. ma
Ambient Temperature .................................. 75 max. °C

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No.10 and anode

With \( E = 1250 \) volts (Except as noted)

**Sensitivity:**
- Radiant, at 4400 angstroms: \(- 6 \times 10^3 \) \( \text{a/ln} \)
- Cathode radiant, at 4400 angstroms: \(- 0.048 \) \( \text{a/w} \)
- Luminous, At 0 cps: \( 3 \) \( 7.5 \) \( 60 \) \( \text{a/ln} \)
- Cathode luminous: \( 4 \times 10^{-5} \) \( 6 \times 10^{-5} \) \( \text{a/ln} \)
- Current Amplification: \( 1.25 \times 10^5 \)
- Equivalent Anode-Dark—Current Input at a luminous sensitivity of 7.5 a/ln: \( 8 \times 10^{-10} \) \( 2 \times 10^{-9} \) \( 1 \) \( \text{lm} \)
- Equivalent Noise Input: \( 3 \times 10^{-12} \) \( 1 \times 10^{-11} \) \( \text{lm} \)
- Anode-Pulse Rise Time: \( 2.1 \times 10^{-9} \) \( \text{sec} \)
- Electron Transit Time: \( 2.3 \times 10^{-8} \) \( \text{sec} \)
- Quantum Efficiency at 4300 angstroms: \( 14 \) \( \% \)

a Made by Corning Glass Works, Corning, New York.
b Magnetic shielding in the form of foil or tape as available from Magnetic Shield Division, Perfection Mica Company, 1322 North Ellston, Chicago 24, Illinois, or equivalent.
c Averaged over any interval of 30 seconds maximum.
d 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 and a light input of 10 microlumens is used.
e 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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
f Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
g See Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter at front of this Section.
h At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant such as dry ice.
i Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.
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.


SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-II RESPONSE IS SHOWN AT THE FRONT OF THIS SECTION

ENVIRONMENTAL TESTS-
The 4460 is designed to withstand the shock, vibration, and acceleration tests shown below which are equivalent to those specified in MIL-E-5272C for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

One-Hundred Per-Cent Shock and Vibration Testing:
Each 4460 is subjected in sequence to shock and then to vibration as specified below with the tube non-operating.

Shock. These tests are performed first, per method of MIL-E-5272C, Paragraph 4.15.5.1, Procedure V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred per-cent testing of all 4460's is performed. Each 4460 is subjected to three impact shocks in each direction of the three orthogonal axes shown in the accompanying ORTHOGONAL AXES USED DURING ENVIRONMENTAL TESTS drawing. The peak acceleration of the impact shock is 30 ± 3 g's and the time duration is 11 ± 1 milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies variable-sinusoidal frequency vibration to the tube, per method of MIL-E-5272C, paragraph 4.7.14.1 and paragraph 4.15.5.1. One-hundred per-cent testing of all 4460's is performed. Each 4460 is vibrated in each of the three orthogonal axes shown in the accompanying ORTHOGONAL AXES USED DURING ENVIRONMENTAL TESTS drawing and as specified in the schedule below. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.

<table>
<thead>
<tr>
<th>Double Amplitude Inches</th>
<th>Acceleration g's</th>
<th>Frequency cps</th>
<th>Cycle Duration per axis minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.050 ± 0.005</td>
<td>20 ± 2</td>
<td>20 - 87</td>
<td>5</td>
</tr>
<tr>
<td>-</td>
<td>87 - 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.050 ± 0.005</td>
<td>20 ± 2</td>
<td>2000 - 87</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>87 - 20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tube Rejection Criterion. Upon completion of the One-Hundred Per-Cent Shock and Vibration Testing each tube is tested at an anode-to-cathode voltage of 1250 volts under the conditions shown under Characteristics Range Values for Equipment Design and will meet the specified values.

Design Tests:

Vibration. These tests are performed under conditions equivalent to those described in MIL-E-5272C, paragraph 4.7.14 and paragraph 4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes shown in the accompanying Orthogonal Axes Used During Environmental Tests drawing. The total test period for each tube is six hours. Tubes are operating during the test.

Acceleration. These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C, paragraph 4.16.3, Procedure III, except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes shown in the accompanying Orthogonal Axes Used During Environmental Tests drawing and the tubes are non-operating.

* Military Specification MIL-E-5272C (AG), 13 April 1959; and Amendment 1, 5 January 1960.
DIMENSIONS IN INCHES

Note: Within this length, maximum diameter of tube is 0.78".
Note: The plane of each dynode spacer is parallel to the X-Z plane. The Z-axis is the major axis of the tube.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

Note: Adjustable between approximately 500 and 1500 volts DC.

$C_1, C_2: 0.01 \mu F, 500$ volts (dc working) 
$R_1: 91,000$ ohms, 2 watts 
$R_2$ through $R_{11}: 47,000$ ohms, 1 watt
AVERAGE ANODE CHARACTERISTICS

DYNOE - NO 1-TO-CATHODE VOLTS = 208
EACH SUCCEEDING-DYNOE-_STAGE_VOLTS = 104
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
OPERATED AT COLOR TEMPERATURE OF
2870° K.
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/9 OF E BETWEEN CATHODE AND DYNODE N=1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/2 OF E BETWEEN DYNODE N=10 AND ANODE.

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

Current Amplification

Supply Volts (E) Between Anode and Cathode

92CM-10657RI

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.

DATA 5
6-64
TYPICAL ANODE-DARK-CURRENT
CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF E BETWEEN CATHODE AND DYNODE NO.1; 1/12 OF E FOR EACH SUCCEEDING STAGE; AND 1/2 OF E BETWEEN DYNODE NO.10 AND ANODE.

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

DASHED PORTION INDICATES POSSIBLE INSTABILITY. TUBE TEMPERATURE = 25° C

TYPICAL TIME RESOLUTION
CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING

1/6 OF E BETWEEN CATHODE AND DYNODE NO.1; 1/12 OF E
FOR EACH SUCCEEDING DYNODE STAGE; AND 1/2 OF E
BETWEEN DYNODE NO.10 AND ANODE.

PHOTOCATHODE FULLY ILLUMINATED.
Photomultiplier Tube

RUGGED VIBRATION-RESISTANT STRUCTURE

S-11 RESPONSE ELECTROSTATICALLY FOCUSED
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources. Especially Useful in Missile and Rocket Service and other Industrial and Military Applications where Severe Environmental Conditions may be Encountered.

General:

Spectral Response. ........................................ S-11
Wavelength of Maximum Response .................. 4400 ± 500 angstroms
Cathode, Semitransparent ......................... Cesium-Antimony
Minimum area .................................. 1.2 sq. in.
Minimum diameter ................................ 1.24"
Window .......... Lime Glass (Corning® No.0080), or equivalent
Shape. ........................................ Plano-plano
Index of refraction at 5893 angstroms .......... 1.51
Dynode Material. .................................. Copper-Beryllium

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.10 .................................. 3.2 pf
Anode to all other electrodes ...................... 5.0 pf

Maximum Overall Length (Excluding semiflexible leads) .. 3.18"
Maximum Diameter .................................. 1.56"
Operating Position .................................. Any
Weight (Approx.) .................................. 2.2 oz
Bulb .................................................. T12
Magnetic Shield. ................................... Millen Co.®, or equivalent
Base .................................................. Special

Terminal Diagram:  BOTTOM VIEW

Maximum Ratings, Absolute-Maximum Values:

DC Supply Voltage:
Between anode and cathode. ... 1500 volts
Between anode and dynode No.10 ........ 250 volts
Between consecutive dynodes. .... 200 volts
Between dynode No.1 and cathode. ... 400 volts
Average Anode Current, e ........ 1 ma
Average Cathode Current, d ...... 2 μa
Ambient Temperature. ............... 75 °C
Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between anode and dynode No. 10 and anode.

With \( E = 1250 \text{ volts} \) (Except as noted)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>( 8 \times 10^{-3} )</td>
<td>( a/w )</td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>( - )</td>
<td>( 0.048 )</td>
<td>( a/w )</td>
</tr>
<tr>
<td>Luminous, at 0 cps(^a)</td>
<td>( 3 )</td>
<td>( 10 )</td>
<td>( 80 )</td>
</tr>
<tr>
<td>With dynode No. 10 as output electrode(^f)</td>
<td>( - )</td>
<td>( 6 )</td>
<td>( - )</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source(^g)</td>
<td>( 4 \times 10^{-5} )</td>
<td>( 6 \times 10^{-5} )</td>
<td>( - )</td>
</tr>
<tr>
<td>With blue light source(^h)</td>
<td>( 4 \times 10^{-8} )</td>
<td>( 6 \times 10^{-8} )</td>
<td>( - )</td>
</tr>
<tr>
<td>Current Amplification:</td>
<td></td>
<td>( 1.7 \times 10^{-5} )</td>
<td>( - )</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input at a luminous sensitivity of 10 a/\text{lm}(^j)</td>
<td>( - )</td>
<td>( 5 \times 10^{-10} )</td>
<td>( 2 \times 10^{-9} )</td>
</tr>
<tr>
<td>Equivalent Noise Input(^k),(^m)</td>
<td>( 2.8 \times 10^{-12} )</td>
<td>( 1.8 \times 10^{-11} )</td>
<td>( \text{lm} )</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time(^n)</td>
<td>( 2.4 \times 10^{-9} )</td>
<td>( - )</td>
<td>( \text{sec} )</td>
</tr>
<tr>
<td>Electron Transit Time(^p)</td>
<td>( 2.9 \times 10^{-8} )</td>
<td>( - )</td>
<td>( \text{sec} )</td>
</tr>
<tr>
<td>Quantum Efficiency at 4300 angstroms.</td>
<td>( - )</td>
<td>( 14 )</td>
<td>( - )</td>
</tr>
</tbody>
</table>

With \( E = 750 \text{ volts} \) (Except as noted)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>( 1.8 \times 10^{-2} )</td>
<td>( a/w )</td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>( - )</td>
<td>( 0.048 )</td>
<td>( a/w )</td>
</tr>
<tr>
<td>Luminous, at 0 cps(^a)</td>
<td>( - )</td>
<td>( 0.22 )</td>
<td>( a/\text{lm} )</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source(^g)</td>
<td>( 4 \times 10^{-5} )</td>
<td>( 6 \times 10^{-5} )</td>
<td>( - )</td>
</tr>
<tr>
<td>With blue light source(^h)</td>
<td>( 4 \times 10^{-8} )</td>
<td>( 6 \times 10^{-8} )</td>
<td>( - )</td>
</tr>
<tr>
<td>Current Amplification:</td>
<td></td>
<td>( 3.7 \times 10^{-3} )</td>
<td>( - )</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input at a luminous sensitivity of 10 a/\text{lm}(^j)</td>
<td>( - )</td>
<td>( 5 \times 10^{-10} )</td>
<td>( 2 \times 10^{-9} )</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time(^k)</td>
<td>( 3.1 \times 10^{-9} )</td>
<td>( - )</td>
<td>( \text{sec} )</td>
</tr>
<tr>
<td>Electron Transit Time(^p)</td>
<td>( 3.8 \times 10^{-8} )</td>
<td>( - )</td>
<td>( \text{sec} )</td>
</tr>
</tbody>
</table>

\(^a\) Made by Corning Glass Works, Corning, New York.
\(^b\) Magnetic shielding in the form of foil or tape as available from the James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts, or equivalent.
The 4461 is designed to withstand the shock, vibration, and acceleration tests shown below which are equivalent to those specified in MIL-E-5272C for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

**One-Hundred Per-Cent Shock and Vibration Testing:**

Each 4461 is subjected in sequence to shock and then to vibration as specified below with the tube non-operating.

**Shock.** These tests are performed first, per method of MIL-E-5272C, Paragraph 4.15-5.1, Procedure V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred per-cent testing of all 4461's is performed. Each 4461 (non-operating) is subjected to three impact shocks in each direction of the three orthogonal axes. The peak acceler-
ation of the impact shock is 30 ± 3 g's and the time duration is 11 ± 1 milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies variable-sinusoidal frequency vibration to the tube, per method of MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. One hundred per-cent testing of all 4461's is performed. Each 4461 is vibrated in each of the three orthogonal axes as specified in the schedule below. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.

<table>
<thead>
<tr>
<th>Double Amplitude</th>
<th>Acceleration</th>
<th>Frequency</th>
<th>Cycle Duration Per Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>g's</td>
<td>cps</td>
<td>minutes</td>
</tr>
<tr>
<td>0.050 ± 0.005</td>
<td>20 ± 2</td>
<td>20 - 87</td>
<td>5</td>
</tr>
<tr>
<td>-</td>
<td>87 - 2000</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.050 ± 0.005</td>
<td>-</td>
<td>87 - 20</td>
<td></td>
</tr>
</tbody>
</table>

Tube Rejection Criterion. Upon completion of the Shock and Vibration Testing each tube is tested at a anode-to-cathode voltage of 1250 volts with the light level incident on the tube adjusted to provide an anode current of approximately 8 microamperes. Electrical and/or mechanical tube failures due to shock or vibration will be observed during the vibration test when the specified anode current is monitored. Tube rejection criterion for both tests is that the anode current of 8 microamperes will not change more than ±20 per cent upon completion of the vibration test for each axis.

Design Tests:

Vibration. These tests are performed under conditions equivalent to those described in MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes. The total test period for each tube is six hours.

Acceleration. These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C*, paragraph 4.16.3, Procedure III, except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes. The tubes are non-operating during the test.

* Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.
OPERATING CONSIDERATIONS

The operating stability of the 4461 is dependent on the magnitude of the anode current and its duration. When operating at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4461 usually recovers a substantial percentage of such loss in sensitivity.

It is recommended that the average anode current be well below the maximum rated value of 1 milliamperes when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or magnetic shielding of the 4461 may be necessary.

Adequate shielding should be provided to prevent extraneous radiation from reaching any part of the 4461. The high voltages at which the 4461 is operated are very dangerous. Before any part of the circuit is touched, the power supply switch should be turned off and both terminals of any capacitors grounded.

Accompanying Typical Voltage-Divider Arrangement is recommended for use with the 4461. Resistance values for the voltage-divider arrangement range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for the voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required wattage rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is near the photocathode. The use of resistance values near 1 megohm per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value several times that of the maximum value of anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the leads for dynodes No. 7 and No. 8, dynodes No. 8 and No. 9, dynodes No. 9 and No. 10, and between dynode No. 10 and anode return. In addition to non-linearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make the 4461 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.
DIMENSIONAL OUTLINE

FACEPLATE
(SEE NOTE 1)

PHOTOCATHODE

T12 BULB

METAL FLANGE
(SEE NOTE 2)

DIMENSIONS IN INCHES

Center line of bulb will not deviate more than $2^\circ$ in any direction from the perpendicular erected at the center of bottom of the base flange.

Note 1: Deviation from flatness within the 1.24 inch diameter area will not exceed 0.010 inch from peak to valley.

Note 2: The metal flange should never be employed for mechanical mounting purposes.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

REGULATED DC POWER SUPPLY
(SEE NOTE 1)

LOAD CONNECTION

MULTIPLIER PHOTOTUBE

R1

C1

DY10

R2

C2

DY9

R3

C3

DY8

R4

C4

DY7

R5

TO

C5

DY6

R6

C6

DY5

R7

C7

DY4

R8

C8

DY3

R9

C9

DY2

R10

C10

DY1

PHOTOCATHODE

R12

Note 1: Adjustable between approximately 500 and 1500 volts DC.

Note 2: Capacitors C1 through C4 should be connected at tube socket for optimum high-frequency performance.

C1: 0.05 µf, 500 volts (dc working)
C2: 0.02 µf, 500 volts (dc working)
C3: 0.01 µf, 500 volts (dc working)
C4: 0.005 µf, 500 volts (dc working)
R12: 33,000 ohms, 2 watts

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.

DATA 4
5-65
Typical Sensitivity And Current Amplification Characteristics

<table>
<thead>
<tr>
<th>SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SENSITIVITY - AMPERES/LUMEN (COLOR TEMPERATURE 2870° K)</td>
</tr>
<tr>
<td>CURRENT AMPLIFICATION</td>
</tr>
<tr>
<td>SUPPLY VOLS (E) BETWEEN ANODE AND CATHODE</td>
</tr>
</tbody>
</table>

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

DATA 5
5-65
Typical Anode-Dark-Current Characteristic

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE \( E \) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF \( E \) BETWEEN CATHODE AND DYNODE No.1; 1/12 OF \( E \) FOR EACH SUCCEEDING STAGE; AND 1/12 OF \( E \) BETWEEN DYNODE No.10 AND ANODE.

TUBE TEMPERATURE = 25°C
DASHED PORTION INDICATES INSTABILITY.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

Typical Time Resolution Characteristics

SUPPLY VOLTAGE \( E \) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF \( E \) BETWEEN CATHODE AND DYNODE No.1; 1/12 OF \( E \) FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF \( E \) BETWEEN DYNODE No.10 AND ANODE.
THE PHOTOCATHODE IS FULLY ILLUMINATED.
Multiplier Phototube

**S-20 RESPONSE**

**VENETIAN-BLIND-TYPE**

**FLAT-FACEPLATE TYPE**

**DYNODE STRUCTURE**

For Photometry, Flying-Spot Scanning, and Scintillation-Counter Equipment Requiring Low-Dark Current and High Sensitivity Over a Wide Spectrum (Blue through Near-Infrared).

**General:**
- Spectral Response: S-20
- Wavelength of Maximum Response: 4200 ± 500 ångstroms
- Cathode, Semitransparent: Potassium-Sodium-Cesium-Antimony (Multialkali)
- Shape: Flat, Circular
- Minimum area: 2.2 sq. in.
- Minimum diameter: 1.68 in.
- Window: BoroSilicate Glass®
- Index of refraction at 5893 ångstroms: 1.48
- Dynode Material: Copper-Beryllium
- Direct Inter electrode Capacitances (Approx.):
  - Anode to dynode No. 10: 7 pf
  - Anode to all other electrodes: 8.5 pf
- Maximum Overall Length: 5.81" ± 0.19"
- Seated Length: 4.87" ± 0.19"
- Maximum Diameter: 2.31"
- Operating Position: Any
- Weight (Approx.): 7 oz
- Bulb: T16
- Socket: Cinch® No. 3M14, or equivalent
- Magnetic Shield: JAN® No. S-2004, or equivalent
- Base: Medium-Shell Dihedral 14-Pin (JEDEC Group 5, No. B14-38), Non-hygroscopic

**Basing Designation for BOTTOM VIEW:** 14AA

**Pin Configuration:**
- Pin 1 - Dynode No. 1
- Pin 2 - Dynode No. 2
- Pin 3 - Dynode No. 3
- Pin 4 - Dynode No. 4
- Pin 5 - Dynode No. 5
- Pin 6 - Dynode No. 6
- Pin 7 - Dynode No. 7
- Pin 8 - Dynode No. 8
- Pin 9 - Dynode No. 9
- Pin 10 - Dynode No. 10
- Pin 11 - Anode
- Pin 12 - Do Not Use
- Pin 13 - Focusing Electrode
- Pin 14 - Photocathode

**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices  Harrison, N. J.  DATA 4-16
### Maximum Ratings, Absolute-Maximum Values:

**DC Supply Voltage:**
- Between anode and cathode: 2500 max. volts
- Between anode and dynode No. 10: 300 max. volts
- Between consecutive dynodes: 300 max. volts
- Between dynode No. 1 and cathode: 600 max. volts
- Between focusing electrode and cathode: 600 max. volts
- Average Anode Current: 1 max. ma
- Ambient Temperature: 85 max. °C

### Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between anode and dynode No. 10. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No. 1 potential (referred to cathode) which provides maximum anode current.

With $E = 2000$ volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4200 angstroms</td>
<td>-</td>
<td>$1.1 \times 10^4$</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>-</td>
<td>$6.8 \times 10^{-2}$</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>12</td>
<td>25</td>
<td>240</td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>$1.2 \times 10^{-4}$</td>
<td>$1.6 \times 10^{-4}$</td>
<td>-</td>
</tr>
<tr>
<td>With blue light source</td>
<td>$5 \times 10^{-8}$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>With red light source</td>
<td>$3 \times 10^{-7}$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>$1.6 \times 10^5$</td>
<td>-</td>
</tr>
</tbody>
</table>

Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/1m:
- Min. | $4 \times 10^{-10}$
- Max. | $1 \times 10^{-9}$

Equivalent Noise Input:
- Min. | -
- Max. | $3.8 \times 10^{-12}$

Anode-Pulse Rise Time:
- Min. | $9.8 \times 10^{-9}$
- Max. | -

Electron Transit Time:
- Min. | $5.2 \times 10^{-8}$
- Max. | -

With $E = 1500$ volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4200 angstroms</td>
<td>-</td>
<td>$2.1 \times 10^3$</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>-</td>
<td>$6.8 \times 10^{-2}$</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>-</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>
Cathode luminous:

With tungsten light source \( f \):
\[
1.2 \times 10^{-4} \quad 1.6 \times 10^{-4} \quad \text{a/s/lnm}
\]
With blue light source \( h \):
\[
5 \times 10^{-8} \quad \text{-} \quad \text{a}
\]
With red light source \( k \):
\[
3 \times 10^{-7} \quad 3.1 \times 10^{-8} \quad \text{-}
\]

Current Amplification

Equivalent Anode-Dark Current Input at a luminous sensitivity of 12 a/lnm...
\[
4 \times 10^{-10} \quad 1 \times 10^{-9} \quad \text{lm}
\]

a Corning No. 7056 made by Corning Glass Works, Corning, New York, or equivalent.
b Made by Cinch Manufacturing Company, 1026 South Wabun Avenue, Chicago 24, Illinois.
c Made by JAN Hardware Manufacturing Company, 38-01 Queens Blvd., Long Island City 1, New York.
d Averaged over any interval of 30 seconds maximum.
e Under the following conditions: The light source is a tungsten-filament lamp having a thin glass envelope. It is operated at a color temperature of 2870°K and a light input of 1 microlumen is used.
f Under the following conditions: The light source is a tungsten-filament lamp having a thin glass envelope. It is operated at a color temperature of 2870°K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
g Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No. 5-58 polished to 1/2 stock thickness—manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
h See Spectral Characteristic of 2870°K Light Source and Spectral Characteristic of Light from 2870°K Source after passing through Indicated Blue Filter at front of this Section.

j Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No. 2-62, manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
k See Spectral Characteristic of 2870°K Light Source and Spectral Characteristic of Light from 2870°K Source after passing through Indicated Red Filter at front of this Section.

m At a tube temperature of 25°C. Dark current may be reduced by use of a refrigerant.

n 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.

p 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. This transit time is measured under conditions with the incident light fully illuminating the photocathode.
OPERATING CONSIDERATIONS

The operating stability of the 4463 is dependent on the magnitude of the anode current and its duration. When the 4463 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4463 usually recovers a substantial percentage of such loss in sensitivity.

It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or magnetic shielding of the 4463 may be necessary.

Adequate shielding should be provided to prevent extraneous radiation from reaching any part of the 4463.

The high voltages at which the 4463 is operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section.
Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

Note: Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.
TYPICAL ANODE CHARACTERISTICS

DYNODE No.I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

DYNOE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNOE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNOE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNOE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

SENSITIVITY—AMPERES/LUMEN

CURRENT AMPLIFICATION

MINIMUM SENSITIVITY

TYPICAL SENSITIVITY

MAXIMUM SENSITIVITY

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
DATA 4
6-64

92CM-12312
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C

TYPICAL TIME RESOLUTION CHARACTERISTICS

DYNOE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHTOCATHODE IS FULLY ILLUMINATED.
TYPICAL ANODE-CURRENT CHARACTERISTIC

Dynode No. 1-to-Cathode Volts = 200
Volts per succeeding dynode stage except for dynode-No. 5
Stage = 100
Anode-to-dynode No. 10 Volts = 100
Focusing-electrode voltage is adjusted to that value
between 50 and 100 per cent of dynode No. 1 potential
(referred to cathode) which provides maximum anode
current.

Anode is at ground potential.
TYPICAL ANODE-CURRENT CHARACTERISTICS

TYPICAL ANODE-CURRENT CHARACTERISTICS

DYNOE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNOE-STAGE VOLTS = 125
ANODE-TO-DYNOE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE
BETWEEN 50 AND 100 PER CENT OF DYNOE No. 1 POTENTIAL
(REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE
CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE
POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.

MAGNETIC FIELD INTENSITY — GAUSS

DYNOE No. 1-TO-CATHODE VOLTS = 125
ANODE-TO-DYNOE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE
BETWEEN 50 AND 100 PER CENT OF DYNOE No. 1 POTENTIAL
(REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE
CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE
POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PERPENDICULAR TO MAJOR AXIS OF TUBE.

MAGNETIC FIELD INTENSITY — GAUSS
Multiplier Phototube

S-20 RESPONSE

10-STAGE, HEAD-ON,
FLAT-FACEPLATE TYPE
VENETIAN-BLIND-TYPE
DYNOE STRUCTURE

For Photometry, Flying-Spot Scanning, and Scintillation-Counter Equipment Requiring Low-Dark Current and High Sensitivity Over a Wide Spectrum (Blue through Near-Infrared).

General:
Spectral Response .................................. S-20
Wavelength of Maximum Response .............. 4200 ± 500 angstroms
Cathode, Semitransparent ....................... K-Na-Cs-Sb (Multialkali)
Shape ............................................... Flat, Circular
Minimum area ..................................... 5.27 sq. in.
Minimum diameter ................................ 2.59 in.
Window ............................................. Lime Glass
Index of refraction at 5893 angstroms .......... 1.51
Dynode Material .................................. Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.10 ......................... 7 pf
Anode to all other electrodes ................. 8.5 pf
Maximum Overall Length ....................... 6.31"
Seated Length .................................... 5.38" ± 0.18"
Maximum Diameter ................................ 3.06"
Operating Position ................................ Any
Weight (Approx.) ................................... 7 oz
Bulb .................................................. J24
Socket .............................................. Cinch b No.3M14, or equivalent
Magnetic Shield .................................. Perfection Mica Co. c, or equivalent
Base .................................................. Medium-Shell Diheptal 14-Pin

Basing Designation for BOTTOM VIEW ........ 14AM

Pin 1 = Dynode No.1
Pin 2 = Dynode No.2
Pin 3 = Dynode No.3
Pin 4 = Dynode No.4
Pin 5 = Dynode No.5
Pin 6 = Dynode No.6
Pin 7 = Dynode No.7
Pin 8 = Dynode No.8
Pin 9 = Dynode No.9
Pin 10 = Dynode No.10
Pin 11 = Anode
Pin 12 = Do Not Use
Pin 13 = Focusing Electrode
Pin 14 = Photocathode
Metal Collar = Do Not Use
Maximum Ratings, Absolute-Maximum Values:

DC Supply Voltage:
- Between anode and cathode: 2500 max. volts
- Between anode and dynode No.10: 300 max. volts
- Between consecutive dynodes: 300 max. volts
- Between dynode No.1 and cathode: 600 max. volts
- Between focusing electrode and cathode: 600 max. volts
- Average Anode Current: 1 max. ma
- Ambient Temperature: 85 max. °C

Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No.1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between anode and dynode No.10. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 2000 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4200 angstroms.</td>
<td>1.1 x 10^4</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms.</td>
<td>6.8 x 10^{-2}</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 cps.</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td>1.2 x 10^{-4}</td>
<td>1.6 x 10^{-4}</td>
</tr>
<tr>
<td>With blue light source</td>
<td>5 x 10^{-8}</td>
<td>-</td>
</tr>
<tr>
<td>With red light source</td>
<td>3 x 10^{-7}</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification.</td>
<td>1.6 x 10^5</td>
<td>-</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/1m.</td>
<td>4 x 10^{-10}</td>
<td>1 x 10^{-9}</td>
</tr>
<tr>
<td>Equivalent Noise Input.</td>
<td>-</td>
<td>3.8 x 10^{-12}</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time.</td>
<td>1.16 x 10^{-8}</td>
<td>-</td>
</tr>
<tr>
<td>Electron Transit Time.</td>
<td>5.8 x 10^{-6}</td>
<td>-</td>
</tr>
</tbody>
</table>

With E = 1500 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4200 angstroms.</td>
<td>2.1 x 10^3</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms.</td>
<td>6.8 x 10^{-2}</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 cps.</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>
Cathode luminous:
With tungsten light source, \( 1.2 \times 10^{-4} \) \( 1.6 \times 10^{-4} \) \( \text{a/lm} \)
With blue light source, \( 5 \times 10^{-2} \) \( \text{a} \)
With red light source, \( 3 \times 10^{-7} \) \( \text{a} \)
Equivalent Anode—Dark
Current Amplification, \( \sim 3.1 \times 10^{4} \)

Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elliston, Chicago 24, Illinois, or equivalent.

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 and a light output of 1 microlumen is used.

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 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58 polished to 1/2 stock thickness—manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

See Spectral Characteristic of 2870°K Light Source and Spectral Characteristic of Light from 2870°K Source after passing through Indicated Blue Filter at front of this Section.

Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62, manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

See Spectral Characteristic of 2870°K Light Source and Spectral Characteristic of Light from 2870°K Source after passing through Indicated Red Filter at front of this Section.

At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

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.

Operating Considerations
It is recommended that the average anode current be well below the maximum-rated value of 1 milliamperes when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or magnetic shielding of the 4464 may be necessary.
Adequate shielding should be provided to prevent extraneous radiation from reaching any part of 4464. The operating stability of the 4464 is dependent on the magnitude of the anode current and its duration. When the 4464 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4464 usually recovers a substantial percentage of such loss in sensitivity.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE is shown at the front of this Section

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT shown under Type 4463 also applies to Type 4464

DIMENSIONS IN INCHES
Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

NOTE: Within 2.59" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNOE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNOE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNOE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

SENSITIVITY—AMPERES/LUMEN (COLOR TEMP. 2870°)
SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.